Assessing the influence of electronic media on student perceptions towards antibiotic resistance.

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ABSTRACT

Background

Antimicrobial resistance (AMR) and the reduced number of new antibiotic discoveries impose a major threat to the quality of human life and effective treatment options. Antibiotic resistant infections require prolonged hospital stays and treatment periods, that depend on more expensive regimens. The lack of knowledge and negative attitude among the public about antibiotics and antibiotic resistance has led to inappropriate antibiotic use.

Effective communication to increase the public's awareness about appropriate antibiotic use and resistance have been advocated by the World Health Organization (WHO) (2014) and the South African National Department of Health (NDoH) (2018) to combat antibiotic resistance. This study investigated the influence of electronic media on antibiotic resistance perceptions among a student community.

Methodology

The study was experimental, quantitative and exploratory in design. The target population was University of the Western Cape (UWC) Economic and Management Studies (EMS) undergraduate level 3 students (2020). Ethics approval and the permission to conduct research at UWC were obtained from the UWC Biomedical Research Ethics Committee (BMREC) and the registrar, respectively.

The four-phased study consisted of a scoping review, baseline (pre- intervention), intervention (electronic media campaign) and post-intervention data collection process. The Arksey and O'Malley methodological framework was used to conduct the scoping review and key messages that were deemed suitable for dissemination in the intervention were identified. Five online posters on antibiotic use and resistance were designed and disseminated to the student community via the UWC Communications and iKamva splash pages for five weeks. The online pre- and post-intervention questionnaires assessed participants' antibiotic resistance perceptions which focused on their knowledge of and attitude towards antibiotic use and resistance. Descriptive and inferential statistics analyses were conducted on the data.

Results

More participants completed the pre-intervention survey (n=64) compared to those in the post-intervention (n=42) survey. The average age range of the participants was 18-24 years. Most of the participants (pre-(37.5%) and post-(35.7%) intervention) were enrolled into the Bachelor of Commerce in Financial Accounting programme.

Electronic media had no influence on the participants' knowledge and attitude towards antibiotic resistance perceptions. There was no significant difference observed between the participants who were exposed to the intervention compared to those who were not on knowledge (antibiotic use (p=0.920); antibiotic resistance (p=0.273)) and attitudes (antibiotic use (p=0.169)).

However, the participants' knowledge and attitude as it related to antibiotic resistance and antibiotic use was lacking. Overall, mean scores among the two study groups for the knowledge on antibiotic use were below 60% (pre- (57%) and post- (51%) intervention) and for the knowledge on antibiotic resistance were below 40% (pre- (33%) and post- (35%) intervention). The term "antibiotic resistance" was correctly recognised (pre-(50%) and post- (61.9%) intervention), but participants did not seem to know its correct definition. Most participants (pre- (62.6%) and post- (76.2%) intervention) thought that antibiotic resistance occurred when one's body became resistant to antibiotics. Participants incorrectly noted that antibiotics were required for common cold (pre- (40.6%) and post-(45.2%) intervention) and flu (pre- (48.4%) and post- (66.7%) intervention). Even though most participants (pre- (81.2%) and post- (73.8%) intervention) were able to correctly identify that COVID-19 did not require antibiotic therapy, only half (pre- (53.1%) and post- (54.8%) intervention) of them were aware that the unnecessary use of antibiotics is an accelerator of antibiotic resistance.

Conclusions

Electronic media had no effect on the antibiotic resistance perceptions of the 3rd year EMS students at UWC. Contextual factors such as the COVID-19 pandemic, migration from on campus learning to online learning, health information overload and conflicting health messages circulating during a viral pandemic may

have contributed to the lack of influence of the study's electronic media campaign. The low mean scores on the knowledge and attitudes signal a need for more tailored antibiotic resistance interventions directed at non-health care students. Future interventions should engage the target group in co-creation of the campaign material to improve uptake.

KEY WORDS

Antibiotics

Antibiotic resistance

Antimicrobial resistance (AMR)

Electronic media

Mass media

Awareness intervention

Antibiotic awareness

AMR interventions

LIST OF ABBREVIATIONS AND ACRONOMS

ABR	Antibiotic resistance
ABS	Antibiotic stewardship
AMR	Antimicrobial resistance
AMS	Antimicrobial stewardship
EMS	Economic and Management Sciences
HIV	Human immunodeficiency virus
MDR-TB	Multi-drug resistant tuberculosis
TB	Tuberculosis
NDoH	National Department of Health
WHO	World Health Organization
WHO GAP	World Health Organization: Global Action Plan on Antimicrobial Resistance
UWC	University of the Western Cape

LIST OF DEFINITIONS

Antibiotic: a natural, semi-synthetic or synthetic substance which is derived from other microorganisms and fight bacterial infections in humans and animals. It may be bactericidal (kill the bacteria) or bacteriostatic (inhibit bacterial growth and multiplication) (CDC, 2021).

Antimicrobial: a substance that may be natural, semi-synthetic or synthetic, which can kill or inhibit the growth of microorganisms. Includes antibiotics, antivirals, antifungals, anthelminthics and antiprotozoals (WHO, 2021).

Antibiotic resistance: occurs when bacteria can resist the effects of an antibiotic molecule it used to be susceptible to (Hughes, 2014).

Antimicrobial resistance: Antimicrobial Resistance (AMR) occurs when microorganisms, i.e., bacteria, viruses, fungi and parasites, change over time and no longer susceptible to medicines making infections harder to treat and increasing the risk of disease spread, severe illness and death (WHO, 2021).

Antimicrobial stewardship: a systematic approach to optimizing the appropriate use of all antimicrobials to improve patient outcome and limit emergence of resistant pathogens whilst ensuring patient safety (Mendelson *et al.*, 2020).

Community: a group of people with diverse characteristics who are linked by social ties, share common perspectives, and engage in joint action in geographical locations or settings (MacQueen *et al.*, 2001).

Perception: as the process of acquiring, interpreting, and representing incoming sensory information (Bingham, 1982).

Mass media: any form of communication that reaches a vast number of people, examples include television, radio, newspapers, social media and blogs (Cambridge Dictionary, 2022).

Electronic media: is a form of mass media that uses digital devices to communicate e.g., television, smart phones and computers, internet and social media software (Dictionary.com, 2022).

Key messages: are take home points that are conveyed to a target audience. They are easily observable and attention grabbing (Carroll *et al.*, 2014).

DECLARATION

I, Prudence Vimbai Munyayi, declare that this thesis entitled *"Assessing the influence of electronic media on student perceptions towards antibiotic resistance"* is my work and that it has not been submitted for any degree or examination to any university. I further declare that the work I am submitting for assessment contains no section copied in whole or in part from any other source unless explicitly identified in quotation marks and with detailed and accurate referencing.

Signature: 

Date: December 2022

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CHAPTER ONE

Introduction

1.1 Background to study

The discovery of antibiotics contributed to decrease in mortality rates due to infectious diseases. With the availability of effective antibiotics, treatment and prophylaxis of common bacterial infections, childhood diseases and the success of minor and major surgeries, and chemotherapy is made possible (WHO, 2015a). However, antibiotic resistance and reduced numbers in the discovery of new antibiotic molecules impose a major threat to the quality of human life resulting in an increase in mortality rate (Prestinaci, Pezzotti and Pantosti, 2015).

At the 20th Nelson Mandela lecture on the 12th of November 2022, the Prime Minister of Barbados and co-chair of the Global Health Initiative the Honourable Mia Mottley, stressed the consequences of antimicrobial resistance (AMR). She highlighted the risk of infection that could cause death as a result of antibiotic resistance as antibiotics were no longer being developed by the pharmaceutical industry since 22 years ago (SABC News, 2022, 60:20).

Antibiotic resistance is a phenomenon that occurs naturally as most antibiotics are natural compounds that are produced by other microorganisms in the environment, and bacteria develop resistance to survive in the environment (Holmes *et al.*, 2016). However, antibiotic resistance is accelerated by overuse and misuse of antibiotics (Ventola, 2015; Holmes *et al.*, 2016; Dadgostar, 2019). The inappropriate use of antibiotics by the public is attributed to lack of knowledge and negative attitudes about antibiotics and antibiotic resistance (Karuniawati *et al.*, 2020).

The consequences of antibiotic resistance have a direct impact on health (death and treatment failure) and the economy (Friedman, Temkin and Carmeli, 2016). If antibiotic resistance is left unchecked, it is estimated to cause 10 million deaths and a loss of $100m by 2050 (O'Neill, 2014).Treatment of antibiotic resistant infections is expensive because it consumes more resources, e.g., prolonged infections, longer treatment periods, longer hospital and intensive care unit (ICU)

stays and need for more expensive medicines. Such factors impose a financial burden on the economy, especially in developing countries (Prestinaci, Pezzotti and Pantosti, 2015; Li and Webster, 2018; Bu-Khamsin *et al.*, 2021).

Resistance is common in infectious diseases such as tuberculosis (TB) and HIV. TB forms one of South Africa's high health burdens with an estimated 193 000 incidences in 2017, of which 12 000 was reported to be drug resistant TB (WHO, 2017). The treatment of uncomplicated TB is normally over a six-month period while that of drug resistant TB can take between 18 to 24 months (Loveday and Cox, 2017; NDoH, 2018). The treatment of multi-drug resistant TB (MDR-TB) requires several expensive antibiotics agents that have a wide range of side effects (Loveday and Cox, 2017) and is made more expensive by the need for quarantine to prevent spread of infection requiring adjuvant medicines (Pooran *et al.*, 2013). The longer treatment duration and unpleasant side effects often result in non-adherence, leading to the emergence of resistance against the regimen (Loveday and Cox, 2017). The development of MDR-TB directly affects the community through health seeking costs, reduced productivity therefore loss of income and indirectly through loss of time and reduced quality of life (Foster *et al.*, 2015). Alerting the public about antibiotic resistance can assist in reducing infection spread, promoting timeous immunisation of babies, minimizing defaulting from treatment regimen and seeking timeous medical attention.

The WHO recognised antibiotic resistance as one of the critical problems of the 21st century and a major crisis that required immediate action (WHO, 2020a). The Centers for Disease Control and Preventions (CDC) reported that there are at least 1.2 million deaths as a result of antimicrobial resistance worldwide (CDC, 2019b).Consequently, the WHO developed a global action plan (GAP), in which one of its 5 key objectives is 'to improve awareness and understanding of antimicrobial resistance through effective communication, education and training' (WHO, 2015b). This includes communication to the public as antibiotic resistance affects everyone. The GAP urged nations to develop action plans to address antimicrobial resistance in their countries from across all sectors i.e., human health, animal health and agriculture.

South Africa's first antimicrobial resistance strategy (2014) was developed before the GAP but has however been improved up to this date. The latest South African antimicrobial resistance strategy framework: a one health approach 2018 – 2024, states that in order to have "appropriate antimicrobial use and improved patient outcome", the foundation should be, to communicate with antimicrobial consumers i.e., the public (NDoH, 2018). Several researchers have investigated the knowledge, attitudes, and practices (KAP) of patients and only a few have investigated the KAP of the public at non-health care facilities (Ramchurren *et al.*, 2017; Farley *et al.*, 2019; Bulabula, Dramowski and Mehtar, 2020; Mokoena, Schellack and Brink, 2021). There is a need to address antibiotic resistance at community level to address inappropriate antibiotic use before people would encounter antibiotic therapy as patients (Ancillotti *et al.*, 2018).

Both GAP and the South African antimicrobial resistance national strategy framework prove that it is very essential to educate the public, as the end users of antibiotics, about antibiotic resistance as their perceptions affects how they use them. The community plays an important role in infection control, i.e., through good hygiene and vaccination and immunisation (WHO, 2015b).

This study explores the implementation of one of the goals of the SA national strategy framework, i.e., communicate antibiotic resistance in the form of key messages to a sector of the public specifically university students. Further, the study determines if electronic media has an influence in a student community's antibiotic resistance perceptions. Perception is defined as the process of acquiring, interpreting, and representing incoming sensory information (Bingham, 1982) that influences behaviour. Consequently, in this study perception refers as an individual's knowledge on and attitudes towards antibiotic use and antibiotic resistance.

1.2 Study rationale

Effective communication, education and training on antimicrobial resistance is underpinned as one of the most important objectives of both the WHO GAP (2015) and the South African AMR strategy framework (2017) (WHO, 2015b;

NDoH, 2018). Interventions have been focused on awareness directed towards healthcare professionals and patients at healthcare facilities but not on the community members located beyond the confines of a health care facility (Khoshgoftar *et al.*, 2021). In South Africa, studies at university level have been limited to understanding the knowledge and perceptions of medical and pharmacy students (Burger *et al.*, 2016; Wasserman *et al.*, 2017).

Antibiotic use and resistance misconceptions significantly increase the possibility of misuse and unnecessary use of antibiotics (Yagoub *et al.*, 2019). A Nepalese study reported that participants who were aware of antibiotic resistance were 27% less likely to misuse antibiotics and those who were aware that antibiotic resistance is a global problem were 51% less likely to misuse antibiotics (Bu-Khamsin *et al.*, 2021). A South African study found that the study participants with high knowledge about antibiotic resistance exhibited more protective behaviours and beliefs (Farley *et al.*, 2019).

This study aims to investigate the use and effectiveness of electronic media in raising awareness on antibiotic resistance among a student community.

1.3 Problem statement

What is the influence of electronic media on the antibiotic resistance perceptions of a student community?

1.4 Research aim

The purpose of the study is to raise awareness about antibiotic resistance to a student community and investigate the effectiveness of electronic media in the dissemination of key messages on antibiotic resistance.

1.5 Research questions

The specific research questions of the study are:

- What are the important key messages from the literature about antibiotic resistance that need to be communicated to the public?
- What are the current perceptions (knowledge and attitudes) about antibiotic resistance among university students?
- What is influence of electronic media on the dissemination of antibiotic resistance key messages?

- What is the influence of electronic media on the perceptions of a student community?

1.6 Research objectives

1.6.1 Literature review:

Objectives:

- Review community perceptions (knowledge and attitudes) on antibiotic use and resistance.
- Report on the relationship between antibiotic use and resistance perceptions and practises.
- Evaluate the use and effectiveness of mass and electronic media to raise awareness on health-related topics.

The research study was conducted in four phases: scoping review, pre-intervention survey, electronic media campaign and post-intervention survey.

1.6.2 Phase 1: Scoping review

Objectives:

- Evaluate the content, objectives, and structure of national and international antibiotic resistance campaigns for community education/awareness.
- Identify the key messages for community education on antibiotic resistance as set out by the WHO GAP, national action plan and other programs and published literature for antibiotic resistance stewardship.

1.6.3 Phase 2: Baseline data collection

Objective:

- Determine the participants' base-line perceptions on antibiotic resistance.

1.6.4 Phase 3: Antibiotic resistance key message dissemination: electronic media intervention

Objectives:

- Design mass media campaign tools

- Disseminate key messages on antibiotic resistance to the student community using electronic media (iKamva and UWC communications).

1.6.5 Phase 4: Post-intervention data collection

Objective:

- Determine participants' antibiotic resistance perceptions after electronic media campaigns.

1.7 Structure of the study

- Chapter One: Introduction
- Chapter Two: Literature review and scoping review
- Chapter Three: Methodology
- Chapter Four: Results and data analysis
- Chapter Five: Discussion
- Chapter Six: Conclusions and recommendations

CHAPTER TWO

Literature review and scoping review

This chapter presents the literature review and the scoping review which were conducted by the researcher. The literature review provides a critical analysis of literature on community perceptions (knowledge and attitudes) on antibiotic resistance and the influence of mass/electronic media as a communication tool. Further it foregrounds the gaps in antibiotic resistance awareness research. The purpose of the scoping review is to map out the key concepts in AMR/antibiotic resistance awareness campaigns and identify key messages suitable for the study's intervention.

Section 2.1 reports on the findings of the literature review and section 2.2 reports on the scoping review and provides justification of the key messages that were selected for the intervention.

2.1 Literature review

2.1.1 Introduction

Appropriate databases, such as Google scholar, PubMed, ScienceDirect and Medline were accessed via the UWC library database. Relevant searches were conducted on the community knowledge, attitudes and practices on antibiotic use and antibiotic resistance, community antibiotic resistance awareness campaigns using mass media and mass media for health promotion. The relevant literature was identified using the following key words: antibiotic resistance, antimicrobial resistance, electronic media, media campaign, mass media, awareness campaign, antibiotic use.

2.1.1.1 Antibiotic resistance

Antibiotics are medicines that are bacteriostatic and/or bactericidal used to treat bacterial infections in humans and animals (CDC, 2021). In humans and companion animals, antibiotics are mainly used for treatment of clinical bacterial infections and to a lesser extent, as prophylaxis. However, in food-producing animals, antibiotics are used as treatment, group prophylaxis and for growth promotion (Mcewen and Collignon, 2017).

Resistance to antibiotics by bacteria poses imminent threat to both human and animal health. Antibiotic resistance is a result of natural selection, bacteria evolving by developing and expressing resistant gene that are shared with other bacteria. However, the inappropriate and overuse of antibiotics accelerate the natural phenomenon. The spread of the resistant bacteria via poor infection control, movement of infected humans and animals and environmental contamination also speed up antibiotic resistance (Mcewen and Collignon, 2017). The use of below optimum doses of antibiotics in food-animal productions has been controversial as it promotes antibiotic resistance but justifiable on economic basis (Mcewen and Collignon, 2017).

Overuse and inappropriate use of antibiotics, the main drivers of antibiotic resistance, are promoted by overprescribing, self-medication and use in horticulture and animal husbandry (WHO, 2015b; Fiore *et al.*, 2017; NDoH, 2018). The CDC reported that 30% of antibiotics prescribed in primary health care are either unnecessary or inappropriate (CDC, 2019a).

In 2019, an estimated 4.95 million deaths were associated with antibiotic resistance, of which 1.27 million deaths attributed directly to antibiotic resistance (Murray *et al.*, 2022). The impact of antibiotic resistance is very detrimental and if left unchecked antibiotic resistance can lead to a post-antibiotic era (WHO, 2020b).

A One Health approach is need to combat antibiotic resistance because they are used in humans, animals and in agriculture. One Health is defined as "the collaborative effort of multiple health science professionals, together with their related disciplines and institutions, working locally, nationally and globally to attain optimal health for people, domestic animals, wildlife, plants and our environment" (One Health Commission, 2018). The multidisciplinary approach is needed to tackle antibiotic resistance as the resistant bacteria are spread between humans, animals and the environment.

2.1.2 Community perceptions (knowledge and attitudes) of antibiotic resistance and antibiotic use

Inappropriate use of antibiotics, namely their misuse and overuse, directly accelerate antibiotic resistance and is a result of lack of knowledge and negative attitudes about antibiotic use and antibiotic resistance (Yagoub *et al.*, 2019; Karuniawati *et al.*, 2020; Serwecińska, 2020). The public members' knowledge and attitudes about antibiotic resistance, how it occurs, and its implications are crucial as they affect their perceptions, thereby their antibiotic use (You *et al.*, 2008; Nepal *et al.*, 2019).

Therefore, it is essential to investigate and understand the public's perceptions in order to identify possible intervention strategies to promote antibiotic resistance awareness (Hawkings, Wood and Butler, 2007; Ancillotti *et al.*, 2018). Globally, many studies have investigated the knowledge, attitude and practices on antibiotic use and resistance. However, there are few studies in Africa and specifically South Africa, that have reported low to moderate knowledge about antibiotic resistance (Jifar and Ayele, 2018).

Antibiotics are often not correctly recognised therapeutic agents by public members in most low- and middle-income countries (LMIC). In most cases, the pharmacotherapeutic action of antibiotics cannot be differentiated from other medicines (Sahoo *et al.*, 2014; Karuniawati *et al.*, 2021; Gunasekera *et al.*, 2022). In a Thailand study , the participants referred to antibiotics as "anti-inflammatories" (Charoenboon *et al.*, 2019). Similarly, a Chinese study reported that only a third (37%) of their participants were able to correctly note that antibiotics and anti-inflammatories were not the same (Yu *et al.*, 2014). In a Mozambican study , antibiotics were incorrectly regarded as medicines for treating pain and muscle weakness but they were correctly recognised for the treatment of TB and some STIs (Cambaco *et al.*, 2020). Two South African studies revealed that their participants were not aware of the phrase "antibiotic resistance" nor its definition and the term "antibiotic" (Watkins *et al.*, 2019; Mokoena, Schellack and Brink, 2021). In one of those studies, the participants confused antibiotics for analgesics (Watkins *et al.*, 2019). There is lack of

existing notions of such pharmacotherapeutic terms in local languages, thereby making the AMR concept difficult to understand among communities.

Many studies have shown that despite respondents correctly identifying antibiotics as effective for the treatment of bacterial infections, they likewise perceived antibiotics as effective for the treatment of viral infections (Asogwa, Offor and Mbagwu, 2017; Ramchurren *et al.*, 2017; Jifar and Ayele, 2018; Jairoun *et al.*, 2019; Shah *et al.*, 2019; Karuniawati *et al.*, 2021; Mokoena, Schellack and Brink, 2021). A public sector hospital study in KwaZulu Natal (KZN), reported that participants believed that antibiotics could be used for viral infections (Ramchurren *et al.*, 2017). The main cause of this misconception is the inability of the public to differentiate between viral and bacterial infections. This is shown by the belief that antibiotics are effective for common respiratory (such as common cold, flu, sore throat) and gastrointestinal conditions (namely diarrhoea and fever) (Jifar and Ayele, 2018; Farley *et al.*, 2019; Shah *et al.*, 2019; Sakr *et al.*, 2020; Karuniawati *et al.*, 2021; Voo, Yan and Sundraraj, 2021; Yousaf *et al.*, 2021).

The concept of antibiotic resistance is known but misunderstood by some communities (Nepal *et al.*, 2019). In some LMIC studies, the participants were not able to recognize and define the phrase "antibiotic resistance" (Watkins *et al.*, 2019; Cambaco *et al.*, 2020; Khan *et al.*, 2020). Although the public is aware about the phenomenon of antibiotic resistance and that it is linked to inappropriate use of antibiotics (Lum *et al.*, 2017), there is significant evidence that the actual definition is misinterpreted (Iqbal *et al.*, 2020; Mokoena, Schellack and Brink, 2021). The common misconception is that antibiotic resistance occurs when the body becomes resistant to the antibiotic rather than when the bacteria become resistant to the antibiotics (Brookes-Howell *et al.*, 2011; Lum *et al.*, 2017; Ramchurren *et al.*, 2017; Bakhit *et al.*, 2019; Iqbal *et al.*, 2020; Mokoena, Schellack and Brink, 2021). A systematic review reported that 88% of the study population identified antibiotic resistance as the body becoming resistant to antibiotics (McCullough *et al.*, 2016). This misconception contributes to the perception that antibiotic resistance is therefore not spread within a community

(Lum *et al.*, 2017; Bakhit *et al.*, 2019), and cultivates the notion that one is not directly affected by the consequences of antibiotics resistance (Tangcharoensathien *et al.*, 2021).

Antibiotic resistance is not seen as a direct threat or problem by the public, therefore there is very little sense of individual involvement from the public (Jairoun *et al.*, 2019; Shah *et al.*, 2019; Bu-Khamsin *et al.*, 2021). An Australian study found that patients do not believe they have a personal role to play in the control and prevention of antibiotic resistance (Bakhit *et al.*, 2019). A Swedish study reported an "individual detachment" to antibiotic resistance and considered the threat as "not so urgent" (Ancillotti *et al.*, 2018). Participants of a Pakistan study reported that they did not care about the use of antibiotics (Khan *et al.*, 2020). There is a belief that antibiotic resistance is only a problem in other countries or only affects those people who take antibiotics (Gunasekera *et al.*, 2022). A WHO study in 12 countries reported that 57% of the participants felt that they were unable to stop antibiotic resistance (WHO, 2015b) . This lack of concern for antibiotic resistance is worrisome especially considering that antibiotics are regarded as drugs of choice for any health condition by the public (Iqbal *et al.*, 2020).

Antibiotics are often regarded as super medicines that are effective against all infections. Almost all participants (83%) of an Ethiopian study believed that antibiotics sped up their recovery from colds and flu (Jifar and Ayele, 2018). In addition, antibiotics are often inappropriately used as prophylaxis for any illness due to their history of being effective in treating bacterial infections (Higuita-Gutiérrez *et al.*, 2020).

Inappropriate and unnecessary use of antibiotics is generally recognised as an accelerator of antibiotic resistance (Bassoum *et al.*, 2018; Jifar and Ayele, 2018; Jairoun *et al.*, 2019; Sakr *et al.*, 2020; Chang *et al.*, 2021). A KZN study reported that only 39% of their participants recognised that unnecessary use of antibiotics resulted in antibiotic resistance (Ramchurren *et al.*, 2017). Similar findings were reported by a Pakistani study which found that almost all of their participants (over 80%) did not identify overuse of antibiotics as part of antibiotic resistance

(Khan *et al.*, 2020). There is lack of awareness in what is considered inappropriate, based on self-reported practices like taking antibiotics as prophylaxis, keeping leftover antibiotics, sharing antibiotics and self-medicating with antibiotics among study participants (Asogwa, Offor and Mbagwu, 2017; Barqawi *et al.*, 2021; Karuniawati *et al.*, 2021).

The detachment towards antibiotic resistance is a result of the public not recognising the consequences of antibiotic resistance. The inability to treat bacterial infections that we once could, is recognized by the public as a consequence of antibiotic resistance (Ramchurren *et al.*, 2017; Farley *et al.*, 2018; Iqbal *et al.*, 2020; Karuniawati *et al.*, 2021). However, it is not considered as urgent as it should be (Ancillotti *et al.*, 2018). The economic consequences of antibiotics are rarely considered by the public. Antibiotic resistance results in the need for second and third-line antibiotics that are more expensive and may have more adverse effects compared to the first-line treatment options. Antibiotics are used in other medical procedures such as chemotherapy and surgeries therefore their effectiveness is essential to optimise pharmacotherapeutic approaches for such clinical situations (MacGowan and Macnaughton, 2017; WHO, 2021). However, the public is not aware of this information. A Pakistani study reported that less than half of their non-healthcare participants (46.4%) were aware that antibiotic resistance could affect the success of medical procedures (Iqbal *et al.*, 2020).

The public is not aware of its role in tackling antibiotic resistance and often put the blame on healthcare professionals. The community's role in handling the threat of antibiotic resistance include practicing good hygiene and sanitation, immunisations, responsible use of antibiotics and proper disposal of antibiotics (WHO, 2020c). An Indian study reported that people perceived that antibiotic resistance could be prevented by good sanitation and hygiene and the use of different pharmacological agents that are not antibiotics (Sahoo *et al.*, 2014). Less than half of participants (47.3%) in a Malaysian study recognised that hand hygiene was essential for antibiotic resistance prevention (Chang *et al.*, 2021).

Such knowledge gaps could be addressed via media campaigns to unpack AMR concepts.

2.1.3 Antibiotic misuse and unnecessary use due to misconceptions

There is a direct relationship between the knowledge and attitudes on antibiotics and antibiotic resistance and the irrational use of antibiotics. Misconceptions about antibiotic use and antibiotic resistance have been linked to inappropriate practices such as the discarding of antibiotics in the bin, requesting for antibiotics to be prescribed, sharing of antibiotics, not finishing the course of the antibiotic regimen, overusing antibiotics, self-medicating (due to previous experience) and using antibiotics as prophylactic therapy. A Lebanese study reported that participants with low knowledge scores on antibiotic use were more likely to exhibit inappropriate antibiotic use practices (Jamhour *et al.*, 2017), while a KZN study reported that patients with high knowledge were six times more likely to report appropriate antibiotic use (Ramchurren *et al.*, 2017).

The most common form of antibiotic misuse is the discontinuation of antibiotics before completing the course and the main reason is resolution of symptoms (Mazińska, Struzycka and Hryniewicz, 2017; Bu-Khamsin *et al.*, 2021). Although current literature argues the role of not completing a course of antibiotics, there is evidence that it promotes other forms of misuse e.g., sharing antibiotics with family and friends, self-medication with leftover antibiotics and improper disposal of antibiotics, inappropriate use of antibiotics for viral infections and as analgesics (Al-Kubaisi *et al.*, 2018; Khan *et al.*, 2020; Bu-Khamsin *et al.*, 2021). A Nepalese study reported that 70% of their participants were self-medicating with leftover antibiotics (Jha *et al.*, 2020). In in-depth interviews conducted in Indonesia, two participants reported that they gave their leftover antibiotics to birds and chickens (Karuniawati *et al.*, 2020). Findings from a South African study reported that those people who claimed to not finishing their course of antibiotics admitted to either throwing them into latrines or storing them for the next time they got sick (Watkins *et al.*, 2019).

Self-medication with antibiotics is a very common practice in communities especially with antibiotics that have been effective in treating similar symptoms

(Khan *et al.*, 2020). Self-medication is mainly a result of the presence of leftover medication. However, the ability to purchase antibiotics without a prescription, friend and family advice and the cost of accessing healthcare are some of the drivers of self-medication (Al Rasheed *et al.*, 2016; Bulabula, Dramowski and Mehtar, 2020; Do *et al.*, 2021). Participants who had admitted to self-medication with antibiotics in a Kuwaiti study had been prescribed an antibiotic in the past 12 months (Awad & Aboud, 2015). A Saudi Arabian study, reported that their participants would use antibiotics from a family member or friend as long as they are treating the same symptoms (Yagoub *et al.*, 2019). In an Indonesian study, self-medication with antibiotics by over half of the participants (55.6%) was attributed to lack knowledge of the indications of antibiotics. However, two South African studies found that less than one-fifth of their participants (16%) claimed to have self-medicated with antibiotics prescribed for someone else (Farley *et al.*, 2019; Bulabula, Dramowski and Mehtar, 2020). Similarly, a KZN study only reported that 28% admitted to having self-medicated with antibiotics (Ramchurren *et al.*, 2017).

Sixty-six percent of prescribers in a South African study reported that they felt pressure from patients to dispense antibiotics (Farley *et al.*, 2018). Demanding antibiotics from prescribers is common practice by the public. This may be due to a need to either validate their sickness or believe that antibiotics are miracle medications. In a KZN study a third of participants (34%) attested that they would request antibiotics from the doctor even if the doctor had advised against it (Ramchurren *et al.*, 2017). Almost a quarter of public health sector participants (24%) in a Cape Town study reported that they would only feel satisfied if they were given antibiotics when they felt ill (Farley *et al.*, 2019).

A scoping review on the factors that influence self-medication with antibiotics identified common cold, flu-related symptoms and sore throats as the conditions that encouraged misuse of antibiotics (Torres *et al.*, 2019). Antibiotics are thought to be indicated for the treatment of respiratory and gastrointestinal conditions which are mainly caused by viruses. Hence, this misconception about the

indications of antibiotics leads to self-medication and prescription requests for viral conditions, especially in the absence of a secondary bacterial infection.

However, high knowledge and attitude scores do not always mean appropriate use of antibiotics (McNulty *et al.*, 2007; Farley *et al.*, 2019) therefore antibiotic resistance awareness requires multi-disciplinary action and that should not be solely directed at increasing knowledge and attitudes.

Studies have been limited to understanding patients' knowledge but interventions to explore uptake of key messages on antibiotic resistance is yet to be documented. In addition, the studies already cited primarily focused on understanding the patients' knowledge, but the investigations did not explore methods aimed at improving participant knowledge. Educating the public, which is not limited to (health facility linked) patients only about infection control, prevention and correct antibiotic use, is crucial to allay misconceptions about AMR. By disseminating appropriate information on antibiotic resistance, it could improve how the public perceives and uses antibiotics.

The question that arises; can electronic media be an effective intervention mechanism to influence a student community's antibiotics resistance perceptions? One possible cohort that could be investigated is university students since they are astute with using electronic media and testing such an intervention in a South African setting is yet to be explored.

2.1.4 Mass media for dissemination of health messages

Mass media refers to any form of communication that reaches a vast number of people, and examples include television, radio, newspapers, social media and blogs (Cambridge Dictionary, 2022). Electronic or digital media is a form of mass media that uses digital devices to communicate e.g., television, smart phones and computers, internet and social media software (Dictionary.com, 2022). Mass media has the ability to disseminate targeted messages to a large audience at low costs (Wakefield, Loken and Hornik, 2010).

Research has shown that mass media campaigns are linked to an increase in the public's knowledge about the issue being addressed (Anker *et al.*, 2016). Health mass media campaigns have shown to be a successful tool to positively change

the behaviours, attitudes, increase knowledge and influence public opinion (Randolph, Whitaker and Arellano, 2012; Martin *et al.*, 2018). Behavioural change occurs after awareness of problem, attitude and perception change (Boles *et al.*, 2014). Therefore, mass media creates awareness of the problem and allows changes in attitudes and perceptions, increasing the probability of behavioural change (by targeting cognitive and emotional response) and increasing interpersonal discussions in the community (Wakefield, Loken and Hornik, 2010).

Public opinion can be influenced either directly or indirectly. Direct influence occurs when the individual is directly in contact with the mass media while, indirect influence occurs when the public opinion formed from mass media becomes a norm in the community and influences individual perceptions (Wakefield, Loken and Hornik, 2010). There is evidence of mass media campaigns giving room for discussions of sensitive issues in society allowing for social change (Papa *et al.*, 2009). A Nepalese study attested that over a third of the participants (40%) obtained information on antibiotic resistance from the internet and social media (Bu-Khamsin *et al.*, 2021). A similar finding was observed by a WHO study conducted among 12 countries reported that 41% of the participants obtained their antibiotic resistance information from media (WHO, 2015b). Websites dedicated to health (57%) and health magazines (36%) were reported to be the top sources of information about antibiotics by participants for a Polish study (Mazińska, Strużycka and Hryniewicz, 2017). A Sri Lankan study reported that 28.7% of their urban participants obtained information about AMR from mass media (Gunasekera *et al.*, 2022).

Social cognitive theory is a conceptual framework, developed by Bandura (2001) which states that an individual's behaviour is influenced by environmental and cognitive factors. The environmental factors include culture and communication policies. Bandura reports that mass media influences people's perceptions via two pathways, direct pathway, and socially mediated pathway. Mass media can emphasise existing behaviour and frame new behaviour that develops into a new social norm (Bandura, 2001). Social cognitive theory has

been used in other health-related mass media campaigns e.g. HIV/AIDS testing in South Africa which reported evidence of the direct and indirect influence of mass media (Do, Figueroa and Kincaid, 2016).

Mass media has been used to address various health problems in the community. A Denmark survey noted a significant increase in awareness of the link between alcohol intake and cancer using a mass media campaign (Christensen *et al.*, 2019). Similarly in England a post-campaign study showed an increase in awareness of alcohol as a risk factor for cancer (Martin *et al.*, 2018). An Iranian study showed an increase in knowledge between baseline and post intervention assessment among viewers of their oral health campaign and the non-viewers (Gholami *et al.*, 2014). However, a systematic review that evaluated overweight and obesity prevention mass media campaigns reported that mass media was effective in intermediate outcomes such as knowledge and attitudes but there was no direct impact on behavioural change (Kite *et al.*, 2018a).

Mass media has been widely used in the education and awareness of the public about HIV/AIDS disease. A Chinese study which investigated the influence of mass media on female sex workers' HIV/AIDS knowledge reported an association between well-designed mass media campaigns and HIV/AIDS knowledge (Xiao *et al.*, 2015). A Ugandan study reported that exposure to mass media increased HIV/AIDS testing among married women and men (Sano *et al.*, 2016). A review on South African mass media campaigns e.g. Siyayingoba Beat It! LoveLife, reported that discussions about HIV testing with family, friends and partners were increased by exposure to the media campaigns (Do, Figueroa and Kincaid, 2016). A Ugandan review found out that, exposure to mass media increased HIV related knowledge and HIV testing among adolescents (Bago *et al.*, 2019). Increase in knowledge on maternal health care in rural Malawi is accredited to the Phukusi la Moyo mass media campaign as women who were exposed to the campaign were more likely to seek maternal health care when compared to those who were not (Zamawe, Banda and Dube, 2016).

Media has been used in various countries to address antibiotic use and resistance. However, there is a paucity of such studies in Africa and South Africa. Two

systematic reviews on the effectiveness of AMR awareness interventions did not identify documented evidence from any African country (Price *et al.*, 2018; Catalán-matamoros, Pariente and Elías-pérez, 2019). Studies that have explored the effectiveness of mass media for antibiotic resistance awareness have reported a multifaceted picture.

A Malaysian study found that their participants had more knowledge on COVID-19 than antibiotic use as a result of multiple media campaigns to make the public aware of the disease and its characteristics (Chang *et al.*, 2021). This indicates that with multiple awareness campaigns by different stakeholders, mass media and electronic media have potential to address the antibiotic use and resistance misconceptions.

The main challenge with using mass media for dissemination of health-related information is the competition with other disciplines for example, product advertisements, entertainment and perceived norms (Papa and Singhal, 2009). Public opinion is only influenced for a short period of time as indicated by the review findings of contraceptive media campaigns (Wakefield, Loken and Hornik, 2010). However, a study done in Canada over a 7-year period proved there is continued improvement in knowledge with increase in exposure (Suman *et al.*, 2017). One challenge with using mass media to improve knowledge, attitudes and perceptions is the fear associated with deviating from the norm in the communities (Papa and Singhal, 2009). Issues are also seen with distortion of information resulting in the opposite effect than the one that is to be expected (Randolph and Viswanath, 2004).

Mass media has been used to address other health issues, although not to explore its influence on an African student community's antibiotic resistance perception.

2.1.4.1 Key messages

Key messages are take home points that are conveyed to a target audience. They are easily observable and attention grabbing (Carroll *et al.*, 2014). It is essential to identify key messages about health and medicine use such as antibiotics from the literature that one can communicate to communities. The WHO has used key messages in their weekly campaigns during the antibiotic resistance awareness

e.g. “The rise of #AntibioticResistance is leading to untreatable infections which can affect anyone, of any age, in any country. It is the bacteria itself, not the person or the animal, that becomes resistant to antibiotics.” (WHO, 2018). One key message used to educate primary school children in the United Kingdom was “Antibiotics don’t work against colds and flu” which resulted in an increase in knowledge in the post-intervention study (Eley *et al.*, 2018)

2.2 Scoping review and key message justification

This section provides an overview of how the scoping review was conducted to identify the key messages. The selection of key messages, which form the basis of the antibiotic resistance awareness intervention, for this study is justified below (section 2.2.2).

2.2.1 Scoping review: Antimicrobial resistance awareness messages communicated with the public.

2.2.1.1 Introduction

The scoping review aimed to examine AMR interventions, specifically the key messages that were disseminated to the targeted communities and their measured outcomes. The aim of AMR interventions directed at communities was to promote behavioural change towards infection control practices e.g., proper handwashing, vaccinations and to discourage inappropriate and unnecessary antibiotic use.

The scoping review was conducted from January 2020 to April 2020. The Arksey and O’Malley methodological framework which was further refined by the Joanna Briggs institute was used to guide the formulation of the scoping review (Arksey and O’Malley, 2005; Peters *et al.*, 2015). The framework comprises of five steps, namely identification of the research question, identification of relevant studies, selection of studies, data charting and collating, and summarizing and reporting the results (The Joanna Briggs Institute Reviewers, 2015).

2.2.1.2 Identification of the research question.

The research question that guided the review was: What are the key messages that were disseminated in the AMR awareness interventions targeted at the public?

The main objectives of the scoping review were to:

- Review content, objectives, and structure of antibiotic resistance campaigns for community awareness in the literature.
- Identify key message applicable to raising student community awareness.

2.2.1.3 Identification of relevant studies.

A systematic scoping review of published literature in English language journals from January 2015 to April 2020 was conducted. The published peer-reviewed and grey literature that reported in English on interventions that were designed for the public, conducted at a non-healthcare facility and aimed to increase antibiotic/antimicrobial resistance awareness were included in the scoping review. Scopus, Cochrane, Taylor and Francis, Elsevier, and Google Scholar were the online databases used to source the literature.

2.2.1.4 Study selection.

The methodology uses a three-step pre-defined search method for identification of studies which are an initial search of at least two online databases, followed by abstract and title analysis and finally search of additional studies from the reference lists of the identified articles (The Joanna Briggs Institute Reviewers, 2015)

Articles were identified from systematic searches of electronic bibliographic databases. The search strategy was developed to include both MeSH (controlled vocabulary) and free-text terms for antimicrobial resistance awareness interventions and the public population. The search probe was conducted using the following terms and their synonyms: antibiotic resistance, antimicrobial resistance, antimicrobial resistance awareness, public, non-health care settings. Boolean operators were used during the search e.g., “antibiotic resistance” AND “awareness campaign”.

Retrieved literature was analysed for keywords in the title and abstract and index terms to describe the articles. The identified keywords and index terms was used in the second search on the above-mentioned databases for additional literature. The last step involved the use of a reference list of the identified literature to

search for relevant additional research. Websites for antimicrobial resistance organisations, e.g., Antibiotic Guardian was also searched for relevant grey literature.

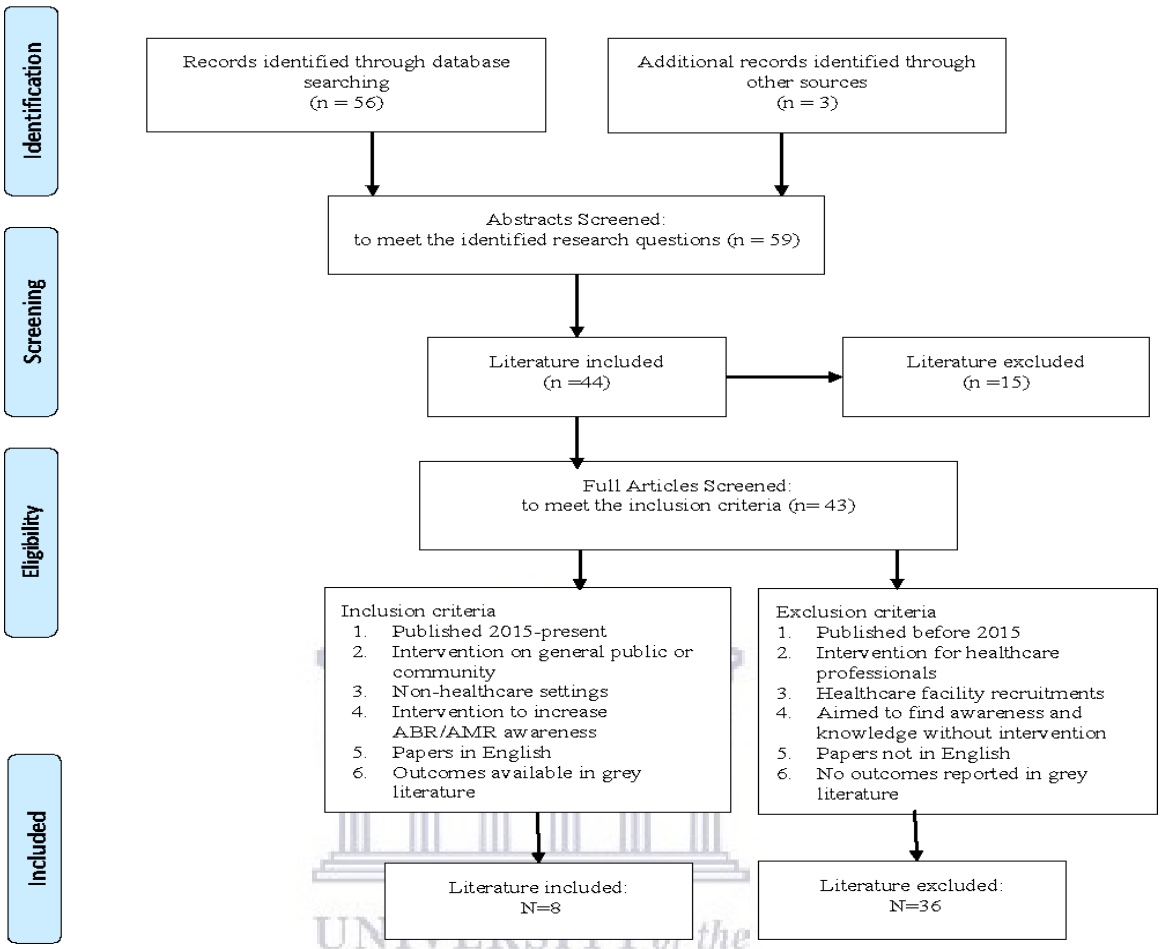
2.2.1.5 Data charting and collating.

Data was extracted using a data charting tool adapted from the Joanna Briggs institute, Appendix A. The charting table includes the following themes: author, year, setting, method of participant recruitment, study design, measured outcomes, objectives/aim, media for intervention and duration of intervention, content of antibiotic resistance intervention, main concept, and key findings.

2.2.1.6 Results

An electronic search and identification of the literature resulted in 56 studies being considered for review. Figure 2.1 outlines and charts the screening process used to select the intervention studies. After elimination of studies that did not meet the inclusion criteria, 7 studies and one website were included for the review. The website, Antibiotic guardian.com, is a website that was designed to promote behaviour change by pledging the users to use antibiotics wisely. The Antibiotic guardian.com is referenced as Public Health England because it is their initiative.

Figure 2.1 PRISMA 2009 flow diagram representing records identified.



From the review thirteen main key messages which were worded differently in the different interventions were identified. Table 2.1 summarizes the key concepts disseminated in the interventions from the Content column of the table in Appendix A. Table 2.1 shows the number of interventions that disseminated each concept.

Table 2.1: Summary of the key messages that were disseminated by the identified AMR interventions and the frequency in which each key message was mentioned in the studies reviewed.

Key AMR awareness message disseminated to the public	**Number of interventions that used the key message (n)**	**References**
Take antibiotics as directed by your healthcare provider.	5	Chaintarli *et al.*, 2016; Eley *et al.*, 2018; Haenssgen *et al.*, 2018; Charoenboon *et al.*, 2019; Public Health England, 2019
Overuse and inappropriate use of antibiotics increases antibiotic resistance.	5	Eley *et al.*, 2018; Haenssgen *et al.*, 2018; Charoenboon *et al.*, 2019; Tamhankar *et al.*, 2019; van Rijn *et al.*, 2019
Antibiotics are not effective against viral infections, e.g., colds and flu.	5	Young *et al.*, 2015; Eley *et al.*, 2018; Public Health England, 2019; van Rijn *et al.*, 2019
Antibiotics should be obtained with a prescription from the doctor.	4	Eley *et al.*, 2018; Haenssgen *et al.*, 2018; Charoenboon *et al.*, 2019; Tamhankar *et al.*, 2019
Bacterial cells develop resistance towards antibiotics not human cells.	3	Young *et al.*, 2015; Eley *et al.*, 2018; Public Health England, 2019
Do not ask the doctor for antibiotics.	3	Haenssgen *et al.*, 2018; Charoenboon *et al.*, 2019; Public Health England, 2019
Antibiotics only treat bacterial infections.	2	Eley *et al.*, 2018; Tamhankar *et al.*, 2019
Antibiotic resistance affects the success of other forms of treatments, e.g., chemotherapy.	2	Eley *et al.*, 2018; Public Health England, 2019
Take leftover antibiotics for disposal to the pharmacy to promote environmental health.	2	Chaintarli *et al.*, 2016; Public Health England, 2019
Antibiotic resistant infections are difficult to	1	van Rijn *et al.*, 2019

treat and require last resort antibiotics.		
Everyone has a role to play in preserving antibiotics.	1	Public Health England, 2019
Do not share antibiotics with family and friends.	1	Public Health England, 2019
Share your knowledge about antibiotic use and antimicrobial resistance with family and friends.	1	Public Health England, 2019

2.2.2 Key message justification

From the thirteen messages identified from the scoping review, only five key messages were selected for dissemination to prevent overloading of information, since the study's target audience are university students who are exposed to extensive information daily. Information overload is defined as provision of too much information or data, that exceeds one's mental capacity, affording less time to process and understand that information (Eppler and Mengis, 2004). One of the disadvantages of information overload includes low retrieval of important information (Matthew, Adebowale and Sarhan, 2016).

Key messages, as defined in section 2.1.4.1, are the main points that an audience should remember after a campaign. In this study the key messages had a "headline" to capture people's attention followed by a "longform" that explains the meaning of headline (Wellcome Trust, 2019) to ensure that the study participants are provided with adequate information to promote understanding of the antibiotic resistance concepts.

To ensure relevance of the key messages to the target audience, findings from South African and African studies which were conducted to explore the knowledge, attitudes and perceptions of patients, public and prescribers on antibiotic use and resistance were studied. One criterion for considering key messages was that they had to address key concepts about antibiotic resistance especially noted in those studies whose participants were identified to have low knowledge. Therefore, key messages that appeared frequently in the scoping review interventions but were not identified as relevant to the target audience

were not selected and the reverse is true. The selected messages were further refined using the recommendations from a Wellcome Trust report.

The Wellcome Trust, a United Kingdom initiative, investigated how to effectively communicate or frame complex issues like antimicrobial resistance, and their research findings offered five recommendations for framing antimicrobial resistance messages. The research was conducted in four stages namely desktop research, media and social media analysis, in-depth interviews with stakeholders and public message testing. The last stage, public message testing, was conducted across seven countries from the Global South and Global North. One of the countries was Kenya, offering an African and developing country perspective (Wellcome Trust, 2019). The Wellcome Trust's five recommendations for communicating antimicrobial resistance effectively are i. Frame antimicrobial resistance as undermining modern medicine ii. Explain the fundamental succinctly iii. Emphasise that this is a universal issue, it affects everyone, including you iv. Focus on the here and now v. Encourage immediate action (Wellcome Trust, 2019). These recommendations were applied in the framing of the key messages for distribution to the student community in this study.

Message 1: "Antibiotic resistance occurs when antibiotics fail to kill bacteria. The body (human cells) does NOT develop resistance to antibiotics.

Antibiotic resistance ***does not*** *only affect those people that take a lot of antibiotics; it affects other people too. Resistant bacteria can spread between people."*

A recent Western Cape study reported that 72% of their study sample believed that antibiotic resistance referred to their changes in the human body (Farley *et al.*, 2019). The belief that the body becomes resistant to antibiotics emanates from the belief that antibiotic resistance did not affect the community therefore they had no role in limiting antibiotic resistance (McCullough *et al.*, 2016).

Message 2: "Antibiotics only treat bacterial infections such as tuberculosis and pneumonia.

*Antibiotics may **ONLY** be used in the treatment of viral infections like the coronavirus if a bacterial infection develops e.g., pneumonia.*

Antibiotics are NOT effective against viral infections such as common colds, sore throats, or the coronavirus.

We should treat the symptoms of common colds and sore throats with over-the-counter medications."

Since the coronavirus epidemic was rampant during the design phase 2 of the study (April 2020), it was essential to include a key message that will contextualise the appropriate use of antibiotics.

A KZN study reported that 70% of their study sample correctly understood that antibiotics are used for treatment of bacterial infections although over half (55%) of them thought that antibiotics were also used in the treatment of viral infections (Ramchurren *et al.*, 2017). A 2019 Western Cape study reported that two-thirds of their sample (66%) thought that antibiotics were good for the treatment of viruses, and that a third (36%) did not know that antibiotics do not work for common colds and sore throats (Farley *et al.*, 2019). The findings are congruent with other studies done in other developing African countries i.e. Senegal, Ethiopia, Tanzania and Namibia (Pereko, Lubbe and Essack, 2015; Goodluck *et al.*, 2017; Bassoum *et al.*, 2018; Jifar and Ayele, 2018). Therefore, the intention for disseminating this key message to South African students was to make them aware of instances where antibiotics are not effective, thereby developing their (cognitive) ability to discern such situations when antibiotics would be most needed.

Message 3: "OVERUSE of antibiotics increases antibiotic resistance.

*Taking antibiotics to prevent getting sick **increases** antibiotic resistance. Antibiotic resistance makes it **difficult** to treat bacterial infections which could be treated previously e.g., tuberculosis.*

*Doctors will know when we need antibiotics. We should **NOT** demand for antibiotics at the clinic or pharmacy."*

Although a KZN study reported high knowledge levels of the drivers of antibiotic resistance, a notable percentage (39%) of the respondents were unsure of the role of overuse of antibiotics in the acceleration of antibiotic resistance (Ramchurren *et al.*, 2017). A Western Cape study and a Ethiopian study also reported high knowledge levels of the drivers of antibiotic resistance (Jifar and Ayele, 2018; Farley *et al.*, 2019). However, even with high knowledge of the drivers of antibiotic resistance, the respondents still reported demanding antibiotics from doctors and needing antibiotics to validate their sickness. Knowledge of key message does not seem to convince the community to use less antibiotics and appropriately, therefore differentiating antibiotic "overuse" and "inappropriate use" is necessary. In a KZN study a third of the participants (34%) had self-proclaimed that they would request antibiotics from the doctor even if the doctor had advised against it. Two thirds (66%) of Medicross prescribers who participated in a Western Cape study disclosed that they felt pressured from patients to prescribe antibiotics even if they knew that it was unnecessary (Farley *et al.*, 2018). The reason for pressurizing prescribers to give antibiotics appears to be a justification of "how sick" one is and how worthy the doctor/hospital visit was (Farley *et al.*, 2019).

Message 4: "We should NOT keep leftover antibiotics for future use or share them among family and friends.

Different antibiotics treat different bacterial infections.

We should only use the antibiotics that are specifically prescribed for us."

Findings from a Western Cape study noted that one-fifth (21%) of patients had admitted to saving leftover antibiotics for use at a later time and almost one-fifth (17%) disclosed that they had shared their antibiotics with friends and family (Farley *et al.*, 2019). A KZN study also reported that over a third of the respondents (41%) shared their antibiotics with family and friends (Ramchurren *et al.*, 2017).

Message 5: "Antibiotic resistance affects the success of other medical procedures.

Antibiotics are used to treat bacterial infections resulting from other diseases e.g., bacterial pneumonia in an HIV/AIDS infected person.

Recovery from surgery and cancer treatments depend on antibiotics to prevent further infection."

The scoping review only identified two studies that included the effects of antibiotic resistance on other medical procedure. Surgeries and organ transplants will become more dangerous as a result of antibiotic resistance (WHO, 2020b). As recommended by the Wellcome Trust, the above message highlights how antibiotic resistance undermines the development of modern medicine. Therefore, disseminating the above key message is crucial in alerting the public about the seriousness of antibiotic resistance.

The five key messages that were selected aimed to clarify the antibiotic resistance misconceptions that were found to be prevalent in South Africa. The selected key messages were included in a poster supported by the addition of graphic illustrations and colour to convey a vivid explanation of the concept to the target group. These are further explained in the methodology section of the thesis.

2.3 Summary

This chapter presented the findings of the literature review and the scoping review. The literature review identified lack of knowledge and negative attitudes on antibiotic use and resistance. Inappropriate antibiotic use and practices were linked to the misconceptions on antibiotic use and resistance. The scoping review identified 7 studies and one website for review. Thirteen key messages were identified and the five that were chosen for the intervention were justified by the literature.

CHAPTER THREE

RESEARCH METHODOLOGY

In this chapter, the study design, setting, target population, sampling, data collection methods and the data analytical procedures are discussed. The study's outline of activities provides the timeline of how each stage was conducted during COVID-19 lockdown restriction levels.

3.1 Outline of activities

The study was conducted sequentially in four phases (Table 3.1) namely, Phase 1: Scoping review, Phase 2: Pre-intervention survey, Phase 3: Intervention: Electronic media campaign and Phase 4: Post-intervention survey, which is presented in the sequence that they were conducted to achieve methodological flow.

3.2 Study design

An experimental research design was used in this study. Experimental research is defined as "a scientific approach where one or more independent variables are manipulated and applied to a dependant variable/s to measure the effect of the latter (Formplus, 2021). A one-group pre-test-post-test design, a class of experimental research design involves having one group of participants undergoing pre-experimental evaluation, an intervention and another evaluation after the intervention (Allen, 2017), was used. The rationale for using the experimental design was that the one-group pre-test-post-test design proves there is a difference between the pre-test and the post-test outcomes (Leedy and Ormrod, 2015). This exploratory study investigates the use of electronic media aimed at changing antibiotic resistance perceptions among a student community.

3.3 Study setting and population.

The target population is the set of units for which the findings of a research are meant to generalize (Lavrakas, 2012). The target population for this research was University of the Western Cape (UWC) Economic and Management Studies (EMS) undergraduate students.

Table 3.1: Timeline of the four phases of research methodology and data collection process during COVID-19 lockdown level restrictions imposed during 2020.

Phase	**Main objective(s)**	**Research activity**	**Researcher's timeline**	**Thesis Chapter**	**COVID-19 lockdown restriction level imposed during the 2020 academic year)**
Preparation		Proposal submission	30 September 2019		-
		Ethics approval	29 November 2019		-
Phase 1: Scoping review	-Review content, objectives, and structure of antibiotic resistance campaigns for community awareness. - Key message identification for student community awareness.	Review Protocol	January 2020 to April 2020	Chapter 2	-
		Literature search			-
		Key message identification			Level 5 (Online learning)
Phase 2: Pre-intervention data collection	Determine the participants' base-line perceptions on antibiotic resistance.	Permission to conduct study at UWC	April 2020	Chapters 3 and 4	Level 5 (Online learning)
		Questionnaire design	May 2020		Level 4 (Online learning)
		Questionnaire pilot study	14 July to 18 July 2020		Level 3 (Online learning)
		Survey: data collection	22 July to 9 September 2020		Level 3 and 2 (Online learning)
Phase 3: Intervention: Electronic media campaign	- Design of electronic media campaign material.	Campaign material design	7 May to 12 June 2020		Level 4 and 3 (Online learning)
		Campaign material pilot	29 July to 2 September 2020		Level 3 and 2 (Online learning)

	- Dissemination of key messages on antibiotic resistance to the student community.	Permission to use UWC electronic platforms	April 2020		Level 5 (Online learning)
		Electronic media campaign	28 September to 30 October 2020		Level 1 (Online learning and year-end assessment)
Phase 4: Post-intervention data collection	Determine participants' antibiotic resistance perceptions after electronic media campaign.	Survey: data collection	9 to 29 of November 2020		Level 1 (Year-end assessment)

The study population, which is the actual set of units to be sampled (Boslaugh, 2007), was third year (level 3) UWC students in the faculty of EMS studying fulltime towards a degree in Bachelor of Administration, Bachelor of Commerce, Bachelor of Commerce in Accounting, Bachelor of Commerce in Financial Accounting and Bachelor of Commerce in Law.

Inclusion criteria

A student community provided a controlled sample that was easy to follow up after the intervention as compared to the use of a residential community. Registered non-science EMS students in the 3rd study year (2020), were selected because the research team wanted to investigate the impact of the intervention without the influence of prior knowledge that is usually embedded among basic and health science students.

3.4 Sample size and sampling

Slovin's formula was used to calculate the required sample size (n) as the total number of the student population (N) was known. The Slovin's formula was applicable because the research accepts 5% margin of error (95% confidence interval) (Tejada and Punzalan, 2012). Below is the Slovin's formula:

$$n = \frac{N}{1 + Ne^2}$$

Where N is the study population size which we know is 599 and e is the margin of error.

Therefore:

$$n = \frac{599}{1 + (599 \times 0.05^2)}$$

n ≈ 240 (40% of the study population

Stratified sampling was used to determine the study sample. This involves having the study population in non-overlapping groups, called strata then drawing a random sample which contains members of each strata (Mclennan, 1999; Lemm, 2010). The method of sampling was chosen as the study population data

was provided in different degree programmes i.e., Bachelor of Administration, Bachelor of Commerce, Bachelor of Commerce in Accounting, Bachelor of Commerce in Financial Accounting and Bachelor of Commerce in Law. **Proportionate stratified sampling** was applied, which is a type of stratified sampling that involves including the same proportion of participants from the strata as the proportion of the sample size in the study population (Lemm, 2010). Since the study sample size of this research study is 40% of the study population, the study sample will include 40% of each stratum.

Systematic sampling was applied to each stratum to draw the required 40% proportion. Systematic sampling involves the use of a fixed interval (I) to select participants for the sampling frame. The interval can be calculated by dividing the number of the study population N by the required sample size (Mclennan, 1999).

$$I = \frac{N}{n}$$

$$I = \frac{599}{240}$$

$$I = 2{,}49$$

Since the interval is a decimal, it was rounded down to a whole number making it 2 resulting in the study sample being higher than the predicted. A random starting point was assigned in Excel, and every second participant chosen. The total study sample was 301. The power for the sample size of 301 was calculated and it was found to be 0.99.

Table 3.2: Breakdown of 3rd year EMS study sample by stratum.

Strata	**Strata size (N)**	**Participants sampled in each stratum (N)**
Bachelor of Administration	111	56
Bachelor of Commerce	121	61
Bachelor of Commerce in Accounting	112	56
Bachelor of Commerce in Financial Accounting	201	101
Bachelor of Commerce in Law	54	27

3.5 Data collection tool

Quantitative research methods yield factual and numerical data that is analysed statistically to examine relationships between variables. In contrast, qualitative research is conducted to explore and understand the meaning that individuals assign to social and human problems, whereby data collection is mainly conducted via open-ended questionnaires, interviews and focus group discussions (Creswel, 2018). Quantitative data was collected in this study as this was a retrospective study to investigate the effectiveness of electronic media in raising awareness about antibiotic resistance. Quantitative data was collected in phases 2 (pre-intervention (baseline) data collection) and 4 (post-intervention data collection)

An electronic questionnaire (Appendix B), that was generated using Google forms, was used for data collection. The contents of the questionnaire that was used in the pre- and post-intervention surveys was the same. The questionnaire had six sections, demographics, antibiotic use, knowledge on antibiotic use, attitudes on antibiotic use, knowledge on antibiotic resistance and attitudes towards antibiotic resistance. The five-point Likert scale was applied on some of the questions to offer flexibility when identifying participant responses. The middle option, "neutral", was included as the concept being investigated might not be familiar to the participants and the researcher wanted to avoid forcing the participants to choose an option when they did not have an opinion on the concept (Fallowfield, 1995). The post-intervention survey has an additional section that investigated if the participants were exposed to the intervention.

3.6 Pilot testing of the questionnaire

The pilot testing of the questionnaire aimed to ensure language and conceptual clarity before commencement of the actual study (Blaxter, Hughes and Tight, 2006). A pilot test was conducted from 14 July to 18 July 2020 with a student cohort from the faculty of EMS. Email requests were sent to 31 participants but only three responses were received. The invited participants were not included in the final surveys. The pilot test was conducted online via Google forms, and the participants were asked questions about the content of the questionnaire, and they were also required to respond to a set of questions that were noted in a feedback

form (Appendix C). The feedback form had questions on how long it took the participants to complete the questionnaire, which question(s) in they found difficult to understand and whether the questionnaire was pitched at a level that was in general, acceptable to the student cohort. The responses from the pilot testing were not included in the pre-intervention, post-intervention nor the final data analysis, but they were used to finalise the study questionnaire for dissemination to the study sample.

3.7 Phase 2: Pre-intervention survey

Pre-intervention data collection was conducted from 22 of July to 9 of September 2020. The participants were sent an email invitation to participate in the pre-intervention survey via Google forms (Appendix D). Email reminders were sent once a week for the duration of data collection.

3.8 Phase 3: Intervention: Electronic media campaign

3.8.1 Electronic media campaign design

The five key messages identified after the scoping (section 2.2.2) were disseminated to the student community in the form of electronic posters. The campaign material design was conducted from 7 May to 12 June 2020, during the COVID-19 lockdown restrictions (levels 3 and 4). Therefore, the researcher had to revise the media type to be used, namely change from print media to electronic posters. A graphic designer worked with the researcher to design the illustrations required to augment the meaning of each key message appearing on each poster. Pictorial imagery was added to the electronic posters as it has been reported to be effective in conveying the message than text alone. Studies on smoking cessation have reported that imagery attracts and holds attention better than text only interventions, garnered strong cognitive and emotional reactions (Noar *et al.*, 2016). The colour red was used in the imagery to indicate that the act being shown was not desirable, e.g., people sharing antibiotics. Red instantly grabs people's attention and is often associated with risk (Leonard, 1999). Illustrations that were storytelling were used, another attempt to grab people's attention. COVID-19 was added as a key message to one of the posters since the electronic media campaign was conducted during the Corona virus pandemic (2020). However, with each illustration, special attention was paid to maintaining scientific relevance and

staying socially conscious as applicable to that the student community. The research team ensured that there was no racial and gender bias associated with the poster illustrations.

Each message was depicted on a different poster, therefore a total of five electronic posters were distributed (Appendix E). This number was deemed appropriate to avoid information overload on a single poster and to allow use of large print for easy reading of the key message as our target audience, mainly comprised of generation Z, known to have a very low attention span (Shatto and Erwin, 2016).

3.8.2 Electronic media campaign material pilot

After the posters were designed, a pilot test was conducted from 29 July to 2 September 2020 with a student cohort from the faculty of EMS to ensure that the key messages were clear and understandable. Email requests were sent to 10 participants but only two responses were received. The participants who were invited to participate in the pilot were excluded from the actual study. The pilot was conducted three weeks before main study commenced and was disseminated via Google forms. Each poster was added in the form of an image and questions on whether the text and illustrations were clear and understandable were asked (Appendix F). There were no significant changes made to the posters after the pilot because the participants reported them to be conceptually clear.

3.8.3 Intervention: Electronic media campaign

The intervention, disseminated as an electronic media campaign ran for a period of five weeks, from 28 September to 30 October 2020. The campaign material was shared with the entire UWC community, not just the study cohort, via two electronic platforms, UWC Communications emails and the iKamva splash page.

iKamva is UWC's eLearning management system that allows students access to valuable resources for self-study, reflection, and assessments. At the onset of the pandemic, iKamva was the main platform used by lecturers and students, therefore students spent a lot of time on the platform. iKamva means "future" in isiXhosa and refers to the social and technological advancement. The iKamva splash page is an announcement page that show on the log in page of iKamva

(Appendix G). On the iKamva splash page, each poster was shared for a week to allow enough exposure for the participants to notice the information on the posters.

The UWC communications is the university's internal communication channel that operates via email. It is used to communicate important information and announcements with the entire university community. To avoid spamming the participants' emails, one email was sent to the participants once a week for the duration of the campaign via the UWC Communications. All the posters were attached in each email correspondence (Appendix H).

3.9 Phase 4: Post-intervention survey

The post-intervention data collection was done from the 9th to the 29th of November 2020. An invitation (Appendix I) was emailed to the participants to participate in the post-intervention survey via Google forms and email reminders were sent once a week for the duration of the data collection period.

3.10 Validity and reliability

3.10.1 Validity

A concerted effort was made to ensure that the questionnaire had content validity, i.e. it measures what the researcher intends to measure (Blanche, Durrheim and Painter, 2006), in this case the antibiotic resistance perceptions of a student community. The questionnaire was designed after a literature review of validated comparable studies was conducted to investigate patients' perceptions of antibiotic resistance (Filipetto *et al.*, 2008; You *et al.*, 2008; Ramchurren *et al.*, 2017; Oh *et al.*, 2018; Farley *et al.*, 2019). The Dendrogram technique(Appendix J) was applied to achieve conceptual clarity and guide the questionnaire design (Schutte, 2006).

The questionnaire had built-in check questions to allow the researcher to identify inconsistencies in the participants' responses. For example, two definitions of antibiotic resistance, that is "Antibiotic resistance is when my body does not respond to antibiotics anymore" and "Antibiotic resistance is when bacteria cannot be killed by antibiotics anymore".

The researcher took some measures to minimize effects of the threats to internal validity associated with the use of the one-group pre-test-post-test design. History effects results from other experiences outside the scope of the research influencing the participants between the pre-test and the post-test. In this study, an example of history effects would be effects of the COVID-19 pandemic on the participants' awareness of viral infections and information updates on the potential treatment options disseminated via mass and social media. The researcher tried to minimize the time between the two surveys (2 months). Maturation effect results from natural change due to growth and learning. The effects of this threat were also minimized by having a short period (2 months) of time between the pre-intervention and the post-intervention surveys (Allen, 2017).

3.10.2 Reliability

Reliability is defined as the ability of a questionnaire to produce the same results under the same conditions. Reliability of the research tool, the questionnaire, was ensured by conducting a pilot study. The pilot study ensured language and conceptual clarity before commencement of the actual study (Blaxter, Hughes and Tight, 2006). Some of the questions in the questionnaire employed a 5-scale Likert-style, to improve reliability by offering accurate levels of measurement (Neuman, 2007). The scoping review of public health campaigns and intervention studies guided the questions selected for this target group, especially questions relating to the sharing of antibiotics, uses of antibiotics and the definition of antibiotic resistance. The Cronbach's alpha was 0.483.

3.11 Data analysis

Data from the online questionnaires was downloaded as Microsoft Excel spread sheet. Data cleaning and check-up was done, followed by numerical data coding. Data coding is when data is summarized and presented in cohesive symbolic categories to provide systematic account of the data (Pallant, 2005). The coded data was exported to the statistical software, Statistical Package for the Social Sciences (SPSS) software, version 27 for Windows (Microsoft, USA). Descriptive and inferential statistics analyses were conducted on the data.

Descriptive statistics are used to simplify data in a structured manner to describe the relationship and draw out patterns between variables, making data logical to the reader (Bulman and Osborn, 1989). Categorical data, described in percentages and frequencies, was presented in tables, pie charts and bar graphs. The categorical data included age, gender, degree, antibiotic use, knowledge on antibiotic use, attitudes towards antibiotic use and knowledge on antibiotic resistance.

The **overall knowledge and attitude score assessment** was calculated from the participants response scales. A score of 1 was awarded for each correct answer or positive attitude and 0 for each wrong answer or negative attitude. The "neutral" response was categorised as an indication that the participant did not know, therefore awarded a score of 0. The correct response was determined from that noted in the current (2015- present) literature pertaining to antimicrobial resistance. To classify "check all that apply" question responses, the participants were awarded 1 score if they had ticked 50% or more correctly. The participants were said to have "good knowledge" if they had an overall score of 50% and above and "poor knowledge" if the overall score was below 50% (Baig *et al.*, 2020).

Inferential statistics was used to explain the relationship between the dependent and independent variables. Prior to analysis, normality tests were conducted for the knowledge on antibiotic use, attitudes on antibiotic use and knowledge on antibiotic resistance (knowledge and attitudes variables) using the Shapiro Wilk test and histograms. The test of normality determines the statistical tests that are used for analysis of the data. The distribution of the data determined the statistical test that could be used the for the different variables. The data from the pre- and post-intervention surveys was grouped into two datasets, dependent sample, and independent sample. The dependent sample comprised of the participants that participated into both surveys whereas the independent comprised of those that participated in either of the two surveys. The p-value of <0.05 was considered statistically significant.

Paired t-tests were used to analyse the relationship between the pre- and post-intervention surveys for the dependent sample, as all variables were normally distributed. To investigate the relationship between post-intervention knowledge and attitudes variables and exposure to the intervention and the electronic media exposed to, the independent t-tests were used.

Independent t-tests or Mann-Whitney U tests were used to analyse the relationship between the pre- and post-intervention surveys overall and for the independent sample, depending on normality of the variables. To investigate the relationship between post-intervention knowledge and attitudes variables and exposure to the intervention and the electronic media exposed to, the independent t-tests or the Mann-Whitney U test were used, depending on the distribution of the data.

3.12 Ethical considerations

Ethical approval was obtained from the University of the Western Cape Biomedical Research Ethics Committee (BMREC) before commencement of quantitative data collection (Ethics Reference Number: BM19/10/6) (Appendix K). Permission to conduct research at the University of the Western Cape was granted by the university's deputy Registrar prior to initiation of data collection (Reference number: UWCRP280120PM) (Appendix L).

Participants were provided with an information sheet that outlined the purpose, objectives, significance, risks, and benefits of the study (Appendix M). Informed consent was requested from the participants before they could proceed to the pre- and post-intervention surveys (Appendix N). The participants who agreed to participate were able to access the online questionnaire.

Anonymity of the participants was ensured throughout the study. Student numbers were used to send an email invitation to participate in the study and for matching the responses from the pre- and post-intervention surveys. Data collected was secured on a password protected laptop accessible only to the researchers. The data will be stored for 3 years, thereafter, deleted from the electronic file.

The researcher sought written permission from the CIECT director, Professor Stoltenkamp and the UWC Communications editor, Mrs N Davids, to have the posters shared via the iKamva splash page and the UWC Communications (Appendix O and P respectively).

There was no direct, physical contact with the participants for the study. No risks to the participants were anticipated for the duration of the study.

3.13 Funding

The study was funded by the National Research Foundation, Community Engagement (2019) grant number 116248.

CHAPTER FOUR

RESULTS

This chapter provides the findings of the pre- and post-intervention electronic surveys that were undertaken with the UWC student cohort. The quantitative analysis is presented into three sections: demographic characteristics of the participants, descriptive statistics, and inferential statistics.

4.1 Demographic characteristics of the participants

The sociodemographic data such gender, age and specific undergraduate programme being pursued at the faculty of EMS are shown in the Table 4.1 below. A total of 64 participants responded in the pre-intervention survey and 42 participants in the post-intervention survey.

Table 4.1: Age, gender and degree being pursued by the participants in the pre- and post- intervention surveys.

Variable	**Pre-intervention survey** N=64 n (%)	**Post-intervention survey** N=42 n (%)
Age (years)		
18-24	50 (78.1%)	34 (81.0%)
25-34	13 (20.3%)	7 (16.7%)
35-44	1 (1.6%)	1 (2.3%)
Gender		
Female	32 (50.0%)	20 (47.6%)
Male	32 (50.0%)	22 (52.4%)
Undergraduate programme enrolled for:		
Bachelor of Administration	12 (18.8%)	6 (14.3%)
Bachelor of Commerce	13 (20.3%)	9 (21.4%)
Bachelor of Commerce in Accounting	8 (12.5%)	7 (16.7%)
Bachelor of Commerce in Financial Accounting	24 (37.5%)	15 (35.7%)
Bachelor of Commerce in Law	7 (10.9%)	5 (11.9%)

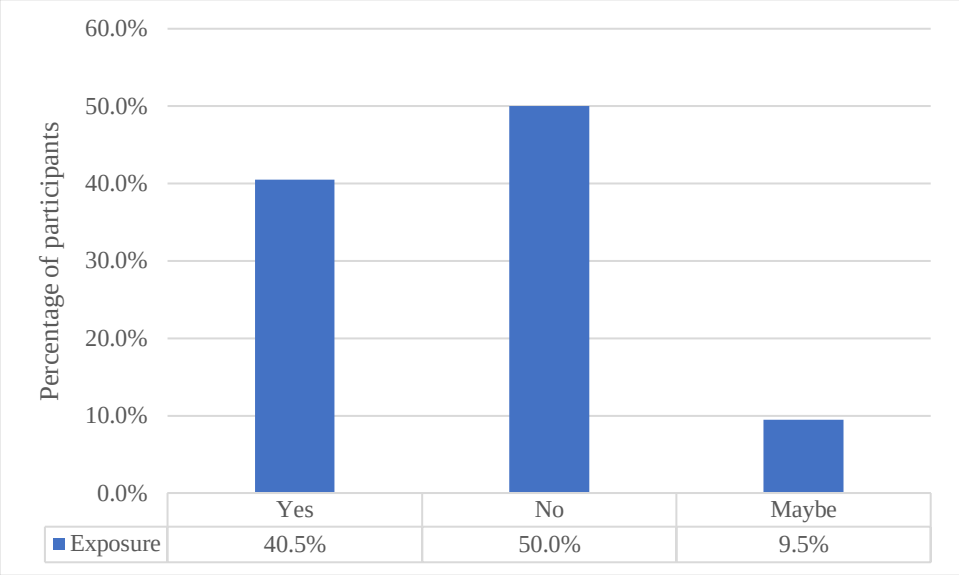
The participants' ages ranged from 20 years to above 40 years, with most of the participants being between 18-24 years old in the pre-(78.1%) and post-(81.0%) intervention surveys. In both surveys, there was almost no gender difference.

Over a third of the participants who participated were enrolled into the Bachelor of Commerce in Financial Accounting programme and they comprised the largest group of the participants in pre (37.5%) - and post (35.7%) -intervention surveys, respectively.

4.1.1 Response to Intervention exposure

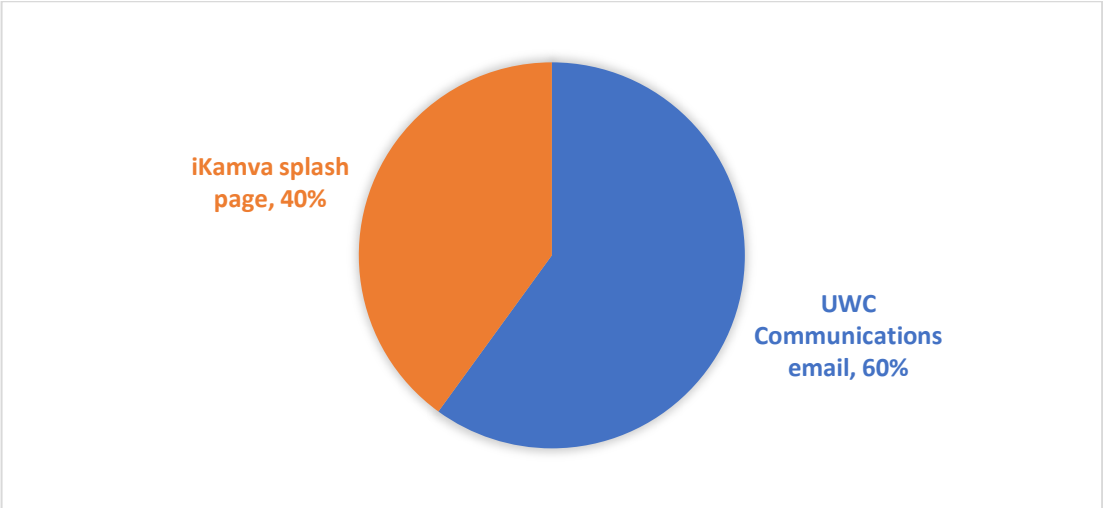
To investigate the participants' exposure to the intervention, the post-intervention survey participants were asked to respond whether they saw any of the online posters on antibiotics between 28 September to 30 October 2020. Forty-point five percent had reported that they had seen the posters, while 50.0% responded they had not seen the posters.

Figure 4.1: Exposure to the online intervention.



Of the 40.5% of the participants that responded that they had seen the posters, most of them had indicated that they had done so via the UWC Communications email (60.0%) compared to the iKamva splash page (40.0%).

Figure 4.2: Type of electronic platform that the participants denoted their exposure to the intervention.



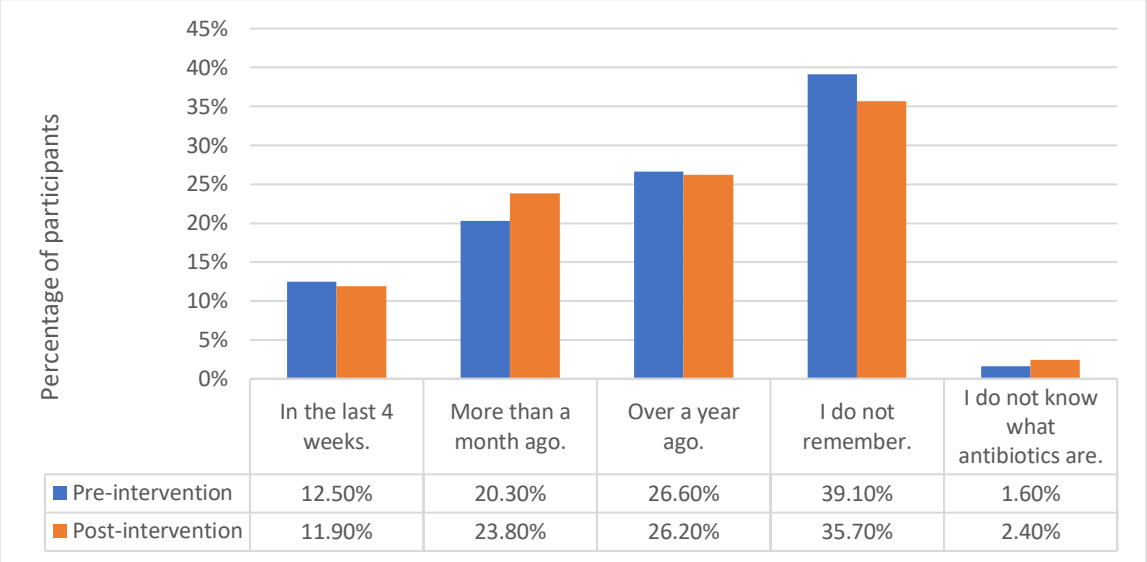
4.2 Descriptive statistical analysis

4.2.1 Antibiotic use

The participants' antibiotic use practises were assessed following their responses to 4 questions which consisted of a mixture of multiple choice, check all that apply and yes/no/sometimes options.

Question 1 evaluated when the participants had last taken antibiotics. Figure 4.3 provides responses, per survey group, inquiring when last the participants had used antibiotics. A quarter of the participants in the pre-(26.6%) and post-(26.2%) intervention surveys, reported that they had last used antibiotics over a year ago. Over a third of the participants in both the pre (39.1%) and post (35.7%) -intervention groups claimed that they did not remember the last time they used antibiotics (Figure 4.3).

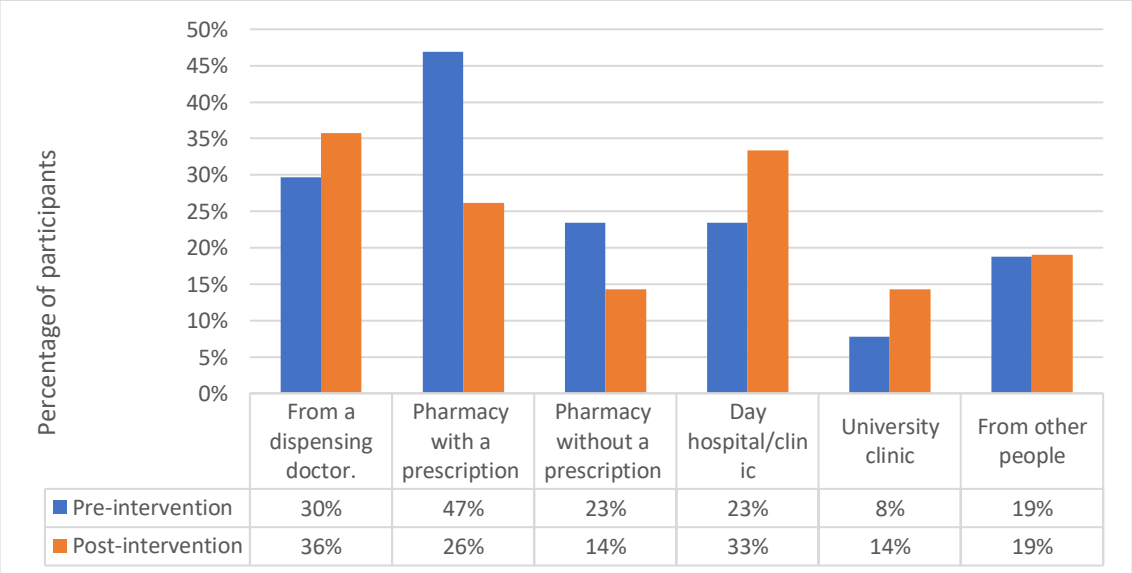
Figure 4.3: Pre- and post-intervention responses to recalling the last time antibiotics were used.



	In the last 4 weeks.	More than a month ago.	Over a year ago.	I do not remember.	I do not know what antibiotics are.
Pre-intervention	12.50%	20.30%	26.60%	39.10%	1.60%
Post-intervention	11.90%	23.80%	26.20%	35.70%	2.40%

Question 2 inquired how the participants usually acquire antibiotics. The most common way to access antibiotics in the pre-intervention participants was from the pharmacy with a prescription (47.0%) whereas in the post-intervention group it was from a dispensing doctor (36.0%). Almost one-fifth (19.0%) of the participants in both survey groups admitted that they used antibiotics which they had received from other people.

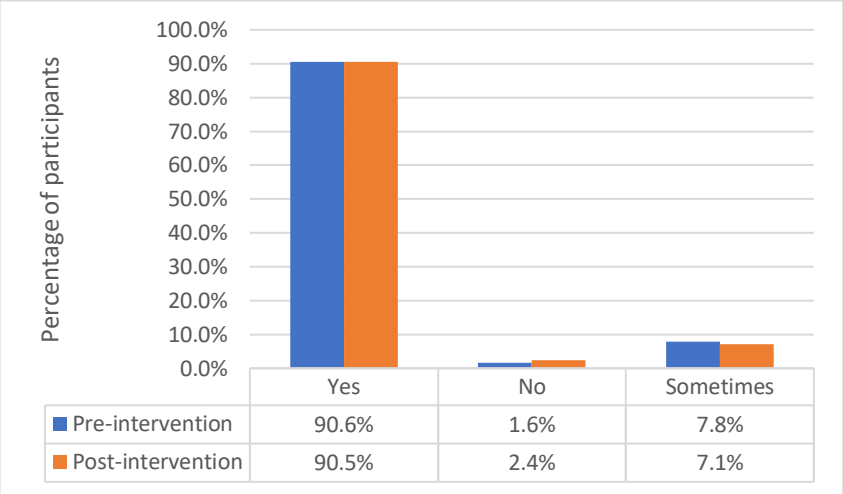
Figure 4.4: Access to antibiotics between the pre-and post-intervention groups.



	From a dispensing doctor.	Pharmacy with a prescription	Pharmacy without a prescription	Day hospital/clinic	University clinic	From other people
Pre-intervention	30%	47%	23%	23%	8%	19%
Post-intervention	36%	26%	14%	33%	14%	19%

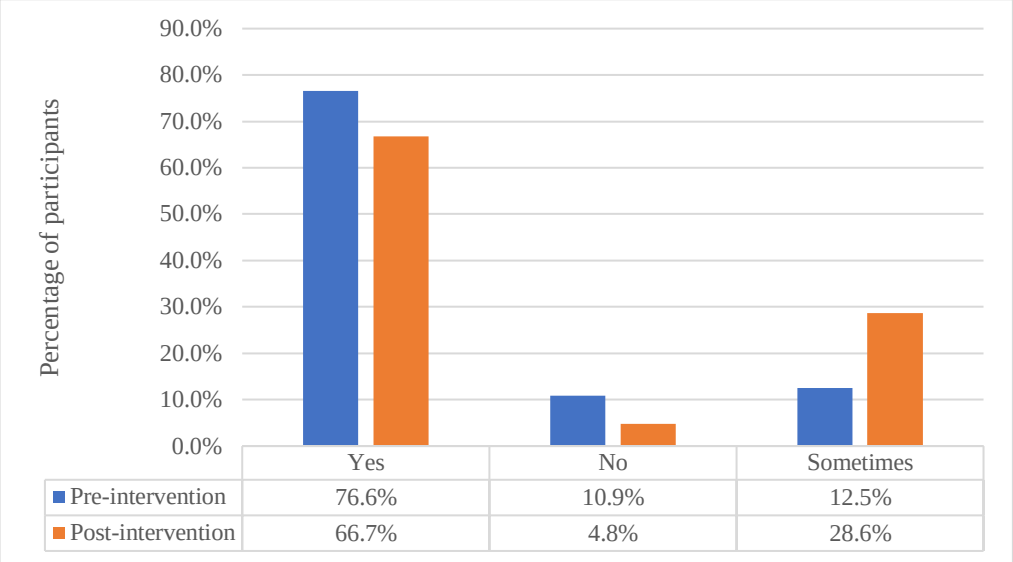
In response to question 3, which inquired whether the participants always take their antibiotics as directed by a healthcare professional, almost all participants in both survey groups answered positively ("yes", 91.0% in both pre- and post-interventions) (Figure 4.5).

Figure 4.5: Participants' responses to ascertain if they follow a healthcare professional's directions when taking antibiotics.



Question 4 evaluated whether the participants took their antibiotics for the recommended duration or not. In both survey groups, the majority responded positively ("yes", (pre- (77.0%)-, post – (67.0%) intervention) (Figure 4.6). However, over quarter (28.0%) of the participants of the post-intervention group responded that they did so "sometimes".

Figure 4.6: Responses to whether participants took antibiotics for the recommended duration.



4.2.2 Knowledge on antibiotic use

In assessing the knowledge on antibiotic use, participants' responses to six questions were analysed from the 5-point Likert scale, yes/no or check all that apply options.

On a statement that antibiotics are used to treat bacterial infections, most participants in both survey groups (pre- (82.8%) and post- (71.5%) intervention) correctly agreed with the statement. However, to the built-in check statement that enquired whether antibiotics are used to treat viral infections, over a third of participants in both the pre- (36.0%) and post- (38.1%) intervention surveys had incorrectly agreed to it. In the pre-intervention survey, 45.3% of the participants also incorrectly reported that they agreed with the statement that antibiotics are used to treat any kind of infection.

In response to the statement that different antibiotics are used to treat different infections, almost all (pre- (82.8%) and post- (81.0%) intervention) participants had correctly agreed with this concept.

Table 4.2: Participants' responses to questions ascertaining their knowledge on antibiotic use (Questions 1-5). The shaded areas highlight the correct responses.

Knowledge questions	**Pre-intervention** (N = 64) **vs Post-intervention** (N = 42)	Strongly agree % (n)	Agree % (n)	Neutral %(n)	Disagree %(n)	Strongly disagree %(n)
Antibiotics are used to treat infections that are caused by a germ called bacteria.	Pre-intervention	**37.5%** (24)	**45.3 %** (29)	**14.1%** (9)	**1.6%** (1)	**1.6%** (1)
	post-intervention	**31.0%** (13)	**40.5 %** (17)	**21.4%** (9)	**7.1%** (3)	**0.0%** (0)
Antibiotics are used to treat infections that are caused by a germ called virus.	Pre-intervention	**9.4%** (6)	**26.6 %** (17)	**26.6%** (17)	**23.4%** (15)	**14.1%** (9)
	post-intervention	**7.1%** (3)	**31.0 %** (13)	**23.8%** (10)	**16.7%** (7)	**21.4%** (9)
Antibiotics are used to treat any kind of infection caused by any kind of germ.	Pre-intervention	**12.5%** (8)	**32.8 %** (21)	**29.7%** (19)	**20.3%** (13)	**4.7%** (3)
	post-intervention	**16.7%** (7)	**26.2 %** (11)	**38.1%** (16)	**11.9%** (5)	**7.1%** (3)
Different antibiotics are used to treat different types of infections.	Pre-intervention	**28.1%** (18)	**54.7 %** (35)	**12.5%** (8)	**4.7%** (3)	**0.0%** (0)
	post-intervention	**26.2%** (11)	**54.8 %** (23)	**14.3%** (6)	**4.8%** (2)	**0.0%** (0)
You usually know when you are sick enough to		**Yes**	**No**		**Sometimes**	
	Pre-intervention	**42.2%** (27)	**32.8%** (21)		**25.0%** (16)	
	post-intervention	**38.1%** (16)	**38.1%** (16)		**23.8 %** (10)	

need antibiotics.				

For question 6, assessing the knowledge on antibiotic use, participants' responses to identifying the conditions for which antibiotics can be indicated were analysed (Table 4.3). Only 18.8% and 26.2% of the participants in the pre- and post-intervention survey groups, respectively, incorrectly identified Coronavirus infection (Covid-19) and pain (pre- (20.3%) and post- (21.4%) intervention) as conditions that required treatment with antibiotics. However, more post-intervention participants than their pre-intervention counterparts believed that antibiotics could be used in treating a cold (pre- (40.6%) and post- (45.2%) intervention), flu, cough with green phlegm (pre- (43.8%) and post- (50%) intervention), inflammation (pre- (40.6%) and post- (42.9%) intervention) and sore throat (pre- (35.9%) and post- (47.6%) intervention). Over a third of participants from both groups responded that antibiotics are required for a cough lasting more than a week (pre- (37.5%) and post- (35.7%) intervention).

More participants in the pre-intervention group correctly identified that an infected wound (pre- (60.9%) and post- (52.4%) intervention), some sexually transmitted diseases (pre- (56.3%) and post- (54.8%) intervention) and a bacterial infection secondary to a viral infection (pre- (71.9%) and post- (69.0%) intervention) required treatment with antibiotics.

Table 4.3: Participants' knowledge on antibiotic use (Question 6)

Considering the following conditions, identify those conditions when can antibiotics be used? Select all that applies.	**Pre-intervention N = 64**		**Post-intervention N = 42**	
	N	%	N	%
Coronavirus infection (Covid-19)	12	18.8%	11	26.2%
Cold	26	40.6%	19	45.2%
Flu	31	48.4%	28	66.7%
Pain	13	20.3%	9	21.4%
Cough with green phlegm	28	43.8%	21	50.0%
Inflammation	26	40.6%	18	42.9%

A cough lasting more than a week	24	37.5%	15	35.7%
Sore throat	23	35.9%	20	47.6%
An infected wound	39	60.9%	22	52.4%
Some sexually transmitted diseases	36	56.3%	23	54.8%
A bacterial infection which presents in a patient with a viral infection	46	71.9%	29	69.0%

4.2.2.1 Overall Knowledge assessment

The mean knowledge scores were 57% (minimum 17%, maximum 100%) and 51% (minimum 0%, maximum 100%) in the pre- and post-intervention surveys respectively. The analysis reveals that in the pre-intervention survey there were more participants (81.2%) with good knowledge compared to those in the post-intervention survey (64.3%).

Table 4.4: Participants' overall knowledge score on antibiotic use.

Survey	**Poor knowledge % (n)**	**Good knowledge % (n)**	**Mean scores (%) (Minimum%–Maximum%)**
Pre-intervention (N=64)	18.8% (12)	81.2% (52)	57.0 % (17% -100%)
Post-intervention (N=42)	35.7% (15)	64.3% (27)	51.0% (0% -100%)

4.2.3 Attitudes on antibiotic use

In assessing the attitudes on antibiotic use, the participants were required to respond to nine questions that were either 5-point Likert scale or yes/no questions.

On questions investigating the participants' expectations when taking antibiotics, most of the participants disagreed with the statements that taking antibiotics ensures not getting sick again with the same condition (pre- (63.9%) and post- (52.4%) intervention) and that they boost one's immune system (pre- (56.2%) and post- (57.1%) intervention). However, half of the participants in both survey groups (pre- (50.0%) and post- (52.4%) intervention), incorrectly agreed that taking antibiotics when one has a cold result in a quicker recovery than one who is not taking such therapy.

Above two thirds (pre-(76.5%) and post-(66.7%) intervention) of the participants in both survey groups disagreed with reserving leftover antibiotics for use later on. Half of the participants in both the pre-(57.8%) and post-(50.0%) intervention surveys did not support having antibiotics available over the counter without a prescription. To the question, should antibiotics be thrown in the bin, about two thirds (pre-(67.2%) and post-(64.3%) intervention) of the participants believed they could. Most participants in both survey groups (pre-(71.9%) and post-(71.4%) intervention) reported that they would not share their antibiotics with other people. In response to whether the participants expected to receive antibiotics during consultation, over a quarter of the participants in both groups responded positively ("no", pre-(37.5%) and post-(26.2%) intervention).

Table 4.5: Participants' responses to questions on attitudes towards antibiotic use in pre- and post-intervention surveys. The shaded areas denote the positive attitudes.

Attitudes towards antibiotic use questions	**Pre-intervention (N=64) vs Post-intervention (N=42)**	Strongly agree %(n)	Agree %(n)	Neutral %(n)	Disagree %(n)	Strongly disagree %(n)
Taking antibiotics when you have a cold helps one recover quicker than not taking antibiotics.	Pre-intervention	14.1% (9)	35.9% (23)	35.9% (23)	4.7% (3)	9.4% (6)
	post-intervention	11.9% (5)	40.5% (17)	33.3% (13)	11.9% (5)	2.4% (1)
Taking antibiotics when you are sick assures you that you do not get sick again with	Pre-intervention	1.6% (1)	10.9% (7)	28.1% (18)	48.3% (28)	15.6% (10)
	post-intervention	0% (0)	11.9% (5)	35.7% (15)	42.9% (18)	9.5% (4)

the same condition.						
Taking antibiotics during a pandemic e.g., COVID-19, before you get sick, boosts your immune system so you will not get sick.	Pre-intervention	1.6% (1)	12.5 % (8)	29.7% (19)	40.6% (26)	15.6% (10)
	post-intervention	0% (0)	7.1 % (3)	35.7% (15)	38.1% (16)	19% (8)
One can reserve leftover antibiotics for the next time they get sick.	Pre-intervention	0% (0)	10.9 % (7)	12.5% (8)	35.9% (23)	40.6% (26)
	post-intervention	2.4% (1)	9.5 % (4)	21.4% (9)	28.6% (12)	38.1% (16)
There is no need to visit the doctor, one can just call their offices to obtain an antibiotic prescription.	Pre-intervention	1.6% (1)	9.4 % (6)	23.4% (15)	43.8% (28)	21.9% (14)
	post-intervention	0.0% (0)	2.4 % (1)	23.8% (10)	47.6% (20)	26.2% (11)
Antibiotics should be available to buy at the pharmacy without prescription.	Pre-intervention	12.5% (8)	18.8 % (12)	10.9% (7)	42.2% (27)	15.6% (10)
	post-intervention	7.1% (3)	19 % (8)	23.8% (10)	28.6% (12)	21.4% (9)

		Yes	No	Sometimes
Should leftover antibiotics that have	Pre-intervention	67.2% (43)	7.8% (5)	25% (16)
	post-intervention	64.3% (27)	11.9% (5)	23.8% (10)

expired be thrown into the bin?				
If a relative, friend or neighbour is sick, would you share with them some of your antibiotics?	Pre-intervention	25.0% (16)	71.9% (46)	
	post-intervention	28.6% (12)	71.4% (30)	
When you visit the clinic or the doctor, do usually you expect antibiotics to be prescribed?	Pre-intervention	37.5% (24)	39.1% (25)	23.4% (15)
	post-intervention	26.2% (11)	47.6% (20)	26.2% (11)

4.2.3.1 Overall Attitude score

The mean attitude scores were 50.0% (minimum 0.0%, maximum 89.0%) and 40.0% (minimum 0.0%, maximum 67.0%) in the pre- and post-intervention surveys respectively. The pre-intervention survey had more participants (56.2%) with positive attitudes than those in the post-intervention survey (38.1%).

Table 4.6: Participants' overall attitude score on antibiotic use.

Survey	**Negative attitudes**	**Positive attitudes**	**Mean attitude scores. (Minimum – maximum)**
Pre-intervention (N=64)	43.8% (28)	56.2% (36)	50.0% (0.0% - 89.0%)
Post-intervention (N=42)	61.9% (26)	38.1% (16)	40.0% (0.0% -67.0%)

4.2.4 Knowledge about antibiotic resistance

In assessing the knowledge on antibiotic resistance, the participants were required to respond to nine questions that were presented either 5-point Likert scale,

yes/no or check all that apply options. Table 4.7 show the participants' responses on antibiotic resistance knowledge questions.

Table 4.7: Participants' responses to questions ascertaining their knowledge on antibiotic resistance. The shaded areas indicate the correct responses.

Knowledge about antibiotic resistance questions	**Pre-intervention** (N = 64) **vs Post-intervention** (N = 42)	Strongly agree %(n)	Agree %(n)	Neutral %(n)	Disagree %(n)	Strongly disagree %(n)
Antibiotic resistance occurs when your body does not respond to antibiotics anymore.	Pre-intervention	25.0% (16)	37.5% (24)	31.3% (20)	3.1% (2)	3.1% (2)
	post-intervention	33.3% (14)	42.9% (18)	21.4% (9)	2.4% (1)	0.0% (0)
Antibiotic resistance occurs when bacteria cannot be killed by antibiotics anymore.	Pre-intervention	25.0% (16)	34.4% (22)	34.4% (22)	4.7% (3)	1.6% (1)
	post-intervention	19.0% (8)	42.9% (18)	33.3% (14)	0.0% (0)	4.8% (2)
Resistant bacteria can spread between people.	Pre-intervention	9.4% (6)	25.0% (16)	45.3% (29)	20.3% (13)	0.0% (0)
	post-intervention	11.9% (5)	19% (8)	54.8% (23)	14.3% (6)	0.0% (0)
Antibiotic resistance is a serious global problem.	Pre-intervention	10.7% (7)	29.7% (19)	56.3% (36)	3.1% (2)	0.0% (0)
	post-intervention	23.8% (10)	23.8% (10)	45.2% (19)	7.1% (3)	0.0% (0)
		Yes		No		I am not sure
Have you heard of the term "antibiotic resistance"?	Pre-intervention	50.0% (32)		42.2% (27)		7.8% (5)
	post-intervention	61.9% (26)		33.3% (14)		4.8% (2)

Participants in both the pre- (50.0%) and post-(61.9%) intervention surveys reported that they had heard the term "antibiotic resistance". In response to the statements on the definition of antibiotic resistance, over half of the participants in both groups (pre- (59.4%) and post- (61.9%) intervention) were able to

correctly define the phrase as "bacteria cannot be killed by the antibiotics". However, a similarly staggering majority (pre-(62.6%) and post-(76.2%) intervention) of the participants also incorrectly defined antibiotic resistance to occur when the body does not respond to antibiotics anymore. To the statement that antibiotic resistance is a serious global problem, 56.3% and 45.2% of the participants in the pre- and post-intervention surveys, respectively, remained neutral in their feedback.

Participants were asked about the factors that contribute to antibiotic resistance (Table 4.8). Only half of the participants were able to correctly indicate that using antibiotics when they are not needed (pre-(53.1%) and post-(54.8%) intervention) and not finishing the course of antibiotics (pre-(56.3%) and post-(50.0%) intervention) contributed to antibiotic resistance. However, less than half of the participants could correctly indicate that taking antibiotics for every sickness (pre-(45.3%) and post-(45.2%) intervention) and keeping antibiotics for later use (pre-(37.5%) and post-(42.9%) intervention) were factors contributing to antibiotic resistance. In addition, less than a quarter of the participants across the two groups seemed to not recognise that lack of infection control (pre-(14.1%) and post-(23.8%) intervention) and sharing their antibiotics with family and friends (pre-(21.9%) and post-(23.8%) intervention) were factors that accelerated antibiotic resistance.

Table 4.8: Participants' responses to a question ascertaining their knowledge on the contributors to antibiotic resistance.

Question 27: What do you think contributes to antibiotic resistance?		
Responses	**Pre-intervention** (N= 64) n (%)	**Post-intervention** (N= 42) n (%)
Using antibiotics when they are not needed.	34 (53.1%)	23 (54.8%)
Taking antibiotics for every sickness.	29 (45.3%)	19 (45.2%)
Lack of infection control.	9 (14.1%)	10 (23.8%)
Not finishing the course of antibiotics.	36 (56.3%)	21 (50.0%)
One person always taking the same antibiotic.	22 (34.4%)	12 (23.8%)

One sharing their antibiotics with family and friends.	14 (21.9%)	10 (23.8%)
Keeping antibiotics for later use.	24 (37.5%)	18 (42.9%)
I do not know.	14 (21.9%)	10 (23.8)

To investigate the participants' knowledge on the effects of antibiotics resistance, question 28 was posed (Table 4.9). Over half of the participants in both surveys (pre-(54.7%) and post- (57.1%) intervention) responded correctly in recognising that there is difficulty to treating bacterial conditions that once could be done successfully. Less than one fifth of the participants (pre-(15.6%) and post-(19.0%) intervention) recognised that there would be no access to antibiotics in the future as a result of antibiotic resistance. Most participants (pre-(64.1%) and post-(71.4%) intervention) incorrectly indicated that the body does not respond to any antibiotics. Over a quarter of the participants (pre-(34.4%) and post-(26.2%) intervention) responded that did not know the effects of antibiotic resistance.

Table 4.9: Participants' responses to the question (28) ascertaining their knowledge on the effects of antibiotic resistance.

Question 28: Effects of antibiotic resistance include:		
Responses	**Pre-intervention** (N = 64) n (%)	**Post-intervention** (N = 42) n (%)
Difficulty treating bacterial conditions that we once could.	35 (54.7%)	24 (57.1%)
Your body not responding to any antibiotics.	41 (64.1%)	30 (71.4%)
The use of expensive antibiotics.	12 (18.8%)	9 (21.4%)
No antibiotics to use in the future.	10 (15.6%)	8 (19%)
The use of last resort antibiotics with major side effects.	20 (31.3%)	9 (21.4%)
Success of other medical conditions compromised.	11 (17.2%)	3 (7.1%)
Scientists discovering new antibiotics.	6 (9.4%)	4 (9.5%)
I do not know.	22 (34.4%)	11 (26.2%)

When posed with the question (Table 4.10) on the treatment of resistant bacteria, less than half of the participants (pre-(43.8%) and post-(45.2%) intervention) indicated that they did not know the therapeutic approach.

Table 4.10: Participants' responses to a question ascertaining their knowledge on the treatment of antibiotic resistant infections.

Question 29: Infections which are resistant to antibiotics require:		
Responses	**Pre-intervention** (N = 64) n (%)	**Post-intervention** (N = 42) n (%)
More than one antibiotic.	11 (17.2%)	7 (16.7%)
Stronger antibiotics.	32 (50.0%)	17 (40.5%)
No antibiotics	3 (4.7%)	3 (7.1%)
New antibiotics	17 (26.6%)	8 (19.0%)
Expensive antibiotics.	6 (9.4%)	3 (7.1%)
I do not know	28 (43.8%)	19 (45.2%)

In response to a question on who the participants thought was affected by antibiotic resistance (Table 4.11), less than half of the participants (pre-(29.7%) and post-(35.7%) intervention) correctly knew that it affected everyone.

Table 4.11: Participants' responses to a question ascertaining their opinion on the who is affected by antibiotic resistance.

Question 31: In your opinion, antibiotic resistance affects:		
Responses	**Pre-intervention** (N = 64) n (%)	**Post-intervention** (N = 42) n (%)
Everyone.	19 (29.7%)	15 (35.7%)
An individual.	12 (18.8%)	7 (16.7%)
Some communities.	0 (0.0%)	1 (2.4%)
Low-income communities.	1 (1.6%)	2 (4.8%)
Only people that take antibiotics.	7 (10.9%)	5 (11.9%)
I am not sure.	25 (39.1%)	12 (28.6%)

4.2.4.1 Overall Knowledge score about antibiotic resistance

The mean knowledge scores were 33.0% (minimum 0.0%, maximum 89.0%) and 35.0% (minimum 0.0%, maximum 89.0%) in the pre- and post-intervention surveys respectively. The post- survey had more participants (31.0%) with good

knowledge than the intervention pre-intervention survey (25.0%), although both scores were very low.

Table 4.12: Participants' overall knowledge score on antibiotic resistance.

Survey	**Poor knowledge**	**Good knowledge**	**Mean knowledge score (minimum %– maximum%)**
Pre-intervention (N=64)	75.0% (48)	25.0% (16)	33.0% (0.0% - 89.0%)
Post-intervention (N=42)	69.0% (29)	31.0% (13)	35.0% (0.0% - 89.0%)

4.3 Inferential statistical analyses

Inferential statistical analysis was conducted to compare the overall difference between the pre-intervention and post-intervention groups, differences in the responses of participants who participated in both surveys (dependant sample) and differences in the responses of participants who participated in only one of the surveys (independent sample). The statistical test used was determined by the data distribution as explained in Section 3.11 in the methodology chapter (Chapter 3).

A retrospective post-hoc power test was performed on the response sample size (64 and 42, pre- and post-intervention respectively) and found to be 68.59%, which is below the minimum 80% required. Therefore, our results must be treated with caution as it is possible a type II error was committed.

4.3.1 Pre-intervention versus post-intervention overall analyses

The statistical analyses aimed to determine whether there were any differences in participant knowledge (on antibiotic use and resistance) and attitude (antibiotic use), between the pre- and post-intervention groups, those exposed and not exposed to the intervention, the influence between the two types of the electronic platforms, gender difference, and the type of undergraduate course that participants were enrolled.

No significant difference was observed on participants' knowledge on antibiotic use (p=0.313), knowledge on antibiotic resistance (p=0.488) and attitude towards antibiotic use (p=0.524) between the pre-intervention and the post-intervention groups (Table 4.13).

Table 4.13: Difference in knowledge (antibiotic use and resistance) and attitude towards antibiotic use between the study groups.

Variable	**N**	**Mean (Standard deviation)**	**Statistical test**	**P-value**
Knowledge on antibiotic use				
Pre-intervention	64	19.50 (2.619)	Mann-Whitney U	0.313
Post-intervention	42	19.07 (3.173)		
Attitudes towards antibiotic use				
Pre-intervention	64	26.77 (4.316)	Independent sample t-test	0.524
Post-intervention	42	26.26 (3.357)		
Knowledge on antibiotic resistance				
Pre-intervention	64	22.63 (4.308)	Mann-Whitney U	0.488
Post-intervention	42	23.19 (4.068)		

There was no statistical significance difference observed in the participants' knowledge on antibiotic use (p=0.920), antibiotic resistance (p=0.273) and attitude (antibiotic use) (p=0.169) that were exposed to the intervention compared to those who were not.

Table 4.14 Difference in knowledge (antibiotic use and resistance) attitude towards (antibiotic use) between participants exposed and those who were not exposed to the intervention.

Variable	**N**	**Mean (Standard deviation)**	**Statistical test**	**P-value**
Knowledge on antibiotic use				
Exposed to intervention	17	19.05 (3.172)		0.920

Not exposed to intervention	21	18.95 (3.186)	Mann-Whitney U	
Attitudes towards antibiotic use				
Exposed to intervention	17	27.35 (3.823)	Independent sample t-test	0.169
Not exposed to intervention	21	25.76 (2.948)		
Knowledge on antibiotic resistance				
Exposed to intervention	17	24.18 (4.517)	Independent sample t-test	0.273
Not exposed to intervention	21	22.67 (3.638)		

No statistical significance difference was observed in participant knowledge on antibiotic use (p=0.311), resistance (p=0.766) and attitude (antibiotic use (p=0.216) between the groups that were exposed to the intervention via the iKamva splash page compared to those exposed via the UWC Communications emails.

Table 4.15 Difference in knowledge (on antibiotic use, resistance) and attitude (antibiotic use) between participants exposed via the iKamva splash page and the UWC communications email.

Variable	**N**	**Mean (Standard deviation)**	**Statistical test**	**P-value**
Knowledge on antibiotic use				
iKamva splash page	15	19.33 (3.416)	Mann-Whitney U	0.311
UWC Communications emails	10	18.00 (2.582)		
Attitudes towards antibiotic use				
iKamva splash page	15	27.07 (3.615)	Independent sample t-test	0.216
UWC Communications emails	10	25.20 (3.553)		
Knowledge on antibiotic resistance				
iKamva splash page	15	23.33 (4.806)	Independent sample t-test	0.766
UWC Communications emails	10	22.80 (3.994)		

Table 4.16 shows the relationship between demographics and the knowledge on antibiotic use for the pre- and post-intervention groups. No statistical difference was observed between the genders in both groups (pre-intervention p=0.149,

post-intervention p=0.538). The undergraduate degree the participants were pursuing did not have any statistical influence on their knowledge on antibiotic use in the pre-intervention survey (p=0.693), however, in the post-intervention survey, there was a statistically significant influence (p=0.022).

Table 4.16: Influence of the participants' demographics on knowledge on antibiotic use.

Variable		N	Mean (Standard deviation)	p-value
Gender				
Pre-intervention	Female	32	19.94 (2.422)	0.149
	Male	32	19.06 (2.770)	
Post-intervention	Female	22	19.36 (2.321)	0.538
	Male	20	18.75 (3.945)	
Degree				
Pre-intervention	B. Admin	12	19.58 (2.778)	0.693
	B. Com	13	18.62 (2.256)	
	B. Com in Accounting	8	19.83 (2.697)	
	B. Com in Financial Accounting	24	16.86 (3.162)	
	B. Com in Law	7	19.86 (2.410)	
Post-intervention	B. Admin	6	18.00 (1.549)	0.022
	B. Com	9	18.22 (2.949)	
	B. Com in Accounting	7	22.29 (3.988)	
	B. Com in Financial Accounting	15	19.20 (2.757)	
	B. Com in Law	5	17.00 (2.345)	

No statistical significant influence by gender was observed on the attitudes on antibiotic use in the pre-intervention (p=0.668) and post-intervention (p=0.649)

groups. Similarly, the undergraduate degree the participants were pursuing did not have any significant influence on the participants' attitudes on antibiotic use in both groups (pre-intervention p=0.231, post-intervention p=0.391).

Table 4.17: Influence of the participants' demographics (gender and undergraduate course being pursued) on their attitudes on antibiotic use.

Variable		N	Mean	p-value
Gender				
Pre-intervention	Female	32	26.53 (4.558)	0.668
	Male	32	27.00 (4.119)	
Post-intervention	Female	22	26.55 (3.789)	0.649
	Male	20	25.95 (2.874)	
Undergraduate course				
Pre-intervention	B. Admin	12	27.17 (3.271)	0.231
	B. Com	13	24.38 (3.124)	
	B. Com in Accounting	8	28.50 (6.000)	
	B. Com in Financial Accounting	24	27.17 (4.715)	
	B. Com in Law	7	27.14 (3.436)	
Post-intervention	B. Admin	6	27.33 (3.777)	0.391
	B. Com	9	25.67 (3.808)	
	B. Com in Accounting	7	26.57 (2.760)	
	B. Com in Financial Accounting	15	26.87 (3.642)	
	B. Com in Law	5	20.03 (3.033)	

The participants' gender did not have any influence on their knowledge on antibiotic resistance in both the pre-intervention (p=0.184) and post-intervention (p=0.197) surveys. In addition, no statistical significant influence by

undergraduate degree enrolled for was observed on the participants' knowledge on antibiotic resistance in the pre-intervention (p=0.399) and post-intervention (p=0.714) surveys.

Table 4.18: Influence of the participants' demographics (gender, undergraduate course being pursued) on their knowledge on antibiotic resistance.

Variable		N	Mean (standard deviation)	p-value
Gender				
Pre-intervention	Female	32	21.75 (3.663)	0.184
	Male	32	23.50 (4.765)	
Post-intervention	Female	22	22.33 (3.456)	0.197
	Male	20	24.15 (4.545)	
Undergraduate course				
Pre-intervention	B. Admin	12	23.58 (3.605)	0.399
	B. Com	13	22.77 (4.711)	
	B. Com in Accounting	8	20.50 (4.309)	
	B. Com in Financial Accounting	24	23.08 (4.363)	
	B. Com in Law	7	21.57 (4.685)	
Post-intervention	B. Admin	6	22.83 (4.834)	0.714
	B. Com	9	23.22 (3.833)	
	B. Com in Accounting	7	23.29 (3.773)	
	B. Com in Financial Accounting	15	23.67 (3.352)	
	B. Com in Law	5	22.00 (6.892)	

For further statistical analyses, the data from the pre- and post-intervention surveys was grouped into two datasets, dependent sample, and independent sample. The dependent sample comprised of the participants that participated into both surveys whereas the independent comprised of those that participated in either of the two surveys.

4.3.2 Dependent sample t-test

The dependent sample had 20 participants.

4.3.2.1 Knowledge on antibiotic use

There is a statistical significant difference, (p=0.021), in the mean knowledge scores on antibiotic use between the participants in the pre- (19.95) and post-intervention (18.55) surveys. There was no statistically significant difference

observed on the participants' mean knowledge score on antibiotic use (p=0.787) among those that were exposed to the intervention (18.71) compared to those who were not (18.36) Similarly, no significant difference in knowledge on antibiotic use was evident between the participants that were exposed to the intervention via the electronic platforms (p=0.889), via the iKamva splash page (18.60) compared to those via the UWC Communications emails (18.50). Table 4.19 below shows the difference between the participants' knowledge on antibiotic use and the survey groups, and the exposure to the type of electronic media.

Table 4.19: Difference in mean knowledge score on antibiotic use between survey groups and between participants exposed to the intervention via the two electronic media types.

Variables	**N**	**Mean scores (Standard deviation)**	**Statistical test**	**p-value**
Survey				
Pre-intervention	20	19.95 (2.305)	Paired t-test	p=0.021
Post-intervention	20	18.55 (2.762)		
Exposure to intervention (post-intervention)				
Yes	7	18.71 (3.039)	Independent t-test	p=0.787
No	11	18.36 (2.375)		
Maybe	2			
Electronic Media type (post-intervention)				
iKamva splash page	5	18.60 (3.507)	Independent t-test	p=0.889
UWC Communications emails	6	18.50 (2.881)		

4.3.2.2 Attitudes towards antibiotic use

The difference in the participants' mean scores on attitude on antibiotic between the survey groups, exposure to the intervention and the type of the electronic media is shown in Table 4.20 below. No statistical significant difference was observed on antibiotic use (p=0.173) between the participants' mean scores at pre-intervention (27.70) and post-intervention (26.65).

Mean attitude scores for the participants that were exposed (27.29) to the intervention compared to those who were not (27.00), were not statistically different (p=0.886). The mean attitude score for the participants who were

exposed to the intervention via iKamva splash page (26.20) was similar to those exposed via UWC Communication emails (25.83), as no significant difference between them was evident, p=0.894.

Table 4.20: Difference in the participants' mean attitude scores on antibiotic use between those exposure and those not exposed to the intervention and between the two electronic media they were exposed to.

Variable	N	Mean scores (Standard deviation)	Statistical test	p-value
Survey				
Pre-intervention	20	27.70 (3.262)	Paired t-test	p=0.173
Post-intervention	20	26.65 (3.453)		
Exposure to intervention (post-intervention)				
Yes	7	27.29 (4.751)	Independent t-test	p=0.886
No	11	27.00 (2.280)		
Maybe	2			
Electronic media type (post-intervention)				
iKamva splash page	5	26.20 (4.604)	Independent t-test	p=0.894
UWC Communications emails	6	25.83 (4.262)		

4.3.2.3 Knowledge on antibiotic resistance

Table 4.21 below shows the difference between the participants' mean knowledge scores on antibiotic resistance and the survey groups, the exposure to the intervention and type of electronic media exposed to. There is no statistical difference in the mean knowledge scores (p=0.727) about antibiotic resistance between the pre-(22.50) and post-(22.80) intervention groups.

The participants exposed to the intervention were more knowledgeable (24.57) about antibiotic resistance than those who were not exposed (22.36), but the difference in knowledge on antibiotic resistance between the two cohorts was not statistically significant (p=0.40). Further, there was no significant difference in mean scores for knowledge on antibiotic use (p=0.825), between participants exposed to the intervention via iKamva splash page (22.80) and UWC communications emails (22.00).

Table 4.21: Difference in the participants' mean knowledge scores on antibiotic resistance between those exposure and those not exposed to the intervention and between the two electronic media they were exposed to.

Variable	N	Mean scores (Standard deviation)	Statistical test	p-value
Survey				
Pre-intervention	20	22.50 (4.707)	Paired t-test	p=0.727
Post-intervention	20	22.80 (4.663)		
Exposure to intervention (post-intervention)				
Yes	7	24.57 (5.855)	Independent t-test	p=0.40
No	11	22.36 (3.906)		
Maybe	2			
Electronic media type (post-intervention)				
iKamva splash page	5	22.80 (7.190)	Independent t-test	p=0.835
UWC Communications emails	6	22.00 (4.382)		

4.3.3 Independent sample t-test

The independent sample had 66 participants, 44 from the pre-intervention and 22 from the post-intervention.

4.3.3.1 Knowledge on antibiotic use

Difference in knowledge on antibiotic use and the survey group, the exposure to the intervention and electronic media exposed to is shown in Table 4.22 below. No significant difference on the knowledge on antibiotic use (p=0.869) was observed between the participants of the pre-intervention (mean rank = 33.23) survey and those of the post-intervention (mean rank = 34.05) survey. In the post-intervention survey, the knowledge mean ranks between the participants that were exposed (mean rank 10.25) to the intervention was not significantly different (p=0.848) to the scores of those who were not exposed (mean rank = 10.75). The knowledge about antibiotic use between the participants in the post-intervention group exposed to the intervention via the iKamva splash page (mean rank = 8.30) and those via the UWC Communications emails (mean rank = 5.50) was not statistically different (p=0.255)

Table 4.22: Difference in knowledge on antibiotic use between the survey groups and between those exposure and those not exposed to the intervention and between the two electronic media they were exposed to.

Variable	N	Mean ranks	Sum of ranks	Statistical test	p-value
Survey					
Pre-intervention	44	33.23	1462.00	Mann-Whitney U	p=0.869
Post-intervention	22	34.05	749.00		
Exposure to intervention (post-intervention)					
Yes	10	10.25	102.50	Mann-Whitney U	p=0.848
No	10	10.75	107.50		
Maybe	2				
Electronic media type (post-intervention)					
iKamva splash page	10	8.30	83.00	Mann-Whitney U	p=0.255
UWC Communications emails	4	5.50	22.00		

4.3.3.2 Attitudes on antibiotic use

Table 4.23 shows the difference in the participants' mean attitude scores on antibiotic use between those exposure and those not exposed to the intervention and between the two electronic media they were exposed to. There is no statistical significant difference between the mean attitude score on antibiotic use (p=0.667) between the participants in the pre-intervention (26.34) compared to those in the post-intervention (25.91).

Table 4.23: Difference in the participants' attitudes on antibiotic use between those exposure and those not exposed to the intervention and between the two electronic media they were exposed to.

Variable	N	Mean score. (Standard deviation)	Statistical test	p-value
Survey				
Pre-intervention	44	26.34 (4.690)	Paired t-test	p=0.667
Post-intervention	22	25.91 (3.308)		
Exposure to intervention (post-intervention)				
Yes	10	27.40 (3.307)	Independent t-test	p=0.051
No	10	24.40 (3.098)		
Maybe	2			
Electronic media type (post-intervention)				

iKamva splash page	10	27.50 (3.206)	Independent t-test	p=0.072
UWC Communications emails	4	24.25 (2.363)		

The mean score for the participants exposed (27.40) was higher compared to those not exposed to the intervention (24.40), but the difference was not statistically significant (p=0.051). The participants exposed to the intervention via the iKamva splash page had a high attitude score mean (27.50) than those exposed via the UWC Communications emails (24.25), but there was no significant difference observed between them (p=0.072).

4.3.3.3 Knowledge on antibiotic resistance

Difference in the participants' mean ranks on knowledge on antibiotic resistance between those exposure and those not exposed to the intervention and between the two electronic media they were exposed to, is shown in Table 4.24 below. No statistical significance (p=0.445) was observed in the difference between the pre- (mean rank = 32.23) and post-intervention (mean rank = 36.05) groups, and participants' knowledge of antibiotic resistance.

The participants' mean ranks on knowledge about antibiotic resistance, showed no statistical significant difference (p=0.382) between participants exposed to the intervention (mean rank = 11.65) compared to those who were not (mean rank = 9.35).

No significant difference (p=0.886) was observed in mean ranks between the participants who were exposed to the intervention via the iKamva splash page (mean rank = 7.40) compared to those via the UWC Communications emails (mean rank 7.75).

Table 4.24: Difference in the participants' mean ranks on knowledge on antibiotic resistance between those exposure and those not exposed to the intervention and between the two electronic media they were exposed to.

Variable	**N**	**Mean ranks**	**Sum of ranks**	**Statistical test**	**p-value**
Survey					

Pre-intervention	44	32.23	1418.00	Mann-Whitney U	p=0.445
Post-intervention	22	36.05	793.00		
Exposure to intervention (post-intervention)					
Yes	10	11.65	116.50	Mann-Whitney U	p=0.382
No	10	9.35	93.50		
Electronic media type (post-intervention)					
iKamva splash page	10	7.40	74.00	Mann-Whitney U	p=0.886
UWC Communications emails	4	7.75	31.00		

4.4 Summary

The findings of this study indicate that, overall, there was no significant difference between the pre-intervention and the post-intervention participants' knowledge on antibiotic use, attitudes on antibiotic use and the knowledge on antibiotic resistance. There was no difference observed in the perceptions on antibiotic resistance between the participants that were exposed to the intervention compared to those who were not exposed. Electronic media had no influence, neither negative nor positive, on the participants' perceptions on antibiotic resistance.

CHAPTER FIVE

DISCUSSION

5.1 Introduction

The study aimed to investigate the influence of electronic media on the antibiotic resistance perceptions of a defined student community. The objectives of the study were to identify the key messages for community awareness based of the scoping review (Chapter 2), disseminate the key messages via electronic media (intervention, Chapter 3) and investigate differences in the participants' knowledge and attitudes at pre- and post-intervention (Chapter 3). The discussion focuses on the i) effectiveness of electronic media in influencing antibiotic resistance perceptions, ii) factors that affect effectiveness, and iii) knowledge and attitudes of a student community on antibiotic resistance. Although our study mainly focused on resistance associated with antibiotic use, studies on antimicrobial resistance (AMR) are also included in the discussion to obtain a panoramic view about the community's (or public's) knowledge, attitude, and perceptions about resistance patterns.

At the onset of designing the posters, the COVID-19 pandemic and the lockdown restrictions led to the researchers implementing imminent changes from print to electronic media, namely, the iKamva platform and the UWC communications email as participants were unavailable in person on the UWC campus. Therefore, based on the results from our study this discussion, we interpret the effectiveness of both electronic media and print mass media in disseminating health messages.

5.2 Effectiveness of mass media

In this study no significant influence of electronic media on the participants, antibiotic resistance perceptions were observed (knowledge on antibiotic use p=0.920, attitudes on antibiotic use p=0.169, knowledge on antibiotic resistance p=0.273). In addition, no significant differences in the participants' knowledge and attitudes between the pre-intervention and the post-intervention surveys were noted (knowledge on antibiotic use p=0.313, attitudes on antibiotic use p=0.524, knowledge on antibiotic resistance p=0.488). Various factors which could be

accredited to the lack of influence by electronic media are explored in other studies and discussed later in section 5.3.

A United Kingdom (UK) study on the effectiveness of antibiotic awareness campaigns substantiated our findings and reported that most campaigns have been found to be ineffective in raising awareness on antibiotic resistance (McNulty *et al.*, 2010). As such a systematic review of public-targeted communication interventions to improve antibiotic use conducted in the UK, only identified three studies that measured changes in knowledge and attitudes. Of the three studies identified, two studies reported no significant changes in the antibiotic-related knowledge and attitudes, (Cross, Tolfree and Kipping, 2017), further correlating with our study's findings. However, in a 2018 systematic review on the effectiveness of AMR awareness interventions, the authors concluded that most of their identified studies demonstrated an improvement on the public's knowledge after the awareness campaigns (Price *et al.*, 2018). An inference is that the effectiveness of antibiotic or AMR awareness campaigns is contextualised among others, on the relevance of the topic to the community, duration of exposure, type of mass media (print, electronic, visual etc) and literacy level of the target group.

Health mass media campaigns have led to positive changes in the behaviours, attitudes, knowledge, and influence of public opinion. These campaigns have included health topics such as HIV/AIDS (Do, Figueroa and Kincaid, 2016; Sano *et al.*, 2016; Bago and Lompo, 2019), and lifestyle measures, namely alcohol intake reduction (Martin *et al.*, 2018) and obesity (Boles *et al.*, 2014). In contrast other researchers using mass media campaigns in health promotion interventions found an increased awareness of alcohol as a cancer risk factor (Christensen *et al.*, 2019), and a decrease in the sales of the sugar-sweetened beverages (Farley *et al.*, 2017). Even though a New South Wales study reported an increase in the participants' awareness of health risks and a low quality of life associated with obesity after a mass media campaign, during their last wave of data collection, they also observed a decrease in the intention to increase physical activity and a decrease soft drink consumption (Kite *et al.*, 2018b).

Mass media has also been widely used to raise awareness on antibiotic resistance and the prudent use of antibiotics. However, preliminary data from our scoping review, revealed lack of evidence in the effectiveness of mass media in Africa and other low- and middle-income countries (LMIC). This finding supports those of a systematic review by Catalán-matamoros et al. (2019) analysing media communication on antibiotics and AMR that also did not identify any studies from an African country. A recent systematic review on the effectiveness of interventions to improve the public's AMR awareness, identified only one study from a LMIC but no study from an African country at all (Price *et al.*, 2018), underpinning the paucity of research in this area.

Studies that utilized mass media as an intervention to raise antibiotic resistance awareness have reported a complex picture of their effectiveness. A Netherlands study found that mass media increased antibiotic resistance awareness mainly in participants who were the least knowledgeable (van Rijn *et al.*, 2019). A multifaced antibiotic resistance awareness media campaign in India, reported that most (more than 80%) of the campaign coordinators perceived that the campaign created adequate awareness, but it had lacked the objective data to fully determine the campaign's effectiveness (Tamhankar *et al.*, 2019).

Although no significant influence was observed, the findings from the pre- and post-intervention surveys in this study, which are discussed later in section 5.4, emphasise the requirements for an effective intervention to raise awareness and positively influence the public's antibiotic resistance knowledge, attitudes, and antibiotic use in South Africa.

The following section discusses the contextual factors that may have affected the effectiveness of the electronic media campaign in this study.

5.3 Contextual factors that affected effectiveness of the electronic media

The COVID-19 pandemic had a massive effect on many daily activities including academic teaching, learning and research. The South African government imposed the lockdown in March 2020, during the time the campaign material was being designed. Since print media and electronic media had been

the campaign medium of choice before the pandemic, the illustrations, text of the posters and the dimensions that were considered were specifically designed for the printing of hard copies of posters. As a result, the posters that were used for the electronic media, had more content, which may have overloaded the screen when they were displayed on the participants' electronic devices. Therefore, the decision to change the study's intervention design to disseminate the key messages from print media to restricting it to only using electronic media may have resulted in low exposure to the intervention, with only 40.5% of the post-intervention participants recalling seeing the posters on antibiotic resistance. Furthermore, for final year students their primary attention was directed at accessing academic resources to engage in learning activities to meet their course requirements, rather than focus on the poster display that routinely appeared on the screen of their devices.

The form of media used in mass media campaigns hugely impact the effectiveness of the campaign. The main forms of mass media include television, radio, billboards, print media and social media. The choice of the type of media used in a mass media campaign must be tailored to the characteristics of the target group to be of relevance. Our target population were young adults that were literate, therefore the use of electronic posters was adequate. However, considering their low attention span (Giray, 2022), the use of video content should have been explored. A rise in the effectiveness of video content to convey messages has been seen worldwide and significantly in South Africa. With approximately 90% of young adults accessing social media such as Facebook, Instagram and TikTok, such social media platforms present as powerful platforms for disseminating health awareness messages (Massey, Brockenberry and Harrell, 2021). It was unfortunate that due to university policies, access to university's social media platforms was not possible. Such platforms would have reached more participants especially during their social chats. This notion is supported by the findings of a Saudi Arabian study on the awareness of antibiotic resistance of university students, where 40% of the students reported that they obtained information about antibiotic resistance from the internet and social media (Bu-Khamsin *et al.*, 2021).

Since the UWC communications email and iKamva splash page used in the study focused on academic communications, they may not have been the most appropriate platforms for the dissemination of the key messages. Social media platforms would have provided an informal way of presenting the key messages to the participants in comparison to the academically linked platforms. The onset of the pandemic also saw a rapid rise in the number of email communications being disseminated to the university community about constant lockdown reminders, and national COVID-19 protocol updates which may have lowered the opening rate of the emails titled "Antibiotic resistance information" that contained our intervention material (Appendix H).

Raising awareness on antibiotic resistance during a global pandemic that was caused by a viral infection may have been a misdirected exercise. With the massive rise in the spread of the COVID-19 virus and lockdown protocols that were to be followed, various organisations including governments and universities initiated many media campaigns to update the public. Although the public's reaction to the pandemic concerning antibiotics was an indication of the necessity of antibiotic resistance awareness, information on antibiotic resistance was not at the forefront of people's minds as the corona virus infection and death rates were prominently featured. Countries were repurposing antibiotic agents such as azithromycin, the antimalarial agent chloroquine, and the antiparasitic agent ivermectin for the treatment of the corona virus (Lynch, Mahida and Gray, 2020). The question that arises is: Was our study on mass media directed at antibiotic resistance among final year students perceived as a priority during a viral pandemic? (Refer to Table 3.1 for study timeline)

Since the UWC enforced online (remote) learning due to the lockdown restrictions, **exposure to information overload** is pervasive among university students who are exposed online learning (Armah and Westhuizen, 2017) and the COVID-19 pandemic further intensified the phenomenon. Information overload is defined as when a person is provided with more information that their cognitive capacity limit, resulting in the person's inability to process and comprehend the information (AlHeneidi, AlTerkait and Smith, 2021). As the study participants

were final year B. Com students with a demanding academic schedule, their rapid adaptation to online learning and COVID-19 information, overload may have contributed to the antibiotic resistance intervention having no effect on the participants' perceptions. Findings from a Kuwait study conducted with university students reported an increase in the information overload score in the post-Covid students when compared to the pre-Covid students (AlHeneidi, AlTerkait and Smith, 2021). A Malaysian study reported that two-thirds (69.5%) of the students who had participated experienced information and work overload as result of online learning (Al-Kumaim *et al.*, 2021).

5.4 Antibiotic use, knowledge, and attitudes of the participants

Although our intervention was not effective in influencing the participants' antibiotic resistance perceptions, our survey findings indicate that there are many misconceptions about antibiotic resistance. The following sections discusses the participants' perceptions about antibiotic use, knowledge, and attitudes towards antibiotic use.

5.4.1 Antibiotic use

In this study, we found that most the participants did not remember the last time they had taken antibiotics. This could be an indication that study level 3 EMS students did not often use antibiotics. The most common source to access antibiotics was presenting a prescription at the pharmacy. Similar findings were reported by an Indian study that found that two-thirds (67%) of their participants agreed that they needed to receive a prescription from the doctor before purchasing an antibiotic (Bhardwaj *et al.*, 2021). In contrast a Cape Town study on the use of antibiotics during pregnancy, found that most (70%) of the participants reported that they had purchased antibiotics over the counter without a prescription (Bulabula, Dramowski and Mehtar, 2020). About one-fifth (20%) of the participants in our study's, pre- and post-intervention groups, reported getting antibiotics from other people, which is consistent with the findings of a Cape Town study, which reported that 16% of their participants claimed that they had used antibiotics prescribed for a family member (Farley *et al.*, 2019). Another study conducted in Gauteng province stated that two-thirds (64%) of their participants thought it was acceptable to take antibiotics dispensed to a friend or

family member (Mokoena, Schellack and Brink, 2021). Contrary to our study's finding, a Pakistani study reported that, almost two-thirds (64.1%) of the non-medical students disagreed with sharing antibiotics with family and friends (Iqbal *et al.*, 2020).

Farley et al., (2019) reported that almost all (90%) of their study's participants took their antibiotics for the recommended duration (as prescribed), which is a similar finding in our study, for the responses to pre-(77%) and post-(67%) - intervention surveys. Almost all (90%) of the participants in both the pre- and post-intervention surveys in our study, reported that they took their antibiotics as directed by the healthcare professional. This finding is corroborated by a KZN study on the patient's knowledge, attitudes and practices regarding antibiotic use that reported that almost three-quarters (71%) of their participants take antibiotics as per the directions on the label (Ramchurren *et al.*, 2017), and a recent Gauteng study also noted that a similar high percentage (71%) of their participants taking their antibiotics as directed (Mokoena, Schellack and Brink, 2021).

5.4.2 Knowledge on antibiotic use

The overall mean scores for the knowledge on antibiotic use were higher in the pre-(57%)- compared to the post-(51%) intervention. Although we found that the participants knew that antibiotics were used for bacterial infections, over a third of the participants (pre-(36%) and post-(38.1%) intervention) also thought viral infections could be treated with antibiotics. Similar findings were reported by an Indian study where 45% correctly knew antibiotics were used for treating bacterial infections and almost half (49%) of the same group also believed antibiotics could be used for a viral infection. The same study reported that their younger respondents (18-25 years old), an age-group similar to our study participants, were less likely to correctly identify antibiotics as medication used to treat bacterial infections. Ramchurren et al. (2017) similarly reported that 55% of their participants believed antibiotics were also used to treat viral infections. Other studies done in other developing countries such as Pakistan (Khan *et al.*, 2020), Ethiopia (Jifar and Ayele, 2018), Thailand (Tangcharoensathien *et al.*, 2021), Namibia (Pereko, Lubbe and Essack, 2015) and Lebanon (Sakr *et al.*,

2020) have reported similar findings of people thinking that antibiotics are used for both bacterial and viral infections. This might be a result of not knowing the difference between the two types of infections. In our study the participants knew that different bacterial infections required different types of antibiotic therapy.

We found several misconceptions when participants in our study were required to identify the conditions that required antibiotics. The participants believed that antibiotics could be used to treat colds (pre-(40.6 and post-(45.2%) intervention) and flu (pre-(45.4%) and post-(66.7%) intervention), which correlates with the findings of a Gauteng study that reported that two-thirds (67%) of their participants believed that antibiotics could treat a cold and flu (Mokoena, Schellack and Brink, 2021). A Cape Town study on antibiotic use in pregnancy had contrary findings, as 63% of the participants claimed they would not take antibiotics to treat influenza (Bulabula, Dramowski and Mehtar, 2020). A study conducted in Tanzania also reported that 60.3% of their participants disagreed with taking antibiotics for a cold (Goodluck *et al.*, 2017). The misconception that one required an antibiotic for colds and flu has been reported in many other studies (Bassoum *et al.*, 2018; Huh *et al.*, 2018; Khan *et al.*, 2020; Bhardwaj *et al.*, 2021). This misconception can be explained by either the participants not realising that colds and flus are mainly caused by viruses or because they think that antibiotics can be used for treating viral infections too, therefore, they would be deemed to be effective.

Another finding about the incorrect use of antibiotics was noted for the treatment of inflammation. In our study 42.9% of post-intervention participants thought that inflammation could be treated by antibiotics, this was corroborated by a Thailand study in which a similar percentage (41.3%) of their participants assumed that antibiotics were the same as anti-inflammatories (Tangcharoensathien *et al.*, 2021). Paracetamol was also identified as an antibiotic by 42.93% participants of a study conducted in Indonesia (Karuniawati *et al.*, 2021). A Mpumalanga study also reported that their participants could not differentiate between antibiotics and analgesics (Watkins *et al.*, 2019). These latter two studies were conducted with

low literate participants, yet our participants were university students, which is a cause for concern.

Interestingly, our study participants were able to note that COVID-19 was not a condition that required antibiotics. A study on the knowledge, attitudes and practices towards COVID-19 and antibiotic resistance conducted in Malaysia reported that their participants had more knowledge on COVID-19 than antibiotic resistance (Chang *et al.*, 2021). This may be a consequence of the many mass media campaigns that constantly emphasised the characteristics of this viral disease for which antibiotics were not indicated, thereby suggesting that multimodal awareness campaigns by various organisations, may be effective in tackling the threat of antibiotic resistance.

5.4.3 Attitudes towards antibiotic use

The results in this study indicate that the mean attitude scores in the pre-intervention (50%) was higher than the post-intervention (40%), suggesting that the pre-intervention participants had a more positive attitude towards antibiotic use than those in the post-intervention.

We found that almost two-thirds (63.9%) of the pre- intervention participants and half (52.4%) of the post-intervention our study participants did not believe that taking antibiotics ensured that they would not be sick again with the same condition. They also disagreed that taking antibiotics boosted their immune system (pre-(56.2%) and post-(57.1%) intervention). An Ethiopian study refutes this finding as they reported that almost all (83%) of their participants thought antibiotics speed up recovery from colds and flu (Jifar and Ayele, 2018). However, a Malaysian study reported that only 36.8% of their participants were aware that taking antibiotics did not speed up their recovery from all infections (Chang *et al.*, 2021). About half of our participants, both in the pre- (50%) and post- (52.4%) intervention studies, believed that taking antibiotics when one had a cold resulted in a quicker recovery as compared to not taking such a treatment. This is an indication that antibiotics are seen as miracle drugs by users therefore they are expected to solve the therapy for all diseases (Higuita-Gutiérrez, Villamil and Quiceno, 2020). The use of antibiotics in treating secondary

bacterial infections might have played a role in presenting antibiotics as invincible and effective for all types of infections. Clarification of when antibiotics are used is required in further AMS awareness programs.

Our study showed that most participants in both the pre - (76.5%) and post-(66.7%) intervention surveys disagreed with reserving antibiotics for future use. These findings are similar to those of a Tanzanian study that reported that three-quarter (72.6%) of their participants disagreed with keeping antibiotics for future use (Goodluck *et al.*, 2017). In addition, participants claimed that they did not receive antibiotics from other people (19%) and nor they did not share their antibiotics with other people (pre-(71.9%) and post-(71.4%) intervention). Similar findings are noted in a South African national study where one-fifth of the participants believed they could save antibiotics for later use (21%) and admitted to having shared their antibiotics with other people (17%) (Farley *et al.*, 2019). However, another study noted that almost two-thirds of their participants (64%) believed they could share their antibiotics with a friend or family member if they suffered from the same illness with them (Mokoena, Schellack and Brink, 2021).

Over two thirds (pre-(67.2%) and post-(64.3%) intervention) of our participants believed they could throw their antibiotics into the bin. Similar findings were reported by a Malaysia study where participants admitted to throwing unused and expired antibiotics into dustbins (Irawati *et al.*, 2019). An Australian study reported that their participants admitted to pouring unused antibiotic suspension into sink (Lum *et al.*, 2017). This shows that adequate information is required among communities on the correct disposal of leftover antibiotics in the home. The improper disposal of antibiotics and other medicines end up contaminating the environment promoting harmless bacteria to mutate into drug resistant microbes. Once these drug resistant bacteria infect humans, they are difficult to treat as they are already resistant to available antibiotics (Larsson, 2014; Chang *et al.*, 2015; Anwar, Iqbal and Saleem, 2020).

Half of our participants, pre-(57.5%) intervention and post-(50%) intervention, did not support antibiotics being accessible without a prescription. Ramchurren

et al. (2017) reported similar findings, with 43% of their participants disagreeing to the purchase of antibiotics without a prescription. A Tanzanian study also reported that almost all (81.8%) of their participants did not agree with purchasing antibiotics without a prescription (Goodluck *et al.*, 2017). Contrary to many studies, our participants reported that they did not expect antibiotics to be prescribed to them when they visited the doctor (pre-(39.1%) and post-(47.6%) intervention), while a nationwide South African study reported that two-thirds (66.5%) of prescribers felt pressure from patients to prescribe antibiotics (Farley *et al.*, 2018).

5.4.4 Knowledge about antibiotic resistance

In this study participant knowledge on antibiotic resistance mean scores were low with 33% and 35% in the pre- and post-intervention, respectively. More participants in the post-(61.9%) intervention reported that they had heard the term "antibiotic resistance" than in the pre-(50%) intervention. Antibiotic resistance was correctly recognised from the phenomenon "when antibiotics cannot kill bacteria anymore" by pre-(59.4%) and post-(61.9%) intervention surveys. However, we observed that most of the participants (pre-(62.6%) and post-(76.2%) intervention) defined antibiotic resistance occurring when an individual's body does not respond to antibiotics anymore. Our findings are similar to that of a systematic review which found that almost all (88%) of their respondents thought that antibiotic resistance refers to changes in the human body (McCullough *et al.*, 2016). Studies conducted in India and Pakistan have also reported similar misconceptions (Iqbal *et al.*, 2020; Bhardwaj *et al.*, 2021; Yousaf *et al.*, 2021). Such findings are corroborated by two other South African studies where most of their participants held similar opinions that the body becomes resistant to antibiotics (Farley *et al.*, 2019; Mokoena, Schellack and Brink, 2021). These results showed that many people were confused by the two definitions and a way to better clarify the concept is needed.

Regarding the contributors of antibiotic resistance, over half of our participants (pre-(53.1%) and post-(54.8%) intervention) were able to recognise that unnecessary use of antibiotics was one of them. They also identified keeping

leftover antibiotics for later use as an accelerator for antibiotic resistance (pre-37.5%) and post-(42.9%) intervention). A Senegalese study reported that almost all (83%) of their participants were aware that high antibiotic consumption can lead to antibiotic resistance (Bassoum *et al.*, 2018). Over half (59.6%) of participants in a Malaysian study also identified misuse of antibiotics as an accelerator of antibiotic resistance (Chang *et al.*, 2021). However, in our study, lack of infection control was not recognised as a contributor to antibiotic resistance (pre-(14.1%) and post-(23.5%) intervention recognised). Concurrently, only 47.3% of a Malaysian study recognised hand hygiene (a form of infection control) as essential to prevent antibiotic resistance. These findings suggest that the participants are aware of some of the contributors of antibiotic resistance but there is need for more awareness campaigns to accentuate and introduce the unknown contributors of antibiotic resistance.

About half of our participants (pre-(56.3%) and post-(50%) intervention) knew that not finishing a course could lead to antibiotic resistance. An Ethiopian study reported similar findings with almost all (92.1%) of their participants regarding it necessary to complete a course of antibiotics (Jifar and Ayele, 2018). Current literature argues the importance of finishing the full course, yet self-medication with the leftover antibiotics at a later stage, contributes to inappropriate antibiotic use (Ivanovska *et al.*, 2018).

When participants were asked about untoward effects of antibiotic resistance, over half of the participants (pre-(54%) and post-(57%) intervention) correctly recognised the difficulty when treating those bacterial conditions that could have been previously successfully treated with antibiotics. Similar findings were reported by a Pakistani study where three- quarters (76%) of their medical students and half (50%) of non-medical students agreeing that antibiotic resistance results in difficulty to treat infections (Iqbal *et al.*, 2020). However, most participants, (pre-(64.1%) and post-(71.4%) intervention), also thought that antibiotic resistance resulted in one's body not responding to antibiotic resistance. This notion further emphasises the need for the term "antibiotic resistance" to be correctly defined for communities.

Most of our participants were unaware that some of the consequences of antibiotic resistance were compromising the success of some medical procedures (pre-(82.8%) and post-(92.9%) intervention) and with the possibility that antibiotics may not be available for use in the future (pre-(84.4%) and post-(81%) intervention). Such poor awareness about the consequences of antibiotic resistance contributes to communities not taking the threat that antibiotic resistance poses, seriously, resulting in antibiotic misuse and disposal practices which further aggravates the effectiveness of antimicrobial therapy.

Less than half (pre-(40.4%) and post-(47.6%) intervention) of our participants perceived antibiotic resistance as a serious global problem and only pre-(29.7%) and post-(35.7%) intervention recognised that antibiotic resistance affects everyone. This finding contrasts with that of a Korean study conducted in three different years, where over two thirds (72-76%) of their participants recognised antibiotic resistance as a serious problem in Korea (Huh *et al.*, 2018). A Saudi Arabian study conducted with university students reported that about 55% of their participants identified antibiotic resistance as a public health problem (Bu-Khamsin *et al.*, 2021). In contrast, findings in another Cape Town study noted that almost all of their participants (92%) acknowledged that antibiotic resistance is a serious health problem (Bulabula, Dramowski and Mehtar, 2020). The lack of concern could be a result of antibiotic resistance being "invisible" as reported by an Australian study (Lum *et al.*, 2017). More community-based educational campaigns should focus on the consequences of antibiotic resistance.

5.5 Summary

No significant effect was observed on the participants' antibiotic resistance perception after the electronic media intervention. We observed a low exposure rate which is an indication that the participants did not engage with our choice of media. However, electronic media or mass media is still useful in raising awareness about antibiotic resistance as it is a starting point for conversation in AMR and is a less invasive form of intervention.

Clearly, our findings are an indicator that more community-centred interventions are required to alert the public about the serious threat of antibiotic resistance and their active role targeted at behaviour change is required.

CHAPTER SIX

Conclusions, limitations, and recommendations

6.1 Introduction

The earlier chapters presented the study's background objectives (chapter 1), the literature review and scoping review (chapter 2), methodology (chapter 3), and data analysis (chapter 4) that were required to address the research question. The quantitative data was analysed, and findings were presented (chapter 4) and discussed (chapter 5) framed by the literature that was reviewed. This chapter presents a summary of the main findings, limitations of the study, the conclusion, and recommendations that emanate from the study.

6.2 Summary of findings

This study found that electronic media, the university linked UWC communications email and iKamva splash page, had limited to no influence on the participants' antibiotic resistance perceptions. Exposure to the intervention in the post-intervention survey was only 40.5% among the participants and no significant difference was observed in the three parameters among the participants that were exposed to the intervention compared to those who were not, namely: knowledge on antibiotic use ($p=0.920$), attitudes on antibiotic use ($p=0.169$), knowledge on antibiotic resistance ($p=0.273$). In addition, the study also identified a gap in the participants' knowledge and attitudes pertaining to antibiotic resistance and antibiotic use, which are fundamental concepts for inclusion in an effective antibiotic resistance awareness campaign.

Upon reflection, several contextual factors contributed to the to lack of effectiveness of electronic media in influencing the participants' perceptions relating to antibiotic resistance. These included, the onset of the COVID-19 pandemic, conflict of interest resulting from the viral pandemic, information over-load as a result of the study participants were final year (3rd year) B. Com students and still adjusting to online learning due to COVID-19 protocols, and exposure to the type of electronic media used (or mass media in general).

The participants (pre-(50%) and post-(61.9%) intervention) reported that they had heard of the term "antibiotic resistance" but upon further investigations we found that they (pre-(62.6%) and post-(76.2%) intervention) did not know correctly the most basic definition of the concept. The common misconception was that antibiotic resistance occurred when the body became resistant to antibiotics (pre-(62.6%) and post-(76.2%) intervention) rather than the bacteria becoming resistant to antibiotics.

The participants could not correctly identify the common clinical indications for which antibiotics would be required. This notion arises from their inability to differentiate between bacterial and viral infections and not being able to identify antibiotics in general. However, most of the participants (pre-(81%) and post-(73.8%) intervention) knew that the corona virus disease was not a condition that was treated with antibiotics, due to constant exposure to multimodal COVID-19 media campaigns that dominant (locally, nationally and internationally) during the study period.

We found that over half of the participants are aware of some of the contributors of antibiotic resistance e.g., unnecessary use of antibiotics (pre-(53.1%) and post-(54.8%) intervention) and keeping leftover antibiotics for later use (pre-(37.5%) and post-(42.9%) intervention). However, there is need for more awareness campaigns to accentuate and introduce the unknown contributors of antibiotic resistance for example lack of basic principles of infection control.

Our participants were unaware that some of the key consequences of antibiotic resistance were longer hospital stays, compromising the therapeutic outcomes of some medical procedures and the possibility of antibiotics not being used in the future because of lack of efficacy (Ventola, 2015). The only consequence they were familiar with was difficulty treating bacterial infections (pre-(54.7%) and post-(57.1%) intervention). These results were reflected by less than half of the participants recognising that antibiotic resistance as a serious global problem (pre-(40.4%) and post-(47.6%) intervention). Furthermore, less than half of the (pre-(29.7%) and post-(35.7%) intervention) participants recognised that antibiotic resistance affects everyone.

6.3 Conclusion

The researcher draws the following conclusions from the findings of this study. The study assessed the influence of electronic media on the participants' antibiotic resistance perceptions and found no significant difference between the pre-intervention and post-intervention survey responses: knowledge on antibiotic use ($p=0.313$), attitudes on antibiotic use ($p=0.524$), knowledge on antibiotic resistance ($p=0.488$). However, the participants' knowledge and attitudes on antibiotic resistance were found to be low; the mean scores for knowledge on antibiotic use at pre-intervention was 57% and post-intervention was 51%, attitudes on antibiotic use at pre-intervention was 50% and at post-intervention was 40%, knowledge on antibiotic resistance pre-intervention was 33% and at post-intervention was 35%, thereby signalling the need for more tailored and robust intervention strategies to be directed at university students.

An interpretation of our findings is that the effectiveness of antibiotic or AMR awareness campaigns is contextualised where the relevance of the topic to the community, duration of exposure, type of mass media (print, electronic, visual etc) and literacy level of the target group is identified. Therefore, proper study of the target population is required to plan an effective AMR awareness campaign. Identification of their interests, hobbies, culture to foster more active engagement with the target audience is necessary to achieve co-creation of the intervention. In this regard, the campaign material (messages, design and delivery mode) would require testing and re-testing with the target group until they are tailored and become more meaningful and authentic to secure better uptake.

Findings from the scoping review showed paucity of studies in Africa and other LMIC on the effectiveness of interventions. This indicates a need for more research led by different institutions across the African continent, the testing of different AMR intervention strategies and the findings recorded in a database.

We conclude that the main reason for antibiotic use and resistance misconceptions is the inability of the community to differentiate between bacteria and viruses. AMR awareness campaigns should focus on making a distinction

between the two micro-organisms in either mundane, local, or culturally accepted language to promote better understanding.

Antibiotic resistance is not generally recognised as life threatening by the community. This stems from unfamiliarity with the consequences of antibiotic resistance and lack of a direct link between antibiotic resistance and the consequences. The seriousness of antibiotic resistance should be addressed and highlighted in AMR awareness campaigns.

Our scoping review identified that most AMR awareness campaigns were targeted at healthcare professionals and patients at healthcare facilities and not at the community level. We found a few studies conducted in upper middle- and high-income countries and no studies in Africa that were designed to address the community on antibiotic or AMR awareness. However, it is important to have AMR awareness campaign that target the community to ensure that self-medication with either left-over or the sharing of antibiotics and the improper disposal of antibiotics are addressed.

6.4 Study limitations

Limitations that might have impacted the outcomes of this study are explained. The results must be treated with caution before generalisation to the population of UWC students as we observed low response rates in both the pre- and post-intervention surveys (64 response pre-intervention and 42 responses post-intervention). A statistical software programme (G*power) is a more suitable tool that is used to calculate the sample size for Student t-tests to determine the minimum difference expected between the pre-and post-intervention mean scores for attitudes and knowledge.

Online questionnaires have a low response rate compared to the printed as not all invited participants fill out the questionnaire (Ebert *et al.*, 2018). The data collection tool was accessed online (via Google forms), therefore the participants had access to search the internet during the surveys. Since access to the UWC social media accounts which is a generationally more popular electronic media communication pathway, was not authorised, thus limiting an access to more students. The questionnaire used for data collection only assessed the knowledge,

attitudes, and self-reported antibiotic use, therefore such responses could not be verified. The reliability factor, Cronbach's alpha, was 0.483 which was below the accepted value of 0.7, therefore, questionnaire adjustments are necessary. Since this study was conducted during a global pandemic, the findings set it apart from AMR campaigns that were conducted during a non-pandemic period.

6.5 Recommendations for future electronic and/or mass media interventions directed at university students

Based on the findings of this study and reviewed literature, we recommend the following for future antibiotic resistance awareness campaigns conducted with university students.

- A mixed methods study design would have added more rigor to the study findings, for example the inclusion of online interviews with a student cohort should be supplemented with pre- and post- intervention online surveys.
- Future studies to investigate the effectiveness of an intervention should target an undergraduate study population that is not in the final study level. Working with final year students would result in a low survey response rate. Intervention and data collection should be conducted with careful consideration of the target audience's academic calendar. Launching an intervention or collecting data during the busy seasons, e.g., examination time or end of year would result in poor engagement and low response rates.
- Intervention material should be tailored to the target audience's characteristics. Considerations of their interests, hobbies, literacy level, attention span, popular communication channels require consideration when selecting the media type, contents of the material and illustrations for the study. This will ensure the use of material and media that the target group will most likely engage with. With the target group of 18-24 years, video content should be explored.
- The key messages conveyed in the awareness campaign should be based on the baseline data. Material design must only be conducted once the baseline data has been analysed to identify the knowledge, attitude and

practice gaps. Such a logical approach would assist researchers in designing the content that would be relevant for the target audience.

- The intervention material should be legible e.g., large text on print media and less crowded text on electronic posters. The illustrations must be age appropriate, catchy, and relevant to the topic being addressed.
- Negotiations with the management of institutions must be done to obtain permission to access the university linked social media accounts, that the students follow and interact with, to have a wider reach. However, if access is granted, clear clarification that this information is not the institution's request, but that of the researcher.
- Multiple application of the interventions after certain duration may result in better uptake.

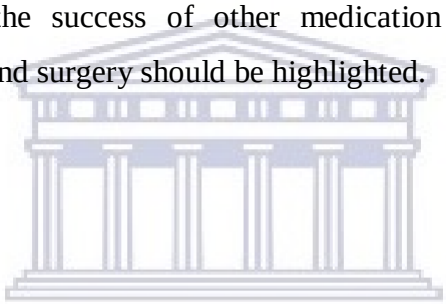
6.6 Recommendations for antibiotic resistance and/or AMR awareness campaigns targeted at university students in non-health disciplines.

Based on the findings of this study (survey and scoping review) and reviewed literature, we recommend the following key themes for future antibiotic resistance and/or AMR awareness campaigns conducted with university students in non-health disciplines.

- Focus on differentiating between bacterial and viral infections. Clarify when and why antibiotics are used in some situations e.g., secondary bacterial infections, prophylaxis, and chemotherapy. Differentiate between infection and inflammation and to avoid their use interchangeably in antimicrobial therapy.
- The key messages for the intervention campaigns must identify ways to define antibiotic resistance in mundane language for easier understanding of the phenomenon. This can be coupled with identification of commonly used antibiotics and their appropriate use.
- Future antibiotic awareness interventions should consider the use of disease-specific antibiotic resistance awareness key messages. The use of bacterial diseases that are prevalent to the country to explain antibiotic resistance can unravel the effects of antibiotic resistance being viewed as

"invisible" e.g. TB etc (Fletcher-Miles *et al.*, 2019; Watkins *et al.*, 2019). As most students reported they did not use antibiotics often and they could not the differentiate between viral and bacterial infections the use of disease-specific messages might produce better understanding of the conditions.

- Emphasis must be placed on the importance of proper disposal practice of leftover antibiotics and the harm that it imposes to the environment if communities remain complacent.
- Consequences of antibiotic resistance must be highlighted to ensure that the target audience understands the need for immediate action in tackling antibiotic resistance. The seriousness of antibiotic resistance and the role of the community must be accentuated. In addition, the effect of antibiotic resistance on the success of other medication procedures such as chemotherapy and surgery should be highlighted.



REFERENCES

Al-Kubaisi, K.A., De Ste Croix, M., Vinson, D., Ellis, L., Sharif, S.I. and Abduelkarem, A.R. (2018) 'What drives using antibiotic without prescriptions? A qualitative interview study of university students in United Arab Emirates', *Pharmacy Practice*, 16(2), pp. 1–7. Available at: https://doi.org/10.18549/PharmPract.2018.02.1172.

Al-Kumaim, N.H., Mohammed, F., Gazem, N.A., Fazea, Y., Alhazmi, A.K. and Dakkak, O. (2021) 'Exploring the Impact of Transformation to Fully Online Learning During COVID-19 on Malaysian University Students' Academic Life and Performance', *International Journal of Interactive Mobile Technologies*, 15(5), pp. 140–158. Available at: https://doi.org/10.3991/ijim.v15i05.20203.

AlHeneidi, H.H., AlTerkait, M.A. and Smith, A.P. (2021) 'Exploring the Influence of E-Learning Systems on Information Overload and Social Media Addiction During the Covid-19 Pandemic', *Sumerianz Journal of Social Science*, 4(42), pp. 59–64. Available at: https://doi.org/10.47752/sjss.42.59.64.

Allen, M. (2017) *The SAGE Encyclopedia of Communication Research Methods, The SAGE Encyclopedia of Communication Research Methods*. Available at: https://doi.org/10.4135/9781483381411.

Ancillotti, M., Eriksson, S., Veldwijk, J., Nihlén Fahlquist, J., Andersson, D.I. and Godskesen, T. (2018) 'Public awareness and individual responsibility needed for judicious use of antibiotics: A qualitative study of public beliefs and perceptions 11 Medical and Health Sciences 1117 Public Health and Health Services', *BMC Public Health*, 18(1), pp. 1–9. Available at: https://doi.org/10.1186/s12889-018-6047-8.

Anker, A.E., Feeley, T.H., McCracken, B. and Lagoe, C.A. (2016) 'Measuring the Effectiveness of Mass-Mediated Health Campaigns Through Meta-Analysis', *Journal of Health Communication*, 21(4), pp. 439–456. Available at: https://doi.org/10.1080/10810730.2015.1095820.

Anwar, M., Iqbal, Q. and Saleem, F. (2020) 'Improper disposal of unused

antibiotics: an often overlooked driver of antimicrobial resistance', *Expert Review of Anti-Infective Therapy*, 18(8), pp. 697–699. Available at: https://doi.org/10.1080/14787210.2020.1754797.

Arksey, H. and O'Malley, L. (2005) 'Scoping studies: Towards a methodological framework', *International Journal of Social Research Methodology: Theory and Practice*, 8(1), pp. 19–32. Available at: https://doi.org/10.1080/1364557032000119616.

Armah, J.K. and Westhuizen, D. Van Der (2017) 'Positive and Negative Feelings of Learning With Digital Technologies Among Higher', (2015).

Asogwa, I., Offor, S. and Mbagwu, H. (2017) 'Knowledge, Attitude and Practice towards Antibiotics Use among Non-medical University Students in Uyo, Nigeria', *Journal of Advances in Medical and Pharmaceutical Sciences*, 15(1), pp. 1–11. Available at: https://doi.org/10.9734/jamps/2017/35671.

Awad, A.I. and Aboud, E.A. (2015) 'Knowledge, attitude and practice towards antibiotic use among the public in Kuwait', *PLoS ONE*, 10(2), pp. 1–15. Available at: https://doi.org/10.1371/journal.pone.0117910.

Bago, J.-L. and Lompo, M.L. (2019) 'Exploring the linkage between exposure to mass media and HIV awareness among adolescents in Uganda', *Sexual & Reproductive Healthcare*, 21, pp. 1–8. Available at: https://doi.org/10.1016/J.SRHC.2019.04.004.

Baig, M., Jameel, T., Alzahrani, S.H., Mirza, A.A., Gazzaz, Z.J., Ahmad, T., Baig, F. and Almurashi, S.H. (2020) 'Predictors of misconceptions, knowledge, attitudes, and practices of COVID-19 pandemic among a sample of Saudi population', *PLoS ONE*, 15(12 December), pp. 1–13. Available at: https://doi.org/10.1371/journal.pone.0243526.

Bakhit, M., Del Mar, C., Gibson, E. and Hoffmann, T. (2019) 'Exploring patients' understanding of antibiotic resistance and how this may influence attitudes towards antibiotic use for acute respiratory infections: A qualitative study in Australian general practice', *BMJ Open*, 9(3). Available at:

https://doi.org/10.1136/bmjopen-2018-026735.

Bandura, A. (2001) 'Social Cognitive Theory of Mass Communication', *Media Psychology*, 3(3), pp. 265–299. Available at: https://doi.org/10.1207/S1532785XMEP0303_03.

Barqawi, H.J., Adra, S.F., Ramzi, H.R., Abouaggour, M.A. and Almehairi, S.K. (2021) 'Evaluating the knowledge, attitudes and practices of the UAE community on microbiota composition and the main factors affecting it: A cross-sectional study', *BMJ Open*, 11(8). Available at: https://doi.org/10.1136/bmjopen-2020-047869.

Bassoum, O., Sougou, N., Diongue, M., Lèye, M., Mbodji, M., Fall, D., Seck, I., Faye, A. and Tal-Dia, A. (2018) 'Assessment of General Public's Knowledge and Opinions towards Antibiotic Use and Bacterial Resistance: A Cross-Sectional Study in an Urban Setting, Rufisque, Senegal', *Pharmacy*, 6(4), p. 103. Available at: https://doi.org/10.3390/pharmacy6040103.

Bhardwaj, K., Shenoy M, S., Baliga, S., Unnikrishnan, B. and Baliga, B.S. (2021) 'Knowledge, attitude, and practices related to antibiotic use and resistance among the general public of coastal south Karnataka, India – A cross-sectional survey', *Clinical Epidemiology and Global Health*, 11(October 2020), p. 100717. Available at: https://doi.org/10.1016/j.cegh.2021.100717.

Bingham, B. (1982) 'Index to immunization.', *Virginia Medical*, 109(6), pp. 373–379. Available at: http://www.sciencedirect.com:5070/referencework/9780123705099/learning-and-memory-a-comprehensive-reference (Accessed: 27 November 2022).

Blanche, M.T., Durrheim, K. and Painter, D. (2006) *Research in practice: Applied methods for social science*. 2nd ed., *Juta and Company Ltd, 2006*. 2nd ed. Cape Town: UCT Press.

Blaxter, L., Hughes, C. and Tight, M. (2006) *How to research*. 3rd ed. England: University Press.

Boles, M., Adams, A., Gredler, A. and Manhas, S. (2014) 'Ability of a mass

media campaign to influence knowledge, attitudes, and behaviors about sugary drinks and obesity', *Preventive Medicine* [Preprint]. Available at: https://doi.org/10.1016/j.ypmed.2014.07.023.

Boslaugh, S. (2007) *Encyclopedia of Epidemiology*. 1st edn, *Encyclopedia of Epidemiology*. 1st edn. Edited by L.-A. Mcnutt. London: Sage Publications. Available at: https://doi.org/10.4135/9781412953948.

Brookes-Howell, L., Elwyn, G., BCh MRCGP FRCGP, B.M., Hood, K., Wood, F., Cooper, L., Goossens, H., Ieven, M., Butler, C.C. and ChB DCH FRCGP CCH Hon FFPHM, B.M. (2011) '"The Body Gets Used to Them": Patients' Interpretations of Antibiotic Resistance and the Implications for Containment Strategies', *J Gen Intern Med*, 27(7), pp. 766–72. Available at: https://doi.org/10.1007/s11606-011-1916-1.

Bu-Khamsin, A.Y., Fabella, E., Al Abdullah, A.H., Albather, M.R., Al-Hassan, Y.T., Alramadan, H.A., Al Moweshy, A.A., Al Abdullah, A.J. and Al Hassan, H.I. (2021) 'Association between Awareness on Antibiotic Resistance and Antibiotic Misuse Among Saudi University Students', *The Open Public Health Journal*, 14(1), pp. 545–554. Available at: https://doi.org/10.2174/1874944502114010545.

Bulabula, A.N.H., Dramowski, A. and Mehtar, S. (2020) 'Antibiotic use in pregnancy: Knowledge, attitudes and practices among pregnant women in Cape Town, South Africa', *Journal of Antimicrobial Chemotherapy*, 75(2), pp. 473–481. Available at: https://doi.org/10.1093/jac/dkz427.

Bulman, J.S. and Osborn, J.F. (1989) 'Descriptive statistics', *British Dental Journal*, 166(2), pp. 51–54. Available at: https://doi.org/10.1038/sj.bdj.4806708.

Burger, M., Fourie, J., Loots, D., Mnisi, T., Schellack, N., Bezuidenhout, S. and Meyer, J.C. (2016) 'Knowledge and perceptions of antimicrobial stewardship concepts among final year pharmacy students in pharmacy schools across South Africa', *Southern African Journal of Infectious Diseases*, 31(3), pp. 84–90. Available at: https://doi.org/10.1080/23120053.2016.1192808.

Cambaco, O., Alonso Menendez, Y., Kinsman, J., Sigaúque, B., Wertheim, H., Do, N., Gyapong, M., John-Langba, J., Sevene, E. and Munguambe, K. (2020) 'Community knowledge and practices regarding antibiotic use in rural Mozambique: where is the starting point for prevention of antibiotic resistance?', *BMC Public Health*, 20(1), pp. 1–15. Available at: https://doi.org/10.1186/s12889-020-09243-x.

Cambridge Dictionary (2022) *THE MASS MEDIA | English meaning - Cambridge Dictionary*. Available at: https://dictionary.cambridge.org/dictionary/english/mass-media (Accessed: 6 July 2019).

Carroll, C.E., Huang-Horowitz, N.C., Weberling McKeever, B. and Williams, N. (2014) 'Key messages and message integrity as concepts and metrics in communication evaluation', *Journal of Communication Management*, 18(4), pp. 386–401. Available at: https://doi.org/10.1108/JCOM-06-2012-0052.

Catalán-matamoros, D., Pariente, A. and Elías-pérez, C. (2019) 'Patient Education and Counseling What we know about media communication on antibiotics and antimicrobial resistance : A systematic review of the scienti fi c literature', *Patient Education and Counseling*, 102(8), pp. 1427–1438. Available at: https://doi.org/10.1016/j.pec.2019.03.020.

CDC (2019a) 'Antibiotic Resistance Threats in The United States 2019', *Cdc*, 10(1). Available at: https://doi.org/10.1186/s13756-020-00872-w.

CDC (2019b) *Where Resistance Spreads: Across the World | CDC*. Available at: https://www.cdc.gov/drugresistance/across-the-world.html (Accessed: 3 November 2022).

CDC (2021) *Antibiotic Use Questions and Answers | Antibiotic Use | CDC*. Available at: https://www.cdc.gov/antibiotic-use/q-a.html (Accessed: 14 November 2022).

Chaintarli, K., Ingle, S.M., Bhattacharya, A., Ashiru-Oredope, D., Oliver, I. and Gobin, M. (2016) 'Impact of a United Kingdom-wide campaign to tackle

antimicrobial resistance on self-reported knowledge and behaviour change', *BMC Public Health*, 16(1), pp. 1–9. Available at: https://doi.org/10.1186/s12889-016-3057-2.

Chang, Lee, M., Lee, J.C.Y., Lee, N.C.T., Ng, T.Y., Shafie, A.A. and Thong, K.S. (2021) 'Public kap towards covid-19 and antibiotics resistance: a malaysian survey of knowledge and awareness', *International Journal of Environmental Research and Public Health*, 18(8). Available at: https://doi.org/10.3390/ijerph18083964.

Chang, Q., Wang, W., Regev-Yochay, G., Lipsitch, M. and Hanage, W.P. (2015) 'Antibiotics in agriculture and the risk to human health: How worried should we be?', *Evolutionary Applications*, 8(3), pp. 240–247. Available at: https://doi.org/10.1111/eva.12185.

Charoenboon, N., Haenssgen, M.J., Warapikuptanun, P., Xayavong, T. and Khine Zaw, Y. (2019) 'Translating antimicrobial resistance: a case study of context and consequences of antibiotic-related communication in three northern Thai villages', *Palgrave Communications*, 5(1), pp. 1–24. Available at: https://doi.org/10.1057/s41599-019-0226-9.

Christensen, A.S.P., Meyer, M.K.H., Dalum, P. and Krarup, A.F. (2019) 'Can a mass media campaign raise awareness of alcohol as a risk factor for cancer and public support for alcohol related policies?', *Preventive Medicine*, 126, p. 105722. Available at: https://doi.org/10.1016/j.ypmed.2019.05.010.

Creswel, J.W. (2018) *Qualitative, quantitative, and mixed methods approaches. Research Design Qualitative Quantitative and Mixed Methods Approaches*. Fifth edit, *Research Design*. Fifth edit. Edited by J.D. Creswell. Los Angeles: SAGE. Available at: http://www.digitallab.wldu.edu.et/bitstream/123456789/3862/1/%28Creswell%29 Qualitative%2C Quantitative%2C and mixed methods 2nd e.pdf.

Cross, E.L.A., Tolfree, R. and Kipping, R. (2017) 'Systematic review of public-targeted communication interventions to improve antibiotic use', *Journal of Antimicrobial Chemotherapy*, 72(4), pp. 975–987. Available at:

https://doi.org/10.1093/jac/dkw520.

Dadgostar, P. (2019) 'Antimicrobial resistance: implications and costs', *Infection and Drug Resistance*, 12, pp. 3903–3910. Available at: https://doi.org/10.2147/IDR.S234610.

Dictionary.com (2022) *Digital media Definition & Meaning | Dictionary.com*. Available at: https://www.dictionary.com/browse/digital-media (Accessed: 27 November 2022).

Do, M., Figueroa, M.E. and Kincaid, L.D. (2016) 'HIV Testing Among Young People Aged 16–24 in South Africa: Impact of Mass Media Communication Programs', *AIDS and Behavior*, 20(9), pp. 2033–2044. Available at: https://doi.org/10.1007/s10461-016-1402-1.

Do, N., Vu, H.T.L., Nguyen, C.T.K., Punpuing, S., Khan, W.A., Gyapong, M., Asante, K.P., Munguambe, K., Gómez-Olivé, F.X., John-Langba, J., Tran, T.K., Sunpuwan, M., Sevene, E., Nguyen, H.H., Ho, P.D., Matin, M.A., Ahmed, S., Karim, M.M., Cambaco, O., Afari-Asiedu, S., Boamah-Kaali, E., Abdulai, M.A., Williams, J., Asiamah, S., Amankwah, G., Agyekum, M.P., Wagner, F., Ariana, P., Sigauque, B., Tollman, S., van Doorn, H.R., Sankoh, O., Kinsman, J. and Wertheim, H.F.L. (2021) 'Community-based antibiotic access and use in six low-income and middle-income countries: a mixed-method approach', *The Lancet Global Health*, 9(5), pp. e610–e619. Available at: https://doi.org/10.1016/S2214-109X(21)00024-3.

Ebert, J.F., Huibers, L., Christensen, B. and Christensen, M.B. (2018) 'Paper-or web-based questionnaire invitations as a method for data collection: Cross-sectional comparative study of differences in response rate, completeness of data, and financial cost', *Journal of Medical Internet Research*, 20(1), pp. 1–17. Available at: https://doi.org/10.2196/jmir.8353.

Eley, C. V., Young, V.L., Hayes, C.V., Parkinson, G., Tucker, K., Gobat, N. and McNulty, C.A.M. (2018) 'A mixed methods pilot of Beat the Bugs: A community education course on hygiene, self-care and antibiotics', *Journal of Infection Prevention*, 19(6), pp. 278–286. Available at:

https://doi.org/10.1177/1757177418780990.

Eley, Young, V.L., Hoekstra, B.A. and McNulty, C.A.M. (2018) 'An evaluation of educators' views on the e-Bug resources in England', *Journal of Biological Education*, 52(2), pp. 166–173. Available at: https://doi.org/10.1080/00219266.2017.1285808.

Eppler, M.J. and Mengis, J. (2004) 'The concept of information overload: A review of literature from organization science, accounting, marketing, MIS, and related disciplines', *Information Society*, 20(5), pp. 325–344. Available at: https://doi.org/10.1080/01972240490507974.

Fallowfield, L. (1995) 'Questionnaire design', *Archives of Disease in Childhood*, 72(1), pp. 76–79. Available at: https://doi.org/10.1136/adc.72.1.76.

Farley, E., Van den Bergh, D., Coetzee, R., Stewart, A. and Boyles, T. (2019) 'Knowledge, attitudes and perceptions of antibiotic use and resistance among patients in South Africa: A cross-sectional study', *Southern African Journal of Infectious Diseases*, 34(1), pp. 1–9. Available at: https://doi.org/10.4102/sajid.v34i1.118.

Farley, E., Stewart, A., Davies, M.A., Govind, M., van den Bergh, D. and Boyles, T.H. (2018) 'Antibiotic use and resistance: knowledge, attitudes and perceptions among primary care prescribers in South Africa', *South African Medical Journal*, 108(9), pp. 763–771. Available at: https://doi.org/10.7196/SAMJ.2018.v108i9.12933.

Farley, T.A., Halper, H.S., Carlin, A.M., Emmerson, K.M., Foster, K.N. and Fertig, A.R. (2017) 'Mass media campaign to reduce consumption of sugar-sweetened beverages in a rural area of the United States', *American Journal of Public Health*, 107(6), pp. 989–995. Available at: https://doi.org/10.2105/AJPH.2017.303750.

Filipetto, F.A., Modi, D.S., Weiss, L.B. and Ciervo, C.A. (2008) 'Patient knowledge and perception of upper respiratory infections, antibiotic indications and resistance', *Patient Preference and Adherence*, 2, pp. 35–39.

Fiore, D.C., Fettic, L.P., Wright, S.D. and Ferrara, B.R. (2017) 'Antibiotic overprescribing: Still a major concern', *Journal of Family Practice*, 66(12), pp. 730–736.

Fletcher-Miles, H., Gammon, J., Williams, S. and Hunt, J. (2019) 'A scoping review to assess the impact of public education campaigns to affect behavior change pertaining to antimicrobial resistance', *American Journal of Infection Control*, 000. Available at: https://doi.org/10.1016/j.ajic.2019.07.011.

Formplus (2021) *Experimental Research Designs: Types, Examples & Methods, 2021*. Available at: https://www.formpl.us/blog/experimental-research.

Foster, N., Vassall, A., Cleary, S., Cunnama, L., Churchyard, G. and Sinanovic, E. (2015) 'The economic burden of TB diagnosis and treatment in South Africa', *Social Science and Medicine*, 130, pp. 42–50. Available at: https://doi.org/10.1016/j.socscimed.2015.01.046.

Friedman, N.D., Temkin, E. and Carmeli, Y. (2016) 'The negative impact of antibiotic resistance', *Clinical Microbiology and Infection*, 22(5), pp. 416–422. Available at: https://doi.org/10.1016/j.cmi.2015.12.002.

Gholami, M., Pakdaman, A., Montazeri, A., Jafari, A. and Virtanen, J.I. (2014) 'Assessment of periodontal knowledge following a mass media oral health promotion campaign: A population-based study', *BMC Oral Health*, 14(1), pp. 1–7. Available at: https://doi.org/10.1186/1472-6831-14-31.

Giray, L. (2022) 'Meet the Centennials: Understanding the Generation Z Students', *International Journal of Sociologies and Anthropologies Science Reviews (IJSASR)*, 2(4), pp. 9–18.

Goodluck, M., Basiliana, E., Maseke, R.M., Geofrey, N.S. and Debora, C.K. (2017) 'Community knowledge and attitudes on antibiotic use in Moshi Urban, Northern Tanzania: Findings from a cross sectional study', *African Journal of Microbiology Research*, 11(25), pp. 1018–1026. Available at: https://doi.org/10.5897/ajmr2017.8583.

Gunasekera, Y.D., Kinnison, T., Kottawatta, S.A., Silva-Fletcher, A. and

Kalupahana, R.S. (2022) ‘Misconceptions of Antibiotics as a Potential Explanation for Their Misuse. A Survey of the General Public in a Rural and Urban Community in Sri Lanka’, *Antibiotics*, 11(4). Available at: https://doi.org/10.3390/antibiotics11040454.

Haenssgen, M.J., Xayavong, T., Charoenboon, N., Warapikuptanun, P. and Zaw, Y.K. (2018) ‘The consequences of AMR education and awareness raising: Outputs, outcomes, and behavioural impacts of an antibiotic-related educational activity in lao PDR’, *Antibiotics*, 7(4). Available at: https://doi.org/10.3390/antibiotics7040095.

Hawkings, N.J., Wood, F. and Butler, C.C. (2007) ‘Public attitudes towards bacterial resistance: A qualitative study’, *Journal of Antimicrobial Chemotherapy*, 59(6), pp. 1155–1160. Available at: https://doi.org/10.1093/jac/dkm103.

Higuita-Gutiérrez, L.F., Villamil, G.E.R. and Quiceno, J.N.J. (2020) ‘Knowledge, attitude, and practice regarding antibiotic use and resistance among medical students in Colombia: a cross-sectional descriptive study’, *BMC Public Health*, 20(1), pp. 1–12. Available at: https://doi.org/10.1186/s12889-020-09971-0.

Holmes, A.H., Moore, L.S.P., Sundsfjord, A., Steinbakk, M., Regmi, S., Karkey, A., Guerin, P.J. and Piddock, L.J.V. (2016) ‘Understanding the mechanisms and drivers of antimicrobial resistance’, *The Lancet*, 387(10014), pp. 176–187. Available at: https://doi.org/10.1016/S0140-6736(15)00473-0.

Hughes, D. (2014) ‘Antibiotic Resistance’, in *Microbes and Evolution: The World That Darwin Never Saw*. StatPearls Publishing, pp. 49–57. Available at: https://doi.org/10.1128/9781555818470.ch7.

Huh, K., Chung, D.R., Kim, S.H., Cho, S.Y., Ha, Y.E., Kang, C.I., Peck, K.R. and Song, J.H. (2018) ‘Factors affecting the public awareness and behavior on antibiotic use’, *European Journal of Clinical Microbiology and Infectious Diseases*, 37(8), pp. 1547–1552. Available at: https://doi.org/10.1007/s10096-018-3283-x.

Iqbal, M.T., Ahmed, M.H., Omar, N., Ahmed, M.R., Fahad, M., Ali, M. and Kaukab, M. (2020) 'Antibiotic Resistance: KAP Study on Medical and Non-Medical Students of Lahore, Pakistan', *Pakistan Journal of Public Health*, 10(1), pp. 24–31. Available at: https://doi.org/10.32413/pjph.v10i1.504.

Irawati, L., Alrasheedy, A.A., Hassali, M.A. and Saleem, F. (2019) 'Low-income community knowledge, attitudes and perceptions regarding antibiotics and antibiotic resistance in Jelutong District, Penang, Malaysia: A qualitative study', *BMC Public Health*, 19(1), pp. 1–15. Available at: https://doi.org/10.1186/s12889-019-7718-9.

Ivanovska, V., Angelovska, B., Van Dijk, L., Zdravkovska, M., Leufkens, H.G. and Mantel-Teeuwisse, A.K. (2018) 'Change in parental knowledge, attitudes and practice of antibiotic use after a national intervention programme', *European Journal of Public Health*, 28(4), pp. 724–729. Available at: https://doi.org/10.1093/eurpub/ckx240.

Jairoun, A., Hassan, N., Ali, A., Jairoun, O., Shahwan, M. and Hassali, M. (2019) 'University students' knowledge, attitudes, and practice regarding antibiotic use and associated factors: A cross-sectional study in the United Arab Emirates', *International Journal of General Medicine*, 12, pp. 235–246. Available at: https://doi.org/10.2147/IJGM.S200641.

Jamhour, A., El-Kheir, A., Salameh, P., Hanna, P.A. and Mansour, H. (2017) 'Antibiotic knowledge and self-medication practices in a developing country: A cross-sectional study', *American Journal of Infection Control*, 45(4), pp. 384–388. Available at: https://doi.org/10.1016/j.ajic.2016.11.026.

Jha, N., Shrestha, S., Shankar, P. and Bhandary, S. (2020) 'Knowledge, attitude and practice about antibiotic use, self-medication and antibiotic resistance among final year medical students and interns at a medical college in Lalitpur, Nepal', *Journal of Chitwan Medical College*, 10(3), pp. 69–73.

Jifar, Al. and Ayele, Y. (2018) 'Assessment of Knowledge, Attitude, and Practice toward Antibiotic Use among Harar City and Its Surrounding Community, Eastern Ethiopia', *Interdisciplinary Perspectives on Infectious*

Diseases, 2018. Available at: https://doi.org/10.1155/2018/8492740.

Karuniawati, H., Hassali, M.A.A., Suryawati, S., Ismail, W.I., Taufik, T. and Hossain, M.S. (2021) 'Assessment of knowledge, attitude, and practice of antibiotic use among the population of boyolali, indonesia: A cross-sectional study', *International Journal of Environmental Research and Public Health*, 18(16). Available at: https://doi.org/10.3390/ijerph18168258.

Karuniawati, H., Hassali, M.A.A., Suryawati, S., Ismail, W.I., Taufik, T. and Wiladatika, A. (2020) 'Public practices towards antibiotics: A qualitative study', *Clinical Epidemiology and Global Health*, 8(4), pp. 1277–1281. Available at: https://doi.org/10.1016/j.cegh.2020.04.027.

Khan, Faiz Ullah, Khan, Farman Ullah, Hayat, K., Chang, J., Saeed, A., Khan, Z., Ashraf, M., Rasheed, U.M., Atif, N., Ji, W., Aziz, M.M. and Fang, Y. (2020) 'Knowledge, attitude and practices among consumers toward antibiotics use and antibiotic resistance in Swat, Khyber-Pakhtunkhwa, Pakistan', *Expert Review of Anti-Infective Therapy*, 18(9), pp. 937–946. Available at: https://doi.org/10.1080/14787210.2020.1769477.

Khoshgoftar, M., Zamani-Alavijeh, F., Kasaian, N., Shahzamani, K., Rostami, S., Nakhodian, Z. and Pirzadeh, A. (2021) 'The effect of public health educational campaign regarding antibiotic use and microbial resistance on knowledge, attitude, and practice in the Iran', *Journal of Education and Health Promotion*, 10(3).

Kite, J., Gale, J., Grunseit, A., Bellew, W., Li, V., Lloyd, B., Maxwell, M., Vineburg, J. and Bauman, A. (2018) 'Impact of the make healthy normal mass media campaign (Phase 1) on knowledge, attitudes and behaviours: A cohort study', *Australian and New Zealand Journal of Public Health*, 42(3), pp. 269–276. Available at: https://doi.org/10.1111/1753-6405.12779.

Kite, J., Grunseit, A., Bohn-Goldbaum, E., Bellew, B., Carroll, T. and Bauman, A. (2018) 'A Systematic Search and Review of Adult-Targeted Overweight and Obesity Prevention Mass Media Campaigns and Their Evaluation: 2000–2017', *Journal of Health Communication*, 23(2), pp. 207–232. Available at:

https://doi.org/10.1080/10810730.2018.1423651.

Larsson, D.G.J. (2014) 'Antibiotics in the environment', *Upsala Journal of Medical Sciences*, 119(2), pp. 108–112. Available at: https://doi.org/10.3109/03009734.2014.896438.

Lavrakas, P. (2012) *Encyclopedia of Survey Research Methods, Encyclopedia of Survey Research Methods*. Available at: https://doi.org/10.4135/9781412963947.

Leedy, P.D. and Ormrod, J.E. (2015) *Practical Research: PLANNING AND DESIGN*. 11th edn. Essex: Pearson Education, Inc. Available at: https://doi.org/10.1093/ecco-jcc/jjy097.

Lemm, K.M. (2010) 'Stratified Sampling In: Encyclopedia of Research Design'. Available at: https://doi.org/10.4135/9781412961288.

Leonard, S.. (1999) 'Does color of warnings affect risk perception?', *International Journal of Industrial Ergonomics*, 23(5–6), pp. 499–504. Available at: https://doi.org/10.1016/S0169-8141(98)00015-8.

Li, B. and Webster, T.J. (2018) 'Bacteria antibiotic resistance: New challenges and opportunities for implant-associated orthopedic infections', *Journal of Orthopaedic Research*, 36(1), pp. 22–32. Available at: https://doi.org/10.1002/jor.23656.

Loveday, M. and Cox, H. (2017) 'Carpe diem ("seize the day"): Building on the findings of the 2015 world health organization evaluation of the multidrug-resistant tuberculosis (MDR-TB) programme to make the most of shortened MDR-TB treatment in South Africa', *South African Medical Journal*, 107(3), pp. 176–177. Available at: https://doi.org/10.7196/SAMJ.2017.v107i3.12203.

Lum, E.P.M., Page, K., Nissen, L., Doust, J. and Graves, N. (2017) 'Australian consumer perspectives, attitudes and behaviours on antibiotic use and antibiotic resistance: A qualitative study with implications for public health policy and practice', *BMC Public Health*, 17(1). Available at: https://doi.org/10.1186/s12889-017-4813-7.

Lynch, C., Mahida, N. and Gray, J. (2020) 'Antimicrobial stewardship: a COVID casualty?', *Journal of Hospital Infection*, 106(3), pp. 401–403. Available at: https://doi.org/10.1016/j.jhin.2020.10.002.

MacGowan, A. and Macnaughton, E. (2017) 'Antibiotic resistance', *Medicine (United Kingdom)*, 45(10), pp. 622–628. Available at: https://doi.org/10.1016/j.mpmed.2017.07.006.

MacQueen, K.M., McLellan, E., Metzger, D.S., Kegeles, S., Strauss, R.P., Scotti, R., Blanchard, L. and Trotter, R.T. (2001) 'What Is Community? An Evidence-Based Definition for Participatory Public Health', *American Journal of Public Health*, 91(12), p. 1929. Available at: https://doi.org/10.2105/AJPH.91.12.1929.

Martin, N., Buykx, P., Shevills, C., Sullivan, C., Clark, L. and Newbury-Birch, D. (2018) 'Population Level Effects of a Mass Media Alcohol and Breast Cancer Campaign: A Cross-Sectional Pre-Intervention and Post-Intervention Evaluation', *Alcohol and Alcoholism*, 53(1), pp. 31–38. Available at: https://doi.org/10.1093/alcalc/agx071.

Massey, Z.B., Brockenberry, L.O. and Harrell, P.T. (2021) 'Vaping, smartphones, and social media use among young adults: Snapchat is the platform of choice for young adult vapers', *Addictive Behaviors*, 112(July 2020), p. 106576. Available at: https://doi.org/10.1016/j.addbeh.2020.106576.

Matthew, S., Adebowale, S. and Sarhan, M. (2016) 'Information Overload: Causes And Cures', *Multidisciplinary Engineering Science and Technology (JMEST)*, 3(4 April 2016), pp. 1–4.

Mazińska, B., Struzycka, I. and Hryniewicz, W. (2017) 'Surveys of public knowledge and attitudes with regard to antibiotics in Poland: Did the European Antibiotic Awareness Day campaigns change attitudes?', *PLoS ONE*, 12(2), pp. 1–18. Available at: https://doi.org/10.1371/journal.pone.0172146.

Mazińska, B., Strużycka, I. and Hryniewicz, W. (2017) 'Surveys of public knowledge and attitudes with regard to antibiotics in Poland: Did the European

Antibiotic Awareness Day campaigns change attitudes?' Available at: https://doi.org/10.1371/journal.pone.0172146.

McCullough, A.R., Parekh, S., Rathbone, J., Del Mar, C.B. and Hoffmann, T.C. (2016) 'A systematic review of the public's knowledge and beliefs about antibiotic resistance', *Journal of Antimicrobial Chemotherapy*, 71(1), pp. 27–33. Available at: https://doi.org/10.1093/jac/dkv310.

Mcewen, S.A. and Collignon, P.J. (2017) 'Antimicrobial resistance: A One Health perspective', *Microbiology Spectrum*, 6(2), pp. 255–260. Available at: https://doi.org/10.1093/trstmh/trx050.

Mclennan, W. (1999) *An Introduction to Sample Surveys: A User's Guide*. Canberra: AUSTRALIAN BUREAU OF STATISTICS EMBARGO:

McNulty, C.A.M., Boyle, P., Nichols, T., Clappison, P. and Davey, P. (2007) 'The public's attitudes to and compliance with antibiotics', *Journal of Antimicrobial Chemotherapy*, 60(SUPPL. 1), pp. 63–68. Available at: https://doi.org/10.1093/jac/dkm161.

McNulty, C.A.M., Nichols, T., Boyle, P.J., Woodhead, M. and Davey, P. (2010) 'The English antibiotic awareness campaigns: Did they change the public's knowledge of and attitudes to antibiotic use?', *Journal of Antimicrobial Chemotherapy*, 65(7), pp. 1526–1533. Available at: https://doi.org/10.1093/jac/dkq126.

Mendelson, M., Morris, A.M., Thursky, K. and Pulcini, C. (2020) 'How to start an antimicrobial stewardship programme in a hospital', *Clinical Microbiology and Infection*, 26(4), pp. 447–453. Available at: https://doi.org/10.1016/J.CMI.2019.08.007.

Mokoena, T.T.W., Schellack, N. and Brink, A.J. (2021) 'Driving antibiotic stewardship awareness through the minibus-taxi community across the Tshwane District, South Africa—a baseline evaluation', *JAC-Antimicrobial Resistance*, 3(3), pp. 4–9. Available at: https://doi.org/10.1093/jacamr/dlab106.

Murray, C.J., Ikuta, K.S., Sharara, F., Swetschinski, L., Robles Aguilar, G.,

Gray, A., Han, C., Bisignano, C., Rao, P., Wool, E., Johnson, S.C., Browne, A.J., Chipeta, M.G., Fell, F., Hackett, S., Haines-Woodhouse, G., Kashef Hamadani, B.H., Kumaran, E.A.P., McManigal, B., Agarwal, R., Akech, S., Albertson, S., Amuasi, J., Andrews, J., Aravkin, A., Ashley, E., Bailey, F., Baker, S., Basnyat, B., Bekker, A., Bender, R., Bethou, A., Bielicki, J., Boonkasidecha, S., Bukosia, J., Carvalheiro, C., Castañeda-Orjuela, C., Chansamouth, V., Chaurasia, S., Chiurchiù, S., Chowdhury, F., Cook, A.J., Cooper, B., Cressey, T.R., Criollo-Mora, E., Cunningham, M., Darboe, S., Day, N.P.J., De Luca, M., Dokova, K., Dramowski, A., Dunachie, S.J., Eckmanns, T., Eibach, D., Emami, A., Feasey, N., Fisher-Pearson, N., Forrest, K., Garrett, D., Gastmeier, P., Giref, A.Z., Greer, R.C., Gupta, V., Haller, S., Haselbeck, A., Hay, S.I., Holm, M., Hopkins, S., Iregbu, K.C., Jacobs, J., Jarovsky, D., Javanmardi, F., Khorana, M., Kissoon, N., Kobeissi, E., Kostyanev, T., Krapp, F., Krumkamp, R., Kumar, A., Kyu, H.H., Lim, C., Limmathurotsakul, D., Loftus, M.J., Lunn, M., Ma, J., Mturi, N., Munera-Huertas, T., Musicha, P., Mussi-Pinhata, M.M., Nakamura, T., Nanavati, R., Nangia, S., Newton, P., Ngoun, C., Novotney, A., Nwakanma, D., Obiero, C.W., Olivas-Martinez, A., Olliaro, P., Ooko, E., Ortiz-Brizuela, E., Peleg, A.Y., Perrone, C., Plakkal, N., Ponce-de-Leon, A., Raad, M., Ramdin, T., Riddell, A., Roberts, T., Robotham, J.V., Roca, A., Rudd, K.E., Russell, N., Schnall, J., Scott, J.A.G., Shivamallappa, M., Sifuentes-Osornio, J., Steenkeste, N., Stewardson, A.J., Stoeva, T., Tasak, N., Thaiprakong, A., Thwaites, G., Turner, C., Turner, P., van Doorn, H.R., Velaphi, S., Vongpradith, A., Vu, H., Walsh, T., Waner, S., Wangrangsimakul, T., Wozniak, T., Zheng, P., Sartorius, B., Lopez, A.D., Stergachis, A., Moore, C., Dolecek, C. and Naghavi, M. (2022) ‘Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis’, *The Lancet*, 399(10325), pp. 629–655. Available at: https://doi.org/10.1016/S0140-6736(21)02724-0.

NDoH (2018) ‘South African antimicrobial resistance national strategy framework 2018 - 2024’, *Departments of Health and Agriculture, Forestry and Fisheries for the Republic of South Africa*, pp. 1–22.

Nepal, A., Hendrie, D., Robinson, S. and Selvey, L.A. (2019) 'Knowledge, attitudes and practices relating to antibiotic use among community members of the Rupandehi District in Nepal', *BMC Public Health*, 19(1), pp. 1–12. Available at: https://doi.org/10.1186/s12889-019-7924-5.

Neuman, W.. (2007) *Basics of social research: Qualitative and quantitative approaches.* 2nd ed. United States of America: Pearson Education, Inc.

Noar, S.M., Francis, D.B., Bridges, C., Sontag, J.M., Ribisl, K.M. and Brewer, N.T. (2016) 'The impact of strengthening cigarette pack warnings: Systematic review of longitudinal observational studies', *Social Science and Medicine*, 164, pp. 118–129. Available at: https://doi.org/10.1016/J.SOCSCIMED.2016.06.011.

O'Neill, J. (2014) 'Antimicrobial Resistance: Tackling a crisis for the health and wealth of nations The Review on Antimicrobial Resistance'. Available at: https://amr-review.org/sites/default/files/AMR Review Paper - Tackling a crisis for the health and wealth of nations_1.pdf.

Oh, J.M., Ming, L.C., Bakrin, F.S., Goh, B.H., Lee, L.H. and Khan, T.M. (2018) 'Social aspects of antibiotic use in the south and east asian students and general population', *Journal of Young Pharmacists*, 10(1), pp. 66–73. Available at: https://doi.org/10.5530/jyp.2018.10.16.

One Health Commission (2018) *What is One Health? - One Health Commission*. Available at: https://www.onehealthcommission.org/en/why_one_health/what_is_one_health/ (Accessed: 12 February 2023).

Pallant, J. (2005) 'SPSS SURVIVAL MANUAL: A step by step guide to data analysis using SPSS', *Automotive Industries AI*, 181(4), p. 718.

Papa, M.J. and Singhal, A. (2009) 'How Entertainment-Education Programmes Promote Dialogue in Support of Social Change', *Journal of Creative Communications*, 4(3), pp. 185–208. Available at: https://doi.org/10.1177/097325861000400304.

Pereko, D.D., Lubbe, M.S. and Essack, S.Y. (2015) 'Public knowledge,

attitudes and behaviour towards antibiotic usage in Windhoek, Namibia', *Southern African Journal of Infectious Diseases*, 30(4), pp. 134–137. Available at: https://doi.org/10.1080/23120053.2015.1107290.

Peters, M.D.J., Godfrey, C.M., Khalil, H., McInerney, P., Parker, D. and Soares, C.B. (2015) 'Guidance for conducting systematic scoping reviews', *International Journal of Evidence-Based Healthcare*, 13(3), pp. 141–146. Available at: https://doi.org/10.1097/XEB.0000000000000050.

Pooran, A., Pieterson, E., Davids, M., Theron, G. and Dheda, K. (2013) 'What is the Cost of Diagnosis and Management of Drug Resistant Tuberculosis in South Africa?', *PLoS ONE*, 8(1). Available at: https://doi.org/10.1371/journal.pone.0054587.

Prestinaci, F., Pezzotti, P. and Pantosti, A. (2015) 'Antimicrobial resistance: A global multifaceted phenomenon', *Pathogens and Global Health*, 109(7), pp. 309–318. Available at: https://doi.org/10.1179/2047773215Y.0000000030.

Price, L., Gozdzielewska, L., Young, M., Smith, F., MacDonald, J., McParland, J., Williams, L., Langdridge, D., Davis, M. and Flowers, P. (2018) 'Effectiveness of interventions to improve the public's antimicrobial resistance awareness and behaviours associated with prudent use of antimicrobials: A systematic review', *Journal of Antimicrobial Chemotherapy*, pp. 1464–1478. Available at: https://doi.org/10.1093/jac/dky076.

Public Health England (2019) *Antibiotic Guardian | Pledge to be an Antibiotic Guardian, British Society for Antimicrobial Chemotherapy*. Available at: https://antibioticguardian.com/ (Accessed: 20 January 2020).

Ramchurren, K., Balakrishna, Y., Mahomed, & S. and Mahomed, S. (2017) 'Southern African Journal of Infectious Diseases Patients' knowledge, attitudes and practices regarding antibiotic use at a regional hospital in KwaZulu-Natal, South Africa 2017', *Southern African Journal of Infectious Diseases* [Preprint]. Available at: https://doi.org/10.1080/23120053.2018.1516393.

Randolph, K.A., Whitaker, P. and Arellano, A. (2012) 'The unique effects of

environmental strategies in health promotion campaigns: A review', *Evaluation and Program Planning*, 35(3), pp. 344–353. Available at: https://doi.org/10.1016/j.evalprogplan.2011.12.004.

Randolph, W. and Viswanath, K. (2004) 'Lessons learned from public health mass media campaigns: marketing health in a crowded media world*', *Annu Rev Public Health*, 25(14.), pp. 419–37.

Al Rasheed, A., Yagoub, U., Alkhashan, H., Abdelhay, O., Alawwad, A., Al Aboud, A. and Al Battal, S. (2016) 'Prevalence and Predictors of Self-Medication with Antibiotics in Al Wazarat Health Center, Riyadh City, KSA', *BioMed Research International*, 2016. Available at: https://doi.org/10.1155/2016/3916874.

van Rijn, M., Haverkate, M., Achterberg, P. and Timen, A. (2019) 'The public uptake of information about antibiotic resistance in the Netherlands', *Public Understanding of Science*, 28(4), pp. 486–503. Available at: https://doi.org/10.1177/0963662518823701.

SABC News (2022) *Prime Minister Mia Mottley delivers the 20th Annual Nelson Mandela Lecture*. Available at: https://www.youtube.com/watch?v=hyEQL52Gv4E&t=1s (Accessed: 16 November 2022).

Sahoo, K.C., Tamhankar, A.J., Johansson, E. and Stålsby Lundborg, C. (2014) 'Community perceptions of infectious diseases, antibiotic use and antibiotic resistance in context of environmental changes: A study in Odisha, India', *Health Expectations*, 17(5), pp. 651–663. Available at: https://doi.org/10.1111/j.1369-7625.2012.00789.x.

Sakr, S., Ghaddar, A., Hamam, B. and Sheet, I. (2020) 'Antibiotic use and resistance: An unprecedented assessment of university students' knowledge, attitude and practices (KAP) in Lebanon', *BMC Public Health*, 20(1), pp. 1–9. Available at: https://doi.org/10.1186/s12889-020-08676-8.

Sano, Y., Sedziafa, A.P., Amoyaw, J.A., Boateng, G.O., Kuuire, V.Z., Boamah,

S. and Kwon, E. (2016) 'Exploring the linkage between exposure to mass media and HIV testing among married women and men in Ghana', *AIDS Care*, 28(6), pp. 684–688. Available at: https://doi.org/10.1080/09540121.2015.1131970.

Schutte, D.W. (2006) 'The Dendrogram Technique as a tool to development questionnaires', *Journal of Public Administration*, 41(3.1), pp. 616–630.

Serwecińska, L. (2020) 'Antimicrobials and antibiotic-resistant bacteria: A risk to the environment and to public health', *Water (Switzerland)*, 12(12). Available at: https://doi.org/10.3390/w12123313.

Shah, P., Shrestha, R., Mao, Z., Chen, Yilin, Chen, Yan, Koju, P., Liu, X. and Li, H. (2019) 'Knowledge, attitude, and practice associated with antibiotic use among university students: A survey in Nepal', *International Journal of Environmental Research and Public Health*, 16(20). Available at: https://doi.org/10.3390/ijerph16203996.

Shatto, B. and Erwin, K. (2016) 'Moving on From Millennials: Preparing for Generation Z', *Journal of continuing education in nursing*, 47(6), pp. 253–254. Available at: https://doi.org/10.3928/00220124-20160518-05.

Suman, A., Bostick, G.P., Schopflocher, D., Russell, A.S., Ferrari, R., Battié, M.C., Hu, R., Buchbinder, R. and Gross, D.P. (2017) 'Long-term evaluation of a Canadian back pain mass media campaign', *European Spine Journal*, 26(9), pp. 2467–2474. Available at: https://doi.org/10.1007/s00586-017-5249-6.

Tamhankar, A.J., Nachimuthu, R., Singh, R., Harindran, J., Meghwanshi, G.K., Kannan, R., Kumar, N.S., Negi, V., Jacob, L., Bhattacharyya, S., Sahoo, K.C., Mahadik, V.K., Diwan, V., Sharma, M., Pathak, A., Khedkar, S.U., Avhad, D., Saxena, S., Nerkar, S., Venu, V., Kumar, S., Shandeepan, G., Singh, K.R., Gashnga, R. and Kumar, A. (2019) 'Characteristics of a nationwide voluntary antibiotic resistance awareness campaign in India; future paths and pointers for resource limited settings/low and middle income countries', *International Journal of Environmental Research and Public Health*, 16(24). Available at: https://doi.org/10.3390/ijerph16245141.

Tangcharoensathien, V., Chanvatik, S., Kosiyaporn, H., Kirivan, S., Kaewkhankhaeng, W., Thunyahan, A. and Lekagul, A. (2021) 'Population knowledge and awareness of antibiotic use and antimicrobial resistance: results from national household survey 2019 and changes from 2017', *BMC Public Health*, 21(1). Available at: https://doi.org/10.1186/s12889-021-12237-y.

Tejada, J. and Punzalan, J. (2012) 'On the misuse of Slovin's formula', *The Philippine Statistician*, 61(1), pp. 129–136.

The Joanna Briggs Institute Reviewers (2015) 'The Joanna Briggs Institute Reviewers'. Manual 2015: Methodology for JBI scoping reviews', *Joanne Briggs Institute*, pp. 1–24.

Torres, N.F., Chibi, B., Middleton, L.E., Solomon, V.P. and Mashamba-Thompson, T.P. (2019) 'Evidence of factors influencing self-medication with antibiotics in low and middle-income countries: a systematic scoping review', *Public Health*, 168, pp. 92–101. Available at: https://doi.org/10.1016/j.puhe.2018.11.018.

Ventola, C.L. (2015) 'The Antibiotic Resistance Crisis Part One: Causes and', *P&T*, 40(4), pp. 278–283. Available at: https://www.jstage.jst.go.jp/article/electrochemistry/82/9/82_14-5-E2639/_pdf (Accessed: 1 November 2022).

Voo, A., Yan, S. and Sundraraj, Y.A.A.P. (2021) 'Knowledge , Attitude , and Practices (KAP) of Antibiotic Usage amongst Undergraduate Students of Management and Science University (MSU)', *Journal of Management and Science*, 19(2), pp. 8–17.

Wakefield, M.A., Loken, B. and Hornik, R.C. (2010) 'Use of mass media campaigns to change health behaviour', *The Lancet*, 376(9748), pp. 1261–1271. Available at: https://doi.org/10.1016/S0140-6736(10)60809-4.

Wasserman, S., Potgieter, S., Shoul, E., Constant, D., Stewart, A., Mendelson, M. and Boyles, T.H. (2017) 'South African medical students' perceptions and knowledge about antibiotic resistance and appropriate prescribing: Are we

providing adequate training to future prescribers?', *South African Medical Journal*, 107(5), pp. 405–410. Available at: https://doi.org/10.7196/SAMJ.2017.v107i5.12370.

Watkins, J.A., Wagner, F., Gómez-Olivé, F.X., Wertheim, H., Sankoh, O. and Kinsman, J. (2019) 'Rural South African community perceptions of antibiotic access and use: Qualitative evidence from a health and demographic surveillance system site', *American Journal of Tropical Medicine and Hygiene*, 100(6), pp. 1378–1390. Available at: https://doi.org/10.4269/ajtmh.18-0171.

Wellcome Trust (2019) *Reframing resistance*. Available at: https://wellcome.org/sites/default/files/reframing-resistance-report.pdf.

WHO (2015a) 'Antibiotic Resistance: Multi-Country Public Awareness Survey', *World Heatlh Organization*, pp. 1–51. Available at: https://apps.who.int/iris/handle/10665/194460.

WHO (2015b) 'Global action plan on antimicrobial resistance', *WHO*, pp. 1–28. Available at: https://www.who.int/publications/i/item/9789241509763.

WHO (2017) *SA TB profile*. Available at: https://extranet.who.int/sree/Reports?op=Replet&name=/WHO_HQ_Reports/G2/PROD/EXT/TBCountryProfile&ISO2=ZA&outtype=html (Accessed: 12 July 2019).

WHO (2018) *World Antibiotic Awareness Week 2018*. Available at: https://www.who.int/campaigns/world-antimicrobial-awareness-week/2018 (Accessed: 5 December 2022).

WHO (2020a) *10 global health issues to track in 2021, WHO: Newsroom spotlight*. Available at: https://www.who.int/news-room/spotlight/10-global-health-issues-to-track-in-2021 (Accessed: 3 November 2022).

WHO (2020b) *Antibiotic resistance*. Available at: https://www.who.int/news-room/fact-sheets/detail/antibiotic-resistance.

WHO (2020c) 'Drug resistance WHO Global Strategy Recommendations', pp. 2–3.

WHO (2021) *Antimicrobial resistance*. Available at: https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance (Accessed: 14 November 2022).

Xiao, Z., Li, X., Lin, D. and Tam, C.C. (2015) 'Mass Media and HIV/AIDS Prevention among Female Sex Workers in Beijing, China', *Journal of Health Communication*, 20(9), pp. 1095–1106. Available at: https://doi.org/10.1080/10810730.2015.1018575.

Yagoub, U., Qahtani, B. Al, Hariri, I. Al, Zahrani, A. Al and Siddique, K. (2019) 'Antibiotic resistance: a hospital-based multicenter study in tabuk city, kingdom of saudi arabia', *Infection and Drug Resistance*, 12, pp. 1815–1825. Available at: https://doi.org/10.2147/IDR.S200996.

You, J.H.S., Yau, B., Choi, K.C., Chau, C.T.S., Huang, Q.R. and Lee, S.S. (2008) 'Public knowledge, attitudes and behavior on antibiotic use: A telephone survey in Hong Kong', *Infection*, 36(2), pp. 153–157. Available at: https://doi.org/10.1007/s15010-007-7214-5.

Young, V.L., Rajapandian, V., Eley, C. V., Hoekstra, B.A., Lecky, D.M. and McNulty, C.A.M. (2015) 'Monitoring web site usage of e-bug: A hygiene and antibiotic awareness resource for children', *JMIR Research Protocols*, 4(4), pp. 1–9. Available at: https://doi.org/10.2196/resprot.4049.

Yousaf, M.A., Zahid, H., Khalid, Z., Khan, A.T.-A., Noreen, M., Saleem, T., Farooq, S., Yousaf, I. and Sakr, S. (2021) 'Knowledge, Attitude and Practices of University students towards Antibiotic Use and Resistance: Questionnaire Based Assessment', *BioScientific Review*, 3(3). Available at: https://doi.org/10.32350/bsr.0303.05.

Yu, M., Zhao, G., Stålsby Lundborg, C., Zhu, Y., Zhao, Q. and Xu, B. (2014) 'Knowledge, attitudes, and practices of parents in rural China on the use of antibiotics in children: A cross-sectional study', *BMC Infectious Diseases*, 14(1), pp. 1–8. Available at: https://doi.org/10.1186/1471-2334-14-112.

Zamawe, C.O.F., Banda, M. and Dube, A.N. (2016) 'The impact of a

community driven mass media campaign on the utilisation of maternal health care services in rural Malawi', *BMC Pregnancy and Childbirth*, 16(1). Available at: https://doi.org/10.1186/s12884-016-0816-0.

APPENDIX A: SCOPING REVIEW DATA

First author, year,	Settings	Method of Participant recruitment Country	Study design	Objectives/ Aim	Media for intervention and duration of intervention	Content of Antibiotic resistance intervention	Main concept	Key findings	Measured Outcomes
Van Rijn, 2019,	The Netherlands	Web recruited participants N = 2037	Randomized control study	To test to what extent an educational video on the intricacies (details0 of antibiotic resistance affects public attitudes towards antibiotic resistance and how such information is absorbed by the most likely targets of public health campaigns.	1,3 min video 16-29 May 2020 (2 weeks)	-A bacterial infection can be combatted with antibiotics. The antibiotics destroy bacteria or slow them down in their growth. - In some cases, the bacteria are not sensitive to an antibiotic. These bacteria are resistant because they have protected themselves against the antibiotic. -Then the infection is caused by resistant bacteria. This type of infection is more difficult to treat because the usual antibiotics are no longer working, and doctors must choose antibiotics which they have less experience with or have more side effects. -Too much or wrong use of antibiotics increases the chance that the bacteria become resistant. That is why it is important to carefully consider whether	- Bacteria develop resistance to antibiotics. - Antibiotic resistant infections are difficult to treat and require last resort antibiotics. - Overuse and inappropriate use of antibiotics increases antibiotic resistance.	General awareness of antibiotic resistance increased p=0.048. Test group awareness higher than control group p=0.019.	Knowledge and attitudes

						the use of antibiotics is necessary. This way, the treatment of infections remains also possible in the future.			
Ashok J. Tamhankar, 2019,	India	Nation-wide campaign	Cross-sectional study	To report the results and characteristics of a campaign conducted in India on a voluntary initiative, entitled 'Antibiotic Resistance Awareness Campaign (AMRAC-17)' and discusses future paths and pointers	Posters, pamphlets/ booklets, audio and video messages, radio broadcast, lectures, slogan competitions, rallies	Key message (WHO): 'Take antibiotics only with advice of doctor' **Poster** -Antibiotics won't make your cold or flu better faster. -Taking antibiotics when you don't need them puts you and your family at risk. Take doctors' advice. Combat drug resistance. No care today, no cure tomorrow.	-Antibiotics only treat bacterial infections. -Antibiotics should be obtained with a prescription from the doctor. -Inappropriate use of antibiotics increases	More than 80% of campaign coordinators perceived that the campaign delivered the targeted messages. No outcome measurement was done on the recipients of the material.	Voluntary initiative results and characteristics

				for resource-limited settings/low- and middle-income countries.	Held from 13–19 November 2017 (1 week)	- Do not throw expired antibiotics in soil. **Pamphlets** -Incorrect use of antibiotics can lead to the development of antibiotic resistance bacteria. -Use antibiotics wisely for the benefit of your health and environment. -Antibiotics only fight against bacterial your infections. Antibiotics should be prescribed by a doctor it should not be used for self-treatment. -Use antibiotics when needed otherwise you will face problems like increased treatment failure, increased morbidity and mortality, exposure to adverse drug effects, increased treatment costs, adverse effects on environment, additional hospital admissions.	antibiotic resistance.		
Young V L, 2019,	England	High school students (13-16 yrs.) N = 235	Pre-post study	To investigate the ability of the debate kit to increase knowledge and awareness of antibiotic and antibiotic	e-Bug Antibiotic Resistance debate lesson June-July 2016 (≈ 2 months)	-Antibiotic are drugs that affect bacterial cells, but not our human cells. -Antibiotic resistance is when a target bacterium becomes resistant to a particular antibiotic.	-Bacterial cells become resistant to antibiotics not the human cells. -Antibiotics are not effective	There was significant improvement in most of the questions before and after the intervention $p<0.05$.	Knowledge and awareness

				resistance in secondary school students aged 13–16 years.		-Antibiotics can't help with viral illnesses, only bacterial ones. Viruses have a different structure to bacterial cells and so antibiotics do not affect the. -In fact, it is bacterium which becomes resistant. -Antibiotics only kill bacteria and do not have a direct effect on pain, our immunity or inflammation.	against viral infections		
Charlotte Victoria Eley	The United Kingdom	Adults with learning disabilities N=7-9 (different number participants attended each session) Young parents N=2-4	Pre-post study.	The aim of this study was to pilot the Beat the Bugs hygiene and self-care intervention in two different learning environments. Key objectives were to assess: the impact of the course on knowledge; the impact on self-reported behavior; its acceptability to users and course leaders; and to transferability to other settings.	Beat the bugs 6 module course with PowerPoint presentation, games and videos. Each course was done over a six-week period. Data collection done between September 2016 and April 2017.	- Many bacterial infections are easily treated with antibiotics. However, the bacteria are fighting back, and some bacteria have developed resistance against antibiotics; these are called antibiotic resistant bacteria. - Colds, flu and other respiratory tract infections are the most common infections in the community and are the most easily spread. They are mostly caused by viruses and, as such, cannot be treated by antibiotics. - Antibiotics treat infectious diseases caused by bacteria, such as meningitis, tuberculosis	-Bacteria are developing resistance towards antibiotics. -Antibiotics are not effective against viral infections, e.g., colds and flu. -Antibiotics are only effective against bacterial infections. -Antibiotic resistance is accelerated by overuse of antibiotics. -Antibiotic resistance affects the	A significant improvement in knowledge was observed in both pilot groups ($p<0.05$) except in the Food Bugs session ($p=0.06$). Focus groups conducted 6 weeks after the intervention reported that both pilots retained the knowledge obtained in the course.	Knowledge, behavior and acceptability of the Beat the Bugs

						and pneumonia. They do not harm viruses, so antibiotics cannot treat diseases such as colds and flu, which are caused by viruses - Through increased exposure to the antibiotics, bacteria are becoming resistant to them. - Infections caused by antibiotic resistant bacteria pose a serious health risk. Patients who are immuno-compromised (through cancer or HIV treatment, pregnancy or other illnesses) are less able to control the infection with antibiotics. - **We can help prevent antibiotic resistance by:** -only using antibiotics prescribed for you by your doctor because each prescription is targeted to each patient and each infection. -always take the antibiotics exactly as prescribed otherwise the bacteria are not completely destroyed and the infection can come back.	success of other forms of treatments, e.g., chemotherapy. - Antibiotics should be obtained with a prescription from the doctor. -Take antibiotics as directed by a healthcare professional.		

						-don't use antibiotics for simple coughs and colds because antibiotics do not kill viruses and overuse increases bacterial resistance			
Nutcha Charoenboon, 2019	Thailand	Rural adult villagers N= 1096	mixed-method triangulation design	To contribute to the understanding of the consequences (and their contextual influences) when sharing antibiotic-related information in a rural middle-income setting	Interactive six session activity (half a day) with researchers and the villagers. Incorporated games that allowed information exchange and resulted in poster making of what was understood and interpreted about content exposed to them. Edited posters were displayed in the villages for 3 months.	**Activity incorporated messages, adapted from WHO Antibiotic resistance week messages.** -Only use antibiotics when prescribed by a certified health professional. -Germs can become "stronger" if treated inappropriately until the point that there is no medicine to treat them anymore. -Drug resistance can spread. - "Seeing the doctor" is the best way to assess your medical needs. -Always follow health worker's advice when using antibiotics. -Never demand antibiotics if the health worker says you don't need them. **Posters (edited)** *NB: anti-inflammatory drug refers to antibiotics among the Thai people.*	- Antibiotics should be obtained with a prescription from the doctor. - Take antibiotics as directed by a healthcare professional. - Do not demand antibiotics from a doctor -Inappropriate use of antibiotics increases antibiotic resistance.	The educational activity was associated with more desirable responses about antibiotic resistance and use. Participants of the activity were likely more to seek treatment from formal healthcare facilities as compared to those exposed to indirect communication.	Awareness of Consequences and contextual influences (factors that affect decision making) of antibiotic related information sharing

						-We have to continue taking anti-inflammatory medicine until course is finished as the doctor says. Otherwise, we would have drug resistance. -Consult the doctor before you take anti-inflammatory medicine. -To treat drug resistance symptoms: use medicines correctly as the doctor says, take anti-inflammatory medicines until the course is finished as the doctor says, do not buy anti-inflammatory medicines to take by yourself and should not overdose.			
Haenssgen 2018	Lao PDR (Southeast Asia)	General public 18+ N = 1130	Quasi-experimental design	To inform the awareness agenda from a social sciences perspective by assessing the outputs, outcomes, and behavioural impacts of an ABR-themed educational activity in the low-income setting of Southern Lao PDR.	A six-session interactive activity. Comprised of games and discussions with antibiotic resistance messages imbedded in the activities. (Half a day long)	**Activity incorporated messages, adapted from WHO** **Antibiotic resistance week messages.** - Always follow health workers' advice when using antibiotics. - Never demand antibiotics if health workers say you do not need them. - Only use antibiotics when prescribed by a certified health professional.	-Antibiotics should be obtained with a prescription from the doctor. - Take antibiotics as directed by a healthcare professional. - Inappropriate use of antibiotics increases antibiotic resistance.	An increase in the participants' recognition of the term "due yah" which is translated drug resistance was observed, from 27.6% to 91.4%. However, there was insignificant differences in the knowledge and attitudes of the villagers who participated and	Awareness and behavior

						- Germs can become 'stronger' if treated inappropriately until the point that there is no medicine to treat them anymore - Drug resistance can spread.	-Never demand antibiotics from your health care professional.	those who did not.	
Public Health England, 2020	England	Members of the public. N = not known	N/A	To increase commitment to reducing Antimicrobial Resistance (AMR), change behavior and increase knowledge through an online pledge system for healthcare professionals and members of the public to become Antibiotic Guardians (AG).	Antibiotic Guardian website. Includes video and pledges. (On going since 2014)	General public pledges: -For infections that our bodies are good at fighting off on their own, like coughs, colds, sore throats and flu, I pledge to talk to my pharmacist about how to treat the symptoms first rather than going to the GP. - It is vital we prevent antibiotics from getting into the environment. I pledge to always take any unused antibiotics to my pharmacy for safe disposal. - If I'm prescribed antibiotics, I will take them exactly as prescribed and never share them with others. YouTube video for the public: "-When was the last time you had an infection? It probably wasn't a great worry because you know	- Antibiotics do not work against colds and flu. - Take antibiotics as directed by a healthcare professional. - Take leftover antibiotics for disposal to the pharmacy to promote environmental health. -Bacteria are becoming resistant to antibiotics. -Everyone has a role to play in preserving antibiotics. --Antibiotic resistance affects the success of other forms of	Approximately 82727 pledges (as of April 5, 2020). This number is inclusive of the general public, healthcare professionals and students. Separate research has been conducted to investigate the effectiveness of the intervention.	Knowledge, awareness and behavior

						you can just get antibiotics. But the problem is antibiotics don't work as well as they used to. The bacteria have become resistant in fact there are some bacteria which are now resistant to all antibiotics - This is one of the biggest threats to everyone on earth and the problem is only going to get worse. Unless we act fast and together, we are going to enter an era when no antibiotics work. In fact, modern medicines depend massively on antibiotics. - Did you know cancer treatment destroys the immune system? Most patients need antibiotics to survive. Imagine no heart, bowel or bone operations, no cancer treatment. - This is where we are headed but with three very simple steps, we can all become antibiotic guardians. -*Step 1*: don't demand antibiotics from your doctor. Ask a pharmacist how to treat symptoms. We've all been there begging for antibiotics	treatments, e.g., chemotherapy. -Do not ask the doctor for antibiotics. --Take antibiotics as directed by your healthcare provider. -- Antibiotics do not work against colds and flu. Treat symptoms with over-the-counter medicines. - Do not share antibiotics with family and friends. -Share your knowledge about antibiotic use and antibiotic resistance with family and friends.		

						because you feel terrible or worse still if you are looking after a sick child. We don't need them every time, in fact, although every day infections may make you feel unwell antibiotics make very little difference to cold, flus and sore throats and coughs. So, ask a pharmacist about over-the-counter remedies that can treat your symptoms. - *Step 2*: take antibiotics exactly as they are prescribed. Never save them for later. Never give them to someone else. They will work better, and bacteria are less likely to become resistant. - Step 3: spread the word. Tell your friends and family to use antibiotics properly. Send them this video and share it. Antibiotics as some of our precious medicine and we all quaint to lose them unless we all become antibiotic buddy.			
Katerina Chaintarli, 2016	United Kingdom	Members of public N = 782	Cross-sectional study	The aim of this evaluation was to determine whether	Antibiotic Guardian website pledge	-For infections that our bodies are good at fighting off on their own, like coughs, colds, sore	-Take leftover antibiotics for disposal to the pharmacy to	Self-reported behaviour increased from	Knowledge and behaviour

		Is this author linked to the AG website above?		the AG campaign increased engagement and improved AMR knowledge and behaviour.		throats and flu, I pledge to talk to my pharmacist about how to treat the symptoms first rather than going to the GP. - It is vital we prevent antibiotics from getting into the environment. I pledge to always take any unused antibiotics to my pharmacy for safe disposal. - If I'm prescribed antibiotics, I will take them exactly as prescribed and never share them with others.	promote environmental health. -Take antibiotics as directed by your healthcare provider. -Antibiotics do not work against colds and flu.	30.7% to 63.4% after campaign. Members of the public were less likely to report an increase in knowledge/ Awareness of antibiotic resistance.	

APPENDIX B: QUESTIONNAIRE

Demographics

2. Please indicate your age in years. *

Mark only one oval.

- ◯ 18-22
- ◯ 23-27
- ◯ 28-32
- ◯ 33-37
- ◯ 38-42
- ◯ 42 and above
- ◯ Other: _____

3. Please indicate your gender. *

Mark only one oval.

- ◯ Female
- ◯ Male
- ◯ Prefer not to say
- ◯ Other

4. In 2020, for which study year are you registered? *

Mark only one oval.

- ◯ 1st year
- ◯ 2nd year
- ◯ 3rd year
- ◯ 4th year

5. Faculty at which your registered. *

Mark only one oval.

- ◯ Law
- ◯ Arts
- ◯ Economic and Management Sciences
- ◯ Education
- ◯ Other: _____

Demographics

6. Which province are you originally from? *

Mark only one oval.

- ◯ Gauteng
- ◯ Western Cape
- ◯ Northern Cape
- ◯ Mpumalanga
- ◯ Eastern Cape
- ◯ KwaZulu Natal
- ◯ Limpopo
- ◯ North West
- ◯ Free State
- ◯ International student

Antibiotic resistance perceptions

7. When was the last time you used antibiotics? *

Mark only one oval.

- ◯ In the last 4 weeks
- ◯ More than a month ago
- ◯ Over a year ago
- ◯ I do not remember
- ◯ I do not know what antibiotics are.

8. How do you usually obtain antibiotics? You can select more than one answer. *

Check all that apply.

- ☐ From a dispensing doctor
- ☐ Buy them from a community pharmacy with a prescription from the doctor
- ☐ Buy from a community pharmacy without a prescription
- ☐ Obtain from the Day hospital or clinic
- ☐ Receive leftovers from relatives, friends, or neighbours

9. Can antibiotics be used to treat infections that are caused by a germ, called bacteria? *

Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly disagree

10. Can antibiotics be used to treat infections that are caused by a germ, called virus? *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

11. Antibiotics can be used to treat any kind of infection caused by any kind of germ (bacteria, fungi and virus). *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

12. Considering the following conditions, in your view when can antibiotics be specifically used? You can select multiple options. *

Check all that apply.

- [ ] Coronavirus disease (Covid-19)
- [ ] Cold
- [ ] Flu
- [ ] Cough with green phlegm
- [ ] Pain
- [ ] Inflammation
- [ ] A cough lasting for more than a week.
- [ ] Sore throat.
- [ ] An infected wound.
- [ ] Some sexually transmitted diseases.
- [ ] A bacterial infection which presents in a patient with a viral disease.

13. Different antibiotics are used to treat different types of infections. *

Mark only one oval.

- Strongly agree.
- Agree.
- Neutral.
- Disagree.
- Strongly disagree

14. Taking antibiotics when you have a cold or flu helps you get better quicker than when you do not. *

Mark only one oval.

- Strongly agree.
- Agree.
- Neutral.
- Disagree.
- Strongly disagree

15. Taking antibiotics when you are sick assures you that you do not get sick again with the same condition. *

Mark only one oval.

- Strongly agree.
- Agree.
- Neutral
- Disagree.
- Strongly disagree

16. Taking antibiotics during a pandemic e.g. COVID-19, before you get sick, boosts your immune system so you will not get sick. *

Mark only one oval.

- Strongly agree.
- Agree.
- Neutral
- Disagree.
- Strongly disagree

17. Can leftover antibiotics be kept for the next time you get sick? *

Mark only one oval.

- Strongly agree.
- Agree.
- Neutral.
- Disagree.
- Strongly disagree

18. Should leftover antibiotics that have expired be thrown into the bin? *

Mark only one oval.

- Strongly agree.
- Agree.
- Neutral.
- Disagree.
- Strongly disagree

19. If a relative, friend or neighbour is sick, you would share with them some of your antibiotics? *

Mark only one oval.

- Strongly agree.
- Agree.
- Neutral.
- Disagree.
- Strongly disagree

20. Do you take your antibiotics as directed by the pharmacist, doctor, or nurse? *

Mark only one oval.

- Yes
- Sometimes
- No

21. You usually know when you are sick enough to need antibiotics. *

Mark only one oval.

- Strongly agree.
- Agree.
- Neutral
- Disagree.
- Strongly disagree

22. When you visit the clinic or doctor, do you expect antibiotics to be prescribed? *

Mark only one oval.

- Yes
- Sometimes
- No

23. There is no need for you to visit a doctor, as you can just call their offices to obtain an antibiotic prescription. *

Mark only one oval.

- Strongly agree.
- Agree.
- Disagree.
- Strongly disagree

24. One should be able to buy antibiotics from the pharmacy without a prescription. *

Mark only one oval.

- Strongly agree.
- Agree.
- Neutral.
- Disagree.
- Strongly disagree

25. You would like to keep left-over antibiotics at home just in case you get sick. *

Mark only one oval.

- Strongly agree.
- Agree.
- Neutral.
- Disagree.
- Strongly disagree

26. Have you heard about the term "antibiotic resistance"? *

Mark only one oval.

- Yes
- No
- I am not sure

27. Antibiotic resistance occurs when your body does not respond to antibiotics anymore. *

Mark only one oval.

- True
- I am not sure
- False

28. Antibiotic resistance occurs when bacteria cannot be killed by antibiotics anymore. *

Mark only one oval.

- True
- I am not sure
- False

29. In your opinion, antibiotic resistance affects: *

Mark only one oval.

- Everyone
- An individual
- Some communities
- Low income communities
- Only people that take antibiotics
- I am not sure.

30. Antibiotic resistance is a serious global problem. *

Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly disagree

31. Resistant bacteria can spread between people. *

Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

32. Infections which are resistant to antibiotics require: (You can select more than one answer) *

Check all that apply.

- ☐ Stronger antibiotics
- ☐ More than one antibiotic
- ☐ No antibiotics
- ☐ New antibiotics
- ☐ Expensive antibiotics

APPENDIX C: PILOT FEEDBACK FORMS

Feedback on Questionnaire

Please highlight any problems you faced when answering the questions. This can be
- Where the question is difficult to understand or answer
- Where the question is either too vague or too complicated
-Where you feel the answers do not match the question
- Or any other issue that you have encountered.

* Required

1. Email *

2. How long did it take you to answer the questionnaire? *

3. Write down the all questions you found difficult to answer and why? E.g. Question 1 - I did not understand the meaning of the word age. *

4. Would you say the questionnaire was hard or difficult to complete? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 5*
- ◯ Somewhat both *Skip to question 5*

5. Why did you think the questionnaire was difficult to complete? *

APPENDIX D: PRE-INTERVENTION SURVEY EMAIL INVITE

I've invited you to fill out a form:

Antibiotic resistance perceptions

Dear Student,

I am inviting you to participate in my research study which aims to investigate the influence of mass media on students' antibiotic resistance perceptions. As such, you are being asked to participate in the study because you are a registered student of UWC in the Faculty of Economic and Management Sciences. It is important that you note that your participation in this study will be anonymous.

The survey is estimated to take you about 10 MINUTES. Your participation in this study will significantly enlighten if mass media may be used in the dissemination of antibiotic resistance information to communities. The information obtained from your contribution will enable the government and policy makers to implement appropriate campaigns to educate communities on antibiotic resistance.

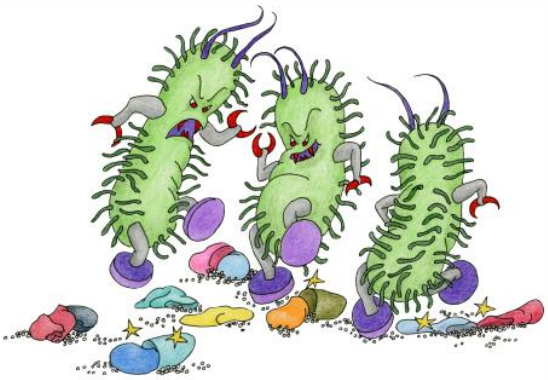
What if I have questions?
If you have any questions about the research study, please contact me, Prudence Vimbai Munyayi at 3970627@myuwc.ac.za or Prof Bheekie at abheekie@uwc.ac.za .

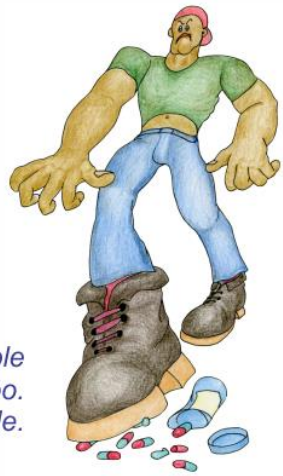
FILL OUT FORM

APPENDIX E: POSTERS

Week 1

Antibiotic resistance occurs when antibiotics fail to kill bacteria.



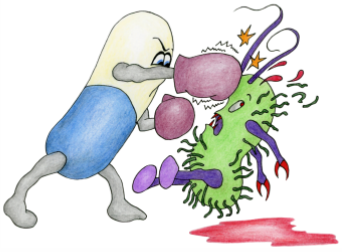


*Antibiotic resistance **does not** only affect those people who take a lot of antibiotics; it affects other people too. Resistant bacteria can spread between people.*

For inquiries contact Prudence Munyayi 3970627@myuwc.ac.za; Prof Bheekie abheekie@uwc.ac.za and Prof Coetzee rcoetzee@uwc.ac.za 2020

Week 2

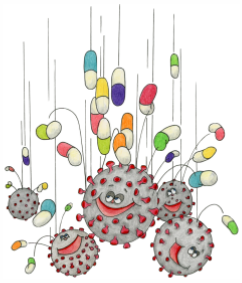
Antibiotics only treat bacterial infections such as tuberculosis and pneumonia.



*Antibiotics may **ONLY** be used in the treatment of viral infections like the coronavirus if a bacterial infection develops e.g. pneumonia.*

Antibiotics are NOT effective against viral infections such as common colds, sore throats or the coronavirus.

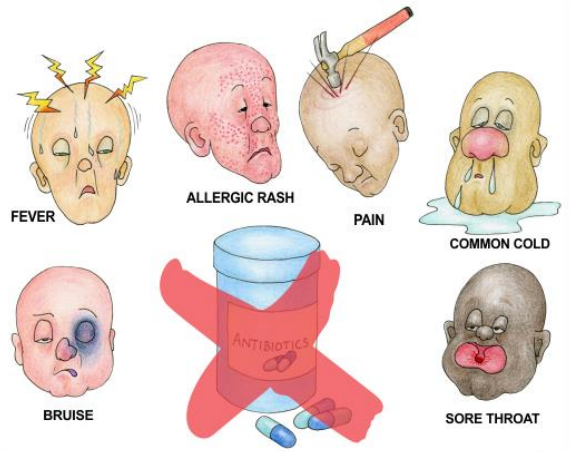
We should treat the symptoms of common colds and sore throats with over-the-counter medications.



For inquiries contact Prudence Munyayi 3970627@myuwc.ac.za; Prof Bheekie abheekie@uwc.ac.za and Prof Coetzee rcoetzee@uwc.ac.za 2020

Week 3

Overuse of antibiotics increases antibiotic resistance.



*Taking antibiotics to prevent getting sick **increases** antibiotic resistance. Antibiotic resistance makes it **difficult** to treat bacterial infections which could be treated previously e.g. tuberculosis.*

*Doctors will know when we need antibiotics. We should **not** demand antibiotics at the clinic or pharmacy.*

For inquiries contact Prudence Munyayi 3970627@myuwc.ac.za; Prof Bheekie abheekie@uwc.ac.za and Prof Coetzee rcoetzee@uwc.ac.za 2020

Week 4

We should not keep leftover antibiotics for future use or share them among family and friends.

Different antibiotics treat different bacterial infections.

We should only use the antibiotics that are specifically prescribed for us.

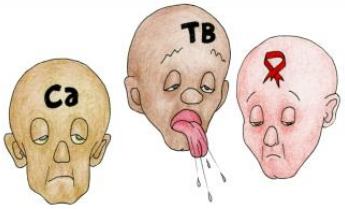
For inquiries contact Prudence Munyayi 3970627@myuwc.ac.za; Prof Bheekie abheekie@uwc.ac.za and Prof Coetzee rcoetzee@uwc.ac.za 20

Week 5

Antibiotic resistance affects the success of other medical procedures.

Antibiotics are used to treat bacterial infections resulting from other diseases e.g. bacterial pneumonia in an HIV/AIDS infected person.

Recovery from surgery and cancer treatments depend on antibiotics to prevent further infection.



For inquiries contact Prudence Munyayi 3970627@myuwc.ac.za; Prof Bheekie abheekie@uwc.ac.za and Prof Coetzee rcoetzee@uwc.ac.za

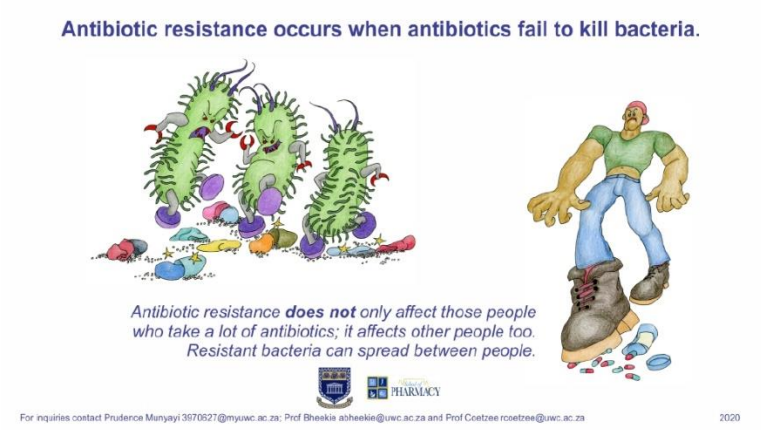
2020

APPENDIX F: POSTER PILOT TEST

Poster pilot test

Dear student,
This a pilot test of the posters intended for use in a research study entitled "Assessing the influence of mass media on student perceptions towards antibiotic resistance." The aim of the pilot test is to investigate if the posters are delivering the message that we intend them to. We would like your feedback on whether or not you understand the message on the posters.

Key message 1



1. Do you understand the message in the above image?

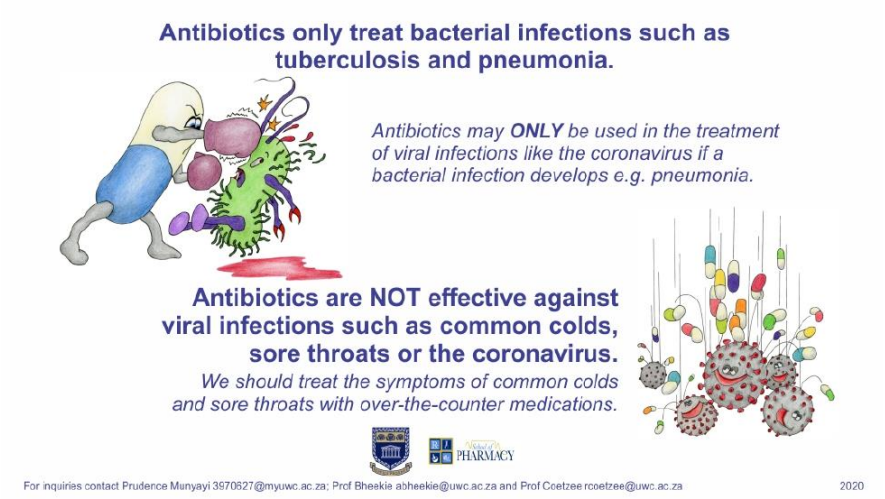
   Mark only one oval.

   - ◯ Yes
   - ◯ No

2. In your own words, please explain what you understand from the text in the image above.

3. Do you have any other comments?

Key message 2



APPENDIX G: iKAMVA SPLASH PAGE

APPENDIX H: UWC COMMUNICATIONS EMAIL

Antibiotic resistance information

Inbox

UWC Communication 29 Sep 2020

to bcc: uwc-student-communication20...

Antibiotic resistance information

Dear Student

PLEASE NOTE THAT THIS COMMUNIQUE IS PART OF A RESEARCH STUDY BEING CARRIED OUT BY A MASTERS STUDENT AND THE MESSAGES RELATED ARE NOT DIRECTLY ENDORSED BY THE UNIVERSITY.

Antibiotic resistance poses a threat to modern medicine. As part of a research study titled 'Assessing the influence of mass media on student perceptions towards antibiotic resistance', Prudence Munyayi has designed posters to share information about antibiotic resistance and appropriate antibiotic use. The study hopes this can start conversations about antibiotic resistance in our campus community.

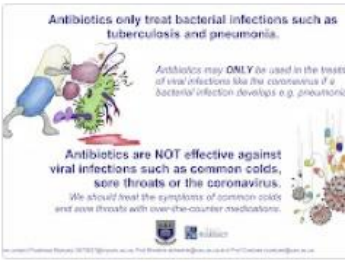
For any inquiries please contact 3970627@myuwc.ac.za

resistance and appropriate antibiotic use. The study hopes this can start conversations about antibiotic resistance in our campus community.

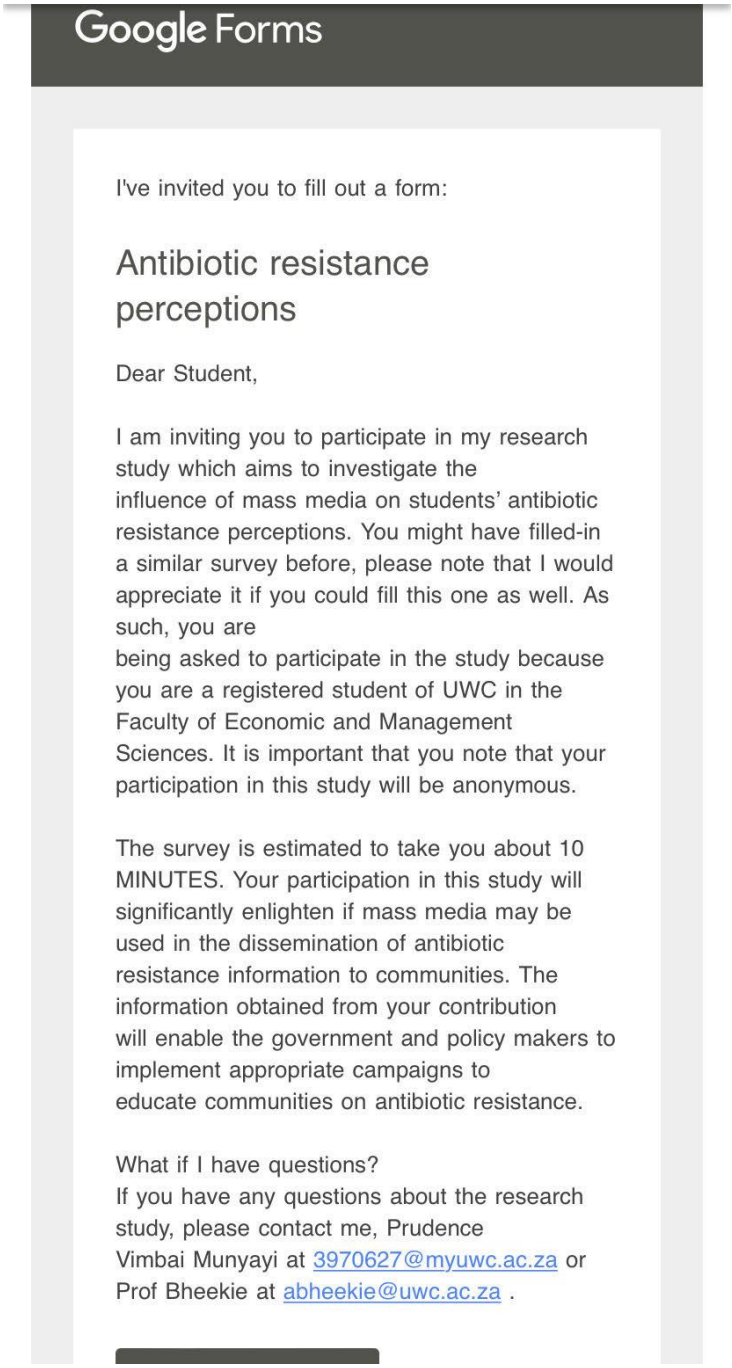
For any inquiries please contact 3970627@myuwc.ac.za

Regards,
Prudence Munyayi

** This email address is not monitored for replies. It is used exclusively to communicate information to the Campus Community. Any IT related problems should be directed to: servicedesk@uwc.ac.za **



APPENDIX I: POST-INTERVENTION SURVEY INVITATION EMAIL



Google Forms

I've invited you to fill out a form:

Antibiotic resistance perceptions

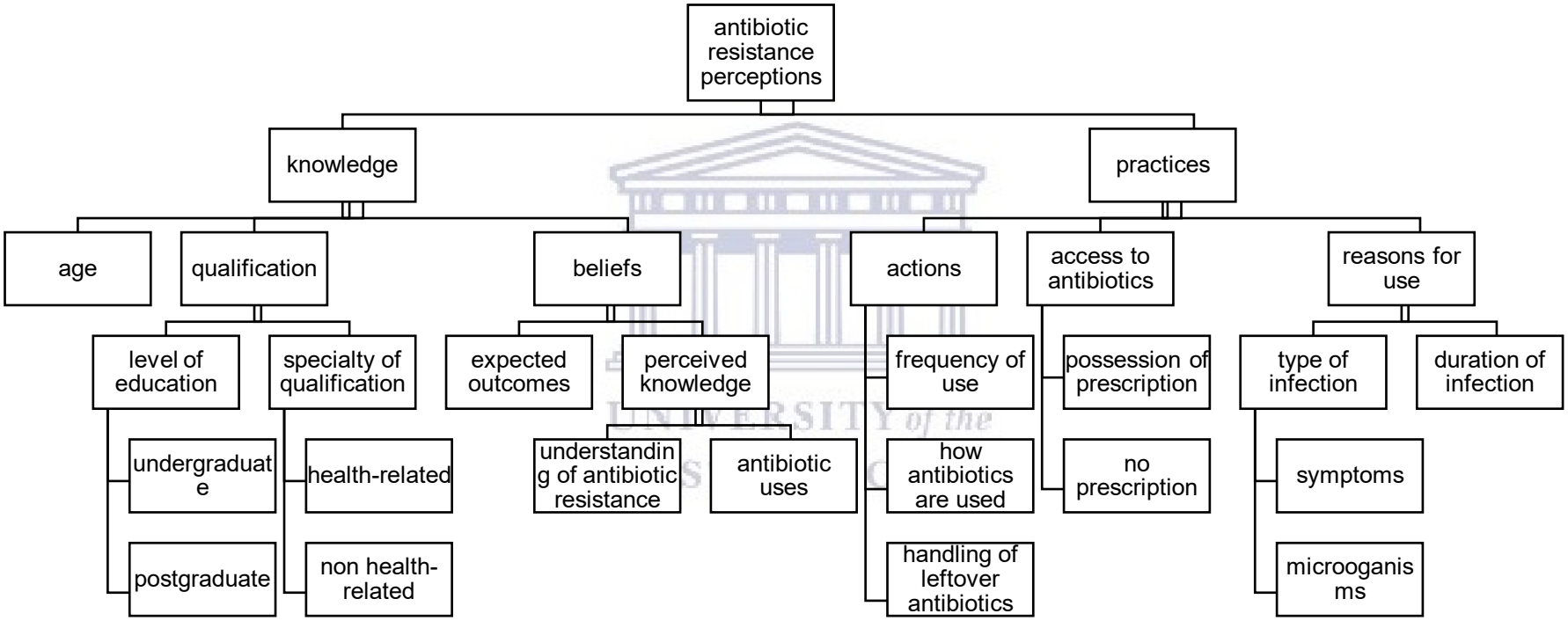
Dear Student,

I am inviting you to participate in my research study which aims to investigate the influence of mass media on students' antibiotic resistance perceptions. You might have filled-in a similar survey before, please note that I would appreciate it if you could fill this one as well. As such, you are being asked to participate in the study because you are a registered student of UWC in the Faculty of Economic and Management Sciences. It is important that you note that your participation in this study will be anonymous.

The survey is estimated to take you about 10 MINUTES. Your participation in this study will significantly enlighten if mass media may be used in the dissemination of antibiotic resistance information to communities. The information obtained from your contribution will enable the government and policy makers to implement appropriate campaigns to educate communities on antibiotic resistance.

What if I have questions?
If you have any questions about the research study, please contact me, Prudence Vimbai Munyayi at 3970627@myuwc.ac.za or Prof Bheekie at abheekie@uwc.ac.za .

APPENDIX J: DENDOGRAM



APPENDIX K: BIOMEDICAL RESEARCH ETHICS COMMITTEE ETHICAL APPROVAL

UNIVERSITY of the WESTERN CAPE

OFFICE OF THE DIRECTOR: RESEARCH
RESEARCH AND INNOVATION DIVISION

Private Bag X17, Bellville 7535
South Africa
T: +27 21 959 4111/2948
F: +27 21 959 3170
E: research-ethics@uwc.ac.za
www.uwc.ac.za

28 January 2020

Ms PV Munyayi, Prof A Bheekie and Dr R Coetzee
School of Pharmacy
Faculty of Natural Science

Ethics Reference Number: BM19/10/6

Project Title: Assessing the influence of mass media on student perceptions towards antibiotic resistance.

Approval Period: 29 November 2019 – 29 November 2020

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report in good time for annual renewal.

Permission to conduct the study must be obtained and submitted to BMREC for recordkeeping.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

NHREC REGISTRATION NUMBER -130416-050

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

APPENDIX L: PERMISSION TO CONDUCT RESEARCH AT UWC

UNIVERSITY of the WESTERN CAPE

DEPUTY REGISTRAR: Academic Administration
Administration Building, 1st Floor
ashaikjee@uwc.ac.za, nschoeman@uwc.ac.za
021 959 2110

28 January 2020

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT THE UNIVERSITY OF THE WESTERN CAPE

Name of Researcher	:	Prudence Munyayi
Research Topic	:	Assessing the influence of mass media on student perceptions towards antibiotic resistance
Date of issue	:	28/01/2020
Reference number	:	UWCRP280120PM

This serves as acknowledgement that you have obtained and presented the necessary ethical clearance and your institutional permission required to proceed with the above referenced project.

Approval is granted for you to conduct research at the University of the Western Cape for the period **28 January 2020** to **29 November 2020** (or as determined by the validity of your ethics approval). You are required to engage this office in advance if there is a need to continue with research outside of the stipulated period. The manner in which you conduct your research must be guided by the conditions set out in the annexed agreement: *Conditions to guide research conducted at the University of the Western Cape.*

The University of the Western Cape promotes the generation of new knowledge and supports new research. It also has a responsibility to be sensitive to the rights of the students and staff on campus. This office will require of you to respect the rights of students and staff who do not wish to participate in interviews and/or surveys.

It is also incumbent on you to first furnish this office with a copy of the proposed publication should you wish to reference the University's name, spaces, identity, etc. prior to public dissemination.

Please be at liberty to contact this office should you require any assistance to conduct your research or specifically require access to either staff or student contact information.

Yours sincerely

DR AHMED SHAIKJEE
DEPUTY REGISTRAR
OFFICE OF THE REGISTRAR

UWC
UNIVERSITY OF THE WESTERN CAPE
PRIVATE BAG X17, BELLVILLE
STUDENT ADMINISTRATION
28 JAN 2020
This document contains a qualified electronic signature and date stamp. To verify this document contact the University of the Western Cape at researchperm@uwc.ac.za.

UNIVERSITY of the WESTERN CAPE

DEPUTY REGISTRAR: Academic Administration
Administration Building, 1st Floor
ashaikjee@uwc.ac.za, nschoeman@uwc.ac.za
021 959 2110

ANNEXURE

CONDITIONS TO GUIDE RESEARCH CONDUCTED AT THE UNIVERSITY OF THE WESTERN CAPE

The onus rests on the researcher/investigator to observe and comply with the conditions set out below with the aim to conduct responsibly ethical research. Clarity must be sought from the authorising office should the interpretation of the conditions be unclear.

1. ACCOUNTABILITY

1.1. The University reserves the right to audit the research practices of the researcher/ investigator to assess compliance to the conditions of this agreement.
1.2. Data collection processes must not be adapted, changed or altered by the researcher/ investigator without written notification issued to the authorising office.
1.3. The University reserves to right to cease research if any proposed change to the data collection process is found to be unethical or in contravention of this agreement.
1.4. Failure to comply with any one condition in this agreement may result in:
  1.4.1. Disciplinary action instituted against a researcher/investigator employed or registered at the University;
  1.4.2. The contravention reported to the organisation employing or registering the external researcher/ investigator.

2. GOVERNANCE

2.1. Approval to conduct research is governed by the Protection of Personal Information Act, No 4 of 2013, which regulates the entire information life cycle from collection, through use and storage and even the destruction of personal information and it is incumbent on the researcher/investigator to understand the implications of the legislation.
2.2. The researcher/investigator must employ the necessary measures to conduct research that is ethically and legally sound.

3. ACQUIRING CONSENT & RIGHTS OF PARTICIPANTS

3.1. It is incumbent on the researcher / investigator to clarify any uncertainties to the participant about the research.
3.2. Written consent must be obtained from participants before their personal information is gathered and documented.
3.3. Participation in the research must be voluntary and participants must not be pressured or coerced.
3.4. Participants have the right to access their personal information, obtain confirmation of what information is in the possession of the researcher / investigator and who had access to the information.
3.5. Participants have the right to withdraw from the research and insist that their personal information not be used.

Administration Building, 1st Floor
ashaikjee@uwc.ac.za, nschoeman@uwc.ac.za
021 959 2110

4. DATA AND INFORMATION MANAGEMENT
4.1. Due diligence must be afforded by the researcher/investigator to: 4.1.1. Mitigate any risks that could compromise the privacy of participants before 4.1.2. during and after the research is conducted; 4.1.3. Collect only information that is relevant to the aim of the research; 4.1.4. Verify all personal information collected about a participant if the information is supplied by a source other than the participant; 4.1.5. Refrain from sharing participant information with a third party; 4.1.6. Apply for an exemption if the identity of participants should be revealed in the interest of the research aims. 4.2. The researcher/investigator must employ appropriate, reasonable and technical measures to protect, prevent loss of and unlawful or unauthorised access of research information.

Should you have any questions relating to this agreement please contact:
ashaikjee@uwc.ac.za, or
researchperm@uwc.ac.za

APPENDIX M: INFORMATION SHEET

Information Sheet to Participate in Pilot study

13 /05 /2020

Dear UWC Student

My name is Prudence Munyayi and I am a Masters student at the School of Pharmacy, University of the Western Cape, Bellville, 021-9592977; 078 052 6080.

You are being invited to consider participating in a questionnaire pilot study for a research that is investigating whether mass media can be used to increase awareness about health message relating to a group of medicines, called antibiotics which are typically used to treat bacterial infections. Antibiotics can either kill or prevent the multiplication of the bacteria. When people misuse and overuse antibiotics it leads to a situation where bacteria resist the effects or action of the antibiotic. As a result there are many misconceptions about the use of antibiotics among the general public that need addressing. This study is an attempt to determine if mass media could be an effective communication tool to inform a community about antibiotic resistance.

The aim and purpose of this research is to explore the use of mass media in disseminating information regarding antibiotic resistance. The goal is to evaluate if mass media can be used as a viable communication tool to inform a student community about antibiotic resistance.
The study is expected to enroll 200 participants in total, with 100 participants in each arm, and will be conducted at the University of the Western Cape, main campus. It will involve the identifying key messages from the literature about antibiotic resistance and disseminating them via mass media to the student community. After a baseline survey, a post-intervention survey will be conducted to determine student perceptions about antibiotic resistance.

The duration of your participation if you choose to enroll in the study is once off, and expected to be 10 minutes. The study is funded by the National Research Foundation. There is no anticipated discomfort for participants contributing to this project, so risk to participants is minimal.
We hope that the study will indicate if mass media may be used for disseminating antibiotic resistance information to the larger communities. The results of the study will provide insight into the effectiveness of mass media as a tool to engage a student community.

This study has been ethically reviewed and approved by the UWC Biomedical Research Ethics Committee (approval number BM19/10/6).
In the event of any concerns/questions you may contact Ms Prudence Munyayi 078 052 6080 or Prof A Bheekie at School of Pharmacy, 021-9592977, or the UWC Biomedical Research Ethics Committee, contact details as follows:
BIOMEDICAL RESEARCH ETHICS ADMINISTRATION
University of the Western Cape

Research Office, New Arts Building
C-Block, Top Floor, Room 28.
Western Cape, SOUTH AFRICA
Tel: 27 21 9592988
Email: research-ethics@uwc.ac.za

Participation in this research is completely voluntary and you may withdraw your participation at any point. In the event of your withdrawal from the study, neither a penalty will be incurred, nor would you lose any benefit to which you are normally entitled. There are no consequences for withdrawal from the study, and the researcher will terminate your withdrawal from the study immediately.
There are no costs that would be incurred as a result of your participation in the study.

Your confidentiality will be protected during the project. Your student number will be only known to the researcher and is only required for sending an email that contains a link to access the questionnaire. The researcher will not ask you for your name. The informed consent form that you sign will be stored in a secure cupboard that is inaccessible to others.
Data will also be stored electronically and will be password protected, which will only be accessible to the researcher. The printed data will be stored in a locked cupboard in an office located on campus and accessible to the research team. Once the study is complete, all the data will be destroyed.

* Required

APPENDIX N: CONSENT FORM

CONSENT FORM

I have been informed about the study entitled: "Assessing the influence of mass media on student perceptions towards antibiotic resistance" conducted by Prudence Munyayi.
I understand the purpose and procedures of the study.
I have been given an opportunity to answer questions about the study and have had answers to my satisfaction.
I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting benefits that I would usually be entitled to.
If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at School of Pharmacy, 021-9592977; 078 052 6080.
If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

BIOMEDICAL RESEARCH ETHICS ADMINISTRATION
University of the Western Cape
Research Office
New Arts Building
C-Block, Top Floor, Room 28.
Western Cape, SOUTH AFRICA
Tel: 27 21 9592988
Email: research-ethics@uwc.ac.za

By clicking 'I agree to participate in this research' below, it implies that you have consented to participate voluntarily in the study.

1. *

Mark only one oval.

◯ I agree to participate in this research

Demographics

APPENDIX O: APPLICATION TO USE UWC COMMUNICATIONS

UNIVERSITY of the WESTERN CAPE

School of PHARMACY

FACULTY OF NATURAL SCIENCES
Private Bag X17 Bellville 7535
Cape Town
SOUTH AFRICA
Tel: 959 2977

23 April 2020

Ms. Nashira Davids
Editor: Media, Marketing and Communications
Institutional Advancement
University of the Western Cape
021 959 2625
0724132749
nndavids@uwc.ac.za

Re: Permission to share research posters with the campus community using UWC communication methods

Dear Ms Davids,

I am a master's student (student number 3970627) at the School of Pharmacy, undertaking a research project titled: **Assessing the influence of mass media on student perceptions towards antibiotic resistance.**

The purpose of this master's study is to identify, key messages from the literature , and communicate them, via mass media, to improve the public's perceptions of antibiotic resistance. Pre- and post-intervention surveys will be conducted to investigate antibiotic resistance perceptions among UWC's student community. The results obtained from the surveys will be compared to determine the effectiveness of mass media for dissemination of antibiotic resistance key messages.

Five key messages were identified. Each key message contains a bold statement to capture the reader's attention followed by a short explanation. These key messages will be delivered in a poster. One of the key messages is:

"Antibiotic resistance occurs when antibiotics fail to kill bacteria. The body (human cells) does not develop resistance to antibiotics.

Antibiotic resistance does not only affect those people that take a lot of antibiotics; it affects other people too. Resistant bacteria can spread between people."

We would like to request to use the UWC communications platforms, iKamva and the university's social media platforms to share our antibiotic resistance key messages with the UWC student community. We intend to have the messages shared with students for a period of about 5-8 weeks (starting from June 2020), depending on what is feasible.

Sincerely,

Prudence Munyayi
Candidate: M.Pharm

Supervisor: Prof A Bheekie

APPENDIX P: APPLICATION TO USE IKAMVA SPLASH PAGE

UNIVERSITY of the WESTERN CAPE

School of PHARMACY

FACULTY OF NATURAL SCIENCES
Private Bag X17 Bellville 7535
Cape Town
SOUTH AFRICA
Tel: 959 2977

25 May 2020

Dr Stoltenkamp
CIECT Director
University of the Western Cape
021 959 3200
jstoltenkamp@uwc.ac.za

Re: Permission to share educational posters with the campus community using the iKamva platform: A mass media intervention master's study

Dear Dr Stoltenkamp,

I am a master's student (student number 3970627) at the School of Pharmacy, undertaking a research project titled: **Assessing the influence of mass media on student perceptions towards antibiotic resistance.**
The purpose of this master's study is to identify, key messages from the literature, and communicate them, via mass media (electronic and social media platforms), to improve the public's perceptions of antibiotic resistance, which is a global concern.

I would like to request the use iKamva, **the advertising space on the sign in page**, to share antibiotic resistance key messages to the campus community.

- I would like to share five antibiotic resistance key messages, in a poster format, with UWC students.
- I hope to have each message displayed for a week, therefore that would be **5 weeks** of dissemination of the messages.

The messages were initially supposed to be shared as posters to be mounted in various areas on campus, but due to the coronavirus lockdown that is not possible. I am exploring access to alternative electronic platforms to ensure dissemination of the key messages.

With this letter I have also attached UWC ethics approval as well as permission from the Registrar to conduct study at UWC. I would gladly forward my full proposal should you require more details of the study.

Sincerely,

Prudence Munyayi

Supervisor: Prof A Bheekie

A place of quality,
a place to grow, from hope
to action through knowledge