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Fernandez: Barriers to Combating Infectious Disease Globally: A Look at Deng
**BARRIERS TO COMBATING INFECTIOUS DISEASE
GLOBALLY: A LOOK AT DENGUE FEVER**

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Infectious disease remains one of the most important concerns in global health. Serious infectious diseases affect hundreds of millions of people worldwide each year. While attention is often focused on HIV/AIDS, malaria or TB, dengue fever and its more lethal variety dengue hemorrhagic fever (DHF) are also a risk for the more than 2.5 billion people living in tropical and sub-tropical regions across the globe, according to the World Health Organization (WHO). Approximately 50 million cases, about 400,000 of which are DHF, are documented each year, with some countries reporting it as a leading cause of child mortality (1). Although overall case fatality rates have been decreasing slightly, there have been significant dengue outbreaks in recent years spanning a broad swath of the globe (2, 3 & 4). The majority of people who are at risk tend to reside in poor, developing countries. It is these very countries that experience the most difficulty in effectively combating any infectious disease. This difficulty arises primarily as a result of the intense poverty that plagues much of the developing world. Endless nation-specific, yet interrelated reasons exist. The scope of all the impediments to effective dengue control would be too broad and complicated to cover in a single commentary. Instead, the paper focuses on several barriers that are common to most countries facing problems associated with infectious disease, especially dengue fever. The overarching point is that no matter what prevents a country or a people from fighting the disease, it will almost always be associated with, or reduced to, financial means (or lack thereof).

DENGUE OVERVIEW

Dengue fever (DF) and dengue hemorrhagic fever (DHF) are spread by mosquitoes, specifically the *Aedes aegypti* breed. This same mosquito has been responsible for transmitting yellow fever in decades past. Four independent viral strains of dengue have been detected, DEN-1, DEN-2, DEN-3 and DEN-4 (5, 6). The initial, non-specific and self-limited presenting signs and symptoms of someone who may have contracted dengue resemble the flu, with exceptionally painful body aches leading to the designation: "bone-break fever." At times it is thought to mimic malaria with high fevers and severe headaches. Subsequent re-infections or new infections with different strains can lead to DHF, which is life-threatening with up to a 50 percent case fatality rate if left untreated (1). Symptoms of DHF include hemorrhaging from the skin, severe dehydration, low blood pressure, and in some cases shock, also referred to as dengue shock syndrome (DSS) (5, 6). Treatment is basic life-support consisting of addressing the symptoms as they occur. Typically it requires re-hydration, bed-rest, and close monitoring of the patient to assure the condition does not worsen.

Unfortunately, many people are unaware of the severity of dengue, thus they do not seek or cannot seek treatment. Some die quickly, in a matter of days, from one of the more deadly forms of the disease. Many methods of assessing and responding to the burden of infectious disease in targeted populations continue to be of urgent interest. Yet

International Journal of Global Health and Health Disparities, Vol. 4, No. 1 [2005], Art. 2 social, political, cultural and environmental barriers consistently prevent effective control of dengue as well as other infectious diseases. Several of these barriers overlap and are reviewed here.

SOCIAL BARRIERS

One obvious solution to dengue would be to exterminate the vector, and many campaigns strive to eliminate the mosquitoes or significantly reduce their numbers. Often, countries endemic with dengue have attempted community education campaigns to help eliminate the mosquitoes. These campaigns strive to get members of a community actively involved in avoiding infection through teaching them about disease transmission. In the case of dengue education campaigns, discussion focused on the mosquitoes that transmit the virus. Since mosquitoes breed in areas of standing water, it makes sense to try to dry up swamps and ditches, use lids on water containers and properly dispose of waste that can accumulate water (i.e., old vehicle tires). Yet, campaigns aimed at benefiting the community and protecting people or residents and community members from future outbreaks raise their own issues. Obviously, drying up swamps, for example, not only rids the area of mosquitoes, but of all other natural wildlife that coexisted in the swamp habitat. Increased urbanization and crowding in developing countries also affects how waste is disposed. Sometimes improper planning or insufficient space forces a nation to deposit mosquito and rodent attracting waste near densely populated communities, which are often impoverished and at high risk of disease from many factors (7). Other times insufficient funding for these educational programs is to blame. Therefore, many programs are discontinued before accomplishing their long-range goals. The intended educational agenda cannot be productive and effective if it is only offered for a brief period of time. To have any major impact, the campaign needs to be sustained for several years, if not permanently. Several educational campaigns in the past have shown a high degree of effectiveness with handling dengue. For instance, in the 1980s, Cuba initiated an educational campaign focusing on increased community awareness of dengue and its vector following an outbreak (8). Active participation of the Cuban citizens allowed for the vector to be virtually eliminated. This campaign was successful primarily due to its long-term commitment to the members of the community years after the initial epidemic.

Another method is the use of the pesticide chemical DDT (dichlorodiphenyl-trichloroethane), which kills the insect (7). Topical spraying of DDT has been effective at controlling disease vectors in the past, but it is often as much a barrier as it is a solution. The carcinogenic, disease-inducing component of the chemical creates its own health risks, a reason its use has been discontinued in the United States and elsewhere. But the question that is often raised is whether the people most at risk are more likely to fall ill to an infection resulting in dengue, for instance, or to die from cancer? There is no easy solution. Chemicals like DDT remain in the environment for years after they are released, but millions of people are suffering or are at risk now. Moderate and controlled DDT use could be a compromise for regions frequently faced with attacks of the dengue virus. Of course many of the decisions regarding the fight against dengue and other threats reside in the hands of the local governments of these countries.

POLITICAL BARRIERS

Disease surveillance, infection documentation and public access to care are all extremely important to help monitor disease trends, predict epidemics and deliver medical treatment to those in need of it. Yet subtle political barriers may prevent accurate reporting. The reasons may be considered in the nation's best political or economic interest, especially in cases where a country's only major industry is tourism. There may be concerns about attracting foreign visitors. If every single case of dengue is reported to a disease surveillance database, which is then published where tourists can access it, vacationers may form unfavorable opinions about traveling to endemic regions. Politicians may worry that tourists could stop visiting the country for fear of becoming infected with this tropical virus. While it is considered outrageous and unethical that there might be "intentional" errors in reporting or official documentation of disease cases, it is not illogical when considered from an economical or political standpoint. The Centers for Disease Control and Prevention (CDC) have noted that underreporting disease information with regards to the Global AIDS Program (GAP) in India is a continual challenge to overcome (9). Similarly, the WHO makes reference to possible weaknesses in data on cholera due to underreporting. They mention that underreporting of disease is quite common in many countries for fear of loss of tourism revenue as well as poor surveillance methods (10).

Intentional underreporting of disease cases in order to maintain an idealized image would be difficult to substantiate. However, when developing nations lack the proper staffing and the financial means to support an efficacious system of surveillance and epidemiological research, such omissions of data whether intentional or unintentional are likely. Without accurate incidence data on dengue, public health agencies are unable to adequately plan for epidemics, manage endemic regions or precisely target areas in immediate need of medical or environmental attention.

Finally, access to care is, and probably will be for years to come, a significant barrier. If there is no data to support a need for more targeted care, medical clinics and/or increased staffing based on the burden of unmet care for dengue sufferers, there will likely be none despite actual need. Indeed, while some bench research is being done, the relevant public health focused research is very limited, which raises another controversial barrier: research, ethics and cultural sensitivity.

CULTURAL OR ETHICAL BARRIERS

The cultural content of public health programming is important because much of the information that is gathered concerning infectious disease is based upon research within populations of developing countries. Currently, live attenuated vaccines against the dengue viral strains are in clinical trials, and further research in the area relating to alternative vaccine options is swiftly underway (11). Vaccines historically have been one of the most effective methods for wide-scale infectious disease control. The economic advantages of cost savings by preventing disease provide a partial explanation for vaccine success. However, vaccine trials raise many ethical questions. For instance, how, where and why clinical trials and other research (including vaccine implementation) is decided and

Consider a poverty stricken section of a population at risk for a particular infectious disease like dengue. Technically, research commences with consent of the individuals involved. "Informed consent" involves clarifying the advantages, disadvantages, risks, side effects, etc. for the research participant thoroughly before the study can begin. In some circumstances, this right of the individual may be abused if, for example, a sizable proportion of this same "at risk" population is illiterate or unable to fully appreciate or comprehend the reasons for the research. Major differences may exist between satisfying a third world nation's healthcare needs versus those of more developed nations. In this circumstance, it is easy to imagine stretching the concept of "informed consent" to barely mean "consent" in general, if at all.

These essential ethical questions require continual testing and discussion throughout medical academia, especially global health (12, 13). Research cannot be justified that is not culturally sensitive, or that takes advantage of a vulnerable population. Some public health workers argue that what is needed in these countries is not new research, but more focus on primary care to treat those suffering from infectious disease now. Regrettably, there is again a financial component to this argument. Research can mean more money to public health researchers; more money can mean more research. It is important that basic scientific knowledge of infectious disease is advanced, however, it is equally important that this objective is balanced with the correspondingly imperative need of diagnosing, treating and caring for people suffering from those very diseases worldwide. Unfortunately, the numbers and distribution of medical practitioners, nurses and other healthcare providers per citizen of impoverished countries, is much lower than it needs to be for basic healthcare. This cannot become more obvious than when a nation is challenged by environmental turmoil.

ENVIRONMENTAL BARRIERS

These are important barriers to consider since it is one over which individuals have little control. Natural disasters have enormous adverse effects on developing nations. Climate changes alone can disrupt the environment and affect vector populations, which in turn affect infection rates of dengue (7). Financially disadvantaged countries suffer from the everyday battle of controlling endemic disease within their populations. When natural disasters occur, they not only disrupt the environment, but also increase risk for many infections - especially water-borne and vector-borne infections.

Recently, we learned of the public health tragedy that followed in the wake of the Indian Ocean tsunami. This event affected millions of people, with deaths reaching well over 150,000, according to several media reports including CNN (14). The true tragedy caused by this tsunami occurred for entire nations and individuals in the months afterwards. According to the World Health Organization, in the aftermath of the tsunami, people were at an increased risk of contracting infectious diseases such as malaria and dengue (15), due to disruption of the environment, which created an increase in vector populations from standing water. Human populations in these regions now face more risk of disease after suffering the detrimental effects of the tsunami itself. The tsunami clearly illustrates how natural events create barriers to public healthcare, leaving nations

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in shambles, and populations increasingly vulnerable to disease. What is even more disconcerting is that nations suffering from natural disasters often lose more vital financial resources, rearranging national priorities and further debilitating the effective delivery of medical care.

REMOVING THE BARRIERS

These examples illustrate only a small piece of the complex puzzle facing infectious disease globally. Social, political, cultural and environmental barriers will continue to challenge populations most vulnerable to infectious diseases, such as dengue. Economic constraints will probably always complicate these obstacles. Without financial means, developing nations are left with limited options to providing care to their populations. There is no single, concrete solution, but there is the hope of improvement in the future. If enough people become aware of the various barriers, steps can be taken individually and globally to create a shift in the current state.

The single most important step will require that people most at risk for infectious disease become familiar with why they are at risk, how to decrease that risk, and prevent future infection. Education initiatives alone may be ineffective. Rather, interventions concentrating on educating individuals on infectious disease transmission, as well as insisting upon and monitoring active adjustments in daily routine and behavior, may indeed provide positive, lasting results. People residing in high-risk locales must become familiar with disease vectors in their area, how to avoid infection, and what to do in the event they develop symptoms. Simple precautions can be taken to avoid infection with the dengue virus. Citizens at risk should avoid traveling near standing water or swamplands without proper clothing and mosquito repellent. Over night, residents can further add protection to their homes through the use of bed-nets. Containers meant to store water need to have lids on them to prevent mosquitoes from laying their eggs.

The key to preventing infection is to limit exposure to the transmitting vector. Yet, although people in these regions can actively decrease their risk, it is the responsibility of government and public health officials to initiate appropriate interventions, and maintain them for their citizens. Effort needs to be put forth by public health agencies to consistently keep accurate surveillance data, with continual updates of endemic regions. The reporting of disease rates must improve, as well as campaigns aimed at large-scale vector reduction. Outreach clinics are increasingly necessary in order to provide immediate care in remote locations. The entire order of operations in regards to public health response in developing countries should be continually re-evaluated and improved. Of course, as is ever so obvious, almost none of these important objectives can ever be effectively met without an economic and political drive. Even then, if the movement is present throughout a government or public health agency to initiate change, little can be accomplished with an insufficient budget.

It is unfortunate that the health of millions must be reduced to financial availability. However, this situation is unlikely to change and may become increasingly complicated. Thus, as much as it is the responsibility of public health and government officials to inform and protect people who are at risk, it is just as much everyone's responsibility to realize that very little can be done without financial support. Taken together, increased

International Journal of Global Health and Health Disparities, Vol. 4, No. 1 [2005], Art. 2 awareness could help facilitate funding through philanthropic contributions to countries most at risk and in need of assistance. Once the ball is rolling, public health agencies can perfect their policies and procedures for assessing the infectious diseases most threatening to their populations. This shall be no simple task, yet the need to shed attention on dengue and related challenges is ever present and always evolving.

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