Economic Burden of Meningitis in Sub-Saharan Africa and the Importance of Vaccination Programs: A Case Study of Niger

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The Burden of Meningitis in Sub-Saharan Africa

Throughout sub-Saharan Africa, countries suffer tremendously from the hardships and mortality associated with the burden of disease. Year after year epidemics of meningitis sweep through areas of sub-Saharan Africa known as the “meningitis belt (See Figure 1) (Centers for Disease Control and Prevention 1).” From the eastern coast of Senegal to the west coast of Ethiopia, annual cases of meningitis can surpass 1,000 for a population of 100,000 people. In 1996, the largest epidemic was able to affect more than 250,000 Africans and take more than 25,000 lives (Miller and Sentz 3). It is still not completely understood why for more than 100 years epidemics continue to occur in this region of Africa. Some proposed risk factors include medical conditions, demographic conditions, socioeconomic conditions, and climatic conditions (Centers for Disease 1). These factors, in combination with the detrimental impact disease, decrease the economic capabilities of sub-Saharan Africa and interfere with attempts to make any productive developments. Once monetary funds have been met to acquire vaccinations, health care providers will be fundamental for vaccinating populations at risk. Without the help of health care providers and vaccination campaigns, the people of sub-Saharan Africa will suffer tremendously from meningitis and the economy will struggle to compete globally.

Meningitis is caused by microorganisms such as bacteria, viruses, fungi, or parasites, which can infect the blood and cerebrospinal fluid. Fungal meningitis is the only type that is not contagious, but the more common bacterial and viral meningitides are both contagious. The bacterial infections found most often in Africa, can be spread through the exchange of respiratory and throat secretions from coughing and sneezing (Centers for Disease 1). Epidemics tend to occur in the African meningitis belt during the dry season when temperatures drop at
night and people huddle together for warmth causing the contagious disease to spread (Chonghaile 2054). These epidemic cycles occur every 8 to 12 years but recently have been occurring sooner and more sporadically (“Meningitis” 2). Symptoms of meningitis include sudden onset of fever, headache, and stiff neck as well as nausea, vomiting, sensitivity to light (photophobia), and altered mental status (Centers for Disease 1). Without any treatment, half of those who contract this disease will die. Unfortunately, the scarcity of doctors and health care facilities in sub-Saharan Africa decreases the likelihood that those infected will actually seek treatment (Mills et al. 4). Yet even with treatment, 24 to 48 hours after of onset of symptoms, ten percent of infected people will die. Those who are treated and survive are often left with permanent damage such as mental retardation, deafness, blindness or other neurological disorders (“Meningitis” 2).

The impact of disease affects both the people and economy of these African countries. With 430 million people at risk throughout the meningitis belt, the impact of an epidemic can be catastrophic (“Meningitis” 2). When an epidemics occurs households and communities are left
devastated and depleted of their resources, exacerbating the pervasive poverty of these countries (Colombini et al. 1520). A study performed by Colombini et al. that focuses on Burkina Faso, a country located in the heart of the meningitis belt, reveals the true costs that meningitis has on households and communities. In 2007, the annual gross domestic product (GDP) per capita in Burkina Faso was US $268. This suggests that a household affected with meningitis will have to pay one third of their annual income to afford costs associated with the burden of disease. Those with sequelae, the aftereffects of disease, from meningitis spent anywhere from US $25 to US $154. Moreover, most people in Burkina Faso can only afford essentials such as food, shelter, and clothing. Therefore, with the impact of disease these people end up losing one of these basic necessities (Colombini et al. 1522).

In addition to the basic necessities that are lost when a meningitis epidemic occurs, the people and the economy of sub-Saharan Africa loose labor. Research performed by Bloom et al. introduced the term disability-adjusted life years, referred to as DALYS ("Geography, Demography, and Economic Growth in Africa" 228). DALYS are “the sum of life years lost due to premature mortality and years lived with disability adjusted for severity (Murray and Lopez 1436).” This term can represent quantitatively how people’s lives are affected by disease. In 1995, infectious diseases, like meningitis, accounted for 42.5 percent of lost DALYs in sub-Saharan Africa. A percentage that is much higher than most countries; the next highest percentage was 28.9 recorded for India (“Geography” 228). In 2002, the World Health Organization (WHO) estimated that there was about 891 DALYs recorded in Africa due to meningitis (Miller and Sentz 1). This research indicates that since sub-Saharan Africa is repeatedly affected by meningitis epidemics, these people are losing valuable productive years of their lives or worse, losing their lives. The study done in Burkina Faso by Colombini et al.
reveals that those who were employed, upon contraction of the disease lost an average of 21 work days. Similarly, the students infected with meningitis revealed that they had lost up to 12 days of school due to the disease (Colombini et al. 1522). Since people affected with meningitis oftentimes cannot work and have to pay for the cost associated with disease, the economy of sub-Saharan Africa suffers from minimal economic growth.

From Colombini’s research done in Burkina Faso, it is evident that disease increases loss of work and loss of education. Additional studies have been conducted to make similar connections that the effects of disease on a population will effect economic growth. The studies done by Bloom et al. reveal how quality of labor directly effects economic growth. Workers who are healthier will have more energy and therefore be more productive at work. This productivity then carries over into the overall productivity of the economy. This implies that the workers in sub-Saharan Africa are less efficient in their physical and mental capabilities when affected by disease (“The Effect of Health on Economic Growth” 1). Thus, workers are more unproductive leading to decreased economic growth. Research from Bloom et al. reveals how life expectancy also plays a significant role in the success of an economy. With each year added to life expectancy, the productivity rate of workers raised 4 percent in output towards economic growth ("The Effect of Health” 11). Although this percentage may seem insignificant, the quantitative difference in productivity may be the incentive needed in order to improve health care. An improvement in health care, specifically disease prevention, would lead to increased life expectancy. Consequently, increasing labor productivity and creating an overall benefit for the economy of sub-Saharan Africa.

At this time, sub-Saharan African economy is stuck in an unproductive and unrelenting cycle. Disease inhibits economic growth and decreased economic growth results in lack of
progress that could potentially decrease the prevalence of disease. For instance, not enough economic progress has been made in order to meet Millennium Development Goals (MDGs) and other antipoverty goals (Arieff et al. 6). To accomplish these goals vaccination of at risk populations, especially children, must be pursued (Fourn et al. 2). The MDGs include stated accomplishments to be reached by 2015 such as: reduce by two thirds the mortality rate among children under five, reduce by three quarters the maternal mortality ratio, and to halt and begin to reverse the spread of HIV/AIDS, and the incidence of malaria and other major diseases.

Unfortunately, Africa has made the least amount of progress, compared to any other region, to complete the MDGs allowing disease, such as meningitis, to persist (Arieff et al. 6). Completely the MDGs would mean sub-Saharan Africa would have reduced infant mortality, therefore increasing life expectancy (Fourn et al. 2). This reiterates the fact that longer life expectancy would increase economic development, but as for now a trend of disease and slow economic development is present if sub-Saharan Africa. Lack of technological investment, high population growth, and high rations of foreign debt to national income are a few of the limiting factors that make it difficult for sub-Saharan Africa to escape the unrelenting cycle (Arieff et al. 6). In order stop the cycle of slow economic growth Africa must take initiative to reduce disease in Africa, specifically meningitis, or to eradicate it completely.

The solution to improve the economy of sub-Saharan Africa is to vaccinate the population at risk for meningitis but the problem that persists is lack of funding. The cost of vaccination for meningitis is expensive and the donors needed to lend resources are limited. A campaign that targets only one million people costs around US $2 million, which does not come close to covering the 430 million people at risk throughout the meningitis belt (“Meningitis”4). The cost it took to control the meningitis epidemics during 2000 was close to US $160 million.
In 2000, the estimated price for a polysaccharide vaccine was US $0.55 for one dose (“Meningitis” 5). Although this price seems small, the price to pay for vaccination of an entire population is extremely high. If this price is not reduced no sub-Saharan country will be able to afford to fight against meningitis. The Secretary General for the Niger Ministry of Health stated, “Please, don’t give us a vaccine we can’t afford. That is worse than no vaccine (qtd. in “Meningitis” 6).” This statement is a prime example of how the poorest of developing countries tend to reject new vaccination projects without understanding their full potential. One dose can cost as little as US $0.40 but that price for immunity will not be paid unless medical associations begin to stress the importance of prevention (Cerminara 1).

It takes 40 cents per to give a person immunity from meningitis for ten years but it could give the economy of sub-Saharan Africa long-term improvement. With the help of a health care provider one dose can be given to each person living in sub-Saharan Africa which could directly affect their ability to be a part of the positive developments of the economy. Providing a vaccine will allow adults to have more productive days at work and for children to increase their days in school. These two factors alone would add a great deal of progress to the current economy. Education about these vaccinations needs to be voiced so that all people understand their importance. If sub-Saharan Africa continues to lack funding and health care providers remain scarce, there is no way that the economy in Africa can excel. However, if funding exists and there are professionals to administer vaccinations, the economy will have the chance to overcome meningitis and finally be able to thrive.
The Importance of Health Care Providers in Meningitis Vaccination Programs

Currently millions of people in sub-Saharan Africa are at risk for contracting meningitis which is a vaccine-preventable disease. However, the problem is that not all people at risk are being vaccinated. In order to eliminate meningitis from sub-Saharan Africa, millions of Africans need to be provided with essential pharmaceuticals at an affordable price and in sufficient quantities. Although there are some vaccination programs already in progress, they need to be made more efficient by effectively vaccinating more people. This will require national government to set aside part of their budgets in order to pay for vaccinations, especially during major epidemics. In addition to monetary issues, public awareness is crucial; specifically, education on the disease, as well as early diagnosis (Chonghaile 2055). Other obstacles, such as resistance to vaccinations, also exist along the road to eradication. Once these obstacles can be overcome, the people of sub-Saharan Africa can be vaccinated and the economy of Africa will be able to thrive. In order to accomplish eliminating meningitis epidemics, physicians, physician assistants, nurses and other health care providers will be necessary to educate the public and to administer vaccines.

The ideal approach to control epidemics in sub-Saharan Africa is to detect the disease early and then vaccinate the at-risk population. However, this course of action is not usually successful. To diagnose meningitis, a lumbar puncture must be performed. This requires inserting a needle into the lower spine in order to obtain a sample of cerebrospinal fluid which can them confirm presence of the disease. The problem with this method is that guidelines are based upon whether the disease is at an alert threshold or at an epidemic threshold. An alert threshold is when there are five cases out of 100,000 people versus an epidemic threshold is ten or fifteen cases out of 100,000 people (“Meningitis” 1). Only once an epidemic threshold has
been reached, then an investigation team is set to confirm the etiology, the cause, of the disease. Only after a confirmation has been made will the investigation team initiate an emergency response. In theory, this method should prevent 70 percent of cases, yet in reality it is slow and ineffective. During the epidemic of 1996 in Ghana, a study performed by Woods et al. showed that the mass campaigns only prevented 23 percent of the cases (“Meningitis” 1). Most of the time these campaigns are launched too late, only after the epidemic has subsided.

Recognizing an epidemic is the first step before vaccinations can be administered, but there are also obstacles that interfere with vaccination once an epidemic is detected. For instance, the Expanded Program of Immunization (EPI) fears that religious arguments will prevent the effectiveness of routine vaccinations (Fourn et al. 2). In addition to religious beliefs others have mixed feelings about vaccinations due to any post-immunization detrimental effects and defective vaccination services. Negative rumors can also increase a population’s reticence towards vaccination. A study done by Fourn et al. revealed some opinions of reticent individuals who had adverse emotions to vaccines due to religious beliefs. One mother had stated that “It is the vaccines that make our children sick (Fourn et al. 6).” Other parents insisted on their beliefs because they viewed vaccination “as the white witch doctor’s work,” or in other words the Devil’s work (Fourn et al. 7). A solution to make parents like these allow their children to be vaccinated is to educate them on the benefits of immunization. Public awareness can be increased by placing advertisements in newspapers and other means of local media (Chonghaile 2055). However, for those who are illiterate, words of mouth is the most efficient solution. Fourn et al. suggests using a resource person of the same religion to education other members, or similarly a person who would be trusted within the community (8). Once a small group of a
religious sect is educated, positive attitudes of vaccination can be spread throughout communities allowing an increase in immunizations to occur.

Although, vaccines should be safe and beneficial, the health care environments, as well as the unskilled workers, that are present in sub-Saharan Africa need to be improved to provide optimal care. Each year an estimated 8 billion to 12 billion injections are administered throughout the world, but only half of these injections are believed to be safe and contaminate-free. In developing countries, like those in sub-Saharan Africa, many of these injections use syringes multiple times. By using the same needle for several patients this increases the chance of spreading infectious diseases such as hepatitis, HIV, and other blood-borne pathogens (Miller and Sentz 5). These are the undesirable occurrences that lead to rumors and detrimental impacts of vaccinating populations. To prevent incidences like these trained health care providers must be used to administer vaccinations. In 2007, the Global Alliance for Vaccines and Immunization (GAVI) announced that they planned to train additional health workers in developing countries, especially in Africa, in order to promote proper implementation of vaccination programs. Doctors working in sub-Saharan Africa often move to the United States or Europe in order to finding higher paying jobs. However, GAVIs plan is to train professionals such as paramedics to administer vaccines. This plan is cost-effective because, paramedics trained in administering vaccines, will most likely not be in high demand in other countries that would pay better wages (Piller 2). The quality of health care in sub-Saharan Africa is deteriorating without the help of trained medical professionals. By implementing a program that will bring them back, this will be able to revive and sustain their health care systems and also allow more meningitis vaccines to be distributed.
While financial obligations continue to be a problem for both health care providers and government systems, there are ways in which meningitis can still be prevented and treated. Providing non-financial rewards to health care providers such as career progression, availability of facilities and materials are some ways to retain staff. In addition to retaining staff, these methods can also be useful in recruit new staff members (Mills et al. 7). Even though evidence reveals that doctors and nurses are leaving sub-Saharan Africa for better financial opportunities, health care organizations such as Doctors Without Borders/Médecins Sans Frontières (MSF) can fill this void. MSF is an international medical humanitarian organization that provides aid to countries in need. Their organization consists of people who are doctors, nurses, epidemiologists, laboratory technicians, and others medical professionals (“About MSF” 1). MSF has responded to epidemics in the meningitis belt by detecting the epidemic and treating those infected. Although, meningitis can be treated, MSF’s concern is prevention of meningitis through vaccination. In 2007, MSF was able to vaccinate over 700,000 people in the meningitis belt within several weeks (“MSF Responds” 1). In addition to providing essentials materials, the members of MSF play an important role in training other staff members to identify and treat meningitis. In their most recent efforts towards vaccinating people of sub-Saharan, MSF has supported WHO’s vaccination campaign, the Meningitis Vaccine Project (MVP) (Cerminara 1). The help that MSF provides is essential for vaccine implementation and should set an example for other organizations in order to obtain more health care providers to participate in vaccination programs.

In 2001, WHO launched MVP in hopes to be the solution to the outbreaks of meningitis epidemics in sub-Saharan Africa. WHO’s plan is to eliminate the epidemics of meningitis in Sub-Saharan countries by using a meningococcal conjugate A vaccine, called MenAfriVac.
WHO estimates that the project will take about a decade to complete. Their strategy includes two parts: mass-vaccination and integrating into routine childhood vaccination programs. The mass vaccination campaign would immunize one- to 29-year olds with a single dose of the MenAfriVac allowing rapid immunization amongst large populations. The bigger challenge is incorporating the MenAfriVac into infant immunizations. In spite of these challenges, with the help of donor agencies and the commitment of public health organizations, MVP can be accomplished by preventing epidemics of meningitis throughout sub-Saharan Africa ("Meningitis" 1).

Clearly, it is critical to have a well-trained staff of health care providers to take care of those affected by meningitis. Without these individuals, thousands more people in sub-Saharan Africa would be left untreated and die. Additionally, if more medical professionals can put forth the time and effort to administer vaccinations then the people living in sub-Saharan Africa would acquire immunity and would not be affected by meningitis. The impact that is made by vaccinations is profound. MenAfriVac has the potential to eliminate one of the largest public health problems in sub-Saharan Africa. However, it is not only the health care providers that play a significant role but it is also those who provide funding for vaccine campaigns. If both of these organizations work together their synergistic effect will boost the economy of sub-Saharan Africa and save thousands, maybe even millions of lives.
Niger’s Response to Meningitis and Vaccination Programs

The country of Niger, located in sub-Saharan Africa, is one of poorest countries in the world and for 100 years has been struggling against meningitis epidemics. This country is located right in the center of the meningitis belt and due to lack of resources it suffers greatly every time an outbreak occurs. The health care system is very poor and cannot provide efficient treatment for all of its citizens. As of 2004, there were only 377 doctors in Niger. This indicates that there is less than one doctor for a population of 10,000 people. For people who live in rural areas, their health care resources are even more limited. Although the EPI estimates that half of the children of Niger are vaccinated, this percentage is most likely inaccurate and overestimated (“Vaccine Introduction” 1). Niger is attempting to improve their quality and accessibility of health services, yet more improvement is needed in order to eliminate outbreaks of vaccine-preventable diseases, such as meningitis.

In Niger, many factors, such as lack of resources, malnutrition, and poverty, correlate with the high prevalence of meningitis and the lack of vaccination. Although Niger is the third largest global producer of uranium, this is not enough to sustain their economy. Even though the population of Niger is about 14 million, the country has a relatively unproductive economy and relies upon donations to keep their government running. Due to such a high poverty rate, most cannot afford schooling, which leads to many uneducated children (“Vaccine Introduction” 1). Studies also indicate that children under the age of five in Niger on average only visit a health care provider less than one time a year (Mills et al.3). This implies that most families are uneducated about disease, such as meningitis, and if affected, few will seek necessary medical treatment. As a result of malnutrition, lack of medical treatment, and other factors such as contaminated water supplies, life expectancy is only 42 years for men and 43 years for women.
In Niger, a little less than half of the children are underweight and malnourished and poverty is endemic. Research conducted by Gessner et al. from the 1980s to 1996, indicate that Niger had the highest rates of *Streptococcus pneumoniae* meningitis under the age of one year old when compared to Burkina Faso, Senegal, and Ghana. Furthermore, individuals ranging in age from 40 to 49 were more than 50 percent likely to die after contracting meningitis. The research performed by Gessner et al. reveals how devastating meningitis can be without prevention, treatment, or proper education about the disease (5). Considering that both populations of young children and the older populations of Niger are at great risk during epidemic outbreaks it is highly important to improve vaccinating these populations at risk.

Although Niger made attempts to prevent meningitis outbreaks, there were still thousands of people suffering from this disease. In 2009, the largest epidemic swept through the meningitis belt since 1996. This epidemic greatly affected Niger producing a total of 12,604 meningitis cases and 510 deaths (“Meningitis in Chad, Niger, and Nigeria” 60). During this study, Niger was able to collect the most samples of cerebrospinal fluid (CSF) in order to test for etiology. Once confirmation through testing was made, Niger sent requests to the International Coordinating Group on Vaccine Provision for Epidemic Meningitis Control (ICG) for vaccines. As a result, Niger received a totally of 3.5 million doses and even before the outbreak occurred the country had been prepared with a stockpile consisting of about 920,000 doses. Unfortunately, most of affected districts received doses of the vaccines at the peak of the epidemic or after the peak. Although it seemed that Niger was well prepared and equipped to deal with an outbreak of meningitis, damage was still widespread and more could have been done to prevent any detrimental effects. In order for Niger to have produced an effective campaign there should have been adequate quantities of vaccines, better coordination and supervision, and increased
monitoring of distribution of antibiotics (“Meningitis in Chad, Niger, and Nigeria” 63). Like many other countries in the meningitis belt, Niger was in dire need for a better vaccination approach during the outbreak of an epidemic.

As a result of the 1996 meningitis epidemics, WHO recognized the need for an improved vaccination program. With the help of funding from the Bill and Melinda Gates Foundation, WHO was able to launch the Meningitis Vaccine Project in 2001. Less than 10 years later, MVP was finally introduced to Niger in 2010. In the beginning weeks of June, the national introduction committee of Niger met with representatives from the WHO in order to introduce the vaccine and begin distributing resources. WHO understood the implications of educating people about the vaccine so within the same month workshops in Niger were held to focus on communication issues in order to allow a fluid introduction of the MenAfriVac (“MVP Newsletters” 1). On December 10th 2011 the MenAfriVac campaign was officially launched in Niger by the Prime Minister, Mahamadou Danda. A large staff of 5,000 was needed to administer vaccines to almost three million people in only 10 days. This large quantity of health care providers demonstrates their vital importance during meningitis epidemics. Even after the meningitis season ends around the month of June, Niger plans to continue to vaccine the remaining population of some 8 million 1-to 29- year-olds. Since September of 2010, the MenAfriVac was administered to 19.5 million people throughout Burkina Faso, Mali, and Niger (“MVP Newsletters” 1). If by April of 2011 these countries demonstrate real benefits from the vaccination, this will provide much incentive for other donors to fund more extensive campaigns against meningitis (“MVP Newsletters” 1). However, no one has come forth to fund vaccination programs in the remaining 22 countries. Without financial support, the vaccine will not be able to prevent meningitis outside of the Burkina Faso, Mali and Niger (Cerminara 1).
The goal MVP is to eliminate meningitis epidemics from sub-Saharan Africa. So far, the introduction of the MenAfriVac to three countries has showed promise, yet there are still many countries that require vaccination. With the help of health care organizations such as Doctors Without Borders (MSF) and other health care providers, vaccines can be administered to the people of sub-Saharan Africa. One major advantage of this vaccine is that it has the ability to provide immunity for up to ten years and prevent transmission of the disease within a population which could essentially prevent epidemics (Cerminara 1). However, financial barriers still prevent the vaccine from being provided to all 430 million people at risk. Although it may not be evident to funders, but the benefits that MenAfriVac would provide would by far surpass its financial burden for the entire continent of Africa.

More organizations capable of making a monetary contribution need to come forward, if not the remaining countries without the help of MVP will weight down the rest of the continent’s economy. MVP predicts that with the introduction of the MenAfriVac could actually save $US 192 per every DALY that is avoided (“Vaccine Introduction” 1). This means that the people of sub-Saharan Africa could begin to see improved living conditions and the economy would also begin to see increased growth. DALYs represent quantitatively how people’s lives are affected by disease (Murray and Lopez 1436). Therefore, if DALYS are decreasing then this implies that productive years of life will increase. The more productive years individuals in sub-Saharan Africa have, the more they will be able to input towards economic growth. Dr. Tido von Schoen-Angerer, director of MSF's Access Campaign stated “We cannot afford to miss the opportunity to tackle such a deadly disease (Cerminara 1).” Truly, sub-Saharan Africa cannot afford to leave their people unvaccinated. Without implementation of a vaccine that costs less than 40 cents per
dose, the economy of Africa will continue to remain inferior to the rest of the global economy (Cerminara 1).
References


