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Understanding Zika Virus in Rural Costa Rica: Integrating Medical Anthropology and Public Health

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UNDERSTANDING ZIKA VIRUS IN RURAL COSTA RICA

Integrating Medical Anthropology and Public Health

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I hereby reaffirm the Lawrence University Honor Code.

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ABSTRACT

Framed by critical medical anthropology, this applied study utilizes political economic theory and ethnographic methods to contextualize and evaluate the implementation of a global health initiative at the local level, as well as critically evaluates the response of state and international health agencies to the Zika epidemic in Costa Rica. The prevalence of arboviruses including Zika and the potential for epidemics and future population-level health consequences are examined by a multiaxial approach that incorporates themes of culture, socioeconomic context, issues of power and control, and human impact on the natural environment. By combining an interdisciplinary approach that considers the economic, political, and anthropogenic causes of Zika virus incidence with epidemiological data from the rural Pacific-coastal cantons of Garabito and Orotina, this study provides a holistic view, rooted in both critical medical anthropology analysis and public health research, of the shortcomings in Costa Rica's public health prevention efforts to combat Zika infection in vulnerable rural coastal communities.

INTRODUCTION

> Increasingly, inequalities of access and outcome characterize our world. These inequalities could be the focus of our collective action as engaged members of the healing and teaching professions, broadly conceived. We have before us an awesome responsibility—to prevent social inequalities from being embodied as adverse health outcomes.
>
> —Paul Farmer (1999), *Infections and Inequalities* (282)

Zika virus has received media attention in the past four years as an emerging disease with epidemic occurrence in Latin America, where the virus is taking precedence among other endemic mosquito-borne diseases such as Dengue and Chikungunya (Musso, Cao-Lormeau, and Gubler 2015). In addition to transmission via mosquito saliva, the virus spreads via sexual contact and across the placental barrier in pregnant women, compromising neurological development in the fetus and often resulting in a morphological irregularity known as microcephaly (L. Petersen et al. 2016; Centers for Disease Control and Prevention 2016a). Costa Rica saw its first endemic cases of Zika in early 2016—in 2017, the Pacific-coastal cantons of Garabito and Orotina reported the highest cumulative rates per 10,000 persons (Humanos 2015; "Zika 10" 2017). In the first 18 epidemiological weeks (EW) of 2017, 722 cases of Zika were reported, and in the first five EW, 155 cases were confirmed in pregnant women, two of them resulting in cases of congenital Zika ("Zika 10" 2017; Pan American Health Organization/World Health Organization 2017).

In tropical climates where Zika and other arboviruses are prevalent, combatting mosquito breeding habitat is at the core of prevention efforts. To provide better prevention programming for communities, evaluating the knowledge the community already possesses is essential to improving prevention efforts. Additionally, conversations with community members can provide

insight into cultural or societal barriers to prevention efforts (Inhorn and Hahn 2009). However, Zika's unique asymptomatic nature, delayed consequences, and sexual transmission route present a challenging complex for public health campaigns, especially in areas where *Aedes* mosquitos have plagued communities with painful diseases like Dengue and Chikungunya for as long as most can remember. That is because the frequently asymptomatic presentation of Zika shifts the conversation about infection from treatment-focused care to prevention-focused care, which demands community understanding of the virus and organized efforts to eliminate mosquito habitat.

As global temperatures rise and extreme weather events become more frequent, the need for structured intervention in endemic mosquito habitat is essential for preventing disease. In Costa Rica and other parts of Central America, flooding after tropical storms is a predictor for a spike in the incidence of mosquito-borne infections (Ferreira 2014; Roiz et al. 2015). Vigilance is an essential part of preventing mosquito habitat, by eliminating any possible breeding area before the rapid life cycle of *Aedes* culminates in adult mosquitos that can spread disease. The standing water that collects in the aftermath of a tropical storm increases the area for egg-laying and consequently the population of adult mosquitos (Roiz et al. 2015). Prevention materials emphasize the need to eliminate water receptacles in the house and yard and the ability of mosquitos to breed in very little water. Everyday attention to mosquito habitat on personal property is time-consuming but manageable. However, large amounts of standing water that collect after tropical storms cannot be taken care of by individuals and communities alone. The increasing frequency of extreme tropical storms heightens the potential for epidemic outbreaks of arboviruses including Zika and intensifies the need for infrastructure that can manage mosquito habitat. Currently, the large-scale management of mosquito populations in rural Costa Rica is

sporadic, neither serving as a preventative measure, nor effectively managing the potential for outbreaks in the face of extreme weather.

Costa Rica's lauded history of government health initiatives combined with endemic mosquito habitat, a changing climate, and socioeconomic factors create the biosocial context in which the Zika epidemic has been unfolding since 2016. The country's famous disease eradication campaigns and politicized history of healthcare have created a culture of community responsibility that places the individuals most affected by arboviruses and poverty at the heart of eradicating disease in their own communities (Morgan 1989). After the establishment of national healthcare in 1941, "health for all" became a core value of political campaigns, often conflated with morality as politicians emphasized participation in health campaigns as a community responsibility. When the economy fell in 1980, government funding was redirected from the Ministry of Health to other state agencies, and the lack of funding was cited as a consequence of poor community participation in health campaigns, particularly in rural communities (Morgan 1993). The agricultural laborers living in many of the areas where healthcare was needed—due to endemic diseases mainly related to mosquitos—were denied resources they had become accustomed to, with the reasoning that their participation in state interests was not enough to reward them with the shining standard of health at the core of national identity. In retracting medical outreach, the state effectively excluded the rural population from the declaration of "health for all", leading to the contemporary health inequities that impact rural communities.

Today, the Ministry of Health and the social security administration operate small basic care clinics in rural areas, radiating outward from the biomedical nucleus of hospitals and research institutions in San José with increasing sparseness, resulting in health disparities between the capital city and remote areas in the Costa Rican countryside. The inequitable

allocation of resources requires rural communities to participate heavily in the eradication of disease, a feat for which they are undereducated, unprepared, and only partially assisted by state agencies. However, the model of community participation persists in state public health policy and is internalized by rural populations, in part due to a long history of government pressure on communities to contribute in the implementation of disease eradication campaigns (Morgan 1993). The creed of community participation is also widely promoted by international development campaigns that champion community mobilization as a critical element of disease eradication and health improvement (Morgan 1989).

The prevalence of arboviruses including Zika and the potential for epidemics and future population-level health consequences are therefore best examined by a multiaxial approach that incorporates themes of culture, socioeconomic context, issues of power and control, and human management of the natural environment. Drawing from critical medical anthropology, this applied study utilizes political economic theory and ethnographic methods to contextualize and evaluate the implementation of a global health initiative at the local level, as well as critically assess the response of state and international health agencies to the Zika epidemic. By combining an interdisciplinary approach that considers the economic, political, and anthropogenic causes of Zika virus incidence with epidemiological data from the Pacific-coastal cantons of Garabito and Orotina, this study provides a holistic view rooted in both critical medical anthropology analysis and public health research.

Anthropology and Global Health

Utilizing theory from critical medical anthropology as a tool for intervention in global health dilemmas has the potential to improve health and well-being by incorporating anthropological understandings of culture, structures of power, and human interaction with the

environment. Global health research examines the relationship of health to global interactions, including health inequities, distribution of health resources and services, health policy and development programs, social identities, and human impact on the biosphere—goals that overlap with those of anthropological work. Janes and Corbett (2009) present a model that relates anthropological work to global health goals, defining axes upon which anthropological ethnographic study, analyses of the effect of globalized technology and information on local worlds, and critique of health programs and development initiatives can contribute to global health projects. In identifying specific areas of intervention for anthropological work, this model advises interdisciplinary avenues for addressing global health dilemmas through a clear definition of anthropological contributions to the field of global health.

Conditions that Shape Health and Disease

Anthropological theory can thus offer new perspectives for evaluating public health problems, by examining the social, biological, and structural stressors that cause or exacerbate disease. Political economic theory in medical anthropology posits that the principle forces driving sickness and health stem from economic organization and relationships of power (Inhorn and Hahn 2009). Further, tensions that stem from relationships of power or socioeconomic burden may limit health promotion. Poor living conditions shaped by economic struggle, social discrimination, or political strife also have the potential to negatively impact health on a population and individual scale. Work by Paul Farmer and others has exposed the suffering and violence experienced by groups and individuals discriminated against due to racial, ethnic, gender, or other social identities. Termed structural violence, this “social web of exploitation” is characterized by the neglect, criminalization, or harm of disadvantaged communities and is often associated with historical patterns of unequal power, abuse, and corruption (Farmer 2004:317).

Structural violence is relevant to global health research due to its ability to identify and examine the connections between existing health disparities and historical relationships of power and violence. These concepts inform a biosocial model that recognizes health and disease in connection with local understandings of health and illness, local economic, political, and social conditions, and the environment as occupied and reconstructed by humans. Biosocial theory also places health within a sociocultural context that evaluates how local structural realities and individual experiences impact disease exposure and access to medical care (Singer et al. 2017; Singer and Clair 2003).

Syndemic theory, developed by Merrill Singer, examines the biological and social nature of health, synergistic interactions between diseases on a population and individual level, and social conditions which contribute to health disparities (Singer et al. 2011). A *syndemic*, as defined by Singer, describes "the concentration and deleterious interaction of two or more diseases or other health conditions in a population, especially as a consequence of social inequity and the unjust exercise of power" (159). The concept of a syndemic offers a new way of thinking about global health disparities and their distribution, as it shifts the focus towards environments of risk and agents that promote risk, rather than localizing disease to specific groups or behaviors (159). Syndemics involve interactions between diseases on a cellular, species, and population scale and the elements that promote the concentration of diseases in disadvantaged populations (160-164). Applied to Zika virus, the syndemic reflects the deleterious clustering and disease interactions that occur between Zika and other diseases carried by members of the *Aedes* mosquito family, including Dengue and Chikungunya. Syndemics of mosquito-borne disease exist currently and have the potential to foster epidemic outbreaks in the places *Aedes* mosquitos inhabit, which comprise much of the tropics and the Global South. However, *Aedes* has also

proved to be a highly invasive species of mosquito, mainly due to the production of durable, drought-defying eggs and the ability to proliferate in the miniscule amounts of water contained in discarded plastics, as well as the outdoor plumbing and water storage containers common in the Global South (Singer 2017; Egedus, Ortega, and Obando 2014; Warno Utomo and Triwibowo 2016). *Aedes* mosquitos can carry and transmit multiple viruses simultaneously, increasing the risk of co-infection for vulnerable populations and the efficacy of treatment for individuals. On a cellular level, co-transmission also presents the opportunity for mutation of viruses and increased resistance to treatment (Singer 2017).

Anthropogenic forces of globalization, restructuring of the environment, and climate change have intensified the spread of *Aedes* and the potential for arbovirus syndemics. *Aedes* eggs travel to new locations via container shipping and international trade, and the adult mosquitos find new places to proliferate in standing water resulting from anthropogenic modification, including garbage, poorly managed swamp or wetland, and the built environment such as water storage containers, or other outdoor water supplies where water stagnates. Singer proposes a model of planetary health that ties the human use of natural resources and exposure to disease to the changing climate and accelerated spread of disease due to anthropogenic forces (2-4). Contextualized to arbovirus syndemics, planetary health emphasizes the need for state and international development initiatives that address the environmental and social drivers of mosquito-borne disease, including waste management, climate change, poverty, and social marginalization.

Integrating Medical Anthropology and Public Health

Through integration of practice and knowledge, interdisciplinary teamwork between the traditionally academic field of anthropology and the applied, hypothesis-driven epidemiological

field of public health has the potential to improve global health disparities. Public health research and outreach has increased life expectancy and improved health through education and access to technology (Inhorn and Hahn 2009). Vaccination campaigns pioneered by public health campaigns led to the global eradication of smallpox; in Costa Rica and other parts of Latin America, public health campaigns have frequently eliminated malaria and greatly reduced the occurrence of hookworm pestilence and other tropical disease (Inhorn and Hahn: 1; Armus 2003). While the success of public health campaigns is evident, implementation of such programs can be poor. Initiatives based in public health methodology are often inclined to view biomedicine as a solution for ubiquitous application, despite the reality that biomedicine is cultural and integration of biomedicine into health campaigns thus represents a form of sociocultural intervention (Inhorn and Hahn: 8-14). This conviction in biomedicine and narrow focus on global eradication of disease can obscure local conditions and lead to cultural misunderstandings and distrust that diminish the success of health campaigns, causing greater suffering and disease. One of the greatest challenges public health outreach is facing today is the translation of knowledge into action, which is caused by narrow understandings of disease emergence and interaction, and sociocultural barriers inflamed by a lack of understanding or formative research (5).

Anthropological research is founded on principles of cultural relativism, inductive research, cross-cultural reflexivity, and an understanding of human nature as influenced by society and culture (Inhorn and Hahn: 7-16). An anthropological examination of public health issues includes consideration of local understandings of health and disease and respects the authority of perspectives from the study population in evaluating local health conditions (8-11). These perspectives are captured through ethnographic study, which involves extensive fieldwork

within the study population and primarily centers on participant observation and interviews. These methods allow for anthropologists to learn more about local beliefs, values, and perspectives as well as observing local behavior and interactions (20). Critical medical anthropology contextualizes these lived experiences within the political-economic influences that shape human decision-making and action in health contexts (Singer et al. 2011). From this perspective, medical anthropologists develop a holistic understanding of culture and the interactions at a local level that influence health and disease. An anthropological perspective on health and disease also examines biomedicine and international health development as elements of sociocultural intervention, and thus provides a critical analysis of health campaigns and development initiatives, biomedical understandings of illness and suffering, and response to epidemics. Medical anthropological research on epidemics reveals the power structures that influence the production of knowledge about epidemics, and the factors that restrict or allow access, distribution, and interpretation of infectious disease spread (Briggs and Nichter 2009). Termed biocommunicability, this concept can explain the transformation of Zika virus from a trivial concern to a global health threat since it was discovered in Uganda in 1947 (Singer 2017; Simpson 1964).

Interdisciplinary research thus combines the strengths of public health and medical anthropology to produce holistic studies of health disparities that address both epidemiological conditions and the local truths that contribute to the distribution of health and disease. Applied critical medical anthropology integrates ethnographic fieldwork and political-economic theory with the research methodology of epidemiology, resulting in research that broadens understandings of the causes of ill health and offers quantitative and qualitative evidence of lived experiences with disease. Ethnography in particular can be used to amplify local conditions and

individual perspectives that may be lost in epidemiological research, or suppressed by systemic assumptions that perpetuate the relationship between social inequalities and disease.

Research Question

Combining the strengths of critical medical anthropology and public health research allows for a broad examination of the political, ecological, economic, and social factors that aggravate and sustain the epidemic potential of the Zika virus. This thesis utilizes quantitative epidemiological data and qualitative ethnographic data to highlight how the spread of Zika is a syndemic, intensified by the presence of other arboviruses, climate change, poverty, and the relationships of power that drive state and international health policy. Ethnographic fieldwork contextualizes arbovirus syndemics in rural Pacific-coastal Costa Rica, where Zika virus has hit the hardest. Participant observation and interviews with locals provide insight into biosocial patterns of mosquito-borne disease, lived experiences with illness and endemic arboviruses, and the inequitable distribution and lack of commitment in health program implementation. The inadequate translation of knowledge regarding Zika virus at the state, regional, and global level is also examined. Woven into epidemiological data, qualitative data from ethnographic fieldwork highlights patterns in disease prevalence and incidence, as well as possible barriers to the success of health campaigns. As a region experiencing socioeconomic and health burdens, including the interaction of multiple mosquito-borne viruses, the mid-Pacific cantons of Garabito and Orotina represent a case study for a biosocial understanding of disease. In this thesis, the analytical concept of syndemics is used as a framework to understand the extent that social, economic, political, and environmental burdens contribute to the incidence of Zika virus. Historical, biological, and socioeconomic factors are incorporated into contemporary lived experiences of arbovirus syndemics. Furthermore, the unique challenges presented by secondary effects of Zika

(microcephaly, neurological disorders) are considered in the context of rural health operations and the global distribution of health information.

BACKGROUND

Foundations of National Healthcare

The history of healthcare in Costa Rica is fraught with both corporate and political entities, which have shaped the concept of health into a political symbol at the core of national programming. The Zika prevention programming in rural areas today fits into a trend of inconsistency that has characterized health campaigns since the appearance of organized healthcare in 1900. When the United Fruit Company settled on the Atlantic coast at the turn of the 20th century, they brought a level of organization to health and sanitation that redefined medical care and uprooted the ethnomedicine that defined local medical practice (Morgan 1993; Palmer 2003). While the United Fruit Company reduced rates of endemic diseases such as hookworm and malaria, the services they provided were stratified, prioritizing the care of American expatriates working for the company over that of native laborers, although two to three percent of all employees' salaries were deducted as compensation for the health and sanitation services implemented by the company. In the late 1930's, the UFC abandoned its plantations on the Atlantic coast to seek out better business on the Pacific coast. The company left behind a ghost town of health infrastructure that was only partially reinvigorated over the course of four decades by a menagerie of foreign development agencies. United Fruit thus introduced the model for disease eradication that would hold true for decades and guide intervention by state and international agencies, and eventually shape healthcare into a national value.

Costa Rica established a welfare state to support national healthcare in the 1940's, a decade after United Fruit abandoned the Atlantic coast and left the health of former laborers in

the hands of the state (Morgan 1993). Today, health policy and administration is the responsibility of the Ministry of Health (MOH)—the symbol of national healthcare—and supported by the state and international agencies such as the Red Cross, the World Health Organization, and the Pan-American Health Organization (Del et al. 2010). As the prevention arm of the Ministry of Health, the social security administration, or the *Caja*, has been successful in improving rates of disease through the propagation of small clinics, which mirror the rural health outposts founded by the UFC in the early 20th century. The national slogan surrounding healthcare in Costa Rica is "health for all"; however, while the systems are in place to provide low-cost healthcare to the country's 4.5 million people, it is sometimes unclear who is included in the state's definition of "all". In 2004, the health policy was changed to exclude the uninsured from receiving non-emergency care, and all subsidies were lost for those seeking basic care outside of the emergency room. Restricting access has made even basic medical care expensive for the uninsured. For example, seeking non-emergency care at a *Caja* clinic could cost almost as much as seeing a private physician, and amounts to about a half week of wages for agricultural laborers. Along with this restriction, the policy change eliminated the state insurance previously offered to any poor person (Goldade 2009). This policy was changed to restrict the use of low-cost or free medical care by Nicaraguan migrants, but is likely affecting impoverished Costa Ricans as well, that is, those who have temporary or intermittent jobs in construction or agriculture.

Lynn M. Morgan (1993) describes many of UFC's disease eradication measures as militaristic, particularly their malaria eradication strategy, which included fumigation of the laborers' homes under threat of fine if they refused the treatment of their living quarters with DDT. Compliance to fumigation is still seen as a major solution to mosquito-borne viruses, with

regular sprayings carried out by the Department of Vector Surveillance (MOH) during the rainy season and during periods of major outbreak (Bandzuh et al. 2016). During my stay in Quebrada Ganado in May 2017, I witnessed one round of fumigation in which a MOH truck passed through the neighborhood, spraying insecticide. In my interviews, 20% of participants recommended fumigation as a solution to Zika or other arbovirus prevalence in their community. However, participants often reported that the fumigation efforts by the MOH were irregular, or only carried out when an outbreak had already begun. The eradication methods that were effective for the United Fruit Company and early international and state health agencies are no longer applicable to outbreaks of Dengue, Chikungunya, and now Zika due to a growing population and changing environment. Despite this reality, the Ministry of Health continues to employ these methods, which maintain the viruses only in "normal" conditions. The irregular fumigation measures and traditional method of rural health outreach is not enough to prevent the spread of arboviruses, especially considering the anthropogenic impacts on the natural environment and the unique pathology of the Zika virus.

Zika Virus as a New Challenge

Zika virus presents a challenge for public health campaigns primarily because of its asymptomatic nature; in countries where arboviruses such as Dengue and Chikungunya cause great suffering, it is difficult to communicate the necessity of preventing a symptomless disease. Throughout my interviews in Costa Rica, participants repeatedly cited Zika as less severe than Dengue, the primary mosquito-borne ailment in the mid-Pacific region. Very few participants reported on the secondary effects of Zika, either microcephaly or Guillain-Barré. The lack of knowledge about secondary effects represented in my research findings indicates a possible

barrier between the information available and the primary concerns of communities at high risk for Zika.

Symptoms that accompany the Zika virus are mild if they exist at all, making infection difficult to detect. Many people are unlikely to visit clinics when experiencing only a mild fever or headache, and the possibility of crowding at the clinic and paying a premium for non-emergency services likely deter people further. People who experience a rash may be more likely to seek medical assistance because rashes are also associated with Chikungunya, which has more immediate consequences for the infected person. The complications that result from Zika are often less immediate than what veterans of other arbovirus epidemics are familiar with, for the virus frequently causes the most damage by using the infected person as a host. Zika's sexual transmission route presents a pathway for the virus to spread outside of endemic *Aedes* mosquito territory. This is dangerous especially for women, who can receive the virus from their partner and carry it in their bloodstream for several months at minimum. Recent research shows that the virus can stay in the body for anywhere from 3-6 months, and it is still unknown whether infection can affect future pregnancies (Jordan et al. 2017).

Congenital contact has been associated with abnormal cerebral tissue development in fetuses, resulting in the physical appearance of reduced head size as well as life-long auditory and visual defects (Centers for Disease Control and Prevention 2016b). At any stage of pregnancy, a woman infected with Zika can pass the virus to a fetus (E. E. Petersen et al. 2016). In my study, 23% of participants described some aspect of the mother-infant transmission route, and many others alluded to pregnant women or infants at-risk although they were unable to elaborate on why these groups would be more affected by Zika. Focusing on the trans-placental route of Zika transmission and microcephaly may increase awareness of Zika by providing

distinguishing characteristics for the virus, but also presents challenges for public health programming. The Ministry of Health has yet to design information that connects traditional mosquito eradication techniques to the prevention of long-term conditions such as microcephaly. Most of the current health information is dispersed through television, social media, or other technological channels, but the populations most at risk for contracting the virus are also those least likely to own the technology that connects them to helpful information about the disease. The Ministry of Health therefore needs to increase its face-to-face interactions with communities to access a higher percentage of the at-risk population and gain trust for government intervention.

Thus, while Costa Rica has a long history with mosquito-borne disease, the country is still underprepared to handle the unique challenges Zika presents. The secondary potential of the virus to affect individuals via uterine and sexual transmission increases the risk for epidemic levels of infection, and the asymptomatic presentation decreases the likelihood that infected individuals will seek medical care. In communities that experience poverty, chronic disease, and severe symptoms from other arboviruses, the delayed effects of Zika are unlikely to cause immediate concern. Microcephaly and Guillain-Barré may seem like far-off stories for these communities, but as the potential for swells of *Aedes* increases due to tropical storms exacerbated by climate change, so does the potential for disease. Health authorities need to address the lag between infection with the virus and experiences with microcephaly or Guillain-Barré to establish the appropriate amount of concern. Additionally, the Ministry of Health needs to incorporate the changing climate and increased rate of tropical storms into a prevention and management model that effectively limits outbreaks.

The research for this paper was conducted in the spring of 2017 to determine the effectiveness of the Ministry of Health's arbovirus prevention campaigns, with a specific focus on the Zika virus. With a focus on rural health, this study was intended to collect data regarding community compliance with prevention methods, but ultimately resulted in observations of the biosocial spread of Zika and other mosquito-borne disease in the context of a rural, impoverished area with endemic mosquito habitat and multiple barriers to achieving *Aedes* mosquito eradication.

RESEARCH SETTING AND METHODS

This study was conducted in the mid-Pacific coast, Costa Rica, in April and May of 2017. During this time, I stayed in the community of Quebrada Ganado with Doña Maria, a host mother that I was paired with through the Associated Colleges of the Midwest in San José (Figure 1). Quebrada Ganado is about twenty minutes from the tourist town of Jacó by bus, and just under two hours from the capital city of San José. This part of the Pacific coast is frequented by tourists for surfing, as well as a popular national park just south of Jacó. Quebrada Ganado and Tárcoles are small settlements, each defined by a church, a grocery or two, a collection of houses and a soccer field. Transportation by bus is the most popular way to get around, especially for the many residents in these areas that work in tourism in Jacó or at other locations along the coast. The houses in these towns vary in condition, some indicating a greater burden of poverty than others, but all houses are surrounded by tall chain-link fences with padlocked gates. During the time of my research, temperatures reached the high nineties with intense humidity that would break in the afternoon during short bouts of warm rain, dampening the pink-brown dust from the patchy front yards of homes and the soccer field. In early May, the rain began earlier in the afternoon and stayed longer, signaling the start of the rainy season. This climate

fostered an abundance of fruit trees, including the avocado tree in my host mother's backyard, where two macaws lived, engaging in daily warfare with the roosters and chickens she kept.

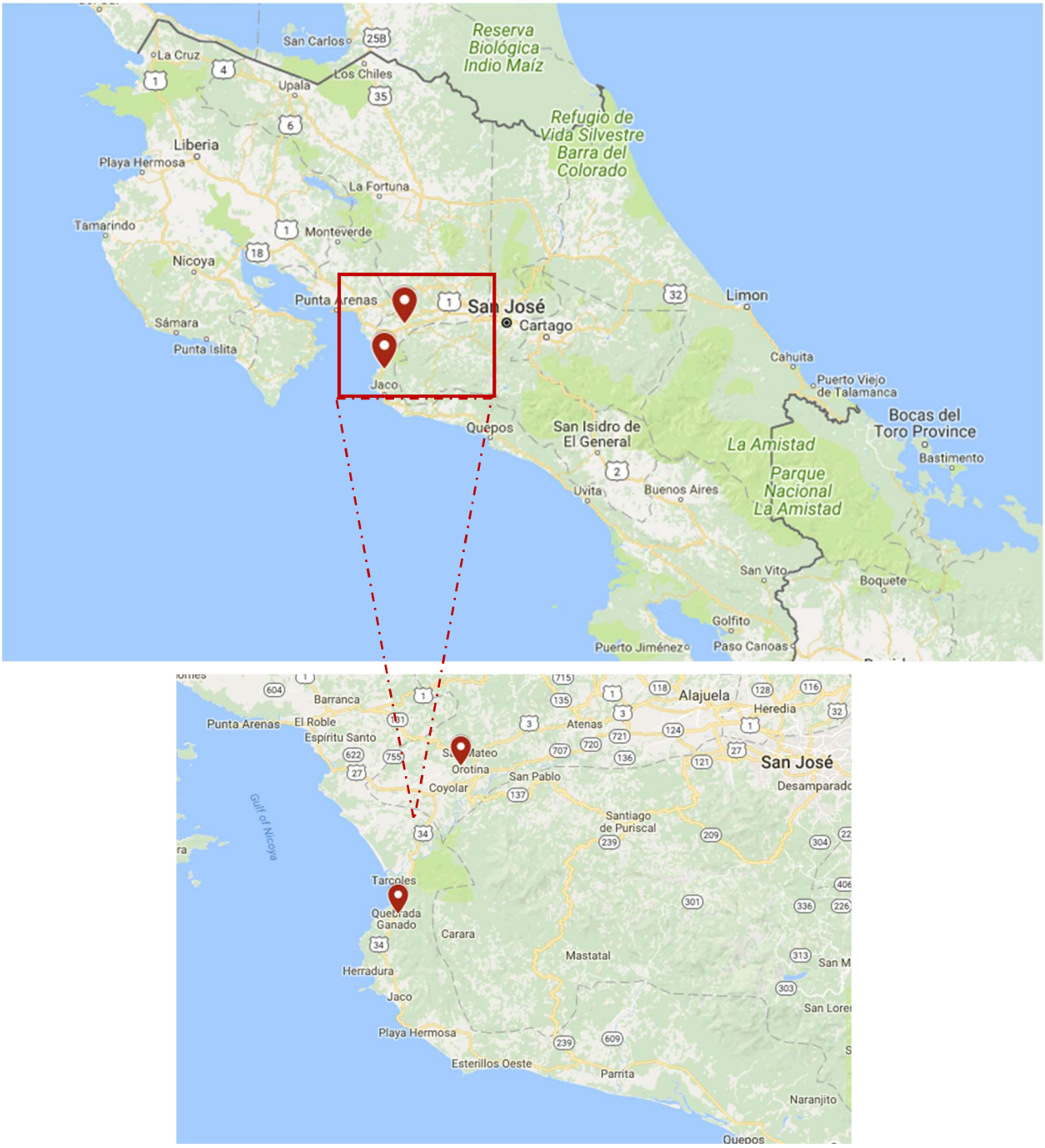

Figure 1. Map of research sites. Source: Google Maps.

Doña Maria was in her late fifties and lived near the center of town in Quebrada Ganado, just a block from the schools, community center, and grocery store. Her son and his young family lived next door and owned a grocery store located on private resort property near Jacó, where white sand beaches attract wealthy locals and expatriates. The majority of my interviews were conducted within blocks of Doña Maria's house, at the local church, the community center for the elderly, the bus stop, schools, and in the homes of neighbors. Doña Maria took me everywhere, serving as my community liaison and unblinkingly introducing me to everyone as her daughter. She seamlessly and comfortably incorporated me into her daily routine and her family, which is how I was able to add Orotina as my secondary field site. Shortly after I arrived in her home, her uncle passed away very suddenly, and I was swept into a whirlwind of Catholic funeral rituals that introduced me to Doña Maria's extended network of kin—aunts, uncles, cousins, nieces and nephews—all of whom gathered in Orotina, at a house kept for generations by Doña Maria's family, beginning with her own grandparents. Orotina is larger and more urban than Quebrada Ganado and located in Alajuela Province, about an hour from San José by bus. The city is centered around a large Catholic church, where the funeral was held, a bus station that transfers commuters to multiple routes, and a small park surrounded by *tiendas* selling groceries and ice cream that relieves the relentless heat. Doña Maria and I frequently made the forty-minute journey to Orotina by bus, and stayed with her daughter who lived on the outskirts of the city in a spacious neighborhood, each house also gated and padlocked as was the trend in every neighborhood I saw in rural and urban Costa Rica. Despite this security, Doña Maria never left me alone in her home, insisting that it wasn't safe. In accompanying Doña Maria to Orotina, I tentatively accepted her encouragement to conduct interviews among her extended family in the downtime between funeral rituals, thus expanding my interviews outside of Quebrada Ganado.

For the participants in my study, 85% were from the canton of Garabito (pop. 21,473), and 15% were from the canton of Orotina (pop. 21,430) (Rica 2014). Most participants were residents of the village of Quebrada Ganado (pop. 1,916) in the Tárcoles district of Garabito (84%) (Egedus, Ortega, and Obando 2014). Thirty-nine percent of participants were male and 61% were female, with an age range from 18 to 74; the mean age was 39 years. Ninety-two percent of participants were Costa Rican, and eight percent were from Nicaragua, Colombia, or the Dominican Republic. All but one of the participants had received some level of education, with 37% ending their education at some point during secondary schooling and 26% having received at least an elementary school education. Only one participant self-identified as unemployed, and 77% of participants participated in paid employment. For the rest, seven percent worked more than one job. The most frequently cited occupations were stay-at-home parent (15%), storekeeper/merchant (15%), administration (14%), and restaurants (10%).

A total of 100 participants answered a 25-question survey that evaluated general knowledge of the Zika virus, usage of prevention practices, and personal perceptions of Zika prevalence and importance with respect to the community. Interviews were audio-recorded for clarity in addition to written documentation of answers in the survey packet. Interviews took place in April and May of 2017. All procedures, including interviewee consent protocol, were approved by the Ethics Review Board of the Associated Colleges of the Midwest, Chicago, Illinois.

This investigation used an ethnographic epidemiological framework to evaluate the level of general knowledge of Zika among participants. Structured interviews documented prevention practices and participants' perceptions regarding responsibility, public health, and disease ecology in their respective communities. Participants reported demographic data (sex, age,

education level, and type of work) and responded to questions regarding general knowledge of the virus. Surveys were evaluated for the following categories: knowledge of symptoms, transmission, prevention, and complications. Surveys were also evaluated for mobility, determined by number of solutions participants offered regarding Zika education and prevention. Responsibility for prevention practices was scored depending on whether responses indicated government or individual efforts were more important for combatting the virus. Disease history was determined based on whether the participant reported a diagnosis of mosquito-borne illness in their family[1]. Responses were then compiled into the following categories: participant demographics, general Zika knowledge, prevention practices, and perceptions. General knowledge encompasses knowledge of symptoms, transmission, and complications. Prevention practices categorize the types of behaviors acknowledged by participants as useful for avoiding an outbreak. Perceptions categorize and describe the concerns and beliefs of participants in relation to education and prevention efforts.

Ethnographic and survey data were analyzed for statistical relationships between demographic factors (sex, age, education level, nationality) and knowledge and perceptions of Zika virus (responsibility, value of health information, symptom knowledge, prevention knowledge, apathy). Statistical relationships between disease history and perceptions were also examined for significance. Ethnographic data from the recorded interviews were transcribed and thematically coded, to highlight both individual voices and salient themes (Table 1). Coding reflects both personal sentiments and themes reported by participants. For example, '[Ap]' could indicate lack of concern on behalf of the informant or reported apathy in the community.

[1] Disease history reflects perceived experiences with mosquito-borne disease. Participants were asked whether they or their family members were diagnosed by a medical professional (see appendix), but the ability to confirm these diagnoses was outside the limits of this study.

Responses were coded in binary format (1=yes, 0=no). Unless otherwise stated, pseudonyms have been used to protect participants' identities.

Table 1. Thematic coding key for transcriptions of interview data.

Lack of Information	Loi
Sanitation - dirty water, garbage	San
Standing Water	SW
Breeding areas or habitat	BH
Natural Environment	NE
Drug prevalence	SFd
DENV, CHIKV, ZIKV	SFc
Disappointment with information received	DwI
Value of Mds visits/health information	VoHI
Places primary responsibility on community	Rc
Places primary responsibility on individuals	Ri
Places primary responsibility on government	Rg
Distrust of Health Officials	DoHO
Apathy or lack of concern	Ap
Organization lacking or of importance	Org
Value of education	VoE
Security or physical safety	SFs
General prevalence of illness or disease as a concern	SFild
Fumigation	Fum
Personal history of disease or family history	DH

FINDINGS

General Knowledge of Zika

Although the vast majority of participants demonstrated knowledge of Zika, that knowledge was limited. Eighty-six percent of participants correctly identified at least two symptoms of Zika infection, but only 38% of participants indicated familiarity with more than two symptoms. Fourteen percent were unable to name any correct symptoms. Ninety-eight percent of participants correctly identified mosquitos as a transmission route for the virus, while 8% identified sexual contact as a transmission route. When asked about complications or at-risk

populations, 49% of participants cited pregnant women as particularly at risk, and 23% described or identified microcephaly as a possible complication. Twenty-eight percent of participants reported personal or familial experience with mosquito-borne disease, often with more than one occurrence in their lifetime. When asked specifically about their experience with Zika, 18 participants reported personal or family experience with the virus, all of which occurred within the past year. Participants who reported a disease history with mosquito-borne illness showed less familiarity with correct transmission knowledge ($p = 0.055$), indicating that previous infection does not promote biomedical knowledge or understanding of these viruses.

Prevention Practices

All participants agreed that prevention was important, with all but one responding that Zika education was important to their communities as well. Eighty-six percent took personal responsibility for Zika prevention in their respective communities, and 97% of total participants described at least one accurate method of prevention. In response to the question "how can you prevent Zika?" the most frequent answer was "eliminate standing water or breeding areas" (62 responses). Thirty-nine percent of participants had more than one response to this prompt. Other suggestions were "collecting garbage", "fumigation", and "using repellent" (Table 2). While

Table 2. Participant responses regarding prevention methods, n = 97.

Suggestion	# Responses
Eliminating Standing Water/Breeding Areas	62
Garbage Collection or Sanitation	32
Repellent	18
Fumigation	8

prevention literature about Zika and other arboviruses emphasizes clean water as mosquito breeding territory, participants in this study were highly concerned about garbage and the possibility that mosquitos could breed in the areas where water collects that were not in their control—street gutters and garbage collecting in public areas were frequently mentioned. Table 3 shows responses regarding how the *community* could be protected from the virus. Garbage collection remained a popular suggestion and received more responses when framed as a community solution than an individual effort (42 responses). In expressing concern about garbage, many participants cited particular types of trash as a problem, including old tires, kitchen appliances, or old cars:

> "The municipality collects the garbage… they come twice a week. But, eventually, they will come less, only when there is a problem or epidemic. They come less frequently to collect garbage that isn't garbage, like old bikes and tires. They don't do it enough, only when there is an outbreak of a disease, when the prevalence is high. So, it's not preventative". —Man, age 38, Quebrada Ganado

> "If you look at who gets Zika and Dengue it's always the people with all the old things in their yard, tires and old kitchen parts". —Woman, age 63, Quebrada Ganado

Eighty percent of participants had more than one suggestion for how to protect or educate their community about Zika, with a total of 59 responses indicating the importance of some form of education in aiding prevention practices (Table 3). Other responses cited eliminating or repelling mosquitos as important for protecting the community (Table 3). Seventy-three percent of participants reported receiving information about Zika, the primary format being pamphlets (30 responses). Participants who reported disease history showed less familiarity with prevention practice ($p = 0.003$), indicating that previous experience with mosquito-borne illness does not reduce risk. Older participants were more likely to recommend fumigation as a method to

eradicate mosquitos (p = 0.00), demonstrating the influence of historical eradication methods on current perceptions of disease eradication.

Table 3. Participant suggestions for protecting their community from Zika, n = 97.

Suggestion	# Responses
Education	59
Garbage Collection or Sanitation	42
Community Organization	38
Eliminate Mosquitos	28
Repellent	7
Impossible	2

Community Perceptions

Participants expressed their thoughts about the virus, prevention efforts, and problems in their respective communities throughout the interviews. In respect to prevention and education, 20% of the participants who reported receiving information about Zika also felt that they had received very little information. Participants expressed a preference for *charlas*, informal lectures to learn more about Zika (42 responses). Arboviruses were the third most common response when participants were asked about the most serious problem in their community (13 responses). The most common concerns were littering (28 responses) and drugs (22 responses). Twenty-seven responses described "apathy" or "lack of concern" as a problem in the community. Participants who had personal or family disease history with arboviruses reported or expressed apathy more frequently (p = 0.006), and were less likely to suggest strategies for mobilization (p = 0.036). Fifty-three percent of participants felt that Zika was "very dangerous", and 15

responses indicated that they perceived Zika as possibly fatal. Sixty-five percent of participants distinguished Zika from other arboviruses, but 35 responses added that Zika was "similar enough" to viruses like Chikungunya or Dengue.

Seventy participants took responsibility as individuals for protecting their communities from disease, and many recommended multi-level interventions that incorporated both state and local government. The recommendation for government assistance decreased with age, with younger participants more likely to demand state involvement at a level of 10% significance ($p = 0.099$), indicating that attitudes towards prevention are shifting in younger generations. Thirty-eight participants cited a need for organization as part of the eradication effort (Table 3). A 32-year-old woman from Quebrada Ganado told me, "We, ourselves, have the primary responsibility and then the [local and state government] have a part in implementing the sanitation campaigns". Others commented on the divide they felt between the community and eradication efforts by the state, recommending new strategies for education and prevention that were lacking in their community. A 50-year-old man from Quebrada Ganado asserted, "The education has to be at the level of the locals. The Ministry of Health isn't in alignment with the Ministry of Education. The problem with the Ministry of Education is that they are working at the level of children but the children aren't the ones in charge of the houses". Later, in response to questions about protecting the community, he elaborated further:

> "I think that the Ministry of Health is lacking in community work. They are doing the prevention work but they aren't doing community work …. The municipality plays a role in the collection of garbage, but prevention and control and education is the government. The organization of the community is in place but we are missing the part of the government".

Several participants explained that they were concerned about disease spread because there was no facilitation by local authorities when it came to eradicating mosquito habitat or picking up

garbage. Javier, a 38-year-old man and prominent community organizer in Quebrada Ganado, explained the need for structure in eradication campaigns: “I think that the information is here. That it came. We all see it on Facebook and television, and some in the schools. The information is here. What’s missing is doing something… the authorities don’t facilitate, there’s not authority”. As he spoke, he pointed to a tire filled with water in the neighbor’s yard. Another man, age 48, also from Quebrada Ganado stated, “… if one family doesn’t clean-up it hurts everyone… if all the houses are clean except for one, the disease continues. Therefore, it’s constant work”.

When asked “what is the worst problem in your community?”, thirteen participants listed arboviruses; when prompted with a specific question about health-related problems in the community, almost half of participants answered that mosquito-borne disease was the most prevalent health concern (42 responses). Over a quarter of participants reported personal or family experience with mosquito-borne illness (28 responses). Another woman, 36 years old, expressed, “[The worst problem] is the spread of viruses in the community… the outbreak. Because I can see a lot of mosquito bites, fever, and a lot of disability”. The “disability” here refers to a general sense of helplessness in the face of poverty, disease, and chronic mosquito plague that residents are unfortunately familiar with, as was very apparent in Quebrada Ganado. This sense of helplessness is measurable, reflected in the participants I spoke with who were unfamiliar with prevention methods despite experiencing mosquito-borne illness, and the more frequent mention or expression of apathy in the same group of participants. As a 63-year-old woman in Quebrada Ganado remarked, “I don’t know how to educate because we’ve had talks. We’ve collected the garbage from our houses… you could come 15 years from now and it would be the same”. Comments like these reflect the helplessness individuals felt in an environment

characterized by seasonal mosquito outbreaks and unlimited *Aedes* habitat despite their best efforts in their homes.

Through the structured interviews, participants revealed other perceived problems in their community. Most concerns were centered on general disease and chronic illness in the community not limited to the prevalence of mosquito-borne viruses. Twenty-eight other responses expressed the abundance of illness or disease other than arboviruses in the community. In one interview, a 39-year-old woman and stay-at-home mother gave me the following insight into the health of Quebrada Ganado, "A problem in the community is there's a lot of asthma, respiratory problems… people suffer here, and there's diabetes". Only two participants made any mention of poverty. An elderly woman from a small community in Garabito described to me how the root of all problems was the prevalence of drugs and disease; she later stated: "A part of the general problem is the health problems—they are one and the same". Repeatedly, participants linked the problem of garbage or pollution in the community to health problems and the spread of disease. Eighty-two participants expressed concern about a lack of sanitation in their community. A 57-year-old woman who was very active in the community explained to me, "The problem with health here is the viruses transmitted by mosquitos. Because there is a problem with drug addiction, people throw garbage in the streets, and there's lots of garbage and the mosquitos come live in the litter".

The salient themes throughout my interactions with 100 participants came down to the relationship between garbage and disorganization in eradication campaigns that left these communities feeling powerless in the face of disease. A 42-year-old man from Quebrada Ganado encapsulated this phenomenon in his statement: "I think that eradication is difficult because [of the environment and need for group effort] ... This community needs a united effort to

accomplish hygiene in every place; there's a lot of sickness and so people don't have peace". The government's focus on community participation in the eradication of mosquito-borne disease creates frustration in the populations bearing the burden of epidemics. Javier, the 38-year-old community organizer from Quebrada Ganado, expressed his frustration with the lack of organization, explaining that "The Ministry of Health, the municipality, and the residents [are responsible for protecting the town]. But the idiosyncrasy is that they only do it when they are obligated. [They say] 'it's not my problem'."

Nearly a third of participants remarked that apathy was a major barrier to eradicating mosquito habitat in their communities and that individuals needed to mobilize to prevent disease. Almost all participants offered a strategy to help their communities, and the frequency of comments about garbage, education, and the willingness to take personal responsibility suggests that the missing link in communities like Quebrada Ganado is a structured intervention strategy. Participants repeatedly insisted that the prevention of Zika was a responsibility shared by everyone, with 86 responses listing *todos* (everyone) or *nosotros mismos* (ourselves) as the primary parties responsible for protecting the community from Zika. The level of community-based concern expressed by participants in this research reflects the potential for community mobility. Communities like Quebrada Ganado understand that health promotion is a group effort and requires multi-level engagement and execution. Understanding the beliefs and attitudes in community and addressing concerns on a local basis are key elements to future health campaigns by the state. Additionally, the collective mindset in cases like that of Quebrada Ganado represent a great asset to health promotion.

DISCUSSION

Todos and the Value of Local Perspectives

Participants in this study demonstrated their knowledge about Zika and *Aedes* habitat through voicing concerns about their neighbors and the environment of their larger communities, indicating acute knowledge of the population-level effects of arbovirus epidemics and the critical importance of collective action in prevention efforts. The impact of other community problems was also understood as influencing disease by many participants. Commentary about drug use and garbage was often linked with the observation of poor health, and garbage especially was tied to the spread of mosquito-borne disease. This commentary in addition to other interview data revealed garbage, pollution, or lack of sanitation to be primary concerns and reveals local knowledge that is being overlooked by state health campaigns. Prevention education put out by the Ministry of Health insists that clean water is the only media that *Aedes* will use as breeding habitat, ignoring the concerns in localities like Quebrada Ganado, where the garbage collecting in the streets is thought to be a source of disease. Local perceptions like these are suppressed by the epidemiological perspective held by the Ministry of Health, which is founded on a history of Dengue management that has followed a standard model for decades (Dick et al. 2012). This standard is increasingly out-of-touch in the face of a changing climate, the new transmission routes demonstrated by Zika, and urbanized environments with growing populations.

We are now beyond what medical anthropologist Merrill Singer terms “ordinary times” in which the traditional models for disease prevention and intervention were developed. Successful health promotion campaigns must appreciate the development of disease within the context of environmental change and anthropogenic remodeling of the environment. In “ordinary times”, remodeling health intervention programs to include climate, social distress, or other

seemingly unrelated factors would have seemed radical and inefficient, but today the understanding of these elements is critical to promoting health and eradicating disease (Singer 2014). The appreciation of the local perspective is crucial to mitigating the impact of these factors on human health, and can be attained through ethnographic methods and engagement with local environments and communities (Inhorn and Hahn 2009). By adapting an anthropological perspective that puts the knowledge of local communities at the forefront of on-the-ground operations, public health institutions can optimize the effectiveness of their campaigns. Anthropological methods of long-term engagement with communities and an understanding of culture and the biosocial nature of health can advise the localization of health initiatives, transforming them from broad applications to effective implementation.

Addressing the concerns of communities is the first step in managing campaigns that improve population health—the primary concern of residents of Quebrada Ganado and Orotina was the lack of waste management by the state, especially in communal areas like street gutters. The failure of state health agencies to acknowledge this issue exacerbated the disconnectedness that locals felt from the "health for all" dogma promoted by the state. A new approach to the implementation of health campaigns, one that incorporates local perspectives, would find not only that the local concerns are valid, but also that their values—of community engagement and collective action—are aligned with those of the state and a great asset to the promotion of health in rural areas. Providing aid to communities like Quebrada Ganado in the form that they require, rather than assuming a one-size-fits-all solution, would better access the enduring structures of community leadership and participation that rural areas need to sustain health programs.

The Right to Health

Differential access to healthcare services also factors into attitudes towards Zika prevention, primarily due to structural forces that place an uneven burden on rural areas under the façade of community participation. Costa Rica established a welfare state in 1941 with the founding of the *Caja*. By 1949, the institution was empowered to "universalize social security services in favor of the workers who reside in the national territory and responsibly pay for social security" (Del et al. 2010). The constitutional right to social security services is thus firmly connected to the labor force; the right to health, however, is not constitutionally protected. Despite the national pride in access to health services through the provision of state insurance, and numerous resolutions that promote access to healthcare, the words of state institutions ring hollow in the ears of rural communities, where intermittent laborers, immigrants, and the poor face monetary barriers to basic medical care. These populations are barred from the "right to health" popularized by political entities by the nature of their placement outside of the category of "wage earners" by the state. The *Caja* divides the groups that receive benefits into four groups: wage-earning workers, independent workers, state-insured beneficiaries, and dependents, or those who rely on a spouse or family member who falls into any of the three previous categories. These categories would appear to cover the majority of the 4.85 million people living in Costa Rica, but there are over 500,000 uninsured residents (Del et al.). While the demand increases for transitory laborers in agriculture, construction, and other temporary work, the *Caja* is lagging in establishing policy that allows citizens to access their right to social security. Additionally, the restriction of healthcare access for migrant or immigrant groups has the potential to exacerbate population health problems, especially when those groups are essential to meeting the state's demand for agricultural productivity and other seasonal work. Accessing

social security benefits is the primary barrier to receiving medical care in Costa Rica and reducing the problems of overcrowding in basic care clinics and emergency care, which are the only services that uninsured residents are permitted to access. These clinics have the greatest geographic spread and are designed to provide care to a maximum of 4,000 insured residents (Del et al.). The positioning of these clinics also makes them the primary care center for uninsured transient workers, who are often resistant to seek medical assistance outside of emergency situations, for which these basic care centers are also not equipped (Goldade 2009).

In my research, over half of participants—58%—reported rarely visiting the local basic care clinic or the hospital and many of them emphasized that they only sought medical assistance for serious health problems (39 responses). A 74-year-old male construction and agricultural worker from Quebrada Ganado stated, "I go to the clinic if I can afford the bills and it's totally necessary [to receive medical care]". Despite his apparent status as a wage earner and his Costa Rican citizenship, his concern over out-of-pocket costs prevented him from seeking preventative or non-emergency care. As a temporary laborer, his access to social security benefits was likely compromised by the cross-talk between employers and the government, resulting in his having to pay expensive out-of-pocket costs relative to his salary. The *Caja* neglects the laborers that it was designed to support by failing to check employers and provide insurance to those who are employed in seasonal or temporary work.

However, it is not only the uninsured who suffer the systemic inadequacies—dependents may also struggle to access medical care. In the case of my host mother, Doña Maria, in Quebrada Ganado, her classification as a dependent did not provide the access to care that she was owed according to the Illness and Maternity package provided by state insurance (Del et al. 2010). Doña Maria was dependent on the wages of her son, who owned a small local grocery.

Having never worked, her access to services at the clinic in Jacó was provided through her son's insurance. When I arrived in Quebrada Ganado in April of 2017, Doña Maria was suffering from a torn ligament in her knee that compromised her mobility. She invited me to tag along on trips to the clinic in Jacó, where she would consult with doctors and receive pain medication. After being recommended for surgery, she received information about how much the operation would cost, which was more than the family was prepared to pay. This resulted in a deeply confusing and stressful few weeks for the family in which they repeatedly called offices of the *Caja* to navigate the situation.

Doña Maria's situation lies in contrast to the experience of my host family in San José, the Morenas, who regularly visited medical professionals for their personal health and the health of their young daughter. My host family in San José consisted of my host mother, Doña Louisa, her daughter and son-in-law, and their preschool-aged daughter. Doña Louisa and her granddaughter sought medical care several times during my stay with them between March and May of 2017; both would be classified as dependents on the social security benefits of Doña Louisa's daughter and her spouse. Their visits to the hospital were for mild health concerns like stomach flu, colds, and regular checkups. Instead of one small, crowded clinic like that of Jacó, the Morena family frequented doctors in one of the many large hospitals of San José. While my relationship with the Morenas was not as close as my relationship with Doña Maria, the frequency and relative ease of their hospital visits felt very different than what I witnessed in Quebrada Ganado. The Morena family fit the "right to health" narrative that the state is championed for, whereas Doña Maria struggled to receive care that she desperately needed to improve her mobility. This was despite both families qualifying for the same type of insurance

and the additional eight percent increase that Doña Maria's son payed for social security benefits based on his status as a business owner (Del et al. 2010).

In Costa Rica, social security benefits designed to provide universal access to comprehensive health care are out of reach for laborers dependent on seasonal or temporary work, and dependents may be struggling in rural areas where health infrastructure is already beyond capacity. Since 1990, the *Caja* has been responsible for prevention, rehabilitation, and recovery efforts related to population health while the Ministry of Health manages policy, nation-wide planning, and health promotion (Del et al. 2010; Bandzuh et al. 2016). By delegating responsibilities among the agencies, the state compromised the dispersal of social security benefits and access to health for rural areas, which are primarily managed by the *Caja*. Geographically and politically distant from the Ministry of Health, rural populations are without advocates to advise social security policy that accurately reflects rural demographics. A few participants in this study reported that visiting the clinic was expensive, even though they were employed and likely qualified for subsidized treatment costs. Another informant reported that people were ignorant of health services because they did not want to go to the clinic; others reported crowded conditions and a lack of organization that deterred them from visiting small clinics run by the *Caja*. A 27-year-old woman from Jacó remarked, "I go to the clinic [only] when I'm sick, because the service is really bad. It's really horrible, there aren't enough chairs in the [waiting room]. I don't like the personnel, there's only like two doctors and like 20 chairs in the whole clinic". The basic care clinics utilized by communities on the rural Pacific coast are clearly beyond their carrying capacity of 4,000 people. Based on my observations, the small clinic in Jacó was receiving patients from small rural communities in Garabito canton in addition to serving the city itself, which collectively numbers over 20,000. This clinic is the only basic

care facility, although emergency services are available at the two hospitals also in Jacó, which require insurance or co-pay.

The infrastructure required to support basic care clinics and other aspects of socialized healthcare are losing much needed support as privatized insurance enters the country. Costa Ricans with the ability to invest in private insurance are doing so, and the state insurance is losing contributors (Del et al). This loss is causing state-funded institutions to suffer in a system that was built for collective wealth. The quality of care is decreasing as the burden of uninsured patients falls on public clinics that are also losing state-insured support, creating a feedback loop that causes wealthier patients to leave state-insured care in search of higher quality medical institutions. Private insurance also draws individuals away from the community model at the root of Costa Rican public health programming, contributing to the weakening of state-run health campaigns and institutions. In my own experience seeking health care in Costa Rica, I was told by locals to go to one of the private hospitals in San José because the quality of care was better. It is my belief that the dichotomy of public and private health care is causing a parallel dichotomy in rural and urban health.

At the heart of the "health for all" dogma is the value of community participation, especially in rural areas. In the beginnings of rural health outreach in Costa Rica, community participation was crucial in rural areas due to the lack of roads and the remoteness of many plantation communities (Morgan 1993). Despite the relative ease of transportation today, the capital city remains the central location for medical care and rural areas, from my observations, receive limited resources in comparison to San José residents. Participant responses in this study reflected the importance placed on individual and community participation in health campaigns, with 47% reporting Zika prevention as a community responsibility and 70% placing primary

responsibility on individual participation. From a top-down perspective, the Ministry of Health and the *Caja* efficiently handle health policy and dispersal of health information through the dispersal of literature and television advertisements on mosquito-borne disease and prevention. However, rural communities like Quebrada Ganado interpret communication from the state to be distant and inconsistent. Of the 73 participants who reported receiving information about Zika, nearly a quarter emphasized that they felt it was incomplete. Although the community appears prepared to accept responsibility for Zika prevention, they are lacking the basic knowledge to effectively combat the disease. Additionally, the socioeconomic conditions in rural areas of Costa Rica limit the resources that people can contribute to eradication efforts.

Management of mosquitos on personal property is a full-time effort on top of the paid employment 77% of participants were engaged in. In the current model of community participation, individuals are expected to contribute to organized, volunteer efforts to eradicate disease in their communities. The prevalence of mosquito-borne disease and the voices of participants in Quebrada Ganado reflect that organized efforts are lacking in their community. While community involvement and feedback is critical to the success of any public health initiative, placing the burden of eradication on populations with limited resources is poor implementation. In areas of rural Costa Rica where mosquito-borne viruses run rampant, poverty, chronic illness, and unemployment are just as prevalent. The historic state mentality of "health for all" and community participation in Costa Rica have been wielded as a shield for political campaigns—all parties recognize the importance of national healthcare, but fail to protect the health of disadvantaged populations. The importance of participation has been internalized by communities such as Quebrada Ganado, where the environment of endemic mosquito habitat, poverty, and pollution combine to mount an enormous challenge to citizens.

The inconsistency of on-the-ground intervention by the state contributes to a framework of structural violence that promotes suffering and disease in rural communities like Quebrada Ganado. As defined by Paul Farmer, structural violence is the interaction of power structures that neglect, criminalize, or otherwise harm disadvantaged communities, resulting in a "social web of exploitation" (2004: 317). It seems that state agencies such as the Ministry of Health are demanding community participation in an exploitative manner penalizing disadvantaged groups disconnected from the resources that wealthier Costa Ricans enjoy. Thus, the dogma of community participation camouflages the neglect of the Ministry of Health and places the blame for outbreaks of mosquito-borne disease on populations that are least equipped to manage it—the poor, the chronically ill, and the uninformed.

Garbage and the Misrepresentation of Mosquito Habitat

The Ministry of Health and the *Caja* distribute information about mosquito habitat that emphasizes the danger of clean water, like that found in water storage containers, washing areas, or houses. An argument that I repeatedly engaged in with my advisor from the Ministry of Health was over the lack of recognition by public health officials of the proliferation of larvae in street litter. Garbage is a visible problem in both semi-urban Orotina and rural Quebrada Ganado, and a salient concern of many participants in my study. In Ministry of Health media, the onus of mosquito prevention is placed on individuals by recommending frequent cleaning or disposal of gutters, old tires, or water storage containers (Figure 2). However, my observations and interviews with locals revealed the most likely source of habitat to be street litter, which is not efficiently managed by municipal entities in rural areas like Quebrada Ganado. Seventy-one percent of participants recalled standing water as a risk factor for arboviruses, repeating the

Figure 2. Ministry of Health educational material regarding elimination of mosquito habitat. Source: Unidad de Comunicación y Educación para la Salud.

information they have received from the Ministry of Health about breeding habitat in their own backyards. I heard commentary about clean water only a handful of times from my participants, suggesting that there is an incongruity between government prevention campaigns and what communities perceive to be threats. Additionally, the presence of the breeding habitat described by the Ministry of Health—old tires, plastic containers, and old machinery—may not have an accessible route of disposal. The sentiment that I perceived from my conversations with community members was that they had enough information to understand the danger of their surroundings, but no aid to eliminate the risk factors present in their environment. In an area where the dominant disease vector reproduces in the amount of water contained in a bottle cap, constant vigilance is needed from individuals but also from local and state government to prevent

epidemics. While individuals are eliminating mosquito habitat on their personal property, there are no obvious measures in place to handle the pileup of viable *Aedes* habitat in street gutters and public property. The state thus distributes out-of-touch information that does not appreciate the adaptability of *Aedes* to the built environment of throw-away plastic and *polluted* water (Warno Utomo and Triwibowo 2016). In disseminating information that prioritizes individual action and propagates the clean water myth, the state defers responsibility for desperately needed waste collection efforts. This neglect contributes to the clustering of disease, in particular mosquito-borne illness, as it exacerbates the burden of prevention that is placed on communities like Quebrada Ganado.

Disease Clustering and Environment

Due to its asymptomatic presentation, Zika has not received the level of attention paid to other viruses carried by *Aedes* in the tropics. Although Dengue and Chikungunya are diagnosed more commonly due to their intense symptoms, the two species of *Aedes* mosquitos active in Costa Rica and other equatorial countries can carry multiple viruses simultaneously. Mosquito borne diseases cluster in Quebrada Ganado and other areas with conditions of climate, neglect, and poverty, where a lack of infrastructure to handle water and garbage results in an outbreak of *Aedes* (Singer 2017). Thus, Zika virus and its complications, although delayed, are worrisome in areas where access to healthcare is limited and government assistance is scarce. Additionally, health literacy in Garabito is poor, with over half of participants in this study reporting that their knowledge or their community's knowledge was limited regarding Zika. The concern expressed by these participants is especially troublesome in light of Zika's sexual transmission route, of which only eight percent of participants were aware.

The potential for catastrophic outbreaks of Zika and other diseases carried by *Aedes* is motivated by circumstances of poverty and healthcare (LaBeaud 2008; Lindoso and Lindoso 2009). Additionally, climate patterns that increase the prevalence of *Aedes* habitat are experienced with greater intensity in equatorial countries; the increase of temperature, rainfall, and extreme weather events exacerbates conditions of neglect and creates epidemic environments for Zika and other vector-borne disease (Ferreira 2014). As the frequency and intensity of rainfall increases, so does the potential for flooding and standing water buildup, which facilitate *Aedes* breeding. In Garabito and Orotina cantons, as discussed above, there is an abundance of places for water to collect, in the old appliances and water collection containers in yards, and especially in the garbage that is thrown in the street gutters and into local rivers. Commentary from my participants indicated that eradication of mosquito habitat through garbage collection and fumigation was sporadically carried out by the Ministry of Health. Participants also indicated that there was not a way for them to easily dispose of old appliances, despite warnings from the Ministry of Health that highlight tires, old containers, and other large pieces of waste as breeding territory for mosquitos. Despite rigorous cleaning and removal of water that I witnessed my participants practicing, the daily practice of *Aedes* habitat monitoring becomes taxing in the wet, humid climate and nearly impossible during the rainy season. Heavy rainfall events wreak havoc on the already poor living conditions experienced by residents of Garabito and Orotina, where the built environment is not designed to prevent commingling of garbage and water.

Already, the efforts of the Ministry of Health are not enough to control *Aedes* populations, and as the frequency of storm events increases, the rate of arbovirus infection will rise to pandemic proportions. Dengue, Chikungunya, and the score of other infections

transmitted by *Aedes* mosquitos will have immediate effects on the rural, coastal towns of Costa Rica and other tropical regions. Moreover, rising temperatures increase the likelihood that *Aedes* will occupy cooler inland areas (Ferreira 2014; Roiz et al. 2015). While the rare symptoms of Zika may become more prevalent in epidemic conditions, the rate of disease in immediate conditions will result in a delayed epidemic of microcephaly. Already struggling with health literacy, access to medical care, and poverty, the rural mid-Pacific coast is ill-equipped to handle a generation of Zika-afflicted infants that require specialized care. A generational peak in microcephaly hosts the potential for additional syndemic vulnerabilites that accompany developmental disability, such as poverty, poor health, and ostracism.

The disproportionate effect of Zika's secondary effects on women and their infants also presents an additional dilemma for public health campaigns in that Zika may be seen as a problem for pregnant women only. As the chain of events that leads to a case of microcephaly caused by Zika is nearly invisible, health education initiatives must eliminate the 'mystery' of Zika transmission through a comprehensive model that includes the familiar model of mosquito transmission, as well as Zika's unique route of sexual transmission, and transmission across the placenta in pregnant women. In my research with residents of Quebrada Ganado and Orotina, I heard many incomplete or unfounded details regarding the effect of Zika on pregnant women and infants. Often this information was muddled with a history of education on Dengue and Chikungunya, indicating that some effort to educate the community had been made by individuals or health professionals. To effectively prevent cases of fetal microcephaly, however, the education on Zika transmission needs to be comprehensive and emphasize that Zika is not just a problem for pregnant women. If the understanding of the virus continues to be centered on an incomplete education of the effects on pregnant women, the potential for discrimination,

ostracism, or other forms of structural violence may be directed towards pregnant women and prevent them from accessing resources, especially if their infants are born with microcephaly.

In Brazil, where the first cases of microcephaly occurred in Latin America, there are strong associations with the rate of the condition in urban slums due to syndemic interactions of disease, poverty, and environmental factors (Snyder et al. 2017). As the virus and its ability to produce disability spread, the association between poor living conditions and microcephalic infants may build to a capacity that exacerbates suffering and elicits further discrimination from health officials, institutions, or other power structures. In the context of Costa Rica's rural-urban dichotomy and the health inequalities that accompany it, health conditions caused by Zika virus will further strain state institutions and increase the potential for discrimination against the communities most affected by the virus due to syndemics of poverty, climate, and mosquito-borne disease. The state must remodel its intervention strategy to effectively combat the conditions that cause disease in communities like Quebrada Ganado and Orotina, by implementing programs that address the physical environment and community education.

Information Inequity

When imagery surfaced in 2015 of Zika complications in infants from Brazil, global health organizations and media outlets leapt into action, inciting a brief panic. Zika appeared in Costa Rica in early 2016, but a year after the first cases appeared, many of the participants in my study were uninformed of the distinguishing characteristics and complications of the virus. These results become more concerning in the context of the study population, as 85% of participants lived in the region most affected by Zika in the previous year (Humanos 2015; "Zika 10" 2017). Before my arrival in Costa Rica, I had been exposed to information about Zika virus primarily through mainstream news coverage. My own research mostly consisted of peer-reviewed

scientific literature that investigated the more nuanced research on transmission routes and *Aedes* mosquitos. However, I received most of my basic knowledge regarding transmission routes, symptoms, and complications from online and television media coverage and travel warnings.

While in Costa Rica, I rarely saw information about Zika virus, and when I did it was almost always in the capital city of San José. At Jacó Clinic, which would have received the largest influx of Zika cases in 2016, there were no pamphlets, posters, or other information on display regarding Zika virus. Rural areas like Quebrada Ganado are clearly outside of what Janes and Corbett (2009) label the "global circulation of health knowledge". In official documentation regarding state insurance coverage and the healthcare system, Costa Rica appears to have an ideal network of coverage that fits the "health for all" slogan. The state and media together promote the symbol of national health perceived by the rest of the world, limiting the interest and investment of non-governmental or other international agencies. Thus, Costa Rica's renowned healthcare system contextualizes the low assistance that Costa Rica receives from international health agencies such as the World Health Organization, as the surface-level appearance of a socialized medical system camouflages the inequity experienced by rural communities. As a result, there are very few non-governmental agencies active in the health sector, and the state's community participation philosophy continues to place the task of disease prevention on rural towns and impoverished areas, which would otherwise benefit from non-governmental aid.

Support for eradication initiatives is funneled through the same channels that fail to reach rural healthcare sites and perpetuate an inequity of resources, especially in the distribution of science and technology (Janes and Corbett 2009). Participants in my research who had access to internet, social media, or television were also some of the most informed about Zika's complications and unique transmission routes. However, only 20% of participants reported

access to these media outlets, and the majority relied on traditional methods such as pamphlets, home visits from health workers, or word-of-mouth. Technological communication pathways are the best way for international health agencies to disseminate information globally, but this method of distribution is not reaching the rural communities and impoverished populations with heightened risk. Prevention policy developed by the Ministry of Health is disconnected from the implementation of prevention practices, which require assistance from state or international funding to accomplish effective eradication measures such as garbage collection. Additionally, the current mode of media-disseminated health education is not sufficient for the most vulnerable populations that need to be informed about Zika due to their proximate exposure to the previously discussed biosocial elements of disease.

The distribution of knowledge related to epidemics is subject to the same structures of power and control that influence the allocation of health resources (Briggs and Nichter 2009). International health agencies displayed immediate concern regarding Zika virus and acted to distribute information globally, primarily in the form of travel warnings aimed at audiences outside of the area experiencing direct contact with the primary disease vector, *Aedes* mosquitos. While the sexual transmission route demanded that countries outside of endemic transmission be warned about possible risks, countries experiencing Zika outbreaks could not act fast enough to prevent epidemic occurrences. Zika's nearly invisible pathology made it so that the first warnings of the virus were infants born with microcephaly in Brazil. The images of these infants that surfaced from Brazil in 2015 were distributed by international health agencies, inciting concern and panic about the implications of a new virus with an asymptomatic pathology and damaging consequences. It is difficult to tell whether the virus or its publicity spread faster, but by 2016 Costa Rica had its first autochthonous cases of Zika, localized to the mid-Pacific coast.

By September of 2017, six cases of congenital Zika were confirmed out of 210 pregnant women infected with the virus ("Zika-Epidemiological Report" 2017). While less than three percent of these pregnancies resulted in congenital Zika syndrome, the press wildfire around the virus painted Zika as rampant, heightening public fear. This is not to say that congenital Zika is unimportant or harmless, but rather to highlight the manipulation of information about the virus that centered the concern on infants, rather than other victims of severe Zika symptoms, such as the patients that experienced the Zika-related paralysis termed Guillain-Barré. Incidence of paralysis is perhaps not as sensational; as a rare symptom of infection with Dengue, Chikungunya, and West Nile virus, Guillain-Barré syndrome is old news (Lebrun et al. 2009).

The selection of research questions by health institutions, the publication of those findings, the distribution of information by international health agencies, and the interpretation of that information by the media influence the knowledge obtained by the public. By the time I left the United States to go to Costa Rica in the early spring of 2017, everyone I knew had a warning or some piece of information to give me about Zika virus—I was reminded repeatedly about congenital Zika and the sexual transmission route. However, shortly after arriving on the Costa Rican coast in April, I realized that the informal information I had received about Zika in the United States was far from common knowledge in these coastal communities. In formally discussing the virus with the 100 locals in my study, only eight identified sexual contact as a transmission route, and often not with any kind of confidence. Somehow, in the seemingly global panic about Zika virus, the coastal town of Quebrada Ganado was out of the loop, and participants in Orotina were only slightly more knowledgeable. Rurality, poverty, and the burden of poor health already experienced by these communities forms a barrier to these types of

international communication, constructed and enforced by the same dynamics of power that restrict access to healthcare and exacerbate conditions of poor health.

CONCLUSION

Applying medical anthropological theory to a quantitative epidemiological analysis of Zika virus in Garabito and Orotina exposes the roots of poor health and disease that result in health disparities. Residents of Quebrada Ganado suffer from a syndemic of arboviruses that now includes Zika. This complex of disease interactions is further sustained and exacerbated by syndemics of poverty, climate change, and chronic disease that are founded in inequalities of access to health resources and political agency. Political power structures have suppressed the rural communities' right to health through decades of enforcement of the community participation model. In theory, community participation has the potential to increase access to health information and medical services by expanding the reach of public health campaigns through local organization and activism. However, budget cutbacks in the health sector and the increasing trend towards private insurance are degrading the already weak foundations of community participation. Utilizing Quebrada Ganado as a model for local structural realities, suffering in rural communities is part of life, as exemplified by the case of Doña Maria's knee injury and the experience of my participants and their families with both chronic and mosquito-borne disease, poverty, and lack of health literacy regarding their own right to health. Costa Rica's "health for all" model does not seem to include the community of Quebrada Ganado and similar areas, despite their vulnerability to mosquito-borne viruses and their enthusiastic declarations of *todos* that fit squarely into the community participation model.

My experience working with a health official in San José made clear to me that the state epidemiological model of intervention did not consider the local structural realities of places like

Quebrada Ganado. The community that I grew to love was reduced, in their eyes, to a hotbed of disease and apathy where poverty and hopelessness were seen as due to individual laziness, and where incidence of mosquito-borne disease was seen as a byproduct of lifestyle and a blemish on the nation's declaration of "health for all". The epidemiological model promoted by the state is rigid, unable to acknowledge the biosocial context of disease: from refusing to accept that *Aedes* will breed in standing water contained in street garbage to failing to see the disproportionate burden of prevention on vulnerable communities. While the bulk of my interaction with state health institutions was through one individual, I saw similar views reflected in the comments made by other people I interacted with in San José and at both research sites. These attitudes also degrade the community participation model, by creating a chain of blame that permits the burden of prevention to fall heavily on the shoulders of the poor, the ill, and the uninformed.

Despite this burden, communities are fighting Zika and other arboviruses as much as possible with the resources they have. Out of Jacó, a program called Jacó Zika Safe is working with schools and other centers of community interaction to increase awareness about mosquito-borne disease, including symptoms, prevention, and the health risks associated with Zika, Dengue, and Chikungunya (Admin 2016). Communities understand the necessity of their participation in health promotion, especially in the prevention of mosquito-borne disease, but need more resources to combat epidemics and address local syndemics. While the state may argue that Jacó Zika Safe is the model of community participation in action, it is more likely a reflection of necessity and desperation in the face of endemic disease and the lack of information or support provided through state channels. State support of these types of community initiatives is needed to help these programs gain traction. Still, community-based programs are not enough to counteract arbovirus epidemics in the face of extreme weather events. If it is not possible for

the state to provide the personnel for prevention initiatives, there must at least be incentives for local participation in campaigns that improve community conditions of littering and other behaviors that promote *Aedes* populations. The first step is for the state to expand their understanding of mosquito habitat beyond clean standing water, as this will both address community frustrations about garbage and reduce the potential for species-level syndemics that increase the vector viability of Zika and other viruses (Singer 2017).

Other health campaigns have found success in using anthropological methods of long-term engagement and ethnographic research to evaluate best practices for the promotion of health and disease prevention, such as incentivized vaccination campaigns in Nigeria and India that addressed local sociocultural context by rewarding participants with food staples or services they needed (Banerjee et al. 2010; Renne 2009). This method of health intervention builds trust with communities and establishes foundations for further establishment of health education programs and long-term prevention campaigns, steps that are being demanded by residents of Garabito and Orotina. Ethnographic research in communities like Quebrada Ganado can partner with epidemiological data to reduce the stigma associated with Zika and other mosquito-borne disease, by highlighting the relationships between quantitative epidemiological and demographic data and the lived experiences of those afflicted with arboviruses.

In exposing the multitude of factors that contribute to the incidence of mosquito-borne disease, a holistic plan for intervention can be developed that engages state health institutions in the eradication of syndemics rather than eradication of isolated disease. As health disparities and vulnerabilities are currently masked by the "health for all" dogma heralded by international institutions of public health, the prevention of Zika in communities like Quebrada Ganado is truly dependent on fulfilling the concept of *todos* for Costa Rica's most vulnerable citizens—that

is, everyone, from the state to the individual level, must be accounted for in their role as it plays into the structures of power and agency that define rural-urban dichotomies of health disparity.

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APPENDIX

Survey (Spanish)

Participante _____

Sitio _____

Sección 1—Demografía

1. ¿Cuántos años tienes?

   - ☐ 18-24
   - ☐ 25-29
   - ☐ 30-34
   - ☐ 35-39
   - ☐ 40-44
   - ☐ 45-49
   - ☐ 50-54
   - ☐ 55-59
   - ☐ 60-64
   - ☐ 65+

2. ¿Costarricense o extranjero?

   - ☐ CR
   - ☐ Otro _____

3. ¿Sexo?

   - ☐ Masculino
   - ☐ Femenino

4. ¿Cuál es su nivel de educación?

   - ☐ Ninguna
   - ☐ Primaria
   - ☐ Secundaria
   - ☐ Universidad
   - ☐ Posgrado

5. Describe el tipo de ocupación.

   - ☐ Desempleado
   - ☐ Agricultura
   - ☐ Gobierno
   - ☐ Turismo (guía/chofer/hotel)
   - ☐ Industria de servicios
   - ☐ Ama de casa
   - ☐ Construcción
   - ☐ Otro _____

Sección 2—Conocimiento del Zika virus

6. ¿Cuáles son los síntomas del Zika?

- ☐ Fiebre
- ☐ Sarpullido-Exantema-Prurito
- ☐ Dolor de cabeza
- ☐ Dolor en las articulaciones
- ☐ Conjuntivitis (ojos rojos)
- ☐ Dolor muscular
- ☐ Microcefalia
- ☐ Otro _____

6a. ¿Hay síntomas diferentes entre niños y adultos? ¿Que son los síntomas diferentes?

7. ¿Alguien en su familia ha sido infectado por Zika?

- ☐ Sí
- ☐ No

7a. ¿(Si dice sí) Fue diagnosticado en el hospital, o cree que tuvo Zika?

- ☐ Hospital
- ☐ Cree
- ☐ Otro _____

8. ¿Conoce los efectos a largo plazo de la infección del Zika?

- ☐ Microcefalia
- ☐ Daños neurológicos
- ☐ No conoce
- ☐ Otro _____

9. ¿Sabe cómo se transmite el virus del Zika?

- ☐ Mosquitos/Zancudos
- ☐ Transmisión sexual
- ☐ No sabe
- ☐ Otro _____

10. ¿Cuáles son los factores de riesgo por el virus?

- ☐ Lugares con mosquitos/zancudos
- ☐ Sexo sin protección
- ☐ No conoce
- ☐ Otro _____

11. ¿Cómo se puede prevenir la infección?
    - ☐ Usando repelente
    - ☐ Eliminada agua estancada
    - ☐ Si ha sido infectados, practica sexo con protección
    - ☐ No conoce
    - ☐ Otro _____

12. ¿Existen síntomas diferentes entre el Zika y el Dengue?

    - ☐ Sí
    - ☐ No
    - ☐ No sabe

Sección 3—Percepciones

13. ¿Cuál es el problema más grave en su comunidad?

14. ¿Cuál es el principal problema de salud en Garabito/Quebrada de Ganado?

15. ¿Con que frecuencia utiliza los servicios ofrecidos en la clínica local?

    - ☐ Con mucha frecuencia
    - ☐ A veces
    - ☐ Solo para serios problemas de salud
    - ☐ Nunca
    - ☐ Otro _____

16. ¿Cuán peligrosa es la infección de Zika?

    - ☐ Muy peligrosa
    - ☐ Peligrosa
    - ☐ No peligrosa
    - ☐ No sabe

17. ¿Es importante la prevención del Zika?

    - ☐ Sí
    - ☐ No

18. ¿Es importante la educación sobre el Zika?

    - ☐ Sí
    - ☐ No

19. ¿Cuáles medidas tomar para protegerse del Zika?

20. ¿Quién tiene el mayor riesgo para infección por el Zika?

21. ¿Quiénes son los más afectados por el Zika?

22. ¿Cómo puede educarse la comunidad sobre Zika y la prevención del virus?

23. ¿Cómo puede protegerse la comunidad ante el Zika?

24. ¿Quién tiene la responsabilidad de proteger su comunidad del Zika?

25. ¿Ha recibido usted información sobre la prevención del Zika? ¿Y cómo la recibió?

- ☐ Sí
- ☐ No

Survey (English)

Participant _____

Site _____

Section 1—Demographics

1. What is your age?

- ☐ 18-24
- ☐ 25-29
- ☐ 30-34
- ☐ 35-39
- ☐ 40-44
- ☐ 45-49
- ☐ 50-54
- ☐ 55-59
- ☐ 60-64
- ☐ 65+

2. Nationality:
   - ☐ Costa Rican
   - ☐ Other_____

3. Sex:
   - ☐ Male
   - ☐ Female

4. What is your education level?
   - ☐ None
   - ☐ Elementary
   - ☐ Middle/High School
   - ☐ College degree
   - ☐ Graduate degree

5. Describe your employment:
   - ☐ Unemployed
   - ☐ Agriculture
   - ☐ Government
   - ☐ Tourism
   - ☐ Service industry
   - ☐ Stay at home mother/parent
   - ☐ Construction
   - ☐ Other _____

Section 2—Knowledge of Zika Virus

6. What are the symptoms of Zika?
   - ☐ Fever
   - ☐ Rash
   - ☐ Headache
   - ☐ Joint Pain
   - ☐ Conjunctivitis
   - ☐ Muscle Pain
   - ☐ Microcephaly
   - ☐ Other _____

   6a. Are there different symptoms between adults and children? What are the differences?

7. Has anyone in your family been infected with Zika?
   - ☐ Yes
   - ☐ No

   7a. If yes, were they diagnosed in a hospital or do you suspect they have Zika?
   - ☐ Hospital
   - ☐ Suspicion
   - ☐ Other _____

8. Are you familiar with any of the long-term effects of Zika?
   - ☐ Microcephaly
   - ☐ Neurological damage
   - ☐ Other_____

9. Do you know how Zika is transmitted?
   - ☐ Mosquitos
   - ☐ Sexual transmission
   - ☐ Other_____

10. What are the risk factors for Zika virus?
    - ☐ Places with mosquitos
    - ☐ Unprotected sex
    - ☐ Other _____

11. How can the virus be prevented?
    - ☐ Using repellent
    - ☐ Eliminating standing water
    - ☐ If infected, practice protected sex
    - ☐ Other_____

12. Are there differences between Dengue and Zika symptoms?
    - ☐ Yes
    - ☐ No
    - ☐ Unknown

Section 3—Perceptions

13. What is the most serious problem in your community?

14. What is the most serious health concern in Garabito/Quebrada de Ganado?

15. How often do you use the health services at your local clinic?
    - ☐ Often
    - ☐ Sometimes
    - ☐ Only for serious health concerns
    - ☐ Never
    - ☐ Other _____

16. How dangerous is infection with Zika?
    - ☐ Very dangerous
    - ☐ Dangerous
    - ☐ Not dangerous
    - ☐ Unknown

17. Is the prevention of Zika important?
    - ☐ Yes
    - ☐ No

18. Is education about Zika important?
    - ☐ Yes
    - ☐ No

19. What measures do you take to protect yourself from Zika?
    - ☐ Use repellent
    - ☐ Remove garbage from the yard
    - ☐ Eliminate standing water
    - ☐ Other _____

20. Who has the most risk for being infected with Zika?

21. Who is most affected by Zika?

22. How can your community be educated about the Zika virus?

23. How can your community be protected from Zika?

24. Who is responsible for protecting your community from Zika?

25. Have you received information about Zika prevention? How did you receive the information?

RCode

Zika Data

Linder Wendt

4/30/2018

```
library(tidyverse)
library(readxl)
library(readr)
library(knitr)
library(broom)
zika <- read.csv("zikadata.csv")
zika <- zika[,1:13]
tc <- read_excel("~/Desktop/Misc/Zika Stuff/Transcription coding.xlsx")
kt <- function(x){
  kable(tidy(x))
}

tc$Participant <- as.integer(tc$Participant)
jzika <- left_join(zika, tc,  by = "Participant")

#Sex as Independent
kt(lm(jzika$VoHI~jzika$Sex))
```

term	estimate	std.error	statistic	p.value
(Intercept)	0.5897436	0.0795559	7.4129432	0.0000000
jzika$Sex	0.0004203	0.1018609	0.0041267	0.9967158

```
#These are clearly not significantly correlated

kt(lm(jzika$Ap~jzika$Sex))
```

term	estimate	std.error	statistic	p.value
(Intercept)	0.2820513	0.0717952	3.9285513	0.0001592
jzika$Sex	-0.0197562	0.0919244	-0.2149179	0.8302779

```
#This clearly will not be statistically significant

#Age as Independent
kt(lm(jzika$Fum~jzika$Age))
```

term	estimate	std.error	statistic	p.value
(Intercept)	-0.2445619	0.1117739	-2.188006	0.0310459
jzika$Age	0.0113264	0.0026856	4.217403	0.0000551

```
#Highly Significant

kt(lm(jzika$Rg~jzika$Age))
```

term	estimate	std.error	statistic	p.value

(Intercept)	0.8209878	0.1473243	5.572656	0.0000002
jzika$Age	-0.0058850	0.0035398	-1.662523	0.0996033

```
#Significant @ 10%

kt(lm(jzika$Ap~jzika$Age))
```

term	estimate	std.error	statistic	p.value
(Intercept)	0.2387577	0.1348049	1.7711356	0.0796470
jzika$Age	0.0007960	0.0032390	0.2457479	0.8063914

```
#This is not close to being significant

#Education as Independent
kt(lm(jzika$Ap~jzika$Education))
```

term	estimate	std.error	statistic	p.value
(Intercept)	0.0760188	0.1648310	0.4611926	0.6456824
jzika$Education	0.0621735	0.0508679	1.2222524	0.2245438

```
#Not significant

kt(lm(jzika$DH~jzika$Education))
```

term	estimate	std.error	statistic	p.value
(Intercept)	0.4169279	0.1673523	2.4913183	0.0144070
jzika$Education	-0.0438871	0.0516460	-0.8497678	0.3975254

```
#No significant correlation

#Disease History as Independent
kt(lm(jzika$Transmission.Knowledge~jzika$DH))
```

term	estimate	std.error	statistic	p.value
(Intercept)	1.0972222	0.0362729	30.249112	0.0000000
jzika$DH	-0.1329365	0.0685493	-1.939284	0.0553427

```
#10% Significant negative correlation between Transimission knowledge and DH

kt(lm(jzika$Prevention.Knowledge~jzika$DH))
```

term	estimate	std.error	statistic	p.value
(Intercept)	1.513889	0.0700913	21.598803	0.0000000
jzika$DH	-0.406746	0.1324602	-3.070704	0.0027637

```
#Highly significant negative correlation

#Will not be significant

kt(lm(jzika$Ri~jzika$DH))
```

term	estimate	std.error	statistic	p.value
(Intercept)	0.7083333	0.0545313	12.9894884	0.000000
jzika$DH	-0.0297619	0.1030544	-0.2887979	0.773346

```
#Not Significant
kt(lm(jzika$Rg~jzika$DH))
```

term	estimate	std.error	statistic	p.value
(Intercept)	0.5694444	0.0584199	9.7474325	0.0000000
jzika$DH	0.0734127	0.1104033	0.6649501	0.5076442

```
#Not significant
kt(lm(jzika$Rc~jzika$DH))
```

term	estimate	std.error	statistic	p.value
(Intercept)	0.4861111	0.0593369	8.192390	0.00000
jzika$DH	-0.0575397	0.1121362	-0.513123	0.60902

```
#Significant at 5%
kt(lm(jzika$Mobilization~jzika$DH))
```

term	estimate	std.error	statistic	p.value
(Intercept)	2.2361111	0.1031623	21.67565	0.0000000
jzika$DH	-0.4146825	0.1949585	-2.12703	0.0359283

```
#highly significant
kt(lm(jzika$Ap~jzika$DH))
```

term	estimate	std.error	statistic	p.value
(Intercept)	0.1944444	0.0508461	3.824176	0.0002308
jzika$DH	0.2698413	0.0960901	2.808211	0.0060128