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Eric Applebach

The Importance of a Comprehensive Response in Improving Healthcare in Low-Resource Countries

This past spring, I had the opportunity to volunteer at a clinic in Gracias, Honduras as it worked to improve healthcare within its community as well as beyond. As I passed between different areas of the facility, I had the chance to see how the clinic was more than just a medical center. It was broadening its gaze and reaching out to the community by addressing the many deeper problems behind poor healthcare while responding to the patients that sought more immediate medical attention. It was practicing medicine that was proactive as well as reactive. The clinic housed two full-time family practitioners, a laboratory, a dentist, and several other physicians who were available on various days of the week. Also, the clinic hosted surgical brigades for a month in both the spring and fall that performed various surgeries while only asking for a donation as compensation. While these personnel were available to receive and combat the consequences of poor healthcare, the clinic also looked beyond reactive medicine and involved itself in combatting the issues behind poor healthcare directly. One way that the clinic undertook to break down the financial barrier specifically, which hinders patients from affording medical treatment, was by working to improve the local economy. To do this, the clinic was involved in loaning money to local residents who presented qualified business startup plans. The clinic would then monitor and aid in their efforts to form and manage the business in order to protect the investment that they put forth. In this way, the clinic provided a holistic response to healthcare. Not only was it responding to the medical needs of the population that it served, it was also investing in that population to provide the resources needed to improve healthcare for future generations.

This type of response is a vital when it comes to healthcare in low-resource settings. Reacting only to the immediate needs of the population ignores the momentum behind the problem. Much like the saying “give a man a fish and you feed him for a day, teach the man how to fish and you feed him for a lifetime,” reactive medicine is unable to change the rates or types of sicknesses that affect so many in low-resource countries; on the other hand, combatting only the roots of poor healthcare leave so many at risk with no chance of alleviation for their current ailments. Addressing healthcare in low-resource countries requires a comprehensive response ensuring that the conditions that affect so many now are cared for while others are working to stem the flow of the need for care. Therefore, a combination of physicians and medical workers reacting to the present conditions complimented by public healthcare preventing future disease provides a comprehensive response to low-resource healthcare. The purpose of this paper is to look at different barriers that hinder healthcare in low-resource areas and to see how physicians and public health personnel are addressing those barriers, adapting their practice to compensate for them, and working together as a team in order to best overcome those barriers with the resources available to them.

In order to fully understand the complexity of the obstacles that hinder healthcare in low-resource settings, it is first important to understand the magnitude of those obstacles. The World Health Organization (WHO) provides volumes of data, collected by public health workers around the world, that can be used to aid physicians and other public health personnel in developing comprehensive strategies in both responding to and improving the current healthcare situation of a particular location. Although the quantity of data available often seems overwhelming, it is vital for healthcare workers to understand and use this data in order to best serve their community.

When it comes to healthcare in low-resource settings, the degree of economic disparity must be understood in order to develop a reaction that accounts for the full extent of the problem. One aspect that can be looked at is the amount that individuals spend annually on healthcare. According to the WHO, individuals living in low-resource countries spend about \$30 annually on healthcare. This is dwarfed by the \$4,586 that individuals in high resource countries spend annually. Beyond that, in the United States, the average individual spends about \$8,467 annually¹. This discrepancy is not due to a lack of interest in medicine but rather a lack of finances to purchase medical treatments, a lack of access to treatment, or a lack of public education on medical treatments available. In low-resource areas it is important that physicians understand the financial disposition of their patients when making a caring and ethical plan of action. Ignoring aspects of their disposition may result in unnecessary harm to the patient or their family. It is important for physicians to work with their patients in order best care for their patients.

By no means does this lack of resources come only in exceptional cases. According to the World Development Indicators of 2008, about half of the world was living on \$2.50 per day or less². In fact, in 2005, over 13% of the world population lived on \$1.00 or less and about 80% of the world population lived on \$10 per day or less². To look at it in a different light, in 2013 the poverty threshold in the United States for an Independent individual was \$11,888 per year³. This amounts to the individual living on about \$32 per day which falls three times higher than what 80% of the world population is living off of. When looking at low-resource countries separate from other high-resource countries, the financial discrepancy is highlighted. For example: in Tanzania, about half of the population lives on less than \$1.25 per day². It is difficult to find information on the population of the United States living on less than \$1.25 per day because it is

so rare. Beyond that, there are many organizations and government programs available to aid individuals in poverty in the United States. Those types of organizations are not likely available for the population in Tanzania

Along with the lack of finances comes the lack of medical personnel. While volunteering in Honduras, I saw many different aspects of the Honduran healthcare system. One of these aspects was the obvious lack of healthcare professionals and infrastructure. In Honduras I stayed with a local woman named Paty Mendoza who had just completed medical school and was doing administrative work at a surgical center while she searched and prepared for a general surgery residency program. Through her I learned about the prosperous medical education system in Honduras and how important students are when it comes to Honduras' healthcare system. In Honduras, when a student begins a rotation at a clinic or hospital, the rotation will benefit the student about as much as the student will benefit the hospital. Due to the lack of healthcare professionals, hospitals often require students to take much of the responsibilities of a physician despite their lack of a completed education or practice. While I was there, Paty recounted one of the many instances when she felt that she was given far more responsibility than should ethically be given to a student. Working late one Sunday night, Paty and a classmate were given the responsibility of taking care of the pediatric ICU when the pediatrician in charge had to leave. With no licensed doctor present, Paty and her classmate took responsibility of the unit and cared for its patients. As the evening went on, a child came in with severe bloody diarrhea and began to convulse. In response, the two students intubated the child and hooked him up to a ventilator with no knowledge of how to operate the machine. After contacting another physician over the phone, they were finally able to properly ventilate the patient knowing the specific parameters needed for the child and the steps required to set those parameters into the machine. Later that

night, Paty's classmate received a newborn from the operating room. Due to complications, the child had to be intubated and given supplementary oxygen. Again, Paty called the physician to learn the parameters for the patient and proceeded to hunt for information online on how to use the machine. Fortunately, Paty was well versed in English as no documentation on operating the instrument was available in Spanish. The baby's condition was eventually stabilized after the ventilator was properly programmed and they were able to move on to other patients. Paty, in a tremendous amount of stress, walked away from the incident, found a corner hidden from other patients and healthcare workers, and broke down. After about 5 minutes of shedding tears she went to the locker room, washed her face, put on her makeup, and continued caring for the patients knowing that she was needed on the floor. The baby remained ventilated in intensive care for 3 weeks and was then able to go home to be with his mother.

This lack of medical personnel does far more than just putting medical students in difficult situations; it creates a large barrier to improving medicine in low-resource countries. Without a sufficient workforce, patients go untreated and public health seldom changes. The lack of personnel is also tied in many ways to economic disparity as the lack of finances pulls children out of schools and can often cause local physicians to leave the country in search of more comfortable working and living conditions⁴. According to the WHO, between the years of 2006-2013, high-resource countries had an average of 29.4 physicians per 10,000 people¹. However, in Low-resource countries, this number was only 2.4 physicians per 10,000 people¹.

This lack of monetary resources along with personnel is both the result of and part of the cause to several barriers that are hindering improvements to healthcare in these settings. Economically, countries with few resources have a more difficult time improving their present conditions in part due to the sickness brought about by the lack of available means. When it

comes to education, poverty often hinders the schooling of children leading to further poverty and fewer educated medical personnel. Governments can also be a part of the problem pulling money away from needed economic and healthcare programs. Culturally, certain practices or beliefs may either aid the advancements of disease or hinder the efforts of healthcare workers. Finally, geographic distances can limit the availability or affordability of transportation limiting public outreach. Looking at the various obstacles, these barriers are being overcome by physicians and public health providers working together to provide a comprehensive approach to the complex situation.

Literature Review:

With the economic conditions encumbering low-resource countries, much of the disease burden on these countries consists of diseases that are either preventable or treatable with existing interventions. These diseases are called diseases of poverty as they are almost directly a result of the poor economic conditions⁵. The WHO estimates these types of diseases as accounting for almost 45% of the disease burden in low-resource countries. As diseases of poverty; tuberculosis, malaria and HIV/AIDS alone account for almost 18% of that burden. The issue mainly involves the lack of access to treatment as the same remedy is readily available in most developed countries⁵. This can either be due to a lack of financial availability meaning the treatment is outside of the price range of the population; or, it can be a result of a general lack of physical access to a clinic carrying the treatment. The WHO estimates that about 47% of Africans and 65% of Indians lack regular access to existing treatments; overall, one third of the world is without access to available treatments with most of this population present in low-resource countries⁵. In this, there is a tremendous opportunity for improvement as the treatments are already being used around the world. They just need to be made more accessible.

With aid being available to so few, organizations like the WHO, “Doctors Without Borders” (MSF), and many others are reaching out by sending medications and medical personnel to help local doctors combat the disease burden. However, these organizations have a very limited supply of resources available themselves pushing physicians make decisions about where care should be given and where it should be withheld. These decisions do not come easily. Many decisions are made with reluctance and frustration knowing that if the individual had only been born under different circumstances, they would easily have received the care that they needed. Allowing a young boy to go home with Type I diabetes who is in DKA is one of those decisions that no one wants to make even if it is the most financially prudent course of action. Withholding treatment from one individual in order to use those resources to help several are decisions that are commonplace in low-resource settings and are based on evidence-based medicine⁶.

Practicing evidence-based medicine is one way that physicians are better using the resources available to them for the population that they serve. It is the use of individual clinical experience along with the most recent, verified, clinically relevant research to provide a healthcare response that is proven effective⁷. Evidence-based medicine has become a foundation for healthcare in developed countries. Practicing evidence-based medicine is very important in high-resource countries and is arguably even more important in low-resource settings. Physicians working with fewer resources cannot afford to use methods that are not verifiably sound. If treatments used by physicians are not backed by supportable evidence, there is a greater potential that those resources are being wasted and that the healthcare provided is not as effective as it could be. It is imperative that physicians in these settings look at statistical evidence in effort to provide the best healthcare approach for the population that they are serving. Continuing

education requirements for healthcare staff keeps them up to date on the latest research in their field so that their medicine may be practiced accordingly. The fewer resources available in low-resource countries necessitate decisions to be made differently by medical workers than they would be made in higher resource settings. However, the decisions that are made are still founded on the same principles.

In order to practice evidence-based medicine in low-resource countries, doctors need to look at both the efficacy and the cost of the treatment among the population being served. The efficacy of a particular treatment (how well the treatment yields its desired result) is measured by using a value called the NNT (Number Needed to Treat). The NNT is calculated by taking the reciprocal of the absolute risk reduction. In other words, it is an indicator of how many people need to be treated in order for a single person to be positively affected by that particular treatment. For example, if a particular drug has an NNT of 10, then out of 10 individuals taking the drug, one would be benefitted. Therefore, the lower the NNT value, the more relevant the treatment is⁸. In low-resource settings, treatments with high NNT's are not utilized frequently due to excessive cost. For example, breast cancer is rarely screened in low-resource areas due to its high NNS (Number Needed to Screen). The NNS for a mammography, to prevent death from breast cancer, is 2,451 for five years for 50-59 year old women. This means that if 2,451 women between the ages of 50 and 59 were screened for breast cancer via mammography over a five year period of time, statistically one woman would be saved⁹. Due to the high cost of mammographies, this form of treatment would be considered inappropriate in low-resource settings. However, if the cost of the drug or treatment is low enough, the drug can be put into practice even with a higher NNT value. An example of this is Aspirin. Aspirin has an NNT of 44 when it is used for 5 years in order to prevent a single heart attack¹⁰ and an NNT of 333 to

prevent a fatal heart attack¹¹. However, Aspirin can be purchased by medical facilities for very little money making it worth purchasing. Many techniques with high NNT's are also utilized as they can be cost free. One study found that for patients with acute lung injury or acute respiratory distress syndrome, decreasing the tidal volume (the amount of air being pushed into the lungs) on the respirator from what was normally accepted as being most beneficial actually decreased the mortality. In this study, the NNT was relatively low (NNT=12)¹². However, even if the treatment had a higher NNT, it could still have been implemented because of its inexpensive cost. Information like this is invaluable when it comes to treating the underserved.

The WHO is working hard to provide physicians with the information they need to make these informed decisions. In 2013, it published its 18th edition of the “WHO Model List of Essential Medicines¹³.” Using up-to-date research and epidemiologic information, the WHO created this list to provide a comprehensive overview of what medications the organization has determined as being efficacious and cost-effective in low-resource settings. Using these tables, Physicians are more easily able to determine what medications they should be using in their practice to best support their community. In this way, public health and research are working together to provide the needed information to better equip responsive medical doctors as they respond to the population's current medical needs.

When determining if a particular drug or treatment is appropriate in low-resource settings, there is an important aspect to keep in mind that is particularly applicable when it comes to low-resource countries. This aspect is the fixed budget effect. For arguments sake, say there is a current drug that has a 50% cure rate for a deadly disease, and it costs \$10 per treatment. There is also a new drug that has a 55% cure rate and costs \$12 per treatment. The decision must be made whether to purchase the new drug or continue treating with the old drug. In places like the

United States, this decision becomes rather easy with all other factors like side effects being held constant. The majority of individuals would pay the extra two dollars in order to purchase the better medication. However, in low-resource countries the fixed budget effect plays a large role. The fixed budget effect takes into account that many medical institutions in low-resource settings are on a fixed budget and must provide for a population that cannot easily pay for the treatments provided. While in Honduras, for example, the patients were only asked to give a donation for the surgery provided but were not required to pay. Therefore, the hospital cannot afford to treat everyone who is in need of treatment, and instead, physicians can only treat as many patients allowed by the quantity of resources they have. Looking back to the hypothetical situation, if the hospital had \$2,400 to use for this particular drug and 400 individuals who were in need of treatment, the original drug would be able to treat 240 individuals, while the new drug would provide treatment for 200. A 50% cure rate with the original drug would cure 120 of the 400 people while the new drug would cure only 110 individuals even with its higher cure rate. Because of the fixed budget effect, the new drug, in this case, should not be utilized. This is one of the aspects that physicians working in these conditions need to keep in mind in order to provide the best healthcare they can for their patient population. In many cases they will not have enough resources to treat everyone and must therefore allocate the treatments appropriately in order to provide the best overall healthcare. The fixed budget effect will play a different role in every clinic depending on the clinic's resources. The WHO is able to provide guidelines to aid in these decisions but ultimately the final decision will be made by the clinic itself based on their situation¹⁴.

When a clinic is funded mainly by the payments made by its patients, it is important for physicians to be aware of the economic status of their patients. Withholding treatment from a

more privileged family within the area may lead to unnecessary loss of life. On the other hand prescribing treatments to a family who cannot financially afford it may compromise the health of members of the family and pressure the family into difficult situations. While attending the Global Missions Health Conference in Louisville Kentucky, I had the opportunity to listen to a physician, Dr. Stephen Merry, recount stories of the time he spent working in sub-Saharan Africa. In one such story he told of a father that came into his clinic whose young boy presented with Diabetic Ketoacidosis (DKA). DKA is a serious complication that presents in diabetic patients and is fatal without treatment; however, it is easily prevented and treatable with insulin. Upon hearing the diagnosis and prognosis, the father asked to have his son discharged so that they could return home and care for the child as he passed away. When practicing in the United States, this condition presents mainly in patients with uncontrolled diabetes or patients who are newly diabetic. In whichever case, it is very treatable and patients are normally able to recover well. However, where individuals are living on less than two dollars per day, type I diabetes is often fatal. It is important for physicians to have a full understanding of their patient's situation before adding a burden onto the family that they are unable to support⁶.

One aspect of medicine that many physicians from developed countries learn from working in developing countries is that saving lives is cannot be their main goal. If that were the goal, working in these situations would burn many physicians out. In this particular case, Dr. Merry recounted becoming frustrated at the father's refusal to treat his child and urged him to do whatever it took to provide the care his son required. Despite this plea, the father was unable to afford the basic medication without compromising the health of his family and was forced to abandon the treatment option and bring his son home to live his final days. The Dr. Merry later regretted his actions as he realized that he had changed the situation entirely. He had made it so

that the disease was no longer completely responsible for the death of the boy. The burden now also rested on the father's shoulders for being unable to afford the medication to care for his child. As opposed to comforting and supporting the family through an understandably difficult time, the physician added a burden of guilt on to the father of the family. This was not done intentionally, but out of the frustration at the injustice of the situation. This further stresses the importance of understanding the background of one's patients; in order to better care for them and to be understanding of their decisions knowing the background they come from⁶.

Dr. Kent Brantly became the first American physician to be infected with Ebola in the recent western Africa Ebola outbreak. However, before he was infected, he worked valiantly alongside other physicians taking care of patients dying from the same disease. Speaking in the fall of 2014 at the Global Missions Health Conference about his experiences, he told of the conditions in which they were operating. While in the clinic in Liberia, 46 patients were diagnosed and treated with Ebola. Of those 46 patients, 45 of them passed away. Later, when talking about his experiences as a commencement speaker at Indiana University School of Medicine, Dr. Brantly stated: "Losing so many patients, certainly, was difficult, but it didn't make me feel like a failure as a physician," he began, according to the Indianapolis Star. "Because I had learned that there was so much more to being a physician than curing illness. That's not the most important thing we do. The most important thing we do is enter into the suffering of others¹⁵." As a physician working in conditions where patients sometimes have few options for treatment, it is important to focus less on defeating the illness and more on supporting the individual. If that includes fighting the disease, then it should be fought. However, other cases call for less aggressive tactics and more care.

One tool that can assist physicians in making those specifically directed decisions is the use of Disability Adjusted Life Years (DALYs). The information used for the calculation of DALYS is collected by public health organizations working to equip physicians with the data needed to make informed decisions on when to treat and when not to. DALYs, at their root, are the number of years of life lost due to illness or death (premature death). It is a number given to a particular disease for a particular population set to measure the size of the disease burden¹⁶. For example, when looking at HIV/AIDs, the number of DALYs caused by this disease will be much higher in sub-Saharan Africa, where HIV/AIDs is more prevalent, than it will in the United States of America. To illustrate DALYs, let's look at an individual with type II diabetes. In this case, the individual was diagnosed when he was 45 years old and proceeded to pass away at the age of 65 due to complications associated with kidney failure. At the age of 65, his life expectancy was 75 years. Therefore, he died 10 years prematurely. He lived with diabetes for 20 years. In order to calculate DALYs, a "disability weight" is given to every disease and is used in order to calculate how many years of their life was "lost" due to the disabling aspects of the disease. In this case we'll say that the disability weight was 0.25 meaning that for every 4 years that this man lived, he lost 1 of them due to the effects of the disease. Combining the 10 years of life lost due to premature death along with the 5 years of life lost due to having the disease for 20 years with a disability weight of .25, then the DALYs lost due to diabetes for this individual was 15 DALYs¹⁶.

DALYs are then generalized for a specific population so that when a patient comes into the clinic, physicians can use those markers as a tool for determining the most appropriate action in caring for a patient. Addressing the patient's needs, a physician can look at the efficacy of the treatment along with the probable DALYs caused by the disease, then combining that with the

cost, determine whether a treatment is effective or not. Here is an example: If a 12 year-old patient, Jack, enters the clinic suffering from asthma, a physician can use the cost and efficacy of a treatment to determine if it is worth prescribing. Let us say that the clinic has a treatment available for \$10 per treatment which is good for one month. The drug can be easily given at home by a parent and according to research; the treatment effectively prevents all effects from asthma each month. Now if the asthma has a disability weight of 0.2, then the number of DALYs prevented from the treatment would be .2 per year. Therefore, the number of treatments necessary to prevent a single DALY would be 5 or \$600 (\$120 x 5 years) worth of drugs. According to the WHO, a good measurement used to determine affordability of a drug is the prevention of a single DALY is worth three times the GNP per capita of the country. Therefore, if the country in which we are working is Tanzania (GNP per capita= \$695) then an affordable cost of treatment per DALY would be \$2,085. Anything over that amount would be determined unaffordable. Therefore, in this case, the treatment would be considered affordable for the family in need. These are the tools that physicians in low-resource countries can use in order to provide cost-effective healthcare to the population that they are serving⁶.

Because of these financial obstacles, prescribing life-style changes to patients and public health education is very important and in some cases has become increasingly more important⁶. One growing problem in low-resource countries is the westernization of their diet. Traditionally, poverty and under-nutrition have been the primary focus of health care providers when it comes to dietary needs; however, with the continuing growth of the global economy, individuals in low-resource areas are gaining more access to high energy density foods¹⁷. Another factor has been the rapid urbanization in low-resource countries. With more access to higher energy and lower nutrient dense foods along with less exercise due to urbanization, the proportion of overweight

and obese individuals has increased and is a growing problem. This fact along with other factors has led to an increase in hypertension, diabetes, cancer, and other chronic diseases in low-resource countries¹⁷. From a physician's perspective, one of the cheapest and most important manners used treat chronic disease, especially in the cases of hypertension and diabetes, is lifestyle change. When an overweight individual enters the clinic with hypertension and a history of tobacco use, medications are rarely the cure to the problem. Prescribing only medications without educating the individual on healthy eating and smoking cessation is very cost ineffective as the two leading contributors to their hypertension are not being addressed. Providing a more holistic approach by encouraging them to consume a more Mediterranean diet and to quit smoking is very cost effective. It may also prevent the symptoms from becoming worse. This is where public health is becoming increasingly important. Educating a patient during a consultation may create a healthier individual, however, when it comes to creating a healthier population, public health plays a very important role⁶.

Due to the high rates of disease, both chronic and acute, economies in low-resource countries are burdened. With diseases affecting life-expectancy, economic productivity, and education rates, the quantity and quality of the workforce available is greatly diminished: all of these aspects work together to keep healthcare from improving. With disease creating a smaller window for employment for the population by decreasing life-expectancy and removing otherwise fit individuals from working, the workforce is hampered by such a large non-working population that it needs to provide for. As a whole, economic productivity is lowered causing a decrease in the GNP per capita of the country so that families have less to live on. This often pulls children out of school so that they may work to support their families and thereby lowering education rates and reducing the economic potential of the following generation. Meanwhile, the

lack of resources contributes to poor nutrition, poor sanitation, and poor water quality. All of these factors, in turn, work to increase or maintain the disease burden on the country¹⁸.

Therefore, by investing in low-resource countries with high disease burdens through medical intervention, the outcome becomes two-fold: Not only do the medical interventions provide a more healthy population in the present, but it may also lead to a more prosperous and healthy population in the future.

Healthcare education is very important when it comes to low-resource medicine. Public health programs working to inform the population about how they may better care for their bodies are able to affect large populations in promoting healthy living. This, in turn, keeps patients out of hospitals and keeps them in good condition to work. Whether it is education on healthy eating or on the importance of using contraceptive devices, providing basic healthcare knowledge is essential when providing low-cost care to communities. One example of the use of community education that has been very important in combating the spread of HIV/AIDS in Africa is the WHO working to inform populations of both the transmission of HIV/AIDS and the use of contraceptive devices. With birth rates high in low-resource countries and the lack of education of contraceptive use, HIV/AIDS spreads easily. Providing education in the classroom has been found to be very beneficial in these areas: reducing the average number of sexual partners, reducing the frequency of sexual relations, and increasing the use of barrier contraceptives. All of these are in turn working to slow the spread of HIV and decreasing the disease burden¹⁹.

Another example of aiding in community healthcare through education was practiced at the clinic in Honduras. As a part of their outreach program to nearby villages, La Clinica San Lucas sent out a dentist with toothbrushes to help educate children at various schools on good

mouth care practices. After he had taught the children about good mouth hygiene, he passed out toothbrushes to all of the kids to be kept at school. The students would brush their teeth every morning before classes started and every afternoon before they left. This way, the kids did not lose their brushes. Along with educating the children and providing brushes, the clinic appointed three leaders among the group to be responsible for monitoring the dental health of their classmates until the team returned to that school. Then, every 6 months, the dentist would visit. At that time he would pull any teeth that had cavities (which turned out to be about 50% of the students) and have his three appointed helpers provide fluoride treatments for the other students. Seeing how the clinic was reaching out to communities, empowering them with the information and tools necessary to maintain their health was a very encouraging site. What was even more encouraging was that it had worked so well with the students.

Similar to appointing leaders and equipping students to monitoring their classmates' dental care, while working with Ebola in Liberia, local clinics would provide education along with personal protective equipment (PPE: basic rubber boots, rubber gloves, and rubber rain coats) to local care givers so that they could safely care for friends and family members at home. This was not something that was put on by the clinics themselves asking families to take on the role of the care-giver; rather, it was a response to so many families not wanting to let their children or family members to die alone in a hospital. Despite the level of transmissibility of Ebola, the clinic found that through the education and the equipment, the local care-givers did a very good job of caring for the sick while not exposing themselves. In one case, a man hosted eight Ebola victims in his house. Throughout the course of time, some of his patients died but others lived and through it all he remained healthy²⁰.

The education of communities and students has allowed for major improvements in public health in low-resource areas at little financial cost to the system. The main cost is the use of personnel available to share the information. With so few local workers available to practice as physicians or in public health and teach students about healthcare, this solution may not be as easy to put into practice. This lack of workers results from the lack of opportunities for further education along with the effects of brain drain.

Brain drain is the emigration of skilled, educated personnel from a country. This educated population is a crucial resource for a developing country and when they leave it has a crippling effect on their healthcare system⁴. Brain drain can mainly be attributed to the pursuit of better living conditions for physicians living in low-resource areas. Due to the world economy, international physicians are able to find positions in healthcare facilities in the United States where opportunities for a more financially prosperous life are readily available²¹. After completing certain standardized exams to display their aptitude, many physicians from low-resource areas find jobs in the United States. This brain drain plays a large role in the low physician density of low-resource countries. Many countries have requested that the United States stem the flow of migrating doctors from low-resource areas in order that they may hold on to this part of their most educated population. However, the United States has been reluctant to answer these requests as many international physicians eagerly fill in gaps in its own healthcare system. International physicians will often work in underserved areas where the demand has not been met²¹. In fact, in 2005, 25% of physicians working in the United States graduated from international programs. 60.2% of those physicians came from low-resource countries⁴. The United Kingdom, on the other hand, has begun cooperating with many low-resource countries and has restricted physician migration from these countries. The UK has organized their

healthcare infrastructure in order to remove significant gaps in their healthcare system that can be seen in aspects of United States' healthcare system. The amount of physician migration is very variable between countries. Liberia has the most physician migration to the United States at 43% of their trained doctors leaving the country and working in the United States. With such large portions of doctors leaving for better conditions, the extent of the lack of physicians is more understandable²¹.

Another aspect that many foreign physicians are aiming to put into place in low-resource countries is continuing education. Continuing education has shown many benefits around the world and is important also for physicians practicing in low-resource settings. Equipping doctors with the knowledge needed to make accurate judgments and decisions is very important when it comes to providing cost-effective healthcare especially with so much research aimed at the field. For example, in Zambia, a randomized controlled trial was conducted in order to determine the effects of hosting continuing education seminars on proper diagnosis and prescription practices. The study found that after four months, physicians who had participated in the continuing education seminars did in fact prescribe medications to patients more accurately. As a result, fewer drugs were prescribed and more non-pharmacological treatments were utilized. By continually educating doctors, evidence-based practices increase and less money was used inappropriately. This money would then be available to provide care for more patients or better treatments²².

Healthcare education can also be improved in low-resource countries for aspiring physicians. For example, while working in Egypt, a physician at the Global Missions Health Conference, Dr. David, spoke on the education system of physicians specializing in Egypt. He talked of the process that it took for surgeons to become licensed in Egypt. As an example, if a

doctor would like to become a cardiothoracic surgeon in Egypt, they must first find another cardiothoracic surgeon and become their apprentice. After studying under the specialist for 2 or 3 years, they take a standardized exam to address their competency and as soon as they pass the exam they are qualified as a cardiothoracic surgeon. With this system there are many oversights. During many of the apprenticeships, the students are only slightly involved in the surgery itself (holding retractors etc.) but as soon as they pass the exam they have a license to operate in ways that they have only seen performed. Dr. David said it as, “you take the exam, you pass the exam, and you get a license to kill²³” which, unfortunately, is the reality of the healthcare system in Egypt. This is another way that public health could greatly impact the current healthcare situation in many low-resource countries. By providing education standards for practicing physicians, many individuals could be spared needless suffering while under the knife of a newly licensed surgeon²³.

Government also plays a large role when it comes to healthcare in low-resource countries and its affordability. On this account, it is difficult for healthcare workers to change their circumstances; it is just another barrier that they must overcome to serve the population. In many undeveloped countries, governments impose high tariffs and taxation on imported medical supplies causing many medicines to be unavailable to the poorer population. This can be seen in many cases with India charging the most at 55% for duties and taxes. Not only is the government doing their population a disfavor by charging such high taxes on drugs, but also, little of the revenue from taxes will go back into the healthcare system. In Pakistan, the government charged 33% duties and taxes on imported pharmaceuticals while only 1% of the national GDP was aimed at healthcare. Meanwhile, 5% of the national GDP was put towards the military. With such a disservice to the population by restricting access to basic medication to their population

and with little financial support for healthcare, many governments in low-resource countries are restricting the growth of their own healthcare system and ignoring the population⁵.

In other low-resource countries, extreme government corruption amplifies this disservice. Taking money or resources from the population in order to bring higher standards of living to government officials is unfortunately a reality for some clinics abroad. This was evident living in Honduras as the only public healthcare insurance program was set aside for government employees and military personnel. There was no support for the general population when sickness struck. Laurie Garrett witnessed this to another degree while in Zaire/Democratic Republic of Congo in the aftermaths of the Ebola crisis. In the years following the 1995 outbreak of Ebola, Zaire/the Democratic Republic of Congo went through a change in leadership as the Zairois troops fled from rebel leader Laurent Kabila's forces as they came into power. Along with this change in leadership came the ransacking of hotels and hospitals of everything that the greedy military deemed expendable. This left the country in a state of crisis. With even fewer supplies and little international help due to the war, the Democratic Republic of Congo became another dictatorship that brought in financial prosperity to its leaders while the rest of the nation paid the bill. The people did not willingly serve their leaders; rather they had no governing power of authority to bring justice as their leaders stole from them. This happened in Kikwit as its Governor, Katshunga, deemed that their use for an ambulance (the only one in the entire region) was insignificant when compared with his own transportation needs. Outfitting the vehicle with couches and repainting it, He used it as his own chauffeur-driven limousine. This level of corruption can cripple the healthcare availability for different areas and there is little that physicians can do to counteract it²⁴.

Beyond governmental influences, there are also cultural influences that can affect the quality of healthcare provided in certain areas. With the largest Ebola epidemic in history coming at last to a close, it is important to understand some of the barriers that local doctors and healthcare personnel had to overcome culturally to provide quality care. These barriers ranged from burial practices to the community's view of hospitals. In Sierra Leon, doctors not only fought the disease that was destroying families but they also had to fight the families themselves in order to give them the care that they needed. As patients were led into hospitals and parents gave their children over to nurses to be put into isolation, they were entrusting their lives or the lives of their loved ones to individuals who they did not know practicing medicine that they did not understand. In many cases, they would never see their loved ones alive again. This brought a significant distrust of hospitals to the community causing families to choose to care for their loved ones at home. That is when the clinics brought education and supplies to aid the caretakers in their involvement. The clinics worked with the population in order to fight Ebola and protect those closest to the disease. Burial practices also contributed greatly to the spread of Ebola as the traditional practice was to wash, touch, and kiss the deceased before they were placed in the tomb. This physical contact was a significant part of the culture in Sierra Leon and to restrict it completely would only fuel the distrust of local hospitals. Hospitals and clinics walked a fine line in order to protect the people while respecting their beliefs. By not allowing these actions, locals believed that their loved ones would not reach the afterlife properly and would haunt them because of their disrespect. As a result, when locals were not allowed to properly bury their family members, they responded with distrust, anger, and occasionally violence. Respecting their beliefs was a very significant part of properly caring for Ebola victims even if it may have led to the spread of the infection. The clinics would work with the population, thoroughly cleaning the

bodies beforehand and doing their best to educate the family on protecting themselves before the burial took place^{20,25}. The work that public health workers performed in educating the population, organizing a proper response, and containing the spread of the disease saved countless lives. It was their response that both empowered local physicians to care for the lives of the sick while working to protect the lives of the healthy. Together, the physicians and public health workers were able comprehensively face the Ebola outbreak. They were able to successfully care for the individuals affected by the disease and contain it protecting further spread and further death.

Finally, in low-resource countries many people lack their own means of transportation and have to travel significant distances in order to visit the nearest clinic. In these cases, patients have to dedicate large amounts of time and money in order to see a doctor. This becomes even more complicated when an individual must wait on diagnostic exams or is under a treatment regimen that requires a trip to the clinic for every dosage. One of these treatment regimens that are very common in sub-Saharan Africa is antiretroviral therapy for HIV/AIDS which requires individuals to return to the clinic monthly for a refill of the medication. When it comes to antiretroviral therapy, adherence is very important to the outcome of the treatment. Missing dosages can allow increased viral loads or possibly the emergence of drug resistant strains. These factors increase the speed of progression towards AIDS and thereby may shorten the lifespan of the individual. With many programs now providing antiretroviral therapy free of charge, the main barrier that affects levels of adherence is geographical. One study interviewed individuals in Uganda about the difficulties of affording transportation to obtain antiretroviral treatment each month. Some were spending almost half of their wage in order to cover the costs of going to the clinic each month, which, in turn, left even less food on the table or money available for other

necessities. One woman lamented: “It happens sometimes that I regret that I’m spending 500 shillings on a boda–boda when I know that back home there is nothing to eat. But then I do not have a choice²⁶.” With these types of decisions being commonplace among many individuals in low-resource countries, providing more geographically accessible healthcare is important to meeting the needs of the population²⁶.

Conclusion:

Sitting down for dinner with a family practitioner, Dr. Rudy, who worked in Honduras for 18 years, we naturally began to talk of his experiences while working in those foreign conditions. Listening to his stories brought me back and made me realize again how little my comprehension was of what working in those conditions is truly like. How does it feel as a general practitioner to perform surgeries with little experience knowing that the alternative option leaves the patient suffering and in far worse condition? What is it like when patients leave your care because of the lack of financial ability to pursue more intensive medicine? What goes through your head when you perform surgeries for ten hours and then leave knowing that the need for surgeries is far more than you can physically provide for? After recounting for some time about his experiences, Dr. Rudy in turn asked me about the paper that I was going to be writing. After listening to me talking about DALYs, cost effective care, and several WHO statistics that I had found fascinating, he gave me a recommendation; Instead of solely focusing on the benefits of a comprehensive approach to low-resource healthcare and the way that physicians are working together with the public health sector to provide better health care, he told me to look into how we can better raise the amount of resources available for doctors and public health workers in those areas. With such a wealth of resources in developed countries,

how can we get people to share those resources with a population that so desperately needs them?

With the cooperation of public health workers and reactive healthcare providers, many countries are seeing great improvements in their own healthcare systems. For example: The United Republic of Tanzania has made impressive bounds between 1990 and 2012 with its under-5 infant mortality rate dropping from 166 to 54 deaths per 1,000 live births in the 12 year span¹. These advancements have brought hope to so many living in difficult conditions. However, more could be done in these countries if more financial resources and personnel were committed to the cause. One way that professional schools are working to raise awareness to conditions in those low-resource conditions is by offering international opportunities for students practicing medicine. More and more medical students are traveling from the United States seeking experience internationally. International rotations for medical school are becoming more common as well as courses in global health and student-run interest groups. These opportunities are sparking a higher awareness of global medicine which is benefitting both students and the low-resource countries that they are traveling to. Students receive clinical training abroad that allows them to see aspects of medicine not as easily seen in the United States. For example: students are exposed to the importance of finances in medicine as well as how palpations can be utilized to aid in diagnosis when other diagnostic measures are unavailable. At the same time, the students are benefitting the countries by helping to provide good healthcare for a short period of time, especially when the need for more personnel is so great. They are then returning to the United States and further spreading awareness of global medicine by sharing their experiences. Education of the practice of medicine in low-resource areas can provide students with a very beneficial clinical experience while also working to aid foreign efforts in improving healthcare²⁷.

This is one step to bringing more aid to low-resource countries. Raising awareness of foreign conditions may result in tremendous improvements of global health just as news coverage during natural disasters brings in significant support with it.

As more support is brought in, health care providers and public health workers will have more opportunities to better support the current disease burden while working to lessen that burden for future generations. This will come through economic development brought on by programs like the ones instituted in Honduras. Investing in the population not only results in more economic prosperity but also in lessening the current burden of disease for the population. Providing public health education allows individuals to better care for their own bodies. This will also work to lessen the burden of disease and provide a healthier population. As economic conditions improve and more physicians begin to practice in low-resource areas, transportation will either become more available or less necessary. This will aid in keeping costs lower for patients and thereby increasing access to healthcare. Finally, with government and cultural practices in place, it is important that medical workers are aware of their circumstances. Respecting authorities and cultural beliefs will allow physicians and public health workers to better integrate into the community and support it without causing conflict and distrust. As reactive medicine and preventative care come together in low-resource settings, a comprehensive approach to the healthcare situation is put into place. This approach effectively overcomes barriers of low-resource medicine saving large populations from undue suffering both in the present and in the future years to come.

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