Malnutrition and Diseases Affecting the Children of Uganda

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Abstract

Every day there are children in underdeveloped countries, such as Uganda, who are struggling to survive on minimal food, money, and other resources. These children do not have the opportunity to enjoy the benefits of a normal childhood because their main focus is on survival. Many of these children will die because of preventable disease and starvation that have resulted from the endless cycle of poverty and lack of education. Those who are lucky enough to survive must fight a daily battle to find the nutrients they need and to combat the diseases they may acquire. It is heartbreaking to know that the lives of so many children are being needlessly cut short due to circumstances beyond their control. If they were assisted, their self-sufficiency may increase and overall quality of life may be improved, including that of future generations. In order to better understand these concepts, this paper will focus on identifying the main health concerns affecting the children of Uganda, with a main focus on children <5 years old. The causes and effects of these health concerns will be explained to demonstrate the need for improved healthcare. This paper will also address ways to treat and prevent this growing problem including the benefits of improving healthcare.

Malnutrition and Diseases Affecting the Children of Rural Uganda

The health of the children in Uganda is affected by the lack of education they receive on health, by poor nutrition, poor sanitation, lack of clean water, and lack of immunizations: "As a general rule, health status is inversely related to wealth. The poorer the country, the more likely its citizens suffer from preventable disease and early death" (Maurer, 2005, p. 108). Therefore in underdeveloped countries, such as Uganda, the primary cause of death involves easily preventable infectious diseases. These diseases can typically be controlled by improving sanitation, immunizations, and health education programs. In underdeveloped countries only 65% of children have basic childhood vaccinations, which leave 1.3 million children dying each year from vaccine-preventable diseases (Maurer, 2005). Uganda has a total population of approximately 33.6 million people, and half of these are between the ages of 0-14. Only 8.2% of the gross domestic product (GDP) is allocated toward health expenditures, and there are only 0.117 physicians available for every 1,000 people in Uganda (Central Intelligence Agency [CIA], 2012). In 2010, the estimated mortality rate for children aged five and under was about one out of every ten. This paper will focus on the health of children aged five and younger. According to a study by the United Nations International Children's Emergency Fund (UNICEF) done between 1992 and 2007, approximately 52% of the people in Uganda live below the international poverty line of $1.25 (U.S. dollars) per day (United Nations Children's Fund [UNICEF], 2010). Only 3.2% of GDP is allocated to educational expenditures (CIA, 2012), and it is the lack of education that plays a big role in the endless cycle of poverty. People living at this level of poverty lack the resources to

grow their own food, buy food, and access healthcare. The ones most affected by poverty are children. Many children in Uganda are orphaned at a young age, forcing them to raise themselves and their siblings on their own. Their young age and lack of resources make them more susceptible to malnutrition, disease, and death. Diseases most often affecting these children include diarrheal diseases, malaria, tuberculosis, and HIV/AIDS. Children already have an underdeveloped immune system, and when that is combined with their malnutrition and impoverished environment, it places them at a higher risk for contracting diseases.

Malnutrition

Despite the advances in medicine, government, and technology, there are still some problems that the world faces which no one has been able to solve; one of these problems is hunger. Even though the world has an abundant supply of food (more than enough to feed the world's population), there are still those who go to sleep night after night with nothing to eat. According to Dushanbe of IRIN news (2009), "Hunger, in most cases, is caused by lack of money rather than a shortage of food production, according to the World Food Program (WFP). In 2008, the number of undernourished people in the world increased by 40 million, despite record harvests" (para. 4). Even the poorest of Americans are still rich compared to poverty-stricken countries. The United Nations has developed a list of Least Developed Countries (LCD) using three criteria: low-income, human resource weakness, and economic vulnerability (Nations Online, 2010). One of the countries included on this list is Uganda: "over 50% of Uganda's children under-five

still suffer from some form of malnutrition, directly and indirectly contributing to up to 60% of child mortality" (Matsamura, 2010, para. 2).

For the purpose of this thesis, malnutrition will be defined "as a pathological state resulting from inadequate nutrition, including under-nutrition (protein-energy malnutrition) due to insufficient intake of energy and other nutrients" (Chang & Ge, 2001, para. 1). The lack of healthcare in underdeveloped countries has resulted in malnutrition, which has led to stunted growth, lowered intelligent quotients, and other physical disabilities. This is especially true for the children, because they are in a state of growth which means their bodies proportionately need more essential nutrients in order for them to grow and develop properly. These children not only suffer from a reduced growth rate, but the lack of nutrients in their diet also results in a weakened immune system, leading to more serious physical problems. Some of the effects of malnutrition include: thin dry skin, thin hair, tender/sensitive joints, anemia, vision problems, and either an extremely thin or bloated appearance. Once someone has lost 40% of his body weight, the problem has become irreversible and inevitably results in death, mostly from heart failure, electrolyte imbalance, and low body temperature. Depending on the type of malnutrition, some children are able to have a full recovery; others suffer from long-term complications. Younger children are more susceptible to malnutrition because they are dependent on others and their developing bodies require more nutrients ("Malnutrition," 2010).

Malnutrition has many different factors that contribute to its cause. Individuals do not have access to an appropriate diet or healthcare mostly due to poverty. Even though

Uganda produces a lot of food it is not equally available throughout the country. There are some people who have access to food; however, their lack of nutritional knowledge results in a diet that is not diverse enough to meet the different nutritional needs of their family members. The lack of access and/or education about sanitation and hygiene affects nutritional status. The frequency of pregnancy leads to multiple children without access to the means to properly care for them. Although the government has established some help to the people, they have not invested enough in nutritional programming and aid at the community level. As mentioned previously, only 8.2% of Uganda's GDP is allocated to healthcare. (Food and Nutrition Technical Assistance [FANTA], 2010a).

Types of Malnutrition

The nutrients are broken up into several categories depending on how they are used by the body. Carbohydrates and fat supply the body with needed energy, proteins are necessary for most body functions, and vitamins and minerals aid the body's immune system. The human body is designed in such a way that each of these nutrients is needed in the right proportions in order to function at a normal, healthy level. These nutrients are obtained from a diverse and balanced diet without which can result in serious health problems (FANTA, 2010a). Undernutrition can result in either growth failure or various micronutrient deficiencies. Growth failure can be classified as either malnourishment (low weight-for-age), acute malnutrition wasting (low weight-for-height), or chronic malnutrition stunting (low height-for-age) (UNICEF, n.d.). Almost 75% of children have iron-deficiency anemia and 20% lack adequate Vitamin A. One in every ten children born in Uganda is already malnourished (FANTA, 2010a). It is estimated that 14% of infants

were of low birth weight (less than 2,500 grams) in 2010, 38% of children less than five had stunted growth, 6% suffered from wasting(low weight-for-height), and 20% were moderately to severely malnourished (low weight-for-age) (UNICEF, 2010). Due to the many types of malnutrition, this paper will mainly focus on those most common in Uganda which includes malnourishment, stunting, and iron and vitamin A deficiencies.

The nutritional requirements needed are determined on an individual basis depending on a number of factors such as age, sex, present health, environmental conditions, and level of physical activity. Malnourishment reflects a low weight-for-age and takes into consideration what is termed "normal" for both height and weight for that particular age. A child that is exposed to chronic malnourishment and/or disease will likely have stunted growth. Stunting can begin even before birth due to poor maternal nutrition. If the child does not have access to enough nutrient-rich foods or is exposed to some type of illness, this stunting will continue and will become permanent around two to three years of age. This child will appear normal in terms of body proportions; however, he will look much younger than his actual age. To have the greatest impact on stunting, there needs to be nutritional interventions during pregnancy and early childhood from birth to 18 months which is considered the most critical period of growth (UNICEF, n.d.).

Micronutrient deficiency diseases can be just as severe as macronutrient deficiency diseases. Even though the body only requires a small amount of micronutrients, they are still essential. Without them, certain diseases and conditions can occur. Most people in underdeveloped countries suffer from a deficiency in iron, vitamin

A, and iodine. Iron is a necessary part of the blood, and if not enough is present, it can result in iron-deficiency anemia. Anemia is considered severe once the hemoglobin level drops below 7.0g/dl. Signs of iron deficiency include paleness, fatigue, headaches, shortness of breath, and pale eyelids, palms, and tongue. A deficiency in vitamin A can cause xerophthalmia (eye disease), as well as, weaken the immune system and amplify the severity and mortality of measles and diarrheal disease. Xerophthalmia can affect the eyes in several ways depending on the severity including night blindness, Bitot's spots (dry, foamy collection on the inner eyelid), keratomalacia (softening and ulceration of the cornea), and corneal xerosis (dullness or clouding of the cornea) (UNICEF, n.d.). Keratinization, which can cause hard, bumpy spots on the skin or intestinal malabsorption, is another result of vitamin A deficiency. The hormone thyroxine is made from iodine, which regulates growth and basal metabolic rate (BMR). A lack of iodine can lead to a goiter, which is an enlargement of the thyroid gland. A goiter can result in difficulty swallowing and breathing. If a developing fetus has an iodine deficiency, the fetus may suffer from mental retardation or even death (Torpy, 2004).

Macro and micronutrients found in foods are not the only nutrients the body requires; in fact, the most vital nutrient to the human body is water. The majority of the human body is made up of water. Water serves several indispensable functions. Water carries nutrients throughout the body, cleanses tissues and blood of wastes, aids in body temperature regulation, participates in chemical reactions, and many more functions. Dehydration can result in weight loss, loss of kidney function, decreased mental and physical functioning, thickened blood, seizures, and death. Unfortunately, people in

underdeveloped countries have to face not only the lack of water but also water contamination (Sizer & Whitney, 2008).

Treatment

The treatment for malnutrition typically depends on the severity of the situation and the age of the child. When children are first admitted for malnutrition, the severity of their status must be evaluated. Special diets must be developed for each of these children so that their bodies can obtain the proper amount of nutrients needed for their recovery. Even for healthy people, most nutrients are not to be given in large quantities. When replenishing the body's supply after a long period of deficit, special attention must be given to the amounts so as not to overdose the body with an amount that it is not able to handle. The goal is to achieve a slow, steady gain in weight. A multivitamin is usually given once the child is in the recovery stage. Most cases of malnutrition can be treated through out-patient care and only the most severe cases, or those which involve other medical complications, are admitted to hospitals. Because there are so many types of malnutrition each of these children would have to have a treatment plan that is individualized to their specific needs (Mother and Child Nutrition, 2009).

Education and Prevention

Many parts of Uganda have fallen into an unending cycle of poverty which has resulted in the premature death of many children. Poverty has been found to be both a cause and an effect of malnutrition. Every 1% increase in malnutrition leads to a 4% increase in poverty. Overall, Uganda's GDP has suffered a yearly loss of about 4.1% which can be attributed to malnutrition. This loss is the result of the decreased

productivity of workers due to their malnutrition and the time many workers must take off to care for sick and malnourished family members. The reduced growth of children as the result of malnutrition has had a negative effect both directly and indirectly on school performance. Stunting often attributes to late enrollment in primary school, and even then, many students struggle due to the lasting effects of malnutrition on brain development. In 2008 only 56% of students completed their primary school education. This lack of education affects the number of available work opportunities later in life which again leads to poverty and malnutrition thus continuing the cycle (FANTA, 2010b).

Some factors of malnutrition are easily prevented by providing an adequate source of the nutrient in need. Micronutrient deficiency diseases, especially, can be prevented by consuming foods that are rich in that specific nutrient. The major micronutrient deficiencies discussed earlier can be prevented by increasing leafy green vegetables, beans, and red meats (for iron deficiency) and fruits and vegetables (for vitamin A deficiency). Iodized salt, seafood, or locally grown plants should be added to the diet to prevent iodine deficiency. Breastfeeding is another way to prevent vitamin A deficiency. Medical clinics need to be set up by the government and other outside organizations to provide the people with supplements needed to replenish their nutrient deficiencies. (Mother and Child Nutrition, 2012).

Uganda has attempted to prevent micronutrient deficiencies by fortifying certain commercialized foods. Currently, the foods most often fortified are salt with iodine, vegetable oil with vitamin A, and maize and wheat flour with iron and folate. The process

of food fortification, however, can only provide a fraction of the required daily amount of the nutrient. Another issue arises due to the lack of access to these commercialized foods resulting from either a lack of money or a lack of access, such as in rural areas of Uganda. Another attempt to provide the people of Uganda with the necessary nutrients is through a process called bio-fortification which enhances food crops with additional nutrients. This selective breeding of crops combines high-nutrient crops with high-yield crops in order to create high-yield crops that also high in nutrients. Examples of these bio-fortified crops include vitamin A-rich orange-fleshed sweet potatoes and high-quality protein maize (FANTA, 2010a).

Deficiency diseases can be prevented by teaching the people which foods they need to concentrate on eating more. Most of the time, however, the resources are not available to put this information to use. Without the support of the government in creating nutrition education programs, or providing the money and means to increase the health of the population, the only other way to prevent malnutrition is with the help of outside organizations. There are several of these organizations that have made it their purpose to help children, such as those who are suffering from malnutrition in underdeveloped countries. Some organizations provide monetary support, while others send medical personnel and supplies to those countries in need. UNICEF, Doctors Without Borders, and WorldHelp are just a few of the agencies that have devoted their resources to helping these starving children:

> Reducing malnutrition in Uganda would require concerted effort and planning, including putting in place the right leadership for multisectoral/interagency

> collaborations, joint action planning, and mobilizing resources to implement strategies and plans. In the short term, Uganda could scale up behavior-changing interventions that raise awareness about nutrition to improve infant and young child feeding practices, improve hygiene and sanitation practices, and reduce the disease burden, and improve dietary diversity. Uganda could also provide incentives for the private sector to invest in nutrition...The government should be willing to increase the financial resources earmarked for nutrition and to mobilize additional resources from development partners. (FANTA, 2010a, p. 5)

Water and Sanitation Issues

Contaminated water contains countless parasites and diseases that, if consumed and left untreated, will inevitably lead to the death, especially in children:

> Nearly 1 billion people in the world lack access to clean water. This causes over 1.6 million unsafe drinking water deaths every year, and the majority are children. Every day, nearly 4,500 children die from water-related illnesses such as diarrhea, malaria, typhoid, cholera, worms, and parasites. (Cause Life, n.d., para. 1)

Only 64% of Uganda's rural population has access to clean drinking water, and only 49% have access to improved sanitation facilities (UNICEF, 2010).

Contaminated Water

The WHO/UNICEF Joint Monitoring Program (JMP) reported there are still 780 million people (almost one-tenth of the world's population) who do not have access to improved drinking water, and 2.5 billion people do not have any form of improved sanitation available. The JMP defines improved drinking water as that which is shielded

from outside corruption. There is, however, a disparity in the accuracy of the number of people who have access to "improved" drinking water due to a lack of education on how to maintain these water sources. There are still 187 million people who are using ponds, lakes, and rivers as a water sources which contain countless parasites, and if left untreated, will cause many life-threatening diseases. The remaining 593 million use unprotected wells and springs (WHO & UNICEF, 2012).

The job of many women and children in the villages is to travel to the local water source, which can sometimes be several miles away, to collect containers of water which they then carry back for their families. These journeys take place each day and are necessary for the survival of each family. Unfortunately, the same act that is necessary for survival is also responsible for many deaths. "Diseases from unsafe water and poor sanitation are responsible for half the deaths in children under five in Uganda. In fact, over 2 million unsafe drinking water deaths occur in the world each year and the majority are children" (Yeatts & Brewer, 2009, p.15). An original study performed by the "Village Health Project" in the Lyantonde and Kiruhura districts of rural Uganda revealed that over 90% of unboiled samples of water (from shallow wells, dams, lakes, etc.) and 44% of boiled samples (thought to be due to placing the boiled water back into contaminated containers) were contaminated with E. coli. All of the samples taken from rainwater collection tanks were negative for E. coli (Klink, 2007).

Diarrheal Disease

Diarrhea is an intestinal disorder characterized by the frequent (three or more) passage of loose or liquid stool. Diarrhea is a common result of an intestinal infection,

which can be caused by a wide range of bacteria, viruses, or parasites (Rotavirus and E. coli being the most common). This infection is easily spread through contaminated food or water or between people due to poor hygiene. There are three types of diarrhea: acute watery diarrhea (lasting hours to days), acute bloody diarrhea (dysentery), or persistent diarrhea (greater than fourteen days). According to the WHO (2009), "diarrheal disease is the second leading cause of death in children under five years old, and is responsible for killing 1.5 million children every year…80% were less than 2 years old" (Diarrheal disease section, para. 1). Children, particularly malnourished children, are at the greatest risk for contracting life-threatening diarrhea due to their underdeveloped immune systems. Severe diarrhea lasts for several days, causing a major loss of fluid and electrolytes. The actual cause of death in people who suffer from these diarrheal diseases is extreme dehydration. There are no signs or symptoms in early dehydration. If no fluid replacement is given, moderate dehydration will develop, which is characterized by thirst, restlessness/irritability, decreased skin elasticity, and sunken eyes. If allowed to progress even further, symptoms become more severe resulting in shock, a decreased level of consciousness, low urine output, cool moist extremities, weak rapid pulse, low blood pressure, and pale skin, which are indications of severe dehydration (WHO, 2009).

There is a three-fold treatment plan for dehydration secondary to diarrheal disease. Oral rehydration salts (ORS) are needed for moderate to severe dehydration, which consists of a combination of clean water, salt, and sugar. This is a simple, inexpensive solution which can be prepared anywhere. Oral rehydration salts replace the water and electrolytes lost as a result of diarrhea. In cases of severe dehydration,

intravenous (IV) fluids may also be needed to achieve adequate rehydration. Zinc supplements have been found to decrease the duration of diarrheal illness and the amount of liquid stool, which will reduce the level of dehydration. Providing nutrient-rich foods also helps to treat the deficiencies that result from diarrhea. Education is a key element to preventing diarrheal deaths. There are several basic prevention methods that can aid in decreasing the number of deaths resulting from diarrheal diseases. Providing access to safe drinking water, adequate sanitation, and a rotavirus vaccine will help to prevent diarrheal diseases. Educating the people on how these infections are spread will help them to take the proper precautionary measures, which include teaching them about personal and food hygiene. Since most diarrheal deaths occur in children less than two, education should be provided to pregnant women and mothers of newborns. Exclusively breastfeeding for at least the first six months of life will help to enhance the infants' immune system aiding them in fighting off infections (WHO, 2009).

Sanitation Issues

Sanitation issues involve many different areas including: the safe collection and disposal of human waste (feces and urine), management and recycling of solid waste (trash), and the collection and recycling of water. A key to solving the sanitation crisis is to realize that progress can be made by making small significant changes to improve conditions. It is not enough to merely provide appropriate facilities for the people in need. They must also learn the importance of using them; therefore, with each change made to sanitation standards, teaching must also be provided on hygiene and why it is necessary. Just by increasing hand washing education, diarrheal diseases can be reduced by up to

45%. If this crucial step is not addressed, then even with the appropriate facilities, the people may not choose to use them because they do not understand their importance. Both children and adults need to understand that a lack of proper disposal of their excrement has dire consequences on their health. This kind of awareness needs to be spread at both the household and community levels (WHO, 2005). The WHO estimates that for every dollar invested in improving sanitation and water conditions, there will be a $3-$34 return depending on the region. It would take an increase of $11.3 billion a year to provide clean water and improved sanitation standards to half of the people worldwide who need access to it. This would in turn drop the rate of diarrheal disease by 10% and produce an $84 billion return on the investment. This return in investment is calculated by factoring the money and time saved from not getting sick. The patients do not have to spend money on medical expenses, the hospitals do not have to provide costly treatments, and the parents are able to continue working, which benefits both their family and their employer. The amount of time saved by providing easier access to water and latrines is also factored in due to the increase in productivity and school attendance (WHO, 2004).

Ways to Improve Sanitation

As for clean drinking water, the solution is quite evident, dig a well. World Help is a Christian organization that leads a program called “Cause Life” which does just this. They raise money to dig wells in developing countries and provide them with clean drinking water. By providing clean drinking water, the people are not only saved from death, but it also helps them to escape the cycle of poverty. Families in underdeveloped countries rely on water for survival, therefore, people will travel long distances to get the

water they need to provide for their families. Most of the time children are given this responsibility which results in them not being able to attend school, either because they are getting the water or have fallen ill due to drinking the dirty water. This process results in a cycle of never-ending poverty which leads to future generations suffering from malnutrition and disease. By simply giving the people a long-term source of clean water, their lives can forever be transformed (Cause Life, 2010).

Due to the expensive nature of clean water wells, many rural areas do not have access to clean drinking water making them extremely susceptible to many different kinds of diseases. A much cheaper water filter, called a biosand filter, was developed by Dr. David Manz in the 1990s which provides rural communities with access to clean drinking water for 12-75 USD. This filter has several layers, each of which serves a specific purpose in water filtration. Any kind of contaminated water source (ponds, rivers, rainwater, etc.) can be poured into the filter with the exception of water that contains chlorine and other chemicals. Studies on the biosand filter have shown that it can successfully filter out up to 100% of helminthes (worms), up to 100% of protozoa, up to 98.5% of bacteria, 70-99% of viruses and can also remove up to 95% of turbidity and iron. Water is poured into the container which has a tight-fitting lid that keeps pests and other source of contamination out of the filtration system. The water then slowly passes through a diffuser, which allows water to enter the filtration without damaging the layers below. Below the diffuser there is about a 5cm space for standing water that will first pass through the 2cm “biolayer” which consists of microorganisms and bacteria which eat away many of the contaminating pathogens. The biolayer is the most important aspect

of the filter and may take up to thirty days to establish before reaching maximum effectiveness. This layer is very sensitive, requiring an oxygen source to survive which is the purpose of the standing water. The standing water allows the dissolved oxygen within the water to be this source of oxygen. It is important the standing water be as close to 5cm as possible to provide adequate oxygenation and avoid evaporation in the usually hot environments. After the water progresses through the biolayer, it will then be processed in the filtration sand which traps pathogens and other solids. Next, there is a layer of separation gravel which just keeps the filtration sand in place so that it does not leave the filter. The final layer consists of drainage gravel which also provides support for the layers above and allows only water to enter the outlet tube. The filter works by gravity and as the water is filtered it will begin to travel up the outlet tube and into a clean water storage container. The design of this filter must also allow only 0.4 liters to filter per minute in order to maintain the proper amount of filtration; all together 12-18 liters of water can be filtered through this system in approximately one hour. To keep the system working at optimal function, it is recommended that the user wait at least one hour between re-filling the filter and no more than two days between uses (Center for Affordable Water and Sanitation Technology, 2011).

The lack of clean water, sanitation, and basic hygiene is the cause of 1.6 million deaths each year. There are an additional 1.8 million people who die from diarrheal diseases each year because of their lack of appropriate water, sanitation, and hygiene, 1.62 million of those are children under the age of five. Studies show that improving sanitation can reduce the number of deaths caused by diarrhea by up to 32%. By

providing hygiene education and encouraging hand-washing, there was up to a 45% reduction in cases of diarrheal diseases. Additionally, providing clean drinking water will reduce up to 40% of diarrheal cases. These statistics alone reveal the importance improving these three resources. If everyone worldwide had access to proper sanitation and clean water, it would lead to an additional annual income of 260 billion dollars, due to the time saved and increased productivity associated with the decrease in illness (WHO, 2005).

Diseases

It is suggested that 75% of the disease burden in Uganda is preventable (Ministry of Health Uganda, 2010). According to the World Health Organization, malaria is one of the leading causes of death in children of Uganda, with most deaths occurring in children under five years of age. There are many ways to prevent death by malaria, such as early detection and providing protection by sleeping under insecticidal nets. Unfortunately, many rural areas do not have access to protective equipment (WHO, 2012d). Uganda has one of the highest infection rates of tuberculosis (TB) in the world, with only a little more than 50% early detection rate. The World Health Organization also reports that more than two million people in Uganda are infected with HIV, with one million dying from AIDS. Half of those affected with TB also have HIV (WHO, 2006).

Malaria

Four forms of malaria are caused by *Plasmodium vivax, P. ovale, P. malariae,* and *P. falciparum. P. falciparum* is the most malignant form of malaria, killing up to 50% of people who contract it. The mosquito *Anopheles* is a vector for which the

protozoan *Plasmodium* is delivered to a new host. *Plasmodium* is in the saliva of the mosquito and is in the sporozoite stage during transmission. The protozoan invades the bloodstream and within 30 minutes, it enters the liver where it begins its reproductive process called schizogony. The sporozoite develops into merozoites, which form into a ring stage and continue to divide producing more merozoites until the red blood cell (RBC) ruptures, causing them to travel throughout the body infecting more RBCs. Each RBC then becomes the new site of reproduction for the merozoites. Approximately 48 hours after a RBC is infected, it then ruptures, releasing the resulting merozoites (around 20) into the bloodstream continuing the chain reaction. Some merozoites can develop into gametocytes, which are harmless within a human host, although, the gametocytes can be transferred to an *Anopheles* mosquito while feeding on an infected human. The protozoans will then go through sexual reproduction within the mosquito and continue the spread of infection (Tortora, Funke, & Case, 2010).

The water source used by people of rural Uganda is often a standing pond of water, which is also used by the local wildlife and is abreeding ground for disease-carrying mosquitoes. According to Yeatts (2009), “during the rainy season, people in some areas of Africa can receive up to 100 infectious mosquito bites per month” (p. 17). Once this parasite invades the body, it begins to destroy red blood cells (RBCs) causing anemia and weakness. These RBCs then begin to attach to the vessel walls, causing reduced blood flow and tissue hypoxia. Since the cells are not circulating, they are unable to travel to the spleen where they would be eliminated. This lack of oxygenation can lead to damage to the liver, kidneys, and brain (Tortora, Funke, & Case, 2010). After the

initial infection, it typically takes anywhere from a week to a month for symptoms to develop. Common first symptoms include fever, chills, sweats, headaches, nausea and vomiting, general malaise, and body aches. Because these symptoms are similar to those that occur with influenza, people are frequently misdiagnosed. These symptoms can enter a cycle of intensification and asymptomatic periods usually lasting 2 to 3 days. In uncomplicated malaria, the cycle consists of a cold, hot, and sweating stage, lasting a total of about 6-10 hours. Other physical signs typically seen in uncomplicated malaria include weakness, perspiration, enlarged spleen, mild jaundice, enlarged liver, and increased respiratory rate and body temperature. According to the CDC (2010), "severe malaria occurs when infections are complicated by serious organ failures or abnormalities in the patient's blood or metabolism" (Severe malaria section, para. 1). Severe malaria can result in cerebral malaria, extreme anemia, hemoglobinuria, acute respiratory distress syndrome, low blood pressure, acute kidney failure, metabolic acidosis, and hypoglycemia (Center for Disease Control [CDC], 2010).

Diagnosis

Prompt diagnosis is a vital part of treating malaria; if malaria is overlooked, there is an increasing likelihood that it could result in death, especially in children. The definitive diagnostic technique for malaria is a blood smear sample stained with Giemsa, which is viewed under the microscope to identify the parasite within the RBCs; it is best seen when in the ring stage. Other forms of diagnostic tests can be used to detect the malaria parasite although these may not be as accurate or cost-effective. An antigen detection test is a type of rapid diagnostic testing which can reveal the results in 2-15

minutes. Although this test is used in many clinical settings, because of some issues regarding its accuracy and cost, the results of this test should be confirmed with the blood smear. A polymerase chain reaction (PCR) test can be used to detect the nucleic acids in parasites but these results take too long to gather in order to be useful for diagnostic purposes. The enzyme-linked immunosorbent assay (ELISA) test can be used to measure previous exposure to malaria by detecting antibodies. A complete blood count (CBC) and chemistry panel should also be collected which can reveal anemia, hypoglycemia, acid-base imbalances, and kidney function to help determine the extent to which the disease has affected the body (CDC, 2012a).

Treatment

Once the diagnosis of malaria has been confirmed by laboratory studies, prompt treatment is vital to improve patient outcomes. When deciding upon a treatment regimen, the three determining factors are: 1-determine the *Plasmodium* species that caused the infection, 2-the patient's current condition, 3-the sensitivity of that particular strain to drugs in the geographical region of origin. Each *Plasmodium* species has a varying degree of the severity of malaria and sensitivity to certain drugs which will affect treatment options. Patients who have been diagnosed with malaria are either considered to have "uncomplicated" malaria or "severe" malaria, which will also determine how aggressively the patient should be treated. If the patient has been found to have uncomplicated malaria as the result of an infection by *P. falciparum*, or it cannot be established which species was the cause and the area in which the infection was acquired is not chloroquine resistant, then the patient can be treated with either chloroquine or

hydrochloroquine. This treatment will begin with a large initial dose followed by smaller sequential doses at 6, 24, and 48 hours. If the patient is found to have uncomplicated malaria as the result of an infection by *P. falciparum*, or it cannot be established which species was the cause and the area in which the infection was acquired is found to be chloroquine resistant, an alternative treatment option must be used. The most effective and safe alternative treatment option is a fixed dose of either atovaquone-proguanil (Malarone) or artemether-lumefantrine (Coartem). The next best treatment is Quinine sulfate plus doxycycline, tetracycline, or clindamycin. The length of treatment depends on the location in which the infection was acquired. An infection acquired in Southeast Asia has a three-day treatment period; infections from Africa and South America must be treated for seven days. If none of these options are available, mefloquine can be used but it has been shown to have the possibility of serious neuropsychiatric side effects. As with most medications, the pediatric dose for anti-malarial medicine is based upon the patient's weight but should never be more than an adult dose. If the patient is under the age of eight, he should not be given a quinine treatment plan combined with doxycycline or tetracycline. Instead, the quinine (or quinine plus clindamycin) should be given for a full week or any of the other treatment alternatives (CDC, 2008).

During pregnancy, women have a decreased immune response making it more difficult for their bodies to fight against the infection. Due to the high risks involved to both the mother and baby, an immediate and effective treatment regimen must be established. Furthermore, the malaria parasite has the ability to invade and replicate within the placenta causing detrimental harm or even death to the developing infant.

Pregnant women with uncomplicated malaria are able to have the same treatment plan as other adults with a few exceptions; they are not to have doxycycline, tetracycline, atovaquone/proguanil, or artemether-lumefantrine unless no other treatment options are available. If the patients are found to have severe malaria, they need to have an immediate and aggressive parenteral treatment plan (most deaths will occur in the first two days without effective treatment). Quinidine gluconate should be given intravenously for at least three intermittent doses, and once the parasite density has been reduced to <1%, they can resume the normal oral treatment regimen for uncomplicated malaria. It is important for the patient to have continuous electrocardiogram monitoring while receiving IV quinidine gluconate due to its cardiotoxic nature (CDC, 2012b).

Level of Occurrence

A questionnaire was given to women in a rural village of Nigeria to evaluate if they understood the causative agent of malaria. Of those surveyed, 40% admitted they did not know what caused malaria, 20% thought it was caused by sunlight, and only 16.5% knew that it was caused by mosquitoes. The lack of education as to the cause of malaria places these women and their children at an increased risk for contracting the disease. These results establish the urgent need to provide education to women in high risk malaria areas as a way of aiding them in the prevention and early detection of malaria for themselves and their children (Ibidapo, 2005). The WHO reported approximately 219 million cases of malaria worldwide, with an estimated 660,000 deaths as a result. The majority of deaths are unfortunately among children, especially under the age of five (WHO, 2012d). Out of the 10,627,000 confirmed cases of malaria reported in Uganda

6,353,000 of those were children under the age of five. Furthermore, 39,000 of those children under five died from malaria-related causes (WHO, 2008). Poor rural populations are the most affected with a large percentage of those living in Africa. Although work is being done to reduce the prevalence of malarial infections, it is still a frequent cause of death among underdeveloped countries (WHO, 2012d).

A report gathered at the Agule Community Health Centre in rural Eastern Uganda (Pallisa District, Agule Sub-county) revealed that most of their patients (70%) were children under the age of five while 30% were aged five years and above. When given a survey, a majority of the respondents (74%) had at least four episodes of malaria, 22.4% had suffered twice a year and 3.6% had suffered from malaria more than five times. Among those who had had four episodes of malaria, most (61.7%) were children under the age of five. This shows that malaria occurrence is common in children below the age of five. This may mean that either the respondents were sleeping in torn mosquito nets, non-treated nets (which are relatively cheaper than treated nets), or they were not practicing other measures of malaria prevention. The survey revealed the ratio of nets to number of people in households is 1:3 with the average number of people in a household being seven. Only 2.6% had a one-to-one ratio of nets to number of persons in a household, while 9.4% had no net at all in their households. In one year, this small rural clinic treated around 1,072 children for malaria with 583 of them being less than five years old (A. Humphrey, personal communication, September 19, 2012).

Education and Prevention

In areas such as Uganda, malaria is one of the leading causes of death, especially among children whose immune systems have not fully developed. The World Health Organization (WHO) suggests vector control is the most effective way to prevent the transmission of malaria. Vector control can be achieved through a few different methods. The most effective practices include the use of insecticide-treated mosquito nets (ITNs) and indoor residual spraying (IRS). The free distribution of long-lasting insecticidal nets (LLINs) among at-risk populations is the best way to insure that they are protected from malaria-infected mosquitoes while they sleep. According to a study performed by UNICEF in 2010, only 33% of children under the age of five had access to an ITN (UNICEF, 2010). Although it is largely dependent on several factors, most IRS will offer protection from 3-6 months. Due to the high risk and complications of malaria among pregnant woman and children under the age of five, the WHO also recommends prophylactic treatment with anti-malarial medications. This works by suppressing the blood stage of malaria in order to prevent infection. Women who are pregnant and are in areas where malaria is common are encouraged to take sulfadoxine-pyrimethamine prophylactically at each check-up after the first trimester; it is also recommended that three doses of sulfadoxine-pyrimethamine be given to infants alongside their routine vaccinations. Due to the dangers of children under five contracting malaria, a combination of amodiaquine and sulfadoxine-pyrimethamine should be given on a monthly basis during months of highest transmission (WHO, 2012d). New studies are being performed on the possibility of developing a genetically engineered *Anopheles*

mosquito that is resistant to the malaria parasite which could potentially reduce the transmission rate of malaria (James, 2008).

Tuberculosis

Tuberculosis (TB) is an infection that most often affects the lungs caused by the bacteria *Mycobacterium tuberculosis.* This bacterium is surrounded by a waxy capsule which is a defense that enables them to survive in a latent phase and still maintain the ability to later activate and replicate. This bacterium is an aerobe, and therefore, most often affects the lungs, although it is capable of infecting other organs (Porth, 2009). Most often, people are infected by breathing in the bacilli that are floating in the air after an infected person coughs, sneezes, or even talks which releases infected respiratory droplets; these droplets can float in the air minutes to hours after release. Physical contact with infected persons or their personal items will not transmit the disease. People do not typically contract tuberculosis from a brief, single exposure, but instead require repeated, prolonged, and close proximity to airborne droplets released by the patient. The likelihood of infection is determined by the number of organisms released into the air, the concentration of organisms within a space, exposure time, and the state of the immune system of persons at risk. Someone with a strong, healthy immune system can typically encase the infecting organism, which prevents it from advancing to an active form of the disease and is therefore termed latent TB. Latent TB does not produce symptoms nor is it contagious; although, it is important to detect and treat this form of TB as well in order to avoid future activation of the disease. If the immune system is not able to appropriately

respond to the first exposure of bacterium, such as those who have HIV/AIDS or are malnourished, then active TB will ensue (Malone, 2011).

Once inhaled, these bacilli travel to the alveoli of the lungs where the body's immune system will activate releasing macrophages to combat the infecting microorganism. However, due to the lipid cell wall and capsule, the macrophages are not able to destroy them but contain the infection through a cell-mediated response. The macrophages are then able to present the antigens to the T lymphocytes, which then cause the macrophages to release enzymes to attack the infecting bacteria; this can also cause injury to the lung tissue itself. This sensitivity reaction sometimes causes gray-white lesions called a Ghon focus. This sensitivity reaction increases with the number of organisms present resulting in tissue necrosis at the central portion of the focus. Tubercle bacilli then drain along the lymph nodes causing granulomas to form, when combined with the lesions on the lung, are called a Ghon complex. These complexes will ultimately heal leaving behind fibrous scar tissue which can be seen on an X-ray. Even after healing, a few of the organisms can remain intact for several years causing the infection to reoccur should the host's defense mechanisms ever decline. People who have latent TB, do not exhibit symptoms of the disease nor can they infect others; although they do have the potential for developing active TB should they be reinfected or the dormant bacterium particles reactivate (Porth, 2009).

People who have a compromised immune system, such as those with HIV/AIDS or people undergoing chemotherapy, malnutrition, or small children whose immune system has not fully developed, are at a higher risk for contracting TB with an initial

exposure due to their immune system not being able to fight off the infection. In the case of a person with a weak immune system, the bacilli will invade the alveoli where the body will attempt to fight it off with the aid of macrophages; however, in this instance, the bacilli will continue to multiply within the macrophages causing more macrophages to gather and eventually form a tubercle of infected macrophages. Symptoms will begin to arise after a couple weeks once the macrophages die and the bacilli escape into the center of the tubercle. If not treated, the center will continue to accumulate and grow more bacilli in a process called liquefaction. Eventually, the tubercle will burst releasing the bacilli into the bronchiole, lungs, and then continue to spread throughout the body, including to the brain which results in TB meningitis (Tortora, Funke, & Case, 2010).

In the initial stages of TB, the person is usually asymptomatic. The first symptoms to typically appear in those with an active TB infection are night sweats, low-grade fever, weight-loss, anorexia, malaise, and fatigue. A persistent and productive cough is a typical sign, but dyspnea and hemoptysis are rare. A patient who is HIV positive must be carefully examined because signs of TB can often be mistaken for other opportunistic respiratory infections. If the infection is large enough, it has the potential to spread systemically. If multiple organs are involved, it is referred to as miliary TB. This can occur during the initial infection or if a latent infection is later activated. These patients may exhibit acute symptoms such as fever, dyspnea, and cyanosis or chronic symptoms such as weight loss, fever, and gastrointestinal issues. Tuberculosis could also cause an enlargement of the liver, spleen, and lymph nodes, as well as, cause other complications such as a pleural effusion, empyema, and pneumonia (Malone, 2011).

Diagnosis

The most common diagnostic tool for TB is the tuberculin skin test (TST), also known as the Mantoux test. This test involves the injection of 0.1 mL of purified protein derivative (PPD) intradermally on the dorsal side of the patient's forearm. The patient returns to have the test read 48 to 72 hours later. The healthcare professional reads the test by examining the injection site for induration (hardening). The site is measured in millimeters of induration. If the test is negative (no induration), then the patient has not been exposed to *M. tuberculosis*. The test is read as positive if induration can be seen at the injection site. It takes approximately 2 to 12 weeks for a reaction to occur once the patient has been exposed to TB. This test, however, will only tell if the person has been exposed to *M. tuberculosis*; it does not tell if the infection is active or latent. Once a person has tested positive with the TST they will always be positive which requires further investigation on the part of the healthcare personnel. This means an accurate health history is important in diagnosing a patient with TB (Malone, 2011). Health history and follow-up testing is also important because false-positive and false-negative reactions are also possible when using the skin test. False-negative reactions can occur if the patient is immunosuppressed, has been exposed to TB recently (within the past 8-10 weeks since it takes 2-12 weeks after exposure for a reaction to be seen), the infection is severe or very old, or if the patient has recently received a live virus vaccination. Patients can have a false-positive reaction if they are infected with non-tuberculosis mycobacterium or have previously received the BCG vaccine (Norris, 2011). A chest x-ray may be useful in diagnosing if TB is suspected, but it cannot be used alone as a

diagnostic criterion due to the fact that many other diseases will appear similar to TB on an x-ray. If a patient has a positive TST, then his sputum must be tested for acid-fast bacilli (AFB). The AFB test requires the culturing of three consecutive sputum samples which are collected on three different days and may take up to eight weeks to culture. Unfortunately, this is often the only test available in underdeveloped countries. The quickest technique for TB testing is the QuantiFERON-TB (QBT) test. This test requires a blood sample which is combined with mycobacterium antigens. The lymphocytes in the blood will secrete γ-interferon if they recognize the antigens which indicate that the body has been exposed to the infecting bacteria. The results can be obtained in a few hours, however, sputum samples and cultures should also be obtained to confirm diagnosis (Malone, 2011).

Treatment

Tuberculosis requires long-term treatment with multiple medications due to drug-resistant TB becoming more common. These drugs must be taken during a six-month period to have the greatest effect. Without the completion of the entire course of treatment, the likelihood of drug resistance increases. The therapy consists of a four-drug treatment regimen: isoniazid (INH), rifampin (Rifadin), pyrazinamide (PZA), and ethambutol. There are six other drugs that can be used to treat TB, although they are used secondary to the main four. There are several reasons for the treatment plan lasting for six-months including the slow-growing nature of the tubercle bacillus and its ability to become dormant, the ability for the bacillus to be concealed within the body's macrophages, and to fight against drug resistance. In fact, pyrazinamide is the only drug

that has the ability to work on dormant bacilli. Although there has been a lot of research into finding new quicker acting TB drugs, none have been developed since rifampin. The goal of research is to find a drug (or set of drugs) that can be effective in less than 3 months and work against the drug-resistant strains. There are two types of drug-resistant strains multidrug resistant (MDR) strains and extensively drug-resistant (XDR) strains. The former refers to TB strains that are resistant to rifampin and INH, and the latter consists of those strains which are resistant to rifampin, INH, and at least one of the secondary drugs. Current studies are being performed on the effectiveness of the drug diarylquinoline and its ability to "impede the synthesis of ATP in mycobacterium and its effect on killing both dormant and actively growing bacilli" (Tortora, Funke, & Case, 2010, p. 684). Latent TB should be treated seriously in order to prevent it from developing into an active infection. Latent TB requires a much less aggressive treatment due to the smaller number of infecting organisms and typically only involves one drug. Isoniazid is usually prescribed for six to nine months. HIV patients must complete a nine-month treatment. Otherwise healthy patients may stop after six months, but it is recommended that they also continue treatment for the full nine months. If the patient has a resistance to INH, then rifampin may be prescribed for four months (Malone, 2011).

Level of Occurrence

It is estimated that around half a million children worldwide are infected with TB each year with up to 70,000 of them dying from the disease. In Uganda alone there are approximately 102,000 case of TB each year placing it 16th among the TB high burden countries. Uganda is one of the countries that is facing the dual TB and HIV/AIDS

epidemic with around 60% of the patients infected with TB are also co-infected with HIV/AIDS; this places TB as the number one killer of HIV/AIDS patients (Ministry of Health Uganda, n.d.). Many children live in impoverished areas where healthcare is non-existent, insufficient, or just not affordable to receive the treatment they so desperately need. Children, especially those in underdeveloped countries, are at a particularly higher risk for contracting and dying from a TB infection. This is due to several reasons including their underdeveloped immune system, misdiagnosis due to nonspecific symptoms, and lack of early detection. Newborns whose mothers have TB increase their child's risk of contracting it as well, especially in those who are infected with HIV. Young and malnourished children are also extremely susceptible to diseases such as TB. Children generally contract TB from an infected adult so children who are exposed to TB should be tested early. Since an AFB test requiring a sputum sample is typically the only test available in underdeveloped countries (such as Uganda), it is particularly difficult to test for TB in children. Children usually have a difficult time producing a sputum sample, and even if they are able, it may not provide accurate results which leads to a low detection rate. With the proper treatment, recovery is anticipated; however, this is dependent upon early detection and the ability to afford treatment (WHO, 2012a).

Education and Prevention

Currently, the only prevention available for TB is education, screening, and a limited vaccine. The only vaccine that has been discovered to date is the Bacillus Calmette-Guérin (BCG), which provides a narrow defense against only the severe forms of TB; the protection is not life-long and is dangerous for those infected with HIV. In

communities where TB is prominent, education should be provided about the ways that TB is spread, signs and symptoms to watch for, and when treatment should be sought. Because TB spreads through the air, any family who has a confirmed case of TB with children showing the typical signs and symptoms should be immediately treated. Even those who are not showing any signs of the disease should still be placed on isoniazid as a preventative treatment. The reason for so many deaths from TB (especially in children) is because of the lack of diagnosis; therefore, increased testing should be done on those who are most at risk for TB particularly those who have compromised immune systems due to HIV or malnutrition. Educational systems should be introduced as a part of maternal and child health services which would provide early awareness and preventative care for those at greatest risk for contracting TB. Additional teaching should also be provided to healthcare workers to improve their recognition of TB. Future development of quicker and easier testing methods, medication that has a shorter treatment time, and an effective vaccine are still needed (WHO, 2012a).

HIV/AIDS

The human immunodeficiency virus (HIV) is a retrovirus made up of "two identical strands of ribonucleic acid (RNA), the enzyme reverse transcriptase, and an envelope of phospholipids" (Tortora, Funke, & Case, 2010, p. 540) that replicates from RNA to deoxyribonucleic acid (DNA) inside living cells. It is speculated that dendritic cells are the cause of the virus spreading throughout the immune system by transporting them to the lymphoid organs. There are glycoprotein spikes (gp120) on the envelope of the virus which are used to attach to the receptors of CD4 T cells. Once the HIV is fused

to the CD4 T cell, the envelope detaches and it opens the infected cell to allow the uncoated virus to enter. The RNA of the virus will then use reverse transcriptase to transcribe viral DNA, which is then replicated and will eventually enter the nucleus of the infected cell becoming a permanent part of its structure (Tortora, Funke, & Case, 2010). Once the viral DNA has entered the nucleus of the host cell, it will be replicated every time the cell divides; it will create more infected cells. Initially, the body's B cells will still be able to make HIV antibodies which keeps the viral load down until the virus progresses. In a normal healthy person, the CD4 count should remain between 800 and 1200 cells per microliter of blood. The immune system diminishes as the virus spreads and begins to destroy the CD4 T cells; the body can remain relatively healthy as long as the count stays above 500 cells per microliter of blood. The normal life span for these cells is 100 days, but once infected with HIV, they can only live for two days (Kwong & Bradley-Springer, 2011). HIV is able to hide within the memory T cell which allows them to act as a latent virus "hiding" from the immune system until it is later activated. HIV is also able to mutate quickly which helps it to evade the body's immune system which could also cause later problems of drug resistance (Tortora, Funke, & Case, 2010).

The human immunodeficiency virus has several stages it goes through before it is considered AIDS. Approximately 1-3 weeks from the time the virus initially enters the body, the patient will go through a period known as acute infection in which there will be a quick increase in the viral load and symptoms typically include flu-like symptoms, headache, body aches, diarrhea, pharyngitis, lymphadenopathy, photophobia, rash, and possible meningitis. The early chronic infection period (also referred to as the latent

phase) usually begins around three weeks and can last up to eight years depending on whether the patient is receiving treatment or not. In the latent phase, the CD4 count remains above 500 cells per microliter of blood and the viral load is 200-500 cells per microliter of blood. This phase is generally asymptomatic. When symptoms do occur, they include fatigue, headache, low grade fever, and night sweats. The best time to test for the HIV virus is three to four months following infection. The disease will then progress to the intermediate chronic infection period (early symptomatic phase) when the CD4 count reaches 200-500 cells per microliter of blood and the viral load begins to increase. This phase indicates the disease is progressing closer to AIDS and includes symptoms such as night sweats, fever, chronic diarrhea, headache, fatigue, increased risk for infection, and possible neurological symptoms. The infection that is most often seen with this phase of HIV is oral candidiasis (thrush). The final stage of the disease is the late chronic infection period, better known as AIDS. A person is considered to have AIDS once the CD4 count drops below 200 cells per microliter of blood and viral load increases to 5,000-10,000 cells per microliter of blood. Because AIDS indicates a severe immunodeficiency, the patient is prone to opportunistic infections; these infections do not generally affect people with a healthy immune system but can cause serious health problems in those affected with AIDS (Kwong & Bradley-Springer, 2011).

Diagnosis

Due to the importance of detecting HIV early, the CDC recommends routine screening for those who are at greatest risk, especially those who are being treated for tuberculosis due to the increased risk for contracting TB as a result of HIV in nations

where both diseases are prominent. HIV is traditionally diagnosed by testing for HIV antibody production using the enzyme-linked immunosorbent assay (ELISA), and if the test comes back positive, it will be repeated and the diagnosis will be confirmed using the Western blot test. There is, however, an issue with antibody testing due to the length of time between infection and seroconversion. There can be up to a three-month delay in which antibodies would not yet be detectable; therefore, testing performed during this time period could result in false negative results. New research and development has yielded new forms of testing that is relatively inexpensive and produces rapid results (10-20 minutes) to be used in emergency situations and in underdeveloped countries where testing is frequently needed. These tests use urine, a drop of blood, or an oral swab of fluid which makes testing easy and can potentially be used for home testing. The further production and availability of simple, inexpensive, rapid testing for HIV would be a vital resource for early detection of HIV in underdeveloped countries (Tortora, Funke, & Case, 2010).

Treatment

Those who are found to be infected with HIV should begin treatment immediately in order to suppress HIV replication and maintain the CD4 count. The typical treatment is a combination drug therapy called highly active antiretroviral therapy (HAART) (Faulhaber & Aberg, 2009). It is estimated that only 39% of the people who need treatment for HIV in Uganda have access to the medication, 8% of whom are children (United Nations, 2009).

Level of Occurrence

About 1.5 million pregnant women in low to middle income countries were found to be infected with HIV with less than half of them being treated to prevent mother-to-child transmission (WHO, 2011). In Uganda alone, there is an estimated 150,000 children (0-14) who are living with HIV and 1.2 million children were orphaned due to their parents having HIV/AIDS (UNICEF, 2010). Uganda has the eighth highest death rate of HIV/AIDS in the world (CIA, 2012).

Education and Prevention

Educating people on the prevention of HIV is a vital aspect to reducing the number of children (and adults) infected with the virus. Though they do not provide total protection, condoms have been shown to be 85% effective in preventing the spread of sexually transmitted infections. Routine testing and counseling should be provided to those who might have been exposed to the infection. Education about male circumcision should be taught to mothers in high risk areas because studies have shown that circumcised males are 60% less likely to contract HIV. For those who already have HIV, adhering to a strict antiretroviral therapy (ART) regimen can reduce the transmission rate to others by about 96%. Research has shown that taking a pre-exposure prophylactic dose of ART or a post-exposure prophylactic dose within 72 hours of exposure can reduce the likelihood of contracting HIV. If an HIV positive mother is not being treated, she has a 15-45% chance of transmitting the infection to her infant. The risk of transmission from mother to infant can be nearly eliminated if the mother is treated with ART during her pregnancy and in the post-natal period as well as treating the infant after birth. Much

work is being done to provide education, diagnostics, and treatment for AIDS in low to middle income countries including a worldwide AIDS awareness day each year (WHO, 2012c).

Improving Access To Healthcare

An organization called "Millennium Villages" is implementing the use of community health workers (CHWs) to provide access to healthcare in even the most remote villages of rural Africa. These individuals have an intimate knowledge of the culture and are widely accepted by the community; this is because they are well-respected locals who are being trained and equipped to diagnose and treat the diseases which are rampant in their villages. These CHWs are then provided with a backpack with all the supplies necessary to diagnose common diseases and medicine to treat them. They are also provided with a cell phone which is able to text healthcare workers information on the patient's status who can then inform the CHW of the proper drug dosage or treatment plan for this particular patient's situation. For their services, CHWs are provided with a means of transportation between villages (typically a bicycle) and a small salary for their efforts. It is estimated that utilizing CHWs reduces the cost of providing healthcare to only about six dollars per person. The ultimate goal is to have one CHW for every five hundred people in rural Africa which would require the training and equipping of about one million CHWs at the cost of $3 billion a year. If this goal is accomplished, then even the most remote village of rural Africa will have access to healthcare which will drastically decrease the number of people (especially children) dying each year from

preventable/treatable diseases. It will also increase the income of these areas by raising the overall health of the community and allowing them to work (Sachs, 2012).

Conclusion

The devastation of a child's death is only amplified by the knowledge that it could have been prevented. In today's society and technology, all of the resources exist to prevent such tragedies as the death of a child due to these types of diseases and malnutrition; however, resources and education are lacking. Many organizations have formed and joined efforts in recent years in an effort to accomplish the millennium development goals (MDGs) established by the United Nations (UN) which include the eradication of extreme poverty and hunger, the reduction of child mortality, and to combat HIV/AIDs, malaria, and other diseases. The UN's mission is to complete at least half of each of their target goals by the year 2015 (United Nations, 2010).

In an effort to address the problem of childhood death related to preventable diseases, the WHO and UNICEF joined together to form the Integrated Management of Childhood Illness (IMCI) program. The strategies of the IMCI represent the methods similar to those of other organizations who also aim to accomplish the MDGs. Their program's approach involves three main elements: "improving case management skills of health-care staff, improving overall health systems, and improving family and community health practices" (WHO, 2013, para. 3). As a part of this strategy, they aim to educate health care professionals to improve their methods by ensuring each child they see is screened for every potential issue during their evaluation in order to insure that all problems are caught and dealt with early. These healthcare workers should also be

provided with additional training of how to effectively handle illnesses that affect these young children. In addition, the children who are extremely sick need to be transported to an appropriate first-level care facility to ensure proper treatment. Health education clinics also need to be provided for parents and those who care for children in order to make them aware of the initial signs and symptoms of common illnesses, as well as, how to prevent these illnesses and care for them appropriately should they become ill. As previously discussed, it is important to provide appropriate funding, resources, and training so that adequate healthcare can be made available to poor rural areas. A wider coverage of immunizations should also be included in this healthcare system (Maurer, 2005).With the collaboration of the various organizations that are partnered with the UN (as well as other private organizations), these goals of providing adequate healthcare and saving the lives of millions of children can be an obtainable reality. The reality of the situation is that overall, people who have the resources to make an impact on these children's lives are not aware of their devastating situation. It is going to take a global effort to give these children the basic necessities they need for survival. Each and every child, no matter what situation each was born into, has the right to life, and every strategy possible should be implemented to ensure this right.

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