Utilization Of Antibiotics In Rural Communities Of Sub-Saharan Africa: Challenges And Resistances
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ABSTRACT
In the last seven decades, antibiotics have greatly influenced the remarkable advancement in world health by becoming the standard therapy for infectious diseases. Antibiotic resistance (ABR) is a significant worldwide human health issue, having notably negative effects in low- and middle-income countries (LMICs). What were once fatal illnesses are now beaten by millions of people. But since there are only so many antibiotics available, misusing them has resulted in antibiotic resistance and decreased efficacy within a few years after the release of every lifesaving antibiotic. The WHO claims that the threat of antibiotic resistance to global health and development. The Sustainable Development Goals (SDGs) must be attained urgently through multi-sectoral approach.

One of the ten leading worldwide public health hazards to civilization, according to WHO, is ABR. The major causes of the emergence of infections that are resistant to antibiotics are their improper usage and excessive use. The spread of bacteria, some of which may be antibiotic-resistant, is encouraged by a lack of safe drinking water, sanitation facilities, and effective infection control and prevention measures. Antibiotic resistance is as significant a threat to international security, food and nutrition security, and industrialization, according to the WHO, as terrorist attacks and global warming. ABR has a huge cost to the economy. Long-term disease not only increases the risk of mortality and incapacity but also lengthens hospital stay, necessitates the use of more expensive medications, and puts a strain on the finances of those affected. In the absence of powerful antibiotics, contemporary medicine’s ability to cure infections, including those that arise following extensive surgeries and invasive procedures, would be compromised.

Due to the lack of adequate mass surveillance, it is difficult to determine the scope of the ABR issue in LMICs, although considerable progress has been made in recent years since the WHO Global Antibiotic Resistance and Use Surveillance System (GLASS) initiative was launched in 2015. One of the main factors influencing the choice of ABR in LMICs is the widespread and frequently improper use of antibiotics in people, animals, and crops. This, combined with the insufficient control of pharmacological byproducts at the centers of manufacturing, must be quickly addressed. ABR spreads more quickly in LMICs because a number of factors including poor sanitation and hygiene insufficient exposure to sufficient health facilities, and a lack of legislation. The aim is to review to predisposing factors that influence the use of antibiotics aimed at informing policy decision on antibiotics use.

Keywords: Antibiotics, resistance, Sub-Saharan, Africa, community.

1 Introduction
Infectious diseases treatment has been transformed by antibiotics. As a result, antibiotics are today employed in almost every aspect of contemporary medicine, including cancer treatment, invasive surgery, and organ transplantation. But practically every new antibiotic drug or class has been followed by the emergence of ABR.
Global demand of antibiotics grew by 35% in the first decade of the twenty-first century, and ABR rates have climbed, especially in regions with a high broad - spectrum antibiotics usage (Jacobs et al, 2019).

In addition, Jacobs et al. pointed out that sub-Saharan Africa has the heaviest infectious disease burden worldwide, including malaria, severe respiratory illnesses, tuberculosis (TB), and AIDS and HIV. As of now, sub-Saharan Africa is mostly affected by HIV/AIDS, malaria, and TB, which together cause about 1.2 million fatalities annually. In a location where accessibility to necessary medications itself is unequal, antibiotic resistance (ABR) increases this burden. Utilization of antibiotics is not just limited to human health; it also affects livestock health and farming, making it a "One Health" problem. Antibiotics are mostly utilized in animal health as "prophylactics" and/or to promote growth. In actual fact, 70% of all antibiotics consumed are used in agriculture and on animals. The creation of novel antibiotics is receiving less funding from drug manufacturers. As a result, there are now fewer and possibly no recent discoveries, and the frequency of development of new products has significantly declined since the 1980s (Jacobs et al, 2019).

Antibiotic Resistance poses significant challenges for the Sustainable Development Goals (SDGs) SDG 1 (poverty), SDG 3 (good healthcare and wellness SDG 6 (hygiene and safe drinking water), and SDG 12 (consuming and production that are sustainable). Antibiotic Resistance is a problem for development and health (Chowdhury et al, 2019). Antibiotic use is constantly expanding in domains such as farming, animal and human health, and other industries. As a result, antibiotic resistance rates are rising internationally. To remedy this, a "One Health" strategy is necessary. Low an Middle Income Countries are the most impacted by ABR. Financial difficulties play a role in this, but so do social conventions and mindsets that inhibit medical professionals from accurately identifying and treating their clients’ health problems. Antibiotic resistance (ABR) is a problem, with sub-Saharan Africa having the highest rates of illness, fatalities, and expenditures globally. Concerns about ABR have sparked localized, nationwide, and even global activities, like the development of National Action Plans (NAPs). An "adaptive approach" that takes into account why and how antibiotic usage has ingrained itself in the culture with both wealthy and developing nations is necessary to combat ABR. According to the World Bank, ABR could push up to twenty-four million people into absolute poverty by 2030. (Chowdhury et al, 2019). However, there are variations in application throughout Africa, and significant problems continue. Recognizing why and how antibiotics are ingrained in cultures and economies is necessary in order to address ABR. This pattern, that is having a significantly negative impact on low- and middle-income countries (LMICs), will be made worse by the COVID-19 pandemic (Chowdhury et al, 2019). Reviewing the contributing variables which impact antibiotic use is the goal in order to guide antibiotic policy decisions (Jacob et al, 2019). According to a comprehensive study that appeared in the Lancet, there were close to 1 million deaths worldwide in 2019 that were attributed to ABR, with Western sub-Saharan Africa bearing the brunt of this burden and Australasia bearing the least. In sub-Saharan Africa, the COVID-19 pandemic has increased the infectious disease burden and antibiotic use, although to present, its reported influence on death rates and morbidity appeared to be lower than that of other endemic diseases like TB, malaria and HIV/AIDS.

Levesque et al. suggested 5 complementary conceptual frameworks of the processes that give rise to people’s capacity to engage with all of these dimensions: 1) The capacity for perception (health education, lifestyle habits, belief, and aspirations); 2) The capacity for seeking (individual and interpersonal values, traditions, sexual identity, and independence); 3) the capacity for reaching (living conditions, transportation, and support networks); 4) the capacity for paying (revenue, investments, social power, and insurance coverage); and 5) the capacity for engaging (autonomy, knowledge compliance, and career assistance) (Chowdhury et al, 2019). The endemicity of HIV/AIDS and problems with the health system architecture in sub-Saharan Africa, which include frequent access to safe drinking water and improved hygiene and are made worse by poverty, increase the risk of infection and the ensuing ABR, with COVID-19 further jeopardizing healthcare infrastructure and services. Rising incidence of unnecessary prescribing and dispensing of antibiotics, inadequate diagnostic methods, and inconsistent application of rules relating to the issuing of antibiotics without the need for a prescription, and inconsistent access to quality healthcare all contribute to the elevated rates of resistance to usually prescribed and distributed antibiotics throughout Sub-Saharan Africa (Jacobs et al, 2019). Five dimensions of accessibility were proposed by Levesque et al. 1) Approachability (clarity, community engagement, and knowledge monitoring); 2) Acceptability (professionalism, social standards, traditions, and sexual identity); 3) Availability (geographical area, accommodations, hours of operation, and consultation methodologies); 4) Affordability (actual expenses, indirect expenses, and potential costs); and 5) Appropriateness (managerial and technical quality, sufficiency, co - ordination, and consistency) (Chowdhury et al., 2019).

The World Health Organization (WHO), the Food and Agriculture Organization (FAO), and the World Organization for Animal Health (OIE) recently (2015) teamed up in response to the growing issue of ABR. The
Global Action Plan on ABR, which offers a structure for creating multi-sectorial national action plans, was created by them together (Jacob, 2019). The World Health Organization's "Global action plan for antimicrobial resistance" has five key goals. The strategy was approved by the World Health Assembly in May 2015 (A68/20) and fits into the "One Health" strategy and the tripartite structure of the WHO, Food and Agriculture Organization (FAO), and Organization for Animal Health (OIE).

1. Increase knowledge and comprehension of antibiotic resistance via training programme, outreach, and interaction.
2. By monitoring and study, increase the body of information and proof. 3. Useful cleanliness, sanitation, and effective infection control practices can lower the rate of infection. 4. Make the best possible use of antibiotics for both animal and human health. 5. Create a financial justification for technology and research and development that considers the requirements of all nations, and enhance funding for innovative drugs, diagnostic equipment, vaccinations, as well as other treatments (WHO, 2015).

2 Literature Review

Antimicrobials are drugs that combat and cure illness in human beings, plants and animals. They include antiparasitics, antibiotics, antifungals, and antivirals (WHO, 2018). When bacteria, fungi, parasites and viruses evolve over time and cease to respond to antibiotics, this condition is known as antibiotic resistance (ABR), which makes infections more difficult to treat and raises the risk of disease spread, life-threatening sickness, and death. Drug resistance causes antibiotics and other antimicrobial medications to lose their effectiveness, making it harder or impossible to treat illnesses (WHO, 2018). Our ability to cure common diseases is still under danger due to the creation and spread of bacteria that are resistant to drugs and have developed new resistance mechanisms. The rising international expansion of multi- and pan-resistant bacteria, commonly referred to as "superbugs," which cause diseases that cannot be treated with currently available medications like antibiotics, is particularly concerning. There are no new antibiotics in the preclinical development. Only 6 of the thirty-two antibiotics WHO listed in 2019 as being in drug trials to treat the WHO classification of essential infections were considered novel (WHO, 2022).

Access to high-quality antibiotics continues to be a major problem. All stages of progress are being impacted by antibiotic scarcity, particularly in health-care systems. As medication resistance increases internationally, making diseases harder to cure and ultimately to mortality, antibiotics are becoming less and less effective. According to the WHO priority pathogen list, new antibiotics are desperately required, for instance, to combat Carbapenem-resistant gram-negative bacterial infections. However, these novel antibiotics will experience the same fate as the present antibiotics and become useless if people do not adjust how antibiotics are used currently (WHO, 2022) ABR has a substantial financial impact on national economies and healthcare systems because it reduces client or caregiver output by necessitating longer hospitalization and also more costly, aggressive therapy.

Bacterial drug resistance

According to the WHO, widespread rising incidence of resistance against antibiotics commonly prescribed to treat familiar bacterial infections, such as sepsis, urinary tract infections, sexually transmitted infections, and several manifestations of diarrhea, have been observed, suggesting that we are trying to run out of appropriate antibiotics. For instance, the rate of ciprofloxacin resistance, a drug frequently used to treat bladder infections, ranged from 4.1% to 79.4% for Klebsiella pneumoniae and from 8.4% to 92.9% for Escherichia coli in the countries that reported to the Global Antibiotic Resistance and Use Surveillance System (GLASS).

Regular gut bacteria called Klebsiella pneumoniae can result in fatal illnesses. The globe over, K. pneumoniae has developed resistance to the medicines used as a last option (carbapenems). K. pneumoniae is a significant contributor to hospital-acquired illnesses include lung infections, sepsis, pneumonia in infants, and infections in intensive care unit patients. More than half of patients managed for K. pneumoniae infections in some nations do not respond to Carbapenem medicines due to resistance. Fluoroquinolone medications, which are used to treat urinary tract infections, are widely resistant to E. coli. There are nations throughout the world where more than half of patients no longer respond to this medication (WHO, 2018).

For life-threatening infections brought on by Enterobacteriaceae that are resistant to Carbapenem, colistin is the only treatment left (i.e., E. coli, Klebsiella, etc). Additionally, colistin-resistant bacteria have been found in numerous nations and regions, where they are producing diseases for which there is now no efficient antibiotic treatment. Our skin is home to the bacterium Staphylococcus aureus, which is also a frequent source of infections in both the general population and healthcare settings. Those who have methicillin-resistant Staphylococcus aureus (MRSA) infections have a 64% higher mortality rate than those who have infections that respond to treatment (WHO, 2018).
The SDG enhanced system now includes a new ABR indicator for 2019. E. coli resistant to third-generation Cephalosporins (3GC) and Methicillin-resistant Staphylococcus aureus (MRSA) are two specific drug-resistant bacteria that are tracked by this indicator. In 2019, statistics on septicaemia caused by MRSA were provided to GLASS by 25 countries, regions, and zones, whereas data on septicaemia caused by E. coli were provided by 49 countries. The median rate for methicillin-resistant S. aureus was 12.11% (IQR 6.4-26.4) while that of E. coli resistant to third generation Cephalosporins was 36.0%, albeit the findings are not yet nationally representative (IQR 15.2-63.0). The control and management of gonorrhoea have been hampered by extensive resistance in extremely diverse strains of N. gonorrhoeae. Fluoroquinolones, Sulphonamides, macrolides, Tetracyclines, early generation Cephalosporins and Penicillins, have all shown a rapid rise in resistance. Presently, the only empirical single treatment for gonorrhoea available in the majority of nations is the injectable extended-spectrum ceftriaxone (ESC) ceftriaxone (WHO, 2022).

The endemicity of HIV/AIDS and problems with the health system architecture in sub-Saharan Africa, which include fairly frequent clean water access and sanitation facilities and are made worse by poverty, increase the risk of infection and the resultant ABR (Godman et al., 2022), with COVID-19 further jeopardizing healthcare services and infrastructure. The high rates of unsuitable prescribed medication and delivering of antibiotics, inadequate advanced diagnostic, inconsistent application of laws prohibiting the supplying of antibiotics without a prescription, and uneven access to quality healthcare all contribute to the significantly higher rates of resistance to usually prescribed and dispensed antibiotics throughout sub-Saharan Africa. Sub-Saharan African nations are all industrialized and have NAPs.

The NAPs are implemented differently across Sub Saharan Africa, though. Some of the listed Sub Saharan African nations, like Namibia and Botswana have not yet launched NAPs; others like Eswatini, have recently done so; and others, like Nigeria, Ghana, Kenya, Zambia, and South Africa will soon (Godman et al,2022).

**Antibiotic resistance – a policy and health systems issue**

Humanitarian bodies like the WHO have prioritized antibiotic resistance for a long time, and it is a concern in government action objectives. The WHO’s role is to encourage adherence, promote action, launch partnerships, and enable the creation of regulations. It is crucial that the WHO supports worldwide surveillance programs. The researchers of an impact assessment that compared England, France, and Germany came to the conclusion that collaborations between health care providers and patients, as well as liberalized judgment call and an equilibrium between legislation and persuasion, are necessary to combat ABR. A lack of evidence supporting the efficacy of several measures in the human health and livestock sectors in both LMICs and HICs is a contributing factor in the lack of progress in the fight against ABR.

The One Health Strategy’s fundamental tenets include fair and equal access to antibiotics and reliable progress monitoring. Finance models must separate investments in R&D from income profits and market sales while guaranteeing that individuals in need have accessibility to reasonably priced, high-quality medications. A Global Action Plan on ABR was agreed by the World Health Assembly in May 2015 and included the following five goals: “to improve awareness and understanding of ABR through effective communication, education and training; to strengthen the knowledge and evidence base through surveillance and research; to reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures; to optimize the use of antibiotic medicines in human and animal health; to develop the economic case for sustainable investment that takes account of the needs of all countries, and to increase investment in new medicines, diagnostic tools, vaccines and other interventions”(Wall,2019).

In order to persuade policy makers to take action, the Lancet Commission on Infectious Diseases called for statistics on the scope of ABR’s burden and its contributions to excess mortality in 2013. The appeal was heeded: Three years later, the British Government and the Wellcome Trust released its final study, which contained the disturbing prediction that, at the current rate of development of resistance, 10,000,000 people would die from ABR in 2050. As was already established, these modeling-based data have come under fire for being unreliable and weakening the work done to combat ABR. The UN Intergovernmental Coordination Group (IACG), under the direction of the WHO Director-General, produced the study "No time to wait - protecting the future against drug-resistant diseases" as another, more current policy document. Five groups of recommendations were presented to the Member States by the IACG, who urged them to: "Accelerate the development and assessment of new and alternative antibiotics; guarantee equitable access to diagnostics with high standards; immediately halt the use of antibiotics in the animal industry; and strengthen long-term development and research. An impartial UN body will
oversee the procedure and offer frequent reports to Member States on the most up-to-date information and best evidence about ABR “(Wall, 2019).

**Emergence of Antibiotic Resistance and its Cost**

ABR has been used in human medicine for as long as antibiotic drugs have. In facilities where antibiotics are commonly used, antibiotic-resistant bacteria have been seen immediately following the introduction of brand-new medications (Levy, 1998). As a result, ABR has long dominated the literature in the realm of human medicine. Almost all known bacterial pathogens as well as a large number of human commensals have evolved resistance to one or more clinically used antibiotics over time and into the current. The ones that are most frequently found in a hospital (intensive care) context are extended-spectrum β-lactamases (ESBL). Additionally discovered to have a substantial nosocomial ecology are Vancomycin-resistant enterococci (VRE) and methicillin-resistant Staphylococcus aureus (MRSA) (Otter and French, 2010).

MRSA infections and ESBL-positive bacteria are also becoming more prevalent in the neighborhood.

Given the crucial relevance of this antibiotic therapy, it may also pose a significant problem in the future for Fluoroquinolone resistance to rise as a result of target-site mutations and the global spread of quinolone resistance genes facilitated by plasmids (Cattori et al., 2007; Strahilevitz et al., 2009). The last line of protection against infections other than those in the family Enterobacteriaceae is carbapenems, which include Acinetobacter baumannii and Pseudomonas aeruginosa (Brown et al., 1998). However, since the blaOXA genes were initially identified, there has been a surge in the global spread of novel resistant strains that impart Carbapenem resistance. For example, the OXA-48 type of enzymes, Klebsiella pneumoniae carbapenemase (KPC) type enzymes, New Delhi metallo-β-lactamase (NDM), Verona integron-encoded metallo-β-lactamase (VIM), Imipenemase Metallo-β-lactamase (IMP) have been isolated from a number of bacterial genera irrespective of their geographical distribution (Kumarasamy et al., 2010; Walsh et al., 2011). Healthy adult carriers become a worry as Carbapenemase resistance mechanisms are discovered in hospital settings and to a lesser extent in the community among isolates of E. coli and Klebsiella (Nordmann et al., 2012). Additionally, microbes that produce Carbapenemase have been discovered from factory farms (Fischer et al., 2012).

Although there are few and insufficient data (especially for Sub-Saharan Africa), it is thought that LRS are the groups most negatively impacted by ABR in terms of both deaths, illness, and costs associated (Jacob et al, 2019). The assessment of the effects of ABR is complicated because the majority of data come from hospital-based research in high-risk patient wards (such as intensive care units). According to a thorough analysis of the existing studies, ABR in "ESKAPE" bacteria is strongly linked to higher mortality. These “ESKAPE” bacteria include Enterococcus spp., Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter spp. The WHO has identified these microorganisms as "priority pathogens" for study in the creation of novel medications and preventative measures (Jacob et al, 2019). ABR happens outside of the hospital as well. On the one hand, substantial concentrations of bacteria that are multiple drug resistant have been discovered in the ecosystem, including sources of drinking water and in the microflora of people (Escherichia coli and Klebsiella pneumoniae). On the other hand, common infections found in the population, such Salmonella Typhi (which causes enteric fever), have developed resistance mechanisms, even to important drugs like ceftriaxone. In addition, the public health officials in Pakistan reported a (currently underway) incidence of typhoid fever in November 2016 that was brought on by a variant of Salmonella Typhi that was "extensively drug resistant" (XDR) to all authorized antibiotics. 5,274 instances had already been found as of December 2018. (Jacob et al, 2019). The fact that the XDR Typhi strains from Pakistan and the Democratic Republic of the Congo obtained the gene for ceftriaxone resistance through horizontal transmission from widely spread E. coli and Klebsiella species raised questions (Jacob et al, 2019).

**Human Mobility**

The proliferation of multi-resistant bacteria is significantly impacted by the growing cross-border and cross-continental movements of individuals (Linton et al., 1972; Arya and Agarwal, 2011; Cheng et al., 2012). Examples include the emergence and international spread of the penicillin-resistant Streptococcus pneumoniae international clone 1 (Klugman, 2002) and the more recent occurrence of the Enterobacteriaceae that produces the New Delhi Metallo—lactamase (blaNDM-1) enzyme that inactivates all β-lactam antibiotics, including carbapenems. The blaNDM-1 seems to have originated in the Indian subcontinent and then spread by human migration to the United Kingdom, North America, and other European countries (Arya and Agarwal, 2011; Walsh et al., 2011).
Because illnesses brought on by resistant bacteria are more challenging and costlier to cure, the ABR issue is still a major public health concern. The effects of this issue include increase in private insurance benefits, a rise in healthcare expenses involved with hospital-acquired infections, a prolong hospital stay, more time away from work, a decreased quality of life, a higher risk of mortality due to inadequate or delayed intervention, and a rise in total healthcare costs (Filice et al., 2010; Korczak and Schöffmann, 2010; Roberts et al., 2009; Wilke, 2010). Therefore, the cost of offering no antibiotic treatment choices at all must be taken into account in order to determine the whole economic impact of ABR, as doing so would likely result in the collapse of the entire contemporary health industry in the worst-case scenario (Bliziotis and Falagas, 2007; Alanis, 2005; Pratt, 2010).

In conclusion, as antibiotics lose their effectiveness, everyone will be at danger, but the hazard is highest for youngsters, the aged, and people with impaired immune systems, like cancer patients receiving chemotherapy and recipients of organ transplants (Tablan et al., 2004).

The veterinary medicine and agriculture sector

The use of antibiotics in veterinary medicine began as soon as they were made available for treating human infections in the middle of the 1940s (Gustafson and Bowen, 1997; McEwen, 2000). Despite the fact that some medications are only intended for use in animals, the majority are members of the same groups of antibiotics as those used in human medicine and have the same or very similar structural features (Heuer et al., 2009; Swann, 1969). Every year, a lot of medications are given to animals used in agriculture around the world to produce enough food (beef, poultry, and milk-based products) to sustain a fast expanding human population (Roura et al., 1992; Vazquez-Moreno et al., 1990; Rassow and Schaper, 1996).

The European Medicines Agency (EMA) launched the European Surveillance of Antibiotic Consumption (ESVAC) program in response to a request from the European Commission because data collecting on antibiotic usage in livestock was not standardized to give comparable and reliable information. The ESVAC system is in charge of gathering, examining, and documenting sales data from European nations. This includes annual reporting from EU member states. In ten European nations, the selling of antibiotic drugs for pharmacotherapy use as veterinary medicine ranged from 18 to 188 mg/kg biomass (Grave et al., 2010). Although quinolones for the livestock sector are now completely banned in the United States and Europe, the administering of antibiotics to livestock used for food production can also be done for prophylaxis, -metaphylaxis, and growth promotion (Anderson et al., 2003; Anthony et al., 2001; Cabello, 2006; Casewell et al., 2003). About 70% of all antibiotics used in livestock farming are given for non-therapeutic uses (Pillai and Roe, 2003).

In apple and pear orchards, Oxytetracycline and Streptomycin are frequently used as preventative measures against the fire blight disease (caused by Erwinia amylovora). In the EU, the use of streptomycin is highly regulated and limited to once per year. However, due to the development of streptomycin resistance among E. amylovora in the apple orchards, the use of streptomycin in plant agriculture in the USA has been superseded by Oxytetracycline. According to reports, oxolinic acid was utilized to treat fire blight in Israel and rice blight in Japan (Shitenberg et al., 2001). In Mexico and Central America, gentamicin is used to treat numerous vegetable crop diseases, including Fire Blight (Duffy and Stockwell, 2012). However, considering the ABR issue in human medicine, there is controversy around the usage of antibiotics on plants (McManus et al., 2002).

Antibiotic Resistance in the Environment

According to research findings, ABR is widely distributed in a variety of soil types from different parts of the world. This phenomenon can be explained by the presence of microorganisms that produce antibiotics in soil. Over half of all known clinically useful antibiotics, including amphotericin, gentamicin, erythromycin, tetracycline, streptomycin, and Vancomycin, are produced by the Actinomycetes, which are widespread soil bacteria (genus Saccharopolyspora, Micromonospora and Streptomyces). Bacillus brevis, which produces gramicidin, is one example of a Bacillus species that produces antibiotics (Balz, 2007). Such antibiotics now also find their way into the atmosphere through waste, drainage, and agbusiness from animal and human therapies. To evaluate the occurrence and selection of ABR in environmental bacteria, numerous prospective and retrospective investigations have been conducted. The environmental "resistome" is ultimately the greatest and oldest reservoir of potential ABR (Allen et al., 2010; Aminov and Mackie, 2007; D’Costa et al., 2011). It is hardly unexpected that the soil resistome is so diversified given the strong selection pressure (Knapp et al., 2010). The tetracycline resistome is the best illustration of this. The widespread establishment of resistance has had a significant impact on tetracyclines, an essential family of antibiotics with favorable broad-spectrum efficacy against several infections (Thaker et al., 2010).
Unscrupulous infections that are common in soil, like Acinetobacter spp., Burkholderia spp., Pseudomonas aeruginosa and Stenotrophomonas spp., have a surprising ability to contract novel resistance genes in addition to their inherent resistance to a number of antibiotics (Popowska et al., 2010). Even still, little is understood about the variety, distribution, and ancestry of resistance genes, especially in the case of the ambient bacteria that are currently not cultivable. Tetracycline efflux from soil bacteria and aminoglycoside antibiotics being rendered inactive by phosphorylation and acetylation are two resistance mechanisms that have been discovered (Popowska et al., 2012). Additionally, bacteria resistant to macrolides, such as the brand-new medication Telithromycin, have been discovered in soil (Riesenfeld et al., 2004a). 480 soil-derived Streptomyces strains were tested in a study by D’Costa et al. (2006) against twenty-one antibiotics. Two strains were discovered to be resistant to fifteen of the twenty-one medications, with the majority of bacteria being multi-drug resistance to 7 or 8 antibiotics on average. Additionally, it was revealed that β-lactamases are stored in soil, and if these genes are passed to pathogens, they could have an adverse effect on human health (Allen et al., 2010). Antibiotics in the environment are thought to have aided in the development or autonomous emergence of highly specialized resistance components. These genes are propagated by horizontal gene transfer since they are mostly found on mobile genetic elements like plasmids and conjugative transposons. Plasmids with large host ranges that are conjugative are crucial to this process (Stokes and Gillings, 2011; Martinez, 2009). The incidence of these resistance plasmids in soil has been shown to be extremely high by numerous investigations (Görtz et al., 1996).

Connecting to the Global Antibiotics Resistance Surveillance System (GLASS)

A framework for planning and setting up ABR surveillance at the local and national levels that supports worldwide reporting is the Global Antibiotics Resistance Surveillance System (GLASS), which was created by the WHO. GLASS is currently limited to infections that affect humans. Basic clinical and demographic information is combined with laboratory data from ordinary patient treatment in GLASS surveillance. The main GLASS participants at the national scale and their respective responsibilities. A public health organization that defines, coordinates, and oversees nationwide ABR surveillance is known as the GLASS national coordination center. It should, whenever possible, be connected to industries that are concerned in agriculture, animal welfare, and human welfare. The national reference laboratories offers confirmatory testing and building capacity for the ABR monitoring locations.

In order to give accessibility to lab and epidemiological support, the ABR monitoring sites should create a system that represents the various geographic, demographic, and socioeconomic levels in the nation. Both inpatient and outpatient medical facilities are acceptable. Blood, urine, feces, and urethral swabs are the priority specimens, and the eight priority pathogens mostly match those on the WHO’s "Priority Pathogen List for Research and Development of New Antibiotics." The WHO Essential Medicines List includes antibiotics that can be used to treat priority infections or diseases, as well as possible reserve medicines and antibiotics used as indicator (surrogate) goods (i.e., to predict susceptibility or resistance to other antibiotics).

The open-access WHONET software has been modified to make it easier for entering data at surveillance sites and (automatic) analysis at the national coordination center. National systems can be utilized for data management and transfer. GLASS saw participation from seventy-one nations in December 2018, with Sub-Saharan Africa making up the majority of the nations. GLASS was developed as a response to Objective 2 of the WHO’s "Global Action Plan for Antibiotics Resistance" (monitoring of ABR and antibiotic consumption across all sectors), and GLASS data raises awareness among healthcare professionals, patients, and the general public.

Benefits associated with surveillance

Hospital data-based microbiological monitoring offers valuable knowledge at several levels. First off, it offers chances to gather, evaluate, track, and promote better indicators, particularly for blood cultures. In contrast to ABR, it establishes a baseline and offers monitoring of the range of microorganisms that cause illnesses. In fact, the spectrum can change greatly depending on the location and environment. Therefore, surveillance can establish the prevalence and proportions of geographically restricted pathogens like Salmonella species, Burkholderia pseudomallei, and Streptococcus suis, which cause zoonotic meningitis and sepsis in Asia and South-East Asia, respectively (both typhoidal and non-typhoidal). Continuous blood culture surveillance as part of initiatives to build capacity also enables early epidemic warnings for healthcare facilities and local communities (Jacobs et al, 2019).

The Grading of Recommendations Assessment Development and Evaluation (GRADE) approach and a systematic examination of the literature serve as the foundation for the Core Components. In contrast to the 2009 edition, the 2016 WHO IPC guidelines have included ABR and put more of an emphasis on integrating IPC with
WASH, which CBL can significantly help with. Additionally, CBL employees can contribute to IPC guidelines (creation, implementation, and monitoring) and IPC instructional activities depending on their training and competency (Core Components 2 and 3, respectively). Understanding IPC strategies requires knowledge of the habitats and epidemiology of the bacteria that result in health care associated illnesses (HAI).

Due to the fact that clinical microbiologists with IPC training frequently serve as the committee chairs for hospital infection prevention and control, the CBL also makes a contribution in high-income nations. However, trained microbiologists are scarce in LRS’s small, out-of-the-way facilities (Jacobs et al, 2019).

Policy frameworks have been called for based on local situational analyses to meet the needs of individual member states. This was stressed in one of the very first policy documents from WHO on ABR. Following the way the issue has been conveyed as a public health problem over time, it is obvious that the statements have become increasingly alarming while also being compared to other global health problems, especially climate change. Here several similarities, such as the lasting impacts across generations, have been noted. In recent documents, the need to make ABR prevention a United Nations Sustainable Development Goal has also been emphasized (Walls, 2019).

Alternatives to antibiotics

There is no currently understood one global future route that offers a cure for ABR. It is usually safe to suggest that we should utilize the antibiotics we already have more carefully while also researching new ones. The former tactic is mostly discussed in this study. Inventing new antibiotics might appear to be the most logical course of action, but the history of earlier antibiotic classes does not inspire much hope. Neither does the speed at which pharmaceutical firms create their products. Pharmaceutical research may be accelerated by new commercial models in public-private partnerships, but alternative preventative and treatment techniques must also be developed concurrently (Wall, 2019).

3 Method

A search of PubMed, Embase, Scopus, Science Direct, Web of Science, and Google Scholar identified 6804 articles published on antibiotics resistance as at February 3, 2023, after removal of duplicate citations. The search strategy included synonyms of antibiotics resistance and terms describing Sub-Saharan Africa, utilization of antibiotics, predisposing factors, challenges and resistance. Following a review of abstracts, 33 articles were selected for review of full text. We identified 23 reports for review in the grey literature. Between 4th and 5th February, we also performed searches of the grey literature within the Global Health Data Exchange database, international health surveillance programs, and official national health surveillance websites and reviewed surveys, censuses, vital statistics, and reports not already included in previously identified scientific publications. We additionally searched world atlas (Sub-Saharan - World Atlas) and the World Health Organization’s web sites.

4 Results And Discussion

The need for healthcare is ingrained in economic, social, political, organizational, and religious institutions and belief systems. The ability to make the same evidence-based decisions that are accessible to more privileged populations is limited for people living in resource-poor environments. Government buildings that experience "structural violence" make it difficult for the public to obtain antibiotic medications. The preferred primary healthcare option is found in neighborhood retail pharmacies and clinics. Advice about antibiotics is based on accepted practices and supported by trust developed via direct relationships and local expertise. The low population density of infrastructure, the cost of buying antibiotics (accessibility/ability to reach, affordability/ability to pay), political and social factors and integrity (acceptability/ability to seek, approachability/ability to perceive), and the prevalence of unrestricted services (suitability to engage) are all factors that prevent people from getting prescription antibiotics. The ability to participate and the appropriateness to learn are captured by enablers (Chowdhury et al, 2019).

Vaccines are another essential preventive measure to reduce the risk of infectious infections in the future and any subsequent improper antibiotic use that could have an impact on the emergence of ABR. Additionally, vaccines are less prone to cause resistance. But there are issues with existing vaccine uptake and coverage against infectious illnesses among African nations, which are impacted by the availability of facilities for their delivery and inadequate information, both of which can be improved. Given how underappreciated vaccinations are globally in preventing ABR, this is a serious problem. Lockdowns and other preventative efforts to stop the spread of COVID-19, as well
as worries about getting the virus at basic healthcare facilities, have significantly impacted vaccination rates throughout Africa.

Given the consequences for future child morbidity and death, which are noticeably bigger than the effect of COVID-19 among children in Africa, this is a cause for concern. Mobile clinics and health professionals visiting families with unvaccinated children have been implemented in certain countries to address these difficulties, and such initiatives are likely to increase. Along with this, more needs to be done in the way of education and other outreach initiatives to address vaccine reluctance, notably with regard to COVID-19, in order to lessen the spread of infectious diseases and ABR in the future.

Making sure that suitable quality enhancement programs are launched throughout sectors to lessen incorrect antibiotic prescribing and dispensing are further actions to lower ABR rates throughout Africa. These programs often begin in hospitals by determining the present patterns of antibiotic use and resistance, which involves carrying out point prevalence surveys (PPS). The results can then be used to guide next quality-improvement initiatives in health facilities across Africa. To reduce healthcare-associated infections, such initiatives include the creation of infection, prevention, and control (IPC) committees and related activities (HAIs). Where there are no existing antibiotic stewardship programs (ASPs), this can be done.

Studies have also been conducted on the treatment of surgical site infections (SSIs) in Africa due to worries about the consequences of extended antibiotic prophylaxis and adverse events and ABR (Resist, 2022). The findings led to the implementation of numerous educational and other multimodal actions in hospitals to lower the greater incidence of postoperative prolonged prophylaxis (Godman et al, 2022).

It was gratifying to learn that all of the studied sub-Saharan African nations had made progress in developing and putting their NAPs into practice. But some nations are more developed than others. For instance, Botswana will soon launch its NAP while Namibia is waiting to receive authorisation to begin implementing their NAP. Eswatini and other nations have only recently started their NAP journeys. Comparatively speaking, NAPs for Zambia, Ghana, Nigeria, Kenya, South Africa, Zimbabwe, and Uganda are further along, with regular monitoring of agreed-upon actions included. Compared to Namibia and Kenya, countries like Cameroon are also further along with their NAPs; nonetheless, there are challenges with their implementation due to important factors, such as training and knowledge regarding ABR (Wall, 2019).

It was also gratifying to observe that the various sub-Saharan African nations actively track trends in antibiotic usage across sectors. This involves conducting PPS research in hospitals and pursuing deeper understanding of resistance patterns via WHO-GLASS and other initiatives. Both of these tasks are necessary to create and launch appropriate quality improvement initiatives as ASPs to enhance future antibiotic prescription and dispensing practices. However, the success of ASP initiatives varies across sub-Saharan Africa, and it depends on the resources, staff, and knowledge that each country has (Resist, 2022).

South Africa seems to have achieved the most progress among the sub-Saharan African nations evaluated in terms of the implementation of efforts to reduce ABR throughout sectors, including consistent review processes with the execution of their NAP as well as several ASP and other activities. There remains room for development, though. Along with increased IPC programs and activities, as well as ASPs across nations, we are also seen an increase in the usage of the AWaRe categorization of antibiotics, which makes it easier to evaluate the effectiveness of antibiotic prescribing. As time goes on, these activities will continue. This includes creating prospective quality measures based on the AWaRe categorization and recommendations for outpatient clinics across Africa (Wall, 2019).

The difficulties in putting NAPs into practice seemed to be common throughout African nations. Lack of manpower, notably secretariat staff needed to move agreed-upon NAP operations forward, was one of the major problems. This makes issues with inter-sectoral synchronization more difficult. Along with competing demands for limited resources, there are significant challenges with the cash that is available, including those from donors, to properly perform agreed-upon activities. The current COVID-19 outbreak and its unexpected implications, which must also be handled, have made the issue worse. Reduced immunization, particularly among youngsters, and the care of patients with non-communicable diseases (NCDs), who were not effectively monitored and managed during the pandemic due to shutdown measures, are examples of unintended consequences. Consequently, if not adequately treated, there will be an increase in morbidity, mortality, and expenses.

This must be recognized since, if left uncontrolled, an excessive focus on bettering the treatment of individuals with NCDs may divert limited resources from carrying out agreed-upon NAP actions. It’s still unclear whether vaccination is a sensible and necessary tactic. What demographics ought to be targeted, how will immune-compromised people react, and what are the financial ramifications? Another approach proposes to “fight evolution
with evolution," however it is still in the modeling stage. This is the process of using pharmacological sequencing to direct evolution toward genotype states from which resistance cannot arise (Wall, 2019).

The Wellcome Trust commissioned a Lancet Review, which was released in 2016, and 24 scientists suggested antibiotic substitutes. Ten of those that could be combined were examined in greater depth. The approaches that were anticipated to have the greatest potential to offer antibiotic alternatives in terms of high clinical impact and high technical feasibility were phage lysins as therapeutic agents (viruses that can kill bacteria via their enzymes, lysins); vaccines as prophylactics; antibodies as prophylactics (restricting the ability of bacteria to cause illness); and probiotics (preventing bacteria from colonizing in the gut). The authors of the Lancet came to the conclusion that in the future, even though there was disagreement among them, we must rely on antibiotic alternatives.

Probiotics may help to lessen symptoms, provide an alternative to antibiotic treatment for less serious infections, and decrease the need for antibiotic prescriptions. In accordance with FAO and WHO definitions, probiotics are "live organisms that, when administered in sufficient proportions, impart a health benefit on the host." Probiotics and nutritional supplements have become more widely and commercially accepted, yet academic interest and research in these fields have lagged. Single studies only offer weak evidence on their own. Therefore, it is crucial to conduct reviews that pool data, synthesize findings, and take different bacterial strains into account.

According to Wall, 2019, in a comprehensive examination of 17 RCTs, the authors examined if probiotic use would lower antibiotic consumption for prevalent acute illnesses in children. Compared to a placebo group, probiotic-treated infants and kids had a 29% decreased probability of receiving an antibiotic prescription. After analyzing 12 studies on the effectiveness of probiotics in preventing recurrent UTI in women, the authors came to the conclusion that there is low to moderate evidence in favor of probiotic effectiveness and that larger randomized selected and double-blind studies are required to strengthen recommendations. There is also a need for appropriate safety research and evidence-based documentation given the rising intake of probiotics.

Probiotics may safely affect a variety of physiological processes and strengthen the immune system, according to recent theories. According to a meta-analysis of 25 RCTs involving 2810 AAD patients, probiotics reduced diarrhea by 57%. In examining how probiotics can help stop the spread of resistance, the CDC came to the conclusion that "the role of probiotics in preventing drug-resistant infections in humans has not yet been established" and that "although some studies have shown benefit, the data are currently not conclusive enough to issue specific recommendations." Probiotics can therefore currently be used in conjunction with or as a partial replacement for antibiotic therapy. They may therefore be helpful in treating UTIs that are resistant to multiple medications in this fashion.

According to a Cochrane evaluation of paediatric cases, which comprised 23 trials and 3938 individuals, there was a 54% protective effect in the probiotic group with an incidence rate of AAD of 8% compared to 19% in the control group. More safety information, according to the study, is required to decide on probiotic dosage and microbe types.

Probiotics may be used to treat helicobacter pylori infections in pediatric patients, according to a study of both in vitro and in vivo research. There is significant debate regarding how probiotics affect the immune system. The use of probiotics as an adjuvant to raise the rate of H. pylori eradication is still not supported by strong data, primarily because clinical trials' statistical power has been insufficient thus far.

However, there seems to be enough support supporting the use of probiotics instead of antibiotics for some less severe infectious infections. The use of fecal microbial transplantation (FMT) to treat CDAD provides the strongest proof that a therapeutic option other than conventional antibiotics is effective. In this case, the strategy is to transfer a healthy donor microbiota, boost the recipient gut's microbial diversity, and then compete with the resistant or toxin-producing bacteria. As a result, a diversified microbiome that is in balance may prevent the colonization of resistant bacterial clones. As with many antibiotics, future study must consider both the effectiveness and potential risks of such alternatives (Wall, 2019).

Last but not least, in sub-Saharan Africa, there are acknowledged problems and difficulties with experience and knowledge surrounding ABR and ASPs. However, this is starting to change as a result of calls for better qualitative research in this field and increased educational and implementation measures, such as Apps for electronic prescribing, to enhance future prescribing. Additionally, there are numerous active projects in Sub-Saharan Africa to address current issues, such as general and targeted initiatives to advance NAPs (Wall, 2019). Given the high and rising rates of ABR in sub-Saharan Africa as well as the associated financial implications, such operations will continue. As a result, quick action is required in sub-Saharan Africa to lower high ABR rates. As a result, social media platforms will increasingly address issues, frequently with little or no engagement from important healthcare
professionals. Moving forward, all significant stakeholder groups, including donors, will be accountable for such activities (Wall, 2019).

Why Sub-Saharan countries are hit hardest by antibiotics resistance: predisposing factors between prescriber, dispenser, patients, diagnostics and health systems, related to human medicine by Jacobs et al, 2019.

General: Diagnostics market in low-and middle-income countries is uncertain; Diagnostics for bacteriologi cal cultures are considered as “low risk” products, hence low regulatory stringency; No (supra)national “vertical” control programs; Fragmented donor landscape with competing interests.

Prescriber considerations: Absence of local surveillance data obscures awareness and knowledge about ABR in the own practice (“No data, no problem”); Poorly educated and trained in antibiotic use; In the absence of diagnostic tools, he/she prefers to “cover” the patient for bacterial infections, preferably with broad-spectrum antibiotics; Overuse but also suboptimal use: incorrect diagnosis, incorrect dose, timing, route, frequency and duration, no de-escalation (i.e., using an antibiotic of narrow spectrum based on microbiology reports); Extended use of antibiotics e.g., in the case of surgical prophylaxis (to “compensate” for inadequate infection control); The “Knowledge gap”: knowing that antibiotics are not indicated but nevertheless prescribing them (“cough and cold,” watery diarrhea); Fear of non-respecting and losing the patient when not prescribing antibiotics (taking his/her complaints not serious); Reliance on (own) clinical diagnosis

Dispenser and supply: Poor access to antibiotics, inadequate supply leading to incorrect dose, timing, duration.; professional pharmacists (pharmacy attendants, drug sellers); Economic incentives—e.g., selling particular brands; Wants to fulfill the patients’ demand: non-prescription sales of antibiotics, selling incomplete treatments, fear patient would go elsewhere; Substandard (low content, expired, degraded) and falsified Abs

Patient’s attributes, beliefs and socio-cultural factors: Poor health literacy; Out-of-pocket expenditure of healthcare costs; Reluctance to blood sampling; Patient or caretakers’ pressure toward antibiotics (real or perceived by the prescriber); Auto-medication, non-prescription use of antibiotics (frequently associated with too low dose and too short duration); ABS are associated with power (strong, almost magical) and valued higher than the doctor’s visit; Poor awareness and knowledge about ABR: “the patient become resistant, not the bacteria,”; “Antibiotics protect against unsanitary conditions in the environment”; Lay advice about antibiotics (friends, relatives); Storage of antibiotics left-overs at home—self/family medication; Incorrect use—mixed with practices of traditional medicine

Diagnostics (At the first line): Moderate to low clinical competence among frontline health workers; POC testing for malaria in the absence of diagnostic algorithms for other febrile diseases has increased antibiotic prescription; POC testing is not always accepted as part of a patients’ consultation (financial reason or uncertainty of interpretation)

Diagnostics (At the second and third line): Few CBL, low volumes, low quality, not embedded in patient care

Health systems: Distrust in the quality of public (government-run) services; Private market notably insensitive to regulation; National Action Plans on ABR not yet developed or implemented; Regulation (medicines, diagnostics) fragmented and poorly implemented; No health insurance, “out of pocket” payment leads to underdiagnoses and under or overtreatment.

Healthcare facilities: Few or no programs of antibiotic stewardship available; Poor infection prevention and control, fueling transmission of MDR organisms in hospitals, in turn increasing the use of antibiotics; Payment per act in hospitals (consequences of ABR less visible).

Education of providers and prescribers: Professional education not adapted to needs); No registration, recertification or continuing medical education; Gaps in teaching of clinical microbiology and antibiotic prescription; Poor awareness of local/national prescribing guidelines; High influence of pharmaceutical drug promotion/representatives; Hierarchic role model: respect of senior medical staff, reluctance to question prescribing decisions; Autonomy of decision making (particularly in private hospitals) (Jacob et al, 2019).

The need for healthcare is ingrained in political, financial, social, organizational, and religious institutions and belief systems. The ability to make the same evidence-based decisions that are accessible to more privileged populations is limited for people living in resource-poor environments. Government buildings that experience "structural violence" make it difficult for the public to obtain antibiotic medications. The preferred primary healthcare option is found in neighborhood retail pharmacies and clinics. Advice about antibiotics is based on accepted practices and supported by trust developed via direct relationships and local expertise.
Accessibility, price, and cultural and social norms were identified as the primary drivers of informal providers' popularity in a systematic examination of their position in emerging countries. Whether in the context of housing, employment, or healthcare, references to the informal sector are frequently made in a normative manner, which unfairly judges and discriminates against disadvantaged and marginalized inhabitants for whom these services represent the most suitable and affordable option. In this research, informants reported using antibiotics as self-medication because they honestly thought that these drugs would lessen their symptoms and speed up recovery. Findings show how the cultural and social fabric is woven with the acceptance of rural pharmacies as sources of antibiotic medications. The ease of getting to nearby shops and the friendliness and familiarity of dependable pharmacy salespeople reassured customers. The need to quickly and affordably address any current health concerns drove people to seek out care (Wall, 2019)

5 Conclusion
Antibiotic resistance is a problem for both development and health. Medications are used, sought after, and acted upon within social and economic circumstances. To address the underlying economic, social, cultural, and political factors that affect the availability and usage of antibiotic medications in Sub-Saharan countries, multi-sectoral action is required (Chowdhury et al, 2019). Antibiotic use in rural areas is a reflection of a broken public healthcare system that ignores the factors influencing health-seeking behavior and the decline in public confidence in infrastructure and services. The emphasis on changing individual behavior must be matched with consideration of the dynamic, complex processes involved in knowledge acquisition. In relation to the use of antibiotics in human health and agriculture, we need to better understand how social, cultural, and financial environment influence patients, healthcare professionals, and the general public's knowledge, beliefs, attitudes, and behaviors (Wall, 2019).

The WHO EDL offers evidence-based recommendations to help with the selection of the best diagnostics. The WHO EDL is anticipated to encourage access to quality-assured IVDs among healthcare workers, entrepreneurs, legislators, and regulatory agencies in keeping with the already existing WHO Essential Medicines List. Beyond this, the WHO EDL will offer recommendations for harmonizing diagnostics and external standard evaluation programs and will make it easier for groups to purchase diagnostics and provide orientation (Jacobs et al, 2019).

Health care-associated infections can be decreased with the use of infection prevention and control initiatives. Both actively and inactively, the clinical bacteriology laboratory can participate in IPC activities. IPC surveillance is a useful instrument for keeping track of and lowering HAI. CBL may assist with active, IPC team-initiated surveillance efforts that may be directed at a particular ward or procedure (e.g., focused on the intensive care unit or on catheter related bloodstream infections, respectively). Despite the fact that CBL can increase the consistency and precision of IPC surveillance definitions, clinical specimens for CBL should be carefully chosen in consideration of diagnostic stewardship. Given the (abundant) presence of colonizing and contaminating bacteria, cultures developed from superficial wound swabs and urine samples collected from indwelling catheters, for instance, do not necessarily indicate a healthcare-associated infection.

Additionally, the CBL must promptly notify the IPC team of any patients who are infected or colonized by bacteria that require isolation precautions (sometimes known as "alarm bacteria"), such as contact isolation for MDR bacteria (Jacobs et al, 2019). In aquaculture and agriculture, veterinary medicine, human medicine, excessive usage of antibiotics needs to be curbed or minimized. Antibiotic usage in agriculture ought to be completely stopped. The implementation of intensive programs to educate patients and doctors about decreasing antibiotic usage should be put into place. After reviewing more than 500 scientific studies, it has been proposed that banning the non-therapeutic use of antibiotics in food animals will reduce the amount of ABR in the environment, which will improve both animal and human health (Swartz, 2002; FAAIR Scientific, 2002).

The risk of developing ABR can be decreased by using stricter regulations and better management practices when using antibiotics for therapeutic purposes in both people and animals (Defoirdt et al., 2011; Cunha, 2002; Midtlyng et al., 2011). For instance, with active routine monitoring programs that can identify colonized individuals, the nosocomial spread of multi-drug resistant bacteria can be prevented. Many studies have shown that such a "research and confinement" method and/or a "search and destroy" approach, in which an effort is made to eradicate carriage of the organism, can lower the frequency of hospital-acquired infections and be financially advantageous (Muto et al., 2003).

Understanding the human behavior and action in connection to norms, presumptions, beliefs, and attitudes at the junction of economic and social conditions and political power structures is the only way progress will be made. The ingrained economic, political, cultural, and social contexts in which individuals live, work, and get
care must be addressed in interventions aimed at reducing ABR. To ensure that political will results in effective action, sustainable solutions will need multi-sector national action plans with clear objectives and accountability lines. Governments and international organizations are responsible for ABR, both inside and outside of the health sector (Chowdhury et al, 2019).

6 Abbreviation
3GC: Third Generation Cephalosporins
AAD: Antibiotic-Associated Diarrhoea
ABR: Antibiotics Resistance
AIDS: Acquired Immunodeficiency Syndrome
ASPs: Antimicrobial Stewardship Programs
AST: Antibiotic Susceptibility Testing
ABR: Antibiotics Resistance
CBL: Clinical Bacteriology Laboratory
EMA: European Medicines Agency
ESVAC: European Surveillance of Antibiotic Consumption
ESBL: Extended-Spectrum-Lactamases
ESKAPE: Enterococcus spp., Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter spp.
XDR: Extensively Drug Resistant
FAO: Food And Agriculture Organization
GRADE: Grading of Recommendations Assessment Development and Evaluation
HAI: Health Care-Infections
HIV: Human Immunodeficiency Virus
IACG: Intergovernmental Coordination Group
IMP: Imipenemase Metallo-Lactamase
IPC: Infection, Prevention, and Control
KPC: Klebsiella Pneumoniae Carbapenemase
LMICS: Low- and Middle-Income Countries
LRS: Low Resource Settings
MDR: Multidrug Resistant
MRSA: Methicillin-Resistant Staphylococcus Aureus
NAPs: National Action Plans
NDM: New Delhi Metallo-Lactamase
OIE: Organization of Animal Health
PPS: Point Prevalence Surveys
POC: Point-Of-Care Testing.
SAGEIVD: Strategic Advisory Group on In Vitro Diagnostics
SDGS: Sustainable Development Goals
SSIs: Surgical Site Infections
TB: Tuberculosis
VRE: Vancomycin-Resistant Enterococci
VIM: Verona Integron-Encoded Metallo-Lactamase
WASH: Water, Sanitation and Hygiene
WHO: World Health Organization

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