

Prevention of Dengue Virus through Citizen Science

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ABSTRACT

Dengue virus, a mosquito-borne viral infection native to many subtropical regions, is transmitted from *Aedes aegypti* and *Aedes albopictus* mosquitoes to human hosts, resulting in debilitating symptoms for the affected persons.¹ Common vector grounds for these female mosquitoes include uncovered water storage containers and garbage disposal units that are commonly observed amongst endemic regions.^{1,2,5} The virus symptomatology resembles the flu. However, unlike the flu, there is little knowledge about the infectious mechanism utilized by the virus. As a result, opportunities for drug discovery, effective prevention, and management strategies to tackle the infection are hindered. This paper aims to embark on a discussion regarding the lack of awareness and prevention of the dissemination of this virus. Furthermore, it will discuss a citizen science approach to address the public health burden imposed by the Dengue virus and outline suggested improvements in disease control strategies.

Keywords: Vector transmittance, Dengue, epidemiology, citizen science

Despite western medical breakthroughs, many third world countries are still victim to evolving superbugs and lack access to medical treatment. Thus, plagues such as Dengue fever continue to tyrannize various countries. Dengue is a mosquito-borne viral infection responsible for many historic and current epidemics, such as those in South East Asia, and more specifically India, Pakistan, and Bangladesh.¹ As many as 40% of individuals across 128 countries are at risk for acquiring the infection, with nearly 400 million cases reported each year.^{1,2} Dengue thrives in tropical and subtropical regions, particularly in urbanized areas, within these 128 countries.¹

Dengue virus is a vector-borne disease, in which the *Aedes aegypti* and *Aedes albopictus* female mosquitoes act as vectors, or carriers, of the virus and transmit the virus to animals and humans.¹ Mosquitoes may transmit one of the four strains of the virus: DEN-1, DEN-2, DEN-3, or DEN-4, into the bloodstream of individuals upon feeding.¹ This results in severe flu-like symptoms that often progress to severe Dengue fever and death if left untreated.^{1,2} Mortality rates upon contracting the viral infection can be upward of 20%, but upon medical intervention, drop to less than 1%.² Current medical interventions include the admin-

istration of the tetravalent Dengue virus vaccine, which was developed in 2015 using the Yellow Fever backbone and recommended by the World Health Organization.³ However, follow-up studies and surveillance reported an increase in Dengue virus prevalence amongst seronegative individuals—those who received the vaccine and had no previous history of Dengue infection.³ As a result, the vaccine is only beneficial to those who had the virus in the past, reducing their risk of Dengue by 93%, and omits a large portion of the seronegative population that will remain susceptible to the virus. Thus, future drug development would include designing an ideal tetravalent vaccine with Dengue virus (DENV) wild-type structural and non-structural proteins to build immunity amongst the four variable strains of the virus.³

Although current pharmaceutical companies have yet to design an effective antiviral treatment, current options include safe water practices, symptom management through careful observation, and intravenous hydration therapy for those with substantial vascular leakage, the permeability of blood vessels to harmful pathogens.^{4,5} There is a lack of knowledge surrounding the disease pathogenesis which hinders drug discovery. However, this inadequacy in understanding the

burden of this disease is due to the lack of education and awareness of the virus.¹ Modern medicine, vaccines, and public awareness campaigns have decreased the total global incidence of Dengue infection by 28%, however, it is still the leading cause of death and illness in numerous Asian and Latin-American countries. Thus, is this decrease in global incidence attributed to a large decrease in western countries?^{2,1,2,4}

In 2015, Jeelani et al. discussed the lack of epidemiological knowledge about the DENV amongst various classes and educational levels of residents of Puducherry, South India. Puducherry consists of a large population of individuals who have little knowledge about Dengue pathogenesis.⁵ The paper indicates that increased population density, urbanization, lack of vector control, improper water storage, stagnant water bodies, and improper water treatment techniques are major contributing factors to the spread of DENV in subtropical regions. In addition, DENV symptoms of fever and myalgia are often misdiagnosed as symptoms of other common diseases, such as typhoid and influenza.^{1,2,5}

It appears that the lack of knowledge in South East Asian countries pertaining to this viral infection is hindering its eradication. Given this, implementing a citizen science monitoring study could increase DENV education amongst citizens, such as those of Puducherry. Citizen science uses a unique approach to data collection where data is analyzed and interpreted by scientists and community volunteers. When the citizen science approach is carried out with rigour and integrity, it has the potential to produce valuable scientific data that can be applied to solve problems.⁶

A Dengue reporting system following the citizen science approach can be beneficial in collecting data to further research and understand the epidemiology of the disease, through creating an effective vector control system. Based on the information presented, the following is an example of a possible effective citizen science approach. Regions within South East Asia that are heavily affected or at risk, such as India, Pakistan, and Bangladesh, will be the targets of this experiment.¹ In this citizen science approach, water will be the sole measure for larvae testing as it is most convenient for citizens to obtain water samples and mosquitoes prefer to breed in stagnant water. Although larvae presence in a water sample may indicate an increased risk of Dengue fever, it may not be the sole contributor to one contracting the virus.^{1,2,5} This citizen science experiment will commence with each participating household being provided with a water collection kit consisting of four 50 mL sterile test tubes and latex gloves. Citizens will be asked to submerge each sterile test tube in their household drinking, daily usage and community water supplies, and local sewer, separately. Next, citizens will be asked to deliver all four samples to a designated local community location. Sam-

ples will be collected on a weekly basis at the predetermined location and then delivered to a local Primary Health Centre to test for Dengue larvae. According to Jeelani et al. (2015), Puducherry citizens received information regarding DENV through televised programs, radio shows, and local newspapers.⁵ Therefore, results from the science monitoring experiment should be delivered through television, radio, and newspapers to maximize outreach. This particular method promotes a deeper understanding of Dengue epidemiology, transmittance, and prevention of this infection. Subsequently, the citizen science approach allows citizen scientists to make a personal investment in the study and apply the recommendations that may come from this study to their households. As a result, this approach will aim to spread newfound knowledge amongst households, clarify misconceptions, introduce safer household water storage and garbage disposal practices, and decrease DENV rates in targeted geographical locations.

The Dengue virus has the potential to be eradicated, even though current solutions in place to eradicate Dengue are falling short. It is vital to broaden the way in which we think about the problem and how it has been previously addressed. With this in mind, a citizen science approach towards improving education and prevention strategies will be impactful, as it directly incorporates the residents of the high-risk population as a central resource to the solution.

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