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Growing Water Insecurity and Dengue Burden in the Americas

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Growing water insecurity and dengue burden in the Americas

Dengue virus, a vector-borne virus spread predominantly by the *Aedes aegypti* mosquito, is present in over 124 countries with a total population of about 2·5 billion people.[1] Dengue is endemic in most of South America and the Caribbean, and is increasing in prevalence across the Americas with a south to north trajectory. Over the past decade, the dengue disease burden has increased in Central America and is now established in southern parts of Mexico.

In addition to rising temperatures and changes in rainfall distribution, the frequency of extreme weather events driven by climate change and human-motivated factors (eg, migration, population density, water insecurity, sanitation, rapid urbanisation) support the expansion of mosquito habitats, creating conditions that could allow the establishment of new endemic populations. Future climatic conditions are projected to be conducive to the spread of *Aedes aegypti* into southern parts of the USA, with an expected seasonal spread of the mosquito further inland. Mosquito abatement and control remain the primary intervention for the dengue disease burden. Spread of dengue in Mexico and Puerto Rico, and Zika management in Cuba, highlight driving factors behind the increasing burden of these diseases and associated challenges in mosquito eradication.

A high capacity for public health interventions requires resources, disease surveillance and tracking, effective intervention planning and campaigns, and trust in government and public health officials at a local level. Studies of parasitic, bacterial, and vector-borne disease management have identified that the combination of a high capacity for public health and behavioural intervention is crucial in successful projects.[2] Behavioural interventions are complex, and although they are based on trust, they could require increased resources to support water security and infrastructure to overcome cultural reticence and improve drainage and sanitation practices.

The direct effect of human behavioural influences has been observed in Oaxaca City, Mexico, where a consistent increase in the distribution and frequency of dengue virus infections has been seen in the past decade.[3] The rise in the incidence of dengue during the dry season in arid inland regions near the city is due to human-motivated habitat creation through migration, water management, sanitation, and cultural practice.[3] With poor permanent water infrastructure and little piped water, Oaxaca City and its outlying regions are increasingly water insecure. Few resources exist to improve water security, particularly in poor neighbourhoods, creating a disincentive to invite or facilitate surveillance for dengue. With sparsely situated clinics with overworked staff, surveillance is often confined to the very sick who require medical attention. These conditions are ideal for the establishment and spread of *Aedes aegypti* and consequently dengue.

The Caribbean island of Puerto Rico has a long history of dengue surveillance and associations with seasonal and spatial patterns in regional hydroclimatology.[4,5] However, the establishment of dengue and the spread of Zika on the island shows the effect of limited political trust coupled with poor sanitation practices and deferred infrastructure maintenance in urban areas. Puerto Rico has had previous dengue and chikunguya outbreaks, and estimates from the end of 2016 indicated that up to 20% of the population had been exposed to Zika virus.[4,6] Vector-control efforts, including a US Centers for Disease Control and Prevention (CDC)-sponsored aerial fumigation campaign, were met with opposition and scepticism brought about by the complicated relationship between the US Federal Government and Puerto Rico's state and local governments, and ultimately blocked by local political actors. Hurricane Maria and the resulting urban destruction, water insecurity, power shortage, and declining disease surveillance capacity promise to further inhibit these vector-control efforts.

By contrast, the mobilisation on the island of Cuba in anticipation of a Zika virus outbreak shows the efficacy and limitations of a high capacity for public health interventions and local-level responsiveness.[7] Key aspects of this effort included mobilising army reserves to engage in mass home fumigation and sanitation practices, community-based practitioner education and interventions, including fines for people with mosquitos breeding on their property, and decentralised health-service delivery.[8] Even despite the effect of Hurricane Irma along Cuba's northwest coast, infrastructure repair and sanitation support have been rapid. The Cuban management of vector-spread disease is unlikely to be replicable in large democratic countries with well established property rights. However, this example highlights the ability of well established surveillance to allow local-level behavioural interventions in a largely mobilised and trusting population.

Dengue disease management requires the elimination of *Aedes aegypti* mosquito reservoirs in population-dense urban environments. Interventions that are based on education and treatment are unlikely to be successful in the absence of more effective water-distribution systems, and in regions where an absence of trust characterises the relationship between government agencies and the population.

With extreme climate events, such as the flooding that accompanied Hurricane Harvey in Houston, TX, USA, urban areas in the USA could become susceptible to endemic mosquito populations since reconstruction and remediation could take years, with some localities abandoned as standing ruins. Emerging megacities outside of the Americas could be in similarly vulnerable positions, in which water insecurity is a chronic problem amid a growing trend of informal settlements and migrant populations.[9] In regions that are at risk of developing endemic populations, the development of large-scale surveillance capabilities to identify water insecurity and disease prevalence hotspots, aided by both hydroclimatic and sociopolitical information, and coupled with urban drainage and sanitation strategies, are crucial.[10]

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