Underestimating Dengue: A Qualitative Study of Risk Perception in Dhaka, Bangladesh

*Afroza Sultana **Stacie Burke

McMaster University University of Manitoba

*sultaa2@mcmaster.ca **Stacie.Burke@umanitoba.ca

Abstract

Dengue, a mosquito-borne viral infection, is endemic in Bangladesh. This qualitative case study, drawing on interviews and focus groups, examines a low SES ward, seeking to deepen the exploration of community perceptions of dengue risk and its embeddedness with the socioeconomic and political context in Dhaka. The analysis identifies six overarching themes connected with the underestimation of dengue risk. The underestimation of risk becomes apparent in a reduced concern for dengue and dengue vector control, even despite a notable recent epidemic in 2000 and the ongoing circulation of dengue virus in the population.

Keywords: Dengue Risk Dhaka

Introduction:

Dengue, a mosquito-borne viral infection, is endemic in Bangladesh and, with this status, Bangladesh joins more than 100 countries and 40% of the world's population at risk for dengue (García-Betancourt et al., 2014). The World Health Organization has described dengue in Bangladesh as a "major public health problem,"[i] but there have been few community-level studies within the country, which have questioned perceptions of dengue risk. "Risk," according to Deborah Lupton (2013:636), is "about projecting ideas into the future, about imagining the consequences of an action or event," but people must first decide "what is acceptable and harmless against what is dangerous or threatening" and those conceptions are ultimately embedded within "a specific historical, cultural, social and political context" (Lupton, 2013:638). A knowledge, attitude, and practice (KAP) survey undertaken in 2011 by Dhar-Chowdhury et al. (2014:310) suggests that dengue risk is downplayed, that community members are "passive" in household-level prevention efforts and that it is commonly believed that dengue can be "controlled" through the use of insecticides (Dhar-Chowdhury et al., 2014: 314). The current study seeks to deepen the exploration of community perceptions of dengue risk and its embeddedness within the socioeconomic and political context in Dhaka.

Dhaka: The Megacity

In the years following Bangladesh's independence from West Pakistan in 1971, the capital city of Dhaka experienced a massive population influx. Since that time, the trend of expanding population and increasing urbanisation has continued, with an estimated 300,000 to 400,000 of Bangladesh's rural poor migrating to the city each year in search of employment and wages (Kahn et al., 2011: 141). As Dhaka continues to attract "unprecedented population growth," its urban footprint expands outward and the core areas of the city become more densely populated (Ahmed et al., 2014: 31). At the level of the Dhaka Metropolitan Area, current population figures swell to more than 14 million, positioning Dhaka as one of the world's megacities, along with cities like New York, Delhi, and Tokyo (Corner and Dewan, 2014: 5, 10).

Unlike longer established Western megacities that have grown more slowly, megacities in developing countries such as Bangladesh face serious challenges in terms of managing rapid population growth and ensuring adequate infrastructure and urban planning. In Dhaka, the massive post-independence population influx meant that urban development plans quickly became outdated; as a result, the megacity grows "without the support of necessary infrastructure facilities and urban amenities" (Ahmed et al., 2014: 40). High density, inadequate housing, air pollution, extreme traffic congestion, an overburdened and unpredictable electricity supply, deficient sanitation and garbage collection, and an unreliable potable water supply present ongoing challenges

for residents. Undoubtedly, attentions are easily shifted away from more ephemeral concerns, to the ingrained and apparent stressors experienced by the megacity's residents.

A Brief History of Dengue in Bangladesh

It is difficult to target precisely when the dengue virus first entered Bangladesh, but presumably it was after the Second World War as part of a larger pattern of dengue outbreaks emerging in Southeast Asia in the 1950s (Paul, 2014). Aziz et al. (1967) reported on the first potential dengue fever outbreak in Bangladesh, known then as "Dacca fever," in the summer of 1964. Since the initial 1964 dengue appearance, serological studies in Bangladesh in the 1980s and 1990s confirmed the ongoing circulation of dengue virus and established its endemic presence (Paul, 2014). Retrospective serum analyses for 225 febrile patients admitted to a local hospital in 1996 revealed that 55 (24.4%) of those patients possessed anti-DEN IgG antibodies, establishing their bodily histories of dengue infection and proving that the virus was circulating between major outbreaks (Hossain et al., 2003). Only 4 years later, in 2000, a dengue epidemic emerged (Rahman et al. 2002:738). The epidemic expanded, peaked in September and then subsided in December (the onset of the dry season) (Rahman et al., 2002). The cities of Dhaka, Chittagong, and Khulna were particularly affected, with reports of 5,551 dengue infections, of which 4,385 (78.9%) were classified as dengue fever (DF) and 1,166 (21.1%) as dengue hemorrhagic fever (DHF) (Paul, 2014). Overall, 93 deaths were reported (Yunus et al., 2001; Ahmed et al., 2001; Ali et al., 2003).

Dengue cases have appeared in Bangladesh every year since the DF/DHF epidemic in 2000 (Azad et al., 2006; Yunus et al., 2001). In total, between 2003 and 2012, 12,229 cases of dengue and 46 deaths were reported in Bangladesh (Chowdhury et al. 2014). Dengue disease is associated with 4 different serotypes of the dengue *Flavivirus* (DEN-1, DEN-2, DEN-3, DEN-4). According to Paul (2014), all four serotypes were circulating in Bangladesh in 2000, though DEN-3 was the predominant serotype (Islam et al., 2006: 90). Because of the multiple viral serotypes circulating, Bangladesh's status is more particularly defined as "hyperendemic." Disease transmission is possible when the dengue virus is circulating in the bloodstream (viremia), where the virus can be picked up and vectored between bodies by blood-meal seeking insects. *Aedes* mosquitoes, most commonly *Aedes aegypti*, but also potentially *Aedes albopictus* or other *Aedes* species, serve as the primary vectors of dengue virus. An evolutionarily tailored relationship connects dengue virus, *Aedes* mosquitoes, and primates (including humans). The dengue virus itself has adapted a preference for using primate monocytes / macrophages as its "target cell" for replicating and, as a result, has restricted its potential host range to primates (Monath, 1994:2397). Supporting the relationship, *Aedes* mosquitoes have "a predilection for feeding on primate blood" so are effective vectors moving the virus between primates, in particular (Monath, 1994:2400).

Methods

Within the scope of a larger, multidisciplinary dengue research project, three Dhaka city wards, representing high (ward 20), middle (ward 26), and low (ward 69) socioeconomic status (SES) wards, were selected for study (Dhar-Chowdhury et al., 2014). In our study of risk perception, wealth is important to consider. As Lupton (1999:68) notes, for example, "the disadvantaged have fewer opportunities to avoid risks" in the first place due to the lack of means and resources. This study focuses exclusively on residents of ward 69, classified as a low SES ward and vulnerable to myriad effects of poverty, such as food, water, and housing insecurities, poor sanitation, and unemployment. Ward 69 is located in Old Dhaka and is a diverse ward that includes a large Muslim community residing in 11 mohallas (neighbourhoods) and a smaller Hindu "sweeper colony" that has existed since British colonial rule, primarily composed of government employees and their families. In the colony, male residents are traditionally sweepers by occupation; in their own words, they consider themselves "jaat sweeper," or sweeper by caste. In return, for their work, the government provides homes and subsidizes maintenance and amenities, though water and toilet facilities are communal and described as inadequate.

This research into local perceptions of dengue risk is both qualitative and exploratory. The research took place over a 3-month period between October and December, 2012. An initial house-to-house survey of 116 households (93 in the larger ward, and 23 in the sweeper colony) was intended as a general introduction to the ward, to get a general sense of ideas concerning dengue, and to make connections with individuals interested

in participating in follow-up in-depth interviews. Of the 116 individuals participating in the survey, 77 (66.4%) volunteered to be interviewed and from that number, 20 individuals were selected for an interview, subject to continued willingness and availability. In-depth interviews were approximately 1-hour in duration and followed an open-ended semi-structured interview guide. Among the 20 interview participants, 4 females and 4 males were selected from households with some prior dengue experience, and 7 females and 5 males were selected from households with no prior dengue experience. In order to access wider perspectives on dengue, 4 focus group discussions were also conducted: two (one female, one male) focus groups were undertaken in the sweeper colony, and two (one female, one male) in the larger ward. A total of 39 persons, all 18 years of age or older, participated in the four focus groups. All interviews and focus groups proceeded after receiving signed informed consent, were conducted in Bengali, and were audio-recorded with consent, transcribed, and translated into English.

The initial 116 individuals surveyed were represented by 55 (47.4%) women and 61 (52.6%) men. The survey participants' experience with dengue varied: 9 (7.8%) respondents or household members had experienced dengue, 25 (21.6%) reported that relatives outside the household had experienced dengue, 79 (68.1%) reported no dengue experience, and 2 (2.6%) were not sure. When asked if they had received any information on dengue prevention or control, 104 (89.7%) participants indicated that they had not. When asked how dengue was transmitted, only 51 (44%) correctly identified the role of mosquitoes, while 31 (26.8%) of those surveyed did not know, 15 (12.9%) suggested a dirty environment or garbage played a role, 10 (8.6%) implicated stored water, and 9 (7.8%) suggested direct contact with a dengue sufferer could result in dengue transmission. Most survey participants (106, or 91.4%) believed dengue to be a "serious" disease, while 6 (5.2%) thought of it as a "mild" disease, and 4 (3.4%) did not know.

Despite the fact that most qualified dengue as "serious," the in-depth interviews suggest that community members really did not perceive dengue to be a matter of great concern. While we originally believed that community members 'minimized' dengue risk in comparison to other concerns (i.e., they recognize the risk of dengue but choose to give it less attention), the interviews instead suggest that community members 'underestimate' dengue risk (i.e., they do not believe that dengue presents a great risk and therefore give it less attention). In this paper, we explore the subject of risk, highlighting six major themes linked to the underestimation of dengue risk which emerged out of the in-depth interview and focus group transcripts, and concluding with a series of recommendations regarding dengue prevention.

Dengue: A Disease of "Eight to Ten Years Ago"

"Eight to ten years ago," one informant recalled, dengue was a problem, a probable reference to the 2000 dengue epidemic when media was active and engaged in providing daily accountings of new cases and a rising death toll. Disconcerting photos of dengue sufferers, particularly those with dengue hemorrhagic fever, were highlighted. "I read about dengue in the national newspapers," one informant reported, "they had been publishing the eyes of dengue infected people, their eyes and skin, and lips, with blood bumps." Through television announcements, posters, and newspapers, the risk of home water storage for mosquito breeding was emphasized. Regular news about emerging cases, deaths, and the lack of effective treatment for dengue encouraged people to be vigilant about mosquitoes and to "do every possible thing to make sure that they were not bitten by mosquitoes," from mosquito nets, to aerosols and mosquito coils, and ensuring there was no stagnant water in homes. In the aftermath of the 2000 dengue epidemic, the disease seemed to disappear, or lost its urgency as media coverage declined and the dengue prevention campaign was discontinued. Whereas "eight to ten years ago dengue was the headline of every newspaper," one informant believed that since "there is no news of dengue deaths anymore," the threat of dengue had passed, and that dengue was "not a killer disease anymore." This perception, however, does not reflect the reality of dengue in Bangladesh, where dengue cases have continued to emerge every year since the 2000 epidemic (Azad et al., 2006).

The tendency to relax dengue concerns between epidemics is not novel to this community. In Boa Vista, Brazil, for example, Maciel-de-Freitas and Valle (2014:686) noted that, between epidemics, "few resources are allocated

to increase awareness in the affected communities regarding the importance of dengue prevention and almost no regular education efforts are conducted." Between major outbreaks, the invisibility of mosquito-borne diseases can weaken commitments to long-term mosquito control measures. In New York State, where West Nile disease holds outbreak potential, one study determined that 60% of respondents knew that standing water was a risk for mosquito breeding, but only 22% took active measures against it (Tuiten et al., 2009). Whether disease risk is present or not, habits pertaining to mosquito vector control need to be ongoing and ingrained, not only initiated in response to a crisis. Safe water storage is best conceptualized as a matter of routine, with or without the obvious presence of dengue.

As the crisis of the 2000 epidemic retreated, dengue became less visible and other diseases quickly claimed attentions. People believed that cures for dengue must have been innovated and that doctors were more skilled in treating the disease. Attentions instead shifted to "more concerning" diseases; cancer, tuberculosis, asthma, HIV/AIDS, and stroke were mentioned by informants, and characterized as "dangerous," "serious," and "untreatable." One informant believed that since "no medicine can treat cancer… death is certain." Dengue was perceived as less serious because "people hardly die of dengue," particularly if "the dengue patient is taken care of properly," and "sees the doctor in time." Overall, dengue was overwhelmingly viewed as a disease of the past, as less dangerous and treatable, and as less concerning than more insidious diseases.

Dengue and the Language of "Virus Jor"

The tendency to view dengue as less "serious" than other diseases likely emerges because of the complexity of dengue disease, the insights shaped by past personal or familial experience, and dengue's depiction in awareness campaigns. Dengue naming practices can play a profound role in disease perceptions. Since one of dengue's predominant symptoms is fever, it is easy to confuse dengue with other common, fever-producing illnesses. In their study in Merida, Mexico, for example, Lloyd et al. (1994:406) noted that informants did not differentiate dengue from other "mild febrile illnesses." When considered collectively with other fevers, dengue, like those other fevers, was believed to be "inevitable;" as a result, Lloyd et al. (1994) note that informants believed prevention to be futile, focusing instead on providing adequate care in illness in order to avoid serious complications. In her research in Northeast Thailand, Pylypa (2009:76) discovered that the common symptoms of dengue fever (DF), including fever, rash, headache, muscle and joint pains, could easily be confused with "normal fever," "cold with fever," or the fever of malaria; as a result, dengue illness could proceed undetected, and the actual presence of dengue underestimated. Likewise, in their case study of two towns in Colombia, Suarez et al. (2009:S108) noted that informants tended to classify dengue as "synonymous with a common cold or flu," or a "folk flu," and that the use of this "narrative" tended to lessen "the sense of being at risk." In Puerto Rico, Perez-Guerra et al. (2009) determined that both lay people and health professionals alike experienced difficulty differentiating between the common cold and dengue disease due to similar symptoms; thus, dengue disease could be overlooked since people are unlikely to seek out medical care for common colds. As a result, missed dengue diagnoses and the disease's "invisibility" contribute to the underestimation of dengue risk (Perez-Guerra et al., 2009).

In Dhaka, there is no local term used to differentiate between classical dengue fever (DF) and dengue hemorrhagic fever (DHF). A single term, "dengue jor," is used generally for all forms of dengue, a convention that does not suggest there can be variation in disease severity or expression. When community members shared their experiences with dengue and its symptoms, some of those symptoms suggested dengue hemorrhagic fever and dengue shock syndrome, but there was no other term used except "dengue jor." In Dhar-Chowdhury et al.'s (2014:311) study, only 5.6% (or 6 of 107) of focus group participants "had heard about and were aware of potential complications of dengue including hemorrhagic dengue and neuro-dengue," once again suggesting that most were unaware of dengue's variable disease presentations.

The conception of dengue as a simple "virus jor" was influenced by leaflets and posters distributed during the 2000 epidemic. A leaflet obtained from a municipal office archive describes dengue, its cause and typical symptoms, the management of dengue fever, and what to do to prevent dengue. The leaflet introduces dengue

as a type of "virus jor," or viral fever. The leaflet explains that *Aedes* mosquitoes, vectors of the dengue virus, bite during the day, particularly at dawn and at dusk, and that mosquitoes which bite at night are generally not a problem. There is a saying about "virus jor" in Bangladesh: "with or without medicine, virus jor will be cured in seven days." People expect that "virus jor" will happen, perhaps once or twice a year with changing seasons, and that people will generally return to health without undue suffering. As Lupton (1999:20) argues, "Risks that are seen to be rare but memorable tend to be overestimated while those that are considered to be common and less serious are underestimated." Classifying dengue as a "virus jor" identifies it with "common" fevers, meaning that the disease is likely to be viewed as "less serious," less dangerous, and therefore underestimated in terms of its risk. The leaflet advises taking dengue patients to doctors only if the fever is serious, and in brackets it reads "hemorrhagic," but does not provide any guidance on differentiating typical dengue from hemorrhagic dengue. As a result, the various forms of dengue fever remain bound as a single, less threatening, entity.

The True Meaning of "Surviving Dengue"

With the major outbreak in 2000, many in the megacity gained experience with dengue and acquired knowledge that would frame future perspectives on dengue and its potential danger. We think of this as a "surviving dengue" narrative. Dengue survivors interpreted their experience in different ways, depending on the manner in which the disease presented and the support they received in illness. One informant, for example, reflected on the significance of his family's poor economic situation; his disease was "so alarming" and serious that his family wanted him admitted to a hospital, though they struggling to meet the costs. His brother had borrowed money, no easy prospect in a place where "nobody helps the poor." In contrast, another informant recalled his dengue history, reflecting on how she had felt "important" and "special" to have been "a part of" the dengue epidemic that had attracted so much attention, though her family had been "scared" throughout the ordeal. Amongst those who had survived dengue, emerged a sense of resilience for overcoming the disease.

What was absent, however, was the understanding that prior dengue infections could lead to greater vulnerability in future dengue infections, thus weakening the resilience perspective. Overall, dengue infection can result in different disease expressions depending on individual immune response, the infecting serotype of dengue virus, and previous histories of infection (i.e., first infection with dengue virus, versus subsequent infections) (Endy et al., 2004). Regular dengue accounting does suggest that most dengue fever infections will resolve in recovery. Between 2000 and 2009, for example, 23,872 dengue cases were registered with the Government of Bangladesh's health services and, of this number, 233 individuals died (Dhar-Chowdhury et al., 2014:306). Undoubtedly, the large numbers of people who survive dengue infection reinforce the belief that dengue is not dangerous. Among those who have survived dengue, however, is a potentially greater risk for a more adverse experience upon subsequent encounters with dengue. First dengue viral infection often presents in the form of classical DF, but subsequent infections with other dengue virus serotypes can increase the risk for developing dengue hemorrhagic fever (Mizumoto et al., 2014). Because multiple dengue virus serotypes are circulating in Bangladesh (Paul, 2014), this increases the possibility that individuals may be re-infected with a different dengue virus serotype in subsequent infections, a factor which increases the risk (by some 5 to 500 fold) for developing DHF (Endy et al., 2004:990). Informants were not aware of this increased risk for DHF and, as a result, individual feelings of resilience are at odds with the biological reality of primary versus subsequent infections in a hyperendemic setting such as Dhaka.

Islam et al. (2006) noted an increasing (from 65% in 2000 to 78% in 2002) proportion of patients admitted to a local hospital with previous histories of dengue virus (or other *Flavivirus*) infections, reflecting a growing potential for more complex dengue disease expressions. In 2012, an exploratory serosurvey in Bangladesh revealed that 80% of 1,128 individuals sampled possessed IgG antibodies, findings that suggested their bodies had prior experience with dengue infection (Paul, 2014). IgG seroprevalence was found to increase with age, from 41% of those 5 years of age and younger, to 93% among those over 55 years of age. The "widespread seropositivity" identified in this study is concerning for, as Paul (2014:4) argues, it indicates the "potential for future outbreaks of severe dengue illness if the population is exposed to a different serotype." There is a great likelihood for this since, in the 2000 outbreak, "all four serotypes of dengue virus were isolated from cases of

dengue fever" (Paul, 2014:5). Even if this were not the case, travel between dengue endemic countries could easily facilitate the introduction or re-introduction of new dengue virus serotypes (Banu et al., 2014:140; Paul, 2014:4).

It is not uncommon to find that people are unaware that they actually have a history of dengue infection, as was the case in Velasco-Salas et al.'s (2014) Venezuelan study. Based on serological testing, the researchers determined that about 77% of their study population (numbering 1,550) had been previously infected with dengue virus; in comparison, only about 21% reported that they had experienced dengue (Velasco-Salas et al., 2014:1041). As a result, a large number of individuals appear to be entirely unaware of their dengue histories and are at risk for potential complications in subsequent infections. These findings reinforce the idea that dengue disease may be stealthy, perhaps confused with other fever producing illnesses or overlooked altogether if individuals experience asymptomatic or mildly symptomatic disease, a disease expression recognized clinically as "undifferentiated dengue" (Moncayo et al., 2004:1790).

Contextualizing Dengue: Daily Stressors

In order to understand dengue's underestimation, it is important to consider how dengue is contextualized in everyday life, particularly in a low SES ward of the megacity. In their study in Sarawak, Malaysia, Crabtree et al. (2001:284) found that conceptual risks like dengue were difficult to situate in the context of tangible risks already present. In our study, one community member revealingly suggested, "Forget about dengue; listen to our sufferings." Ultimately, "risk knowledges" are "constructed," weighed against each other in the context of daily life (Lupton, 1999:105), because the reality is that risks do not occur in isolation, but overlap with one another (Tulloch and Lupton, 2003: 16). The theme of "contextualizing dengue" recognizes this complexity.

Within Dhaka, the immediacy of daily stressors and local concerns, human rights issues, and large-scale environmental crises can easily outweigh the less prominent risk of dengue. In terms of natural disasters alone, 1998 saw two-thirds of the country struggle with one of the worst floods on record,[ii] while flooding in 2004 was responsible for some 800 deaths and left millions homeless or displaced.[iii] In 2007, a cyclone left approximately 3,500 dead.[iv] Garment factories, common in and around Dhaka and one of the leading employers of women and children, have been plagued with turmoil. In 2010, a garment factory fire claimed more than 20 lives and injured more than 100.[v] In 2012, a garment factory fire on the outskirts of Dhaka was responsible for 117 deaths and hundreds injured. In 2013, the Rana Plaza collapsed, claiming 1,129 lives and injuring 2,515, quickly becoming known worldwide as the deadliest garment factory accident in history. Ongoing political unrest, accompanied with various forms of protest, has become part of daily life. Within this context, drawing attention to the potential risk of dengue in Dhaka is understandably challenging.

Similar to Crabtree et al.'s (2001) Malaysian study, informants did not rate dengue as a high risk in everyday life. In the sweeper colony, limited housing and overcrowding were of particular concern, tending to constrain life choices such as the ability to marry and raise a family because "there is no room." Alongside overcrowding concerns, sweeper colony residents expressed frustration over a lack of adequate toilet facilities. In addition to too few toilets, the facilities were often irregularly cleaned and sometimes out of commission because of the limited availability of water. Ill-functioning sewer drains meant that whenever it rained, particularly in the monsoon/wet season, living spaces were flooded and soiled with dirty, foul-smelling water. Understandably, in the interviews, toilets, not dengue, emerged as a most pressing concern.

Like sweeper colony residents, dengue also did not emerge as a top concern for residents of the larger ward. Instead, attentions were focused on wider socio-political and economic issues affecting daily life, such as chaotic urbanization, uncertainty in business, corruption, gridlock, accidental deaths, violence, fires, and earthquakes. A burgeoning number of crises have rendered community members anxious and unsettled in their lives, concerned over the likelihood of experiencing a "normal death." When asked, one informant recalled the devastating fire in Old Dhaka, the Nimtali tragedy of 2010, caused by an exploded electrical transformer, which ultimately claimed over 100 lives. The tragedy was made worse by the difficulties that emergency responders had experienced trying to access the fire through "tiny, narrow streets." One poorly constructed, five storey

residential building trapped residents inside with its fixed window grills and lack of fire escapes (Dummett, 2010). "If there is any fire again," the informant noted, "we are scared that we will not be rescued in time." Since this interview, another devastating fire did erupt in Old Dhaka, in February 2019, claiming more than 80 lives and injuring many more (Alam, 2019). One informant felt that the "issues" concerning "electricity, water, even mosquitoes" could be deferred, "but fires and earthquakes will not give you a chance for a second thought, you will be dead immediately." Dhaka residents are aware that experts are predicting the likelihood of an impending earthquake, that the effects will be devastating, and that most residents will not be prepared for this crisis (Paul and Bhuiyan, 2010).

Where the residents of the sweeper colony and larger ward did connect was over water concerns. Water scarcity was the most notable concern in the colony, since piped water is supplied only once a day, either in the morning or in the evening, for about half an hour. During this time, residents scramble to store water in as many containers as possible, using the stored water for everything, from consumption, to cooking, cleaning, and bathing. Water storage is also practiced in the larger ward, but for different reasons. Sweeper colony residents have adapted to store water because they do not receive a reliable, continuous supply of water, whereas residents of the larger ward store water because of unpredictable electrical power outages, which compromise the water pumps. In addition to water shortages, an underlying issue of water quality also encourages water storage. Because of the risk of water-borne pathogens and the potential for diarrheal disease, cholera, and hepatitis (Mahbub et al., 2011; Haq, 2006), boiling water is strongly recommended, and the boiled water is then stored in containers.

In Dhaka, this pervasive need to store water creates an unavoidable dengue risk. Communities facing inadequate water supplies "solve their problem of a lack of water" by storing water; it is coincidental but inevitable that, in doing so, they may "contribute to dengue reproduction in their neighbourhood" (Caprara et al., 2009: S131). As a result, dengue becomes "a problem linked to the environment" on many levels, including the tropical/subtropical climate, the successful dispersion of *Aedes aegypti* mosquitoes, and the absence of a regular, dependable, clean water supply necessitating storage (Boischio et al., 2009: S151). Until cities such as Dhaka are able to provide a reliable water supply, people must be equipped with the means and the information to make water storage as safe as possible. In one Colombian study, this meant involving community members in the design of effective custom covers for their large cement and plaster water containers (García-Betancourt et al.,2014).

The "Inside-Outside" Dichotomy: Locating Risk

In general, informants tended to dichotomize inside and outside spaces. Externalizing dengue risk to the "outside" and not the "inside" of households provides another avenue through which dengue risk may be underestimated, a theme previously identified by Dhar-Chowdhury et al. (2013), wherein "sites outside the home" tended to be viewed "as highly probable breeding sites" for dengue mosquitoes. It is revealing that none of the informants with direct experience of dengue thought they had been bitten in their own homes, one targeting a local park, another her doctor's office. Another informant felt her daughter's school must have been the site of her daughter's dengue infection, not believing it could have been the family home. Informants generally differentiated "clean" and "dirty" with the inside-outside dichotomy and suggested that mosquitoes and diseases bred outside in dirt, garbage, and open sewer drains. According to one community member, "We always keep our houses clean. There is no way that our houses could be a source of dengue diseases. It must be the outside." Community members blamed an inadequate number of dustbins and sanitation workers for the dirty state of their mohollas. "We live day after day," one informant noted, "with the rotten garbage. We inhale the acrid smell of this rotten garbage which is not good for our health because this garbage spreads diseases." Though cleanliness, in its traditional sense, is not likely to impact on dengue risk, litter can be a problem for encouraging water collection and mosquito breeding. In their Sri Lankan study, Abeyewickreme et al. (2012:485) identified "solid waste around households, such as cans, car parts, bottles, old and used tyres, plastic materials, broken clay, glass vessles and coconut shells" as significant "outdoor breeding sites for *Aedes* mosquitoes."

The externalizing of risk for mosquitoes and dengue infection creates a false sense of security. In their Venezuelan study, Velasco-Salas et al. (2014:1045) determined that the home was actually the most important site for dengue infection, finding that those "who spent more time within homes, such as domestic workers and housewives, were at higher risk of acquiring a recent dengue infection." Results of entomological studies in Dhaka reinforce the significance of the home in *Aedes* reproduction. Between August 2001 and July 2002, Ahmed et al. (2007) undertook a household-level entomological survey based on a sampling of 14,096 homes in all 90 city wards in order to assess *Aedes* larval density and seasonal variation. Inside the homes, the researchers found "a total of 1617 containers … positive (containing *Aedes* larvae) out of 13,740 wet (water filled) containers" (Ahmed et al., 2007:208). It is within this context of home-based risks for dengue infection, that practices and perceptions relating to water storage is critical. In their study of Martinique and French Guyana, Mieulet and Claeys (2014:590) found that experts and lay people differed over definitions of "stagnant" water; while experts conceptualized stored water as stagnant water and therefore vulnerable to *Aedes* oviposition, lay people argued that because stored water was used regularly, it was not stagnant but "running water." Such conceptions of "stagnant" water are also important in Dhaka. Informants in our study did not specifically identify water stores as a source of dengue risk. Explicitly, community members did not associate dengue risk with the containers used to store water for daily use, since stored water is used and replenished on a daily basis. Old water is reportedly thrown out before new water is added to containers, and informants suggested that they ensure cleaning water containers properly before adding new water and covering their stored water reserves. Informal field observations, however, suggest less rigor, at least in the uncovered containers that were observed. According to informants, the large plastic drums used for water storage were not emptied or cleaned regularly; typically once the drums are half emptied, new water is poured in to fill them, allowing little opportunity to clean the drums. Informants did, however, suggest that drums were always kept covered to exclude mosquitoes. But, again, it did not take long to come across uncovered or half-covered drums.

Normalizing Mosquitoes

Because dengue is transmitted by ubiquitous and persistent mosquitoes, a sense of futility may overshadow attempts to control resident mosquito populations. Community members described mosquitoes variously as "unpleasant," "irritating," and, most important, "uncontrollable." In their examination of risk, Tulloch and Lupton (2003:32) have found that "risks which are defined as subject to personal responsibility are those which are largely seen to be controllable." Those risks, however, "which are conceptualized as external to personal decisions or actions tend to be viewed as non-controllable, as more susceptible to the vagaries of fate" (Tulloch and Lupton, 2003:32). If mosquitoes, and by extension dengue, are perceived as "uncontrollable," and this is certainly an understandable assumption given the nature of mosquitoes, people may simply resign themselves to their existence instead of taking preventive action.

Mosquitoes and their bites were viewed as annoying and perhaps painful, one informant stating, "they bite all the time and make us mad. It's becoming impossible…to sit somewhere and not be bitten by mosquitoes." Overall, there was a sense that the mosquito nuisance was increasing and people were becoming "fed up." As one informant stated, "if even the rich countries cannot kill mosquitoes, how would we be able to do that?" Another informant argued along similar lines: "It doesn't matter what you use, aerosol, mosquito coils, nothing can kill them. They are getting stronger and tolerant to those things." In their 2011 Dhaka survey, Dhar-Chowdhury et al. (2014:311) determined that the majority of individuals surveyed, some 94% of 300, were aware that mosquitoes played a role in the transmission of dengue (Dhar-Chowdhury et al., 2014:311), though the vector's scientific, taxonomic designation of "*Aedes*" is less known. Likewise, in our study, most informants knew that dengue is transmitted by mosquitoes, but most could not identify the "dengue mosquito." As one informant stated, "We wonder how we would even know that was a dengue mosquito, as mosquitoes are everywhere. And not every mosquito spreads dengue."

Identifying "dengue mosquitoes" is one issue, but an accurate understanding of the environmental and behavioural p**references** of *Aedes* mosquitoes is also important. Dhar-Chowdhury et al. (2014:311) identified some misconceptions, with 43% (136 of 300) of their respondents incorrectly believing that *Aedes* mosquitoes

were night-time biters (*Culex* mosquito species are night-time biters, but *Aedes* typically bite during the day). Confusion over mosquitoes in Dhaka is understandable, given their diversity. Between March 2011 and February 2012, Karim et al. (2013) undertook an entomological surveillance project in Dhaka. Unlike the household entomological surveys, this was a broader environmental survey not restricted to homes. In ward 69, they sampled 1,648 mosquitoes (including both adults and larvae) belonging to 11 different species, 43.2% of which were identified as *Culex quinquefasciatus*. In fact, all *Culex* species sampled, when combined, accounted for almost 88% of the total sample. In comparison, *Aedes aegypti* and *Aedes albopictus* represented only 5.5% and 3.3% of the mosquitoes sampled, respectively. They determined that, in ward 69, *Aedes* species were absent in the months between March and June, but were present in other months, achieving a peak in September. Female *Aedes albopictus* mosquitoes, a less frequent but viable vector of dengue, tend to lay their eggs in tree holes (Chowdhury et al., 2014), but they have also been found to use other water collection sites, such as household water stores (Ahmed et al., 2007). All mosquitoes (and their counts) were adversely affected by government applications of adulticides and larvicides, although *Culex* species, which may breed in the dirty waters of city drains, were also killed by chemical contaminants released into the sewers by Dhaka's manufacturing industry (Karim et al., 2013:44).

There is ample opportunity for confusion over "dengue mosquitoes" given the abundance of *Culex* mosquitoes in Dhaka (Karim et al., 2013). The reality is that *Aedes aegypti* and *Aedes albopictus* represent only a small subset of Dhaka's overall mosquito diversity. As a result, people are perhaps more likely to base their understandings of mosquitoes on *Culex*, such as their night-time biting and oviposition in dirty water. Indeed, community members in our study reported that mosquitoes were mostly a night-time annoyance, interrupting sleep with their bites. Mosquito risks can vary from nuisance to disease-transmitting; in our study, community members more often described mosquitoes as "irritating" and "disturbing" than risky or life threatening. This finding coincides with Suarez et al.'s (2009) study in Colombia and Perez-Guerra et al.'s (2009) study in Puerto Rico, where they report that people do not consider mosquitoes as "risky."

Community-based studies have revealed the tendency to view mosquitoes as normal, common, and impossible to eliminate. In Puerto Rico, Perez-Guerra et al. (2009: 222) determined that even though people are aware that eliminating uncovered and stagnant water can help to prevent dengue, some find this a "useless effort" and describe mosquitoes simply as a part of life. In their Colombian study, Suarez et al. (2009:S108) reported that respondents normalize and tolerate mosquitoes in the environment, reasoning that "mosquitoes belong to the tropical ecosystem" and that "their presence in the environment is so ordinary that individuals do not perceive mosquitoes as a menace." The belief is that "mosquitoes are everywhere and are difficult to control" (Perez-Guerra et al., 2009: 222). Poverty may evoke a further sense of powerlessness against mosquitoes and dengue transmission, as expressed by one of Whiteford's (1997: 218) informants in the Dominican Republic: "When we do not have the power to get rid of the garbage, to kill the rats, or keep out the flies, why should we think we can stop the mosquitoes?" Likewise, a Dhaka informant stated simply, "the poor will not survive if the dengue mosquito bites."

Conclusions

For decades now, dengue has been circulating in Bangladesh. The virus has established a hyperendemic focus, involving multiple serotypes. Among those who have been previously infected with dengue virus, and serological studies suggest this proportion is high, there is a risk for more aggressive forms of dengue disease, such as DHF, in subsequent infections involving different viral serotypes. These findings, the epidemiological perspective, establish the reality of dengue risk in Bangladesh. The role of *Aedes* mosquitoes, particularly *Aedes aegypti*, and their close association with homes and water stores, has been well-established. In Dhaka's poor neighbourhoods, vulnerability is enhanced because of pervasive water storage. It has also been well established that community participation is needed to control mosquito vectors and dengue. While dengue prevention aims to 'minimize' the risk of dengue, this goal will be unattainable so long as residents 'underestimate' dengue risk. In this paper, we identify at least six possible themes connected to the underestimation of dengue risk - from historicizing dengue as a disease of "8 to 10 years ago," to the reassuring language of "virus jor," interpretations

of "surviving dengue," the context of daily stressors, the inside-outside dichotomy, and the normalizing of mosquitoes.

Educating on dengue would be a powerful ally to align with prevention campaigns. First, to build on the understandings of "8 to 10 years ago," that it is precisely because dengue was so visible in the past that it presents a current population risk. Similar to other community studies, informants tended to underestimate dengue because they did not realize the extent of the history and ongoing tide of infection. Not only yearly statistics on infection, but communicating the significance of the seroprevalence findings would be useful and helpful in underscoring the potential risks associated with "surviving dengue." Whether symptoms are recognized or not, dengue virus is circulating in the population. Providing a basic understanding of dengue's complexity and the differences in risk associated with primary versus subsequent infections would help to dispel the notion of dengue as a simple "virus jor."

The tendency to normalize mosquitoes and strike an inside-outside dichotomy in dengue risk can also be addressed with education on the biological and environmental history of mosquitoes such as *Aedes aegypti*. It is understandable that mosquitoes are normalized, but it is also important to recognize that *Aedes aegypti* and other *Aedes* species have adapted to life with humans, exploiting opportunities for feeding and breeding within urban environments, even megacities. *Aedes* is not unique to Bangladesh or Dhaka, or the poor communities within the megacity, instead representing a challenge in tropical and subtropical communities around the globe. Since it is likely that Dhaka residents will have to continue to rely on water storage to meet daily needs, understanding the risks associated with mosquito breeding must become equally ingrained.

Understanding the context of daily stressors and understanding that community members are already overwhelmed by the challenges and sense of risk in daily life, simple and straightforward suggestions for mosquito control would likely be most effective. In order to encourage prevention and offset negative attitudes towards the prospect of mosquito control, it might be helpful to provide mosquito control 'success stories' in similar urban or peri-urban, water storing communities (see, for example, Arunachalam et al., 2012; García-Betancourt et al., 2014; Kendall, 1998; Lloyd et al., 1994). Fatalistic attitudes concerning mosquitoes in the urban environment could be offset by the inspiration and encouragement of such successful examples of mosquito control.

References

1. beyewickreme, W., A.R. Wickremasinghe, K. Karunatilake, Johannes Sommerfeld, and Axel Kroeger (2012) Community Mobilization and Household Level Waste Management for Dengue Vector Control in Gampaha District of Sri Lanka; An Intervention Study. Pathogens and Global Health 106(8): 479-487.

2. Ahmed, F. U., C.B. Mahmood, J.D. Sharma et al. (2001) "Dengue and Dengue Haemorrhagic Fever in Children during the 2000 Outbreak in Chittagong, Bangladesh" in Dengue Bulletin Vol. 25, Issue, 2, pp 33-39.

3. Ahmed, Sohel J., Kh. Md. Nahiduzzaman, and Glen Bramley (2014) From a Town to a Megacity: 400 Years of Growth. In: Dhaka Megacity: Geospatial Perspectives on Urbanisation, Environment and Health (A. Dewan and R. Corner, Eds) Dordrecht: Sprinter Science+Business Media. Pp.23-43.

4. Ahmed, Tauhid U., G.M. Saifur Rahman, Kabirul Bashar, Mohammed Shamsuzzaman, et al. (2007) Seasonal Prevalence of Dengue Vector Mosquitoes in Dhaka City, Bangladesh. Bangladesh Journal of Zoology 35(2): 205-212.

5. Ali, M., Y. Wagatsuma, M. Emch et al. (2003) " Use of a geographic information system for defining spatial risk for dengue transmission in Bangladesh: role for Aedes albopictus in an urban outbreak" in The American journal of tropical medicine and hygiene, vol. 69, issue 6, pp 634-40.

6. Arunachalam, Natarajan, Brij Kishore Tyagi, Miriam Samuel, R. Krishnamoorthi, et al. (2012) Community-based Control of Aedes aegypti by Adoption of Eco-health Methods in Chennai City, India. Pathogens and Global Health 106(8): 488-496.

7. Azad, Md. Abul Kalam, Hanif Mohammad, Md. Billal Alam, Anup Kumar Saha, and Tofayel Ahmed (2006) Clinical Presentation of Dengue in 150 Admitted Cases in Dhaka Medical College Hospital. Journal of Medicine 7:3-9.

8. Aziz, M.A., R.R. Graham, and M.B. Gregg (1967) 'Dacca fever' – An Outbreak of Dengue. Pakistan Journal of Medical Research 6: 83-92.

9. Banu, Shahera, Wenbiao Hu, Yuming Guo, Cameron Hurst, and Shilu Tong (2014) Projecting the Impact of Climate Change on Dengue Transmission in Dhaka, Bangladesh. Environment International 63:137-142.

10. Boischio, Ana, Andres Sanchez, Zsofia Orosz, and Dominique Charron (2009) Health and sustainable development: challenges and opportunities of ecosystem approaches in the prevention and control of dengue and Chagas disease. Cad. Saude Publica, Rio de Janeiro 25(Supp 1): S149-S154.

11. Caprara, Andrea, Jose Wellington de Oliveira Lima, Alice Correia Pequeno Marinho et al. (2009) Irregular Water Supply, Household Usage and Dengue: A Bio-Social Study in the Brazilian Northeast. Cad. Saude Publica, Rio de Janeiro 25 (Supp 1): S125-S136.

12. Chowdhury, Rajib, Vashkar Chowdhury, Shyla Faria, et al. (2014) How Dengue Vector Aedes albopictus (Diptera: Cullicidae) Survive during the Dry Season in Dhaka City, Bangladesh? Journal of Vector Borne Disease 51: 179-187.

13. Corner, Robert J. and Ashraf M. Dewan (2014) Introduction. In: Dhaka Megacity: Geospatial Perspectives on Urbanisation, Environment and Health (A. Dewan and R. Corner, Eds) Dordrecht: Sprinter Science+Business Media. Pp.1-22.

14. Crabtree, Sara Ashencaen, Christina M. Wong, and Faizah Mas'ud (2001) Community Participatory Approaches to Dengue Prevention in Sarawak, Malaysia. Human Organization 60(3): 281-287.

15. Dhar-Chowdhury, Parnali, C. Emdad Haque, S. Michelle Driedger, and Shakhawat Hossain (2014) Community perspectives on dengue transmission in the city of Dhaka, Bangladesh. International Health 6: 306-316.

16. Dhar-Chowdhury, Parnali, C. Emdad Haque, Robbin Lindsay, Abdullah Brooks, and Michael A. Drebot (2013) Dengue Transmission and Risk Factors in Dhaka, Bangladesh. GRF Davos One Health Summit, 17-20 November, 2013; Davos, Switzerland.

17. Dummett, Mark (2010) Dhaka: City of Construction Death Traps. BBC News: South Asia, 4 June 2010, http://www.bbc.com/news/10238855.

18. Endy, Timothy P., Ananda Nisalak, Supamit Chunsuttitwat, David W. Vaughn et al. (2004) Relationship of Preexisting Dengue Virus (DV) Neutralizing Antibody Levels to Viremia and Severity of Disease in a Prospective Cohort Study of DV Infection in Thailand. Journal of Infectious Diseases 189: 990-1000.

19. García-Betancourt, Tatiana, Catalina González-Uribe, Juliana Quintero, and Gabriel Carrasquilla (2014) Ecobiosocial Community Intervention for Improved Aedes aegypti Control using Water Container Covers to Prevent Dengue: Lessons Learned from Girardot Colombia. EcoHealth 11: 434-438.

20. Haq, K. A.

21. 2006 "Water management in Dhaka," Water Resources Development, vol. 22, No. 2, pp 291-311.

22. Hlongwana, Khumbulani W., Musawenkosi L.H. Mabaso, Simon Kunene, Dayanandan Govender, and Rajendra Maharaj (2009) Community knowledge, attitudes and practices (KAP) on malaria in Swaziland: A country earmarked for malaria elimination. Malaria Journal 8:29 doi:10.1186/1475-2875-8-29.

23. Hossain, M. Anowar, Mahmuda Khatun, Farzana Arjumand, Ananda Nisaluk, and Robert F. Breiman (2003) Serologic Evidence of Dengue Infection before Onset of Epidemic, Bangladesh. Emerging Infectious Diseases 9(11): 1411-1414.

24. Islam, Mohammed Alimul, Muzahed Uddin Ahmed, Nasima Begum, Naseem Ahktar Chowdhury, et al. (2006) Molecular Characterization and Clinical Evaluation of Dengue Outbreak in 2002 in Bangladesh. Japanese Journal of Infectious Disease 59(2): 85-91.

25. Julhas, Alam, (2019) " Major fire kills at least 81 in old district of Bangladesh's capital." Global News. https://globalnews.ca/news/4982936/dhaka-fire-bangladesh-chawkbazar/.

26. Karim, Md. Rezaul, Md. Muzahidul Islam, Md. Sheik Farid, Md. Abdur Rashid, Tangin Akter, Humayun Reza Khan (2013) Spatial Distribution and Seasonal Fluctuation of Mosquitoes in Dhaka City. International Journal of Fauna and Biological Studies 1(1): 42-46.

27. Kendall, Carl (1998) The Role of Formal Qualitative Research in Negotiating Community Acceptance: The Case of Dengue Control in El Progreso, Honduras. Human Organization 57(2): 217-221.

28. Khan, Md. Mobarak Hossain, Alexander Krämer, and Luise Prüfer-Krämer (2011) Climate Change and Infectious Diseases in Megacities of the Indian Subcontinent. In: Health in Megacities and Urban Areas (Alexander Krämer, Mobarak Hossain Khan, and Frauke Kraas, Eds.) Berlin, Heidelberg: Springer-Verlag. Pp. 134-152.

29. Lloyd, Linda S., Peter Winch, Judith Ortega-Canto, Carl Kendall (1994) The Design of a Community-Based Health Education Intervention for the Control of Aedes aegypti. American Journal of Tropical Medicine and Hygiene 50(4): 401-411.

30. Lupton, Deborah (1999) Risk. London and New York: Routledge.

31. Lupton, Deborah (2013) Risk and Emotion: Towards an Alternative Theoretical Perspective. Health, Risk and Society 15(8):634-647.

32. Maciel-de-Freitas, Rafael and Denise Valle (2014) Challenges Encountered using Standard Vector Control Measures for Dengue in Boa Vista, Brazil. Bulletin of the World Health Organization 92: 685-689.

33. Mahbub, KR., A. Nahar, MM. Ahmed, and A. Chakraborti (2011) "Quality Analysis of Dhaka WASA Drinking Water," Journal of Environmental Science and Natural Resources, Vol.4, No. 2.

34. Mahmud, Abu Hayat (2013) Mosquito menace on the rise in city. Dhaka Tribune, 4 December 2013.

35. Mieulet, Elise and Cécilia Claeys (2014) The Implementation and Reception of Policies for Preventing Dengue Fever Epidemics: A Comparative Study of Martinique and French Guyana. Health, Risk & Society 16(7-8): 581-599.

36. Mizumoto, Kenji, Keisuke Ejima, Taro Yamamoto, and Hiroshi Nishiura (2014) On the Risk of Severe Dengue During Secondary Infection: A Systematic Review Coupled with Mathematical Modeling. Journal of Vector Borne Disease 51: 153-164.

37. Monath, Thomas P. (1994) Dengue: The Risk to Developed and Developing Countries. Proceedings of the National Academy of Science USA 91: 2395-2400.

38. Moncayo, Abelardo C., Zoraida Fernandez, Diana Ortiz, Mawlouth Diallo et al. (2004) Dengue Emergence and Adaptation to Peridomestic Mosquitoes. Emerging Infectious Diseases 10(10): 1790-1796.

39. Paul, Kishor Kumar (2014) Seroprevalence of dengue virus infection in Dhaka, Bangladesh, 2012. icddr,b Health and Sciences Bulletin 12(2): 1-6.

40. Paul, Bimal Kanti and Rejuan Hossain Bhuiyan (2010) Urban Earthquake Hazard: Perceived Seismic Risk and Preparedness in Dhaka City, Bangladesh. Disasters 34(2): 337-359.

41. Perez-Guerra, C.L. E., Zielinski-Gutierrez, D. Vargas-Torres et al. (2009) Community Beliefs and Practices about Dengue in Puerto Rico. Public Health 25(3): 218-225.

42. Pylypa, Jen (2009) Local Perceptions of Dengue Fever in Northeast Thailand and their Implications for Adherence to Prevention Campaigns. Anthropology & Medicine 16(1): 73-83.

43. Rahman, Mahbubur, Khalilur Rahman, A.K. Siddque, Shereen Shoma, et al. (2002) First Outbreak of Dengue Hemorrhagic Fever, Bangladesh. Emerging Infectious Diseases 8(7): 738-740.

44. Suarez, Roberto, Catalina Gonzalez, Gabriel Carrasquilla, Juliana Quintero (2009) An Ecosystem Perspective in the Socio-Cultural Evaluation of Dengue in Two Colombian Towns. Cad. Saude Publica, Rio de Janeiro 25(Supp 1): S104-S114.

45. Tuiten, Wieteke, Constantianus J.M. Koenraadt, Katherine McComas, Laura C. Harrington (2009) The Effect of West Nile Virus Perceptions and Knowledge on Protective Behavior and Mosquito Breeding in Residential Yards in Upstate New York. EcoHealth 6(1): 42-51.

46. Tulloch, John and Deborah Lupton (2003) Risk and Everyday Life. London: Sage Publications.

47. Velasco-Salas, Zoraida I., Gloria M. Sierra, Diamelis M. Guzmán et al. (2014) Dengue Seroprevalence and Risk Factors for Past and Recent Viral Transmission in Venezuela: A Comprehensive Community-Based Study. American Journal of Tropical Medicine and Hygiene 91(5): 1039-1048.

48. Whiteford, L.M. (1997) The Ethnoecology of Dengue Fever. Medical Anthropology Quarterly 11(2): 202-223.

49. Yunus E. B., A.M. Bangali, M.A.H. Mahmood et al. (2001) "Dengue Outbreak 2000 in Bangladesh: From Speculation to Reality and Exercise" Dengue Bulletin Vol. 25, Issue, December, pp 33-39.

[i] http://www.searo.who.int/entity/vector_borne_tropical_diseases/data/data_factsheet/en/index1.html
[ii] BBC, A Chronology of Key Events, 1947-2015; www.bbc.com/news/world-south-asia-12651483
[iii] Ibid.
[iv] Ibid.
[v] Ibid.