Health Equity Forward

Addressing Antimicrobial Drug Resistance in Haiti

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Introduction

Microbial drug discovery is a century-old field that has enabled modern medicine to treat some of the deadliest infectious diseases[1]. In conjunction, germs have simultaneously been evolving to block the drugs' potency, thus rendering the various developed therapeutics ineffective[2]. This phenomenon is called antimicrobial drug resistance (AMR), and it is a growing concern for many scientists and clinicians around the globe as established treatments are slowly losing efficacy[3]. For modern medicine to continue to efficiently treat infectious diseases, we must address AMR outbreaks before we reach high levels of superbug prevalence, or bacteria, viruses, parasites, or fungi that are resistant to multiple different antibiotics. However, it is unrealistic to expect science to be able to develop new antibiotics in time for medical providers to continue to save lives, so it is important for us to understand how AMR is created in the first place. This knowledge will equip us with the ability to slow down AMR evolution and give us time to develop more potent therapeutics.

Even though AMR is health security threat that transcends transnational boundaries, it is disproportionately distributed, and we see higher incident cases in communities riddled with poverty. Take Haiti for example. Denominated the poorest country in the Western Hemisphere, Haiti has been in debt since it gained independence from France, and in 2023, it had a public debt of $5.58 billion US dollars[4,5]. In 2021, the United Nations estimated that 63.1 percent of Haitians are either in or at risk for multidimensional poverty[6]. Uncoincidentally, the country also has one of the largest AMR-associated mortality rates with greater than 90 deaths per 100,000 person-years[7]. However, this increased prevalence of AMR in Haiti cannot just be attributed to the singular causative factor of poverty, but rather the cumulation of a myriad of unfortunate conditions that stem from poverty. This includes but isn't limited to poor living conditions, inaccessibility of microbial therapeutics and standard healthcare access, and limited awareness about AMR in general.

Addressing AMR in Haiti is an equally nuanced problem, and all potential solutions would require systemically situated analysis and interventions on all layers of the socioecological model of health framework. A successful program for tackling AMR in Haiti would include hosting community education events to raise awareness on the effects of drug resistance as primary prevention, training Haitian healthcare workers to provide AMR-specific treatment as secondary prevention, and investing government funds into an emergency stockpile of cheap and accessible generic antibiotics over commercial antibiotics as tertiary prevention. The purpose of this paper is to explore the merits of this program and how these individual

prevention models must work together in tandem to sustainably combat AMR-associated mortality in Haiti.

Haiti's Background

To understand the complexity of AMR-associated mortality in Haiti, we must first understand the basics of Haiti's infrastructure in all spheres. Unfortunately, the healthcare sphere in Haiti is facing a grim horizon-- French surgeon Dr. Peter Tarabula went so far as to describe Haiti's healthcare infrastructure as a "dying" public healthcare system[8]. According to the Pan American Health Organization (PAHO), 40% of Haiti's population does not have access to any form of healthcare services, while the ones who can often pay a small fee based on family size and income to access public facilities[8]. Little or no access to healthcare can be detrimental for infectious diseases since ill individuals would likely take much longer to get diagnosed and begin the treatment process. This individual waiting period between contracting the pathogen and the symptoms becoming drastic enough to seek out hospital-based care for can place the entire community around them at great risk. Just because they are not actively receiving medical treatment for their disease does not mean they are no longer spreading the disease to other individuals. Adding AMR into the mix makes these infectious diseases a death sentence. Treating one individual with AMR is difficult enough, considering that gold-standard treatments do not work for severe cases, and the newer therapeutics are costly and hard to access. Imagine having to treat a whole neighborhood of AMR cases. This could spell disaster for even the most advanced and well-prepared healthcare systems. Given that Haiti's healthcare infrastructure is currently struggling, and most Haitians are unable to even identify whether or not they have an infectious disease at all, AMR places a disproportionate burden on the Haitian healthcare system.

There is also the pertinent issue of Haiti's political instability bleeds into the health services sphere as well. In 2024, almost 40% of healthcare facilities in Port-au-Prince, the Haitian capital, were shut down due to gang-facilitated insecurity and looting[9]. UNICEF states that this insecurity has led about 40% of Haitian healthcare workers to leave the country, leaving Haitian hospitals reeling and understaffed[9,10]. A shortage of healthcare workers and healthcare facilities makes it even more difficult for the small portion of the average Haitian who can access medical care to find a hospital with enough healthcare providers to treat them. With an underequipped healthcare infrastructure, AMR is much more likely to fall through the cracks and remain undetected, as inadequate response to microbial drug treatment can be attributed to different factors at first glance. Overall, Haiti's fractured healthcare foundation leaves it at a greater susceptibility to AMR incident cases.

Training Haitian Healthcare Providers to Handle AMR Cases

With Haitian healthcare workers rapidly leaving the country, it's pertinent that those who remain are well equipped to respond to AMR cases. Nonetheless, it is not enough to simply call for emergency aid from other countries and allow foreign medical providers to temporarily deal with the fallouts of the Haitian AMR crisis. Dr. Paul Farmer, a Harvard-trained physician-anthropologist and co-founder of the humanitarian organization Partners in Health,

wrote in his book, *Reimagining Global Health*, "[…] for every Harvard student trained, there must be at least a dozen more in the developing world who would benefit from the training[11]." He argues that health issues aren't limited to what we consider the global north and that we as a greater society must have more funded tracks to train students from around the world. He's right—allowing healthcare students from an outside country to temporarily provide aid is a Band-Aid solution to an open, gushing wound. Instead of just aiming to push in foreign medical students into Haiti to treat AMR outbreaks and leave immediately after, it's important that we invest into training Haitian medical students in recognizing and determining strategies to deal with AMR in its early stages with one incident case. This is especially important because AMR-associated mortality in Haiti is the result of factors that have perpetuated throughout the history of the country and will not resolve within the duration that foreign aid will last. Even if one AMR outbreak was addressed with foreign support, Haitians are still at a disproportionately higher risk of another AMR outbreak, and it is not a sustainable practice to rely solely on foreign aid.

Culture and health care systems are irreversibly intertwined, and one cannot look to solve health-related issues without fully understanding the cultural layers behind how individuals interact with their healthcare system. Every culture has its own healing practices, and many often hold a pluralistic view of medical systems and draw inspiration for healing from multiple types of medicinal practice. Specifically, Haitian students trained in Haiti about Haiti-specific healthcare problems will be the most equipped to solve these issues, as they know and understand how Haitians view and interact with their healthcare infrastructure. This enables them to make better educated decisions on how to disseminate clinical diagnoses, plan treatment schedules, and make the healing process the most efficient and ideal for the patient. This would serve as a secondary prevention tactic, as it would be preparing Haitian providers to be intervening as early as the first incident before AMR can become an outbreak in Haitian communities.

One of the strategies of accomplishing this goal is running a pilot program that connects Haitian medical students and current providers to researchers and clinicians around the world who are doing research into AMR in other endemic countries around the world. This way, Haitians providing medical support are well informed on the most up-to-date and modern detection methods of AMR and methods that other countries are using to mitigate the effects of AMR once identified in communities. Foreign scientists and clinicians who are passionate about solving AMR can provide necessary and pertinent information over direct patient care as their form of support, and Haitian medical providers can take this knowledge to grow their skillset and better respond to AMR outbreaks. Considering that Haitian healthcare is inaccessible for the average Haitian, we can expect that there is a general distrust between the Haitian population and healthcare. Haitian healthcare workers can mitigate these negative emotions by taking important factors, including type of treatment, treatment duration, and dosage, and making them more palatable to the regular population by combining Haitian cultural healing practices with the foreign treatment. By developing a co-treatment, Haitian providers can use the comfort of

cultural healing practices to allow ill Haitians with AMR to feel more at ease receiving a different type of treatment.

A method of easily introducing this to Haitian medical providers is by including a required segment in their medical training about AMR. The first step to combatting AMR is being educated on its origins and signs, and the simplest way of disseminating this foundational knowledge is to include it in the medical training process. Even so, AMR is a constantly changing phenomenon, and it's likely that pertinent information will change just as rapidly. The influx of AMR knowledge can be addressed by creating partnerships with organizations that focus on AMR to host frequent workshops about the latest AMR news for Haitian healthcare workers to attend. This dual-faced approach to teach and keep Haitian medical providers updated on AMR will result in a new generation of Haitian healthcare workers who are well-equipped to address AMR outbreaks.

Creating a Class of Haitian Citizen-Scientists to Identify and Respond to AMR

Though, these medical students and providers cannot be the only ones who are being informed about AMR and its risks for Haiti. Given that they are already spread far and thin, it's unreasonable to expect that Haitian medical providers would be able to closely monitor and prevent AMR outbreaks from occurring. Haitian citizens must also be aware of the dangers of AMR and strategies that they can use to reduce the risk of themselves and their communities falling susceptible to AMR. Even though AMR sees no transnational borders or socioeconomic status, people who live in vulnerable regions like Haiti are at increased danger of AMR-associated mortality because of factors that are often more prevalent in resource-poor settings. These determinants include poor sanitation and hygiene, lack of access to diagnostic tools and medication, unclean water, and more. Resolving these factors would take much more time than Haitians with infectious diseases who are experiencing AMR have, so it is pertinent that information about how and why AMR exists and what Haitians can do to avoid the rampant spreading of AMR is disseminated to all citizens.

Health education programs as primary prevention strategies are starting to gain traction, and they allow for the average citizen who might not have a strong medical or scientific background to understand the etiology of a disease, how one might be more vulnerable for risk of getting a disease, and methods for reducing the personal chances of developing a disease. Medical providers hosting a health education program for Haitian citizens about infectious disease and AMR can be useful in developing "citizen-scientists" or individuals who don't have formal medical training but still are able to recognize the tell-tale signs of AMR development in a community. This would help by allowing Haitian medical providers to focus on aiding those who actively have infections that have developed AMR, while the citizen-scientists can focus on identifying potential incident cases in their own communities and relaying that information to the Haitian healthcare system. By educating more citizen-scientists, one also creates the opportunity for them to identify practices to decrease their own chances of contracting antimicrobial drug-resistant infectious diseases, which would lower the AMR-associated burden in general.

This program would mimic the training segment and follow-up workshops that Haitian medical providers would receive, but it would be developed in layman's terms to be easily accessible and understandable to the general population. First, it would describe the history of infectious diseases and antimicrobial drug development, and how this invention has allowed us to curb the spread of many fatal diseases. To make it easier for Haitian citizens to understand why this science is specifically pertinent to them, this segment of training would include information about malaria, tuberculosis, and HIV, a few of the infectious diseases that are high in prevalence in Haiti. They might know coworkers, family, friends, or even themselves who are affected by these diseases, which allows them to create a personal connection to the material and find value in understanding. Then, the program would transition into talking about AMR and some of the factors that can lead to AMR evolution, including, but not limited to, lack of access to sanitation and clean water, antibiotics misuse and overuse, and inadequate curbing of infectious diseases. The purpose of this segment would be to allow the Haitian citizens to reflect on their own living habits and how they could personally be increasing the risk of an AMR outbreak without placing any individual blame or fault on them for a problem that is inherently systemic. By being cognizant of these influential factors, Haitian citizens can make choices that can reduce the chances of germs even developing resistance in their communities in the first place. Finally, the program would conclude by discussing some of the signs of AMR and ways in which to inform the Haitian healthcare system about a possible outbreak. This last portion would ideally be streamlined by having designated points of contact at local hospitals so it's easier for the now-citizen-scientists to share their findings.

Though these citizen-scientists would be unable to officially diagnose infectious disease and AMR, they would be able to reduce the stress on Haitian medical providers by screening their communities and only notifying the healthcare system when there are potential incident cases. This allows the Haitian healthcare workers to pour all their effort and resources into treating infected patients who need their attention the most.

<u>Reducing the Financial Strain of Antibiotics by Governmental Investment in Generic Antibiotics</u>

To reduce AMR-associated burden on a community, infected individuals must be treated with antimicrobial drugs as early as possible, so providers can monitor the drug resistance status and alter the drug type given if needed. Early elimination of the infection would decrease the chances of the germs from evolving and becoming resistant to existing therapeutics. However, there remains the major elephant in the room: the issue of finances. It is estimated that the average Haitian earns $1760 USD per year, which is the equivalent of $4.82 USD a day[12]. This figure is likely even smaller, considering that there is a huge disparity in wealth distribution in Haiti. When you compare this to the average commercial antibiotic price tag of roughly $20 USD per prescription plan, which doesn't include the additional cost of importing these antibiotics from foreign countries, it's clear that access to this life-saving medication is extremely inaccessible to the average Haitian[13]. If one takes into account that 40% of Haitians are unable to access healthcare that is more than a small fee, this is clearly where the Haitian government

needs to intervene and develop a public welfare initiative that would allow for Haitians to have antibiotic treatment available when needed[8].

Generic antibiotics are versions of commercial, name-brand antibiotics that have the same bioactive ingredients and biological mechanism of action and effect but are sold for a fraction of the price[14]. Even though commercial antibiotics might be what patients are used to encountering during their treatment schedules, there is not any major reason to select a pricier commercial antibiotic over a cheaper general antibiotic, especially when finances are a concern. Investing in an emergency stockpile of generic antibiotics as tertiary prevention that can address a range of infectious diseases at different rates of AMR would reduce the burden on Haitian medical providers and citizen-scientists from having to worry about identifying but not being able to treat those they've identified to have AMR. This initial and backup investment will allow for the Haitian healthcare system to address incident cases of AMR before they turn into outbreaks and become endemic.

To ensure that this funding for a generic antibiotics stockpile is more than just a singular investment, it would be important to push for policy changes. An annual budget that adjusts based on AMR prevalence and incidence in Haiti can be implemented to ensure that every Haitian who needs treatment receives treatment. Nonetheless, given the financial standing of Haiti, this funding for generic antibiotics could potentially not be a sustainable practice for the government to pursue. To combat this, the reserve of antibiotics can be sold at a greatly reduced price that is affordable for the average Haitian citizen, allowing the Haitian government to recuperate a portion of the funds and replenish the stockpile for more incident cases of infectious disease and AMR. Another method of reducing the overall financial burden on the Haitian government is reallocating a portion of Haitian foreign aid towards the budget for the generics stockpile.

Conclusion

The penultimate goal of reducing AMR-associated burden in Haiti is influenced by a long history behind Haitian healthcare infrastructure and government and social determinants that influence the local community's relationship with receiving healthcare. Given that the factors that created this issue are so deeply rooted in Haitian society, it is nearly impossible to address Haitian AMR-associated mortality by just responding on the surface-level: treating ill individuals whose disease displays AMR characteristics. This paper proposes three different methods that address primary, secondary, and tertiary prevention to make impact on multiple levels of the socioecological model. The first method is by training Haitian healthcare workers to be aware of AMR signs and best treatment practices by incorporating more education about AMR into their medical education, which is a secondary level of prevention. The second method is to train a class of citizen-scientists who can recognize factors that cause AMR and reduce the AMR identification workload on Haitian physicians by educating them on AMR, functioning as a primary prevention. The third method of prevention is a government-affiliated stockpile of accessible, cheap generic antibiotics as a tertiary prevention tactic.

The best part of this program is that it is scalable and adaptable to situations beyond Haiti. If this system works for Haiti, it can be modified and applied to various other resource-poor and vulnerable countries who are facing high-levels of AMR-associated or any infectious disease related mortality. Overall, by combining multiple types of prevention on different levels of the socioecological model of health, Haiti can reduce their AMR burden and create sustainable health practices for their citizens and medical providers.

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