DRAFT Zika Virus Community Response

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The Zika virus, a mosquito-borne disease previously considered mild, has been implicated in an increasing number of microcephaly cases in infants whose mothers were infected during pregnancy. The urgency of addressing its pandemic spread through the Tropics has become acute.

Large scale responses need time to be developed as there is no cure, no vaccine, and no readily available test for the disease. The strategy for responding to Zika may be adapted from those for other mosquito-borne viruses, including the Dengue virus, which is a leading cause of serious illness and death among children in some Asian and Latin American countries, and is transmitted by the same mosquito.

Public health interventions for mosquito borne diseases focus either on large scale actions, such as spraying large areas with pesticide, or recommendations to the public that focus on individual health, such as wearing protective clothing, using insecticide and installing screens on windows and doors. One common recommendation, draining standing water in and around homes, inhibits insect breeding and thus protects not just the individual but also helps protect neighbors. The near eradication of the mosquito in South America during the 1950s was accomplished through a combination of DDT spraying and eliminating standing water.

Here we propose a set of community-level strategies for reducing mosquito reproduction, reducing exposure to the virus, and constraining its geographical spread. The benefits of collective effects leads to the importance of Strategies in which multiple individuals perform actions which mutually reinforce each other. The rapid two to four week generation time of the primary mosquito species carrying the virus, *Aedes aegypti*, means that reducing its reproduction rate may confine it to smaller areas, halting its spread and subsequently enabling more targeted efforts to eliminate the virus in those areas.

The severe nature of the current epidemic and its connection to birth defects implies that the public will be energized to become involved in the eradication of the disease. This makes it possible to engage the community and will enhance effectiveness of community efforts. Grass roots organizations with local neighborhood leadership can be enlisted to organize urban areas, including in the favelas that are often hard to reach for public health efforts.

1 REDUCE MOSQUITO BREEDING

An extensively used method for reducing the spread of mosquito-borne diseases is to reduce the reproduction of mosquitoes. This method has been used effectively to eliminate Dengue fever in Cuba and eradicated mosquitoes from Brazil in the 1950s. These past eradications relied on liberal use of DDT, an insecticide that is now banned in many regions based on concerns over ecological damage. However, a more subtle approach involves the elimination of mosquito breeding sites.

Mosquitoes breed in stagnant water, and the species primarily responsible for spreading Zika and Dengue (*Aedes aegypti*) prefers small man-made containers in and around homes. Existing guidelines suggest these water sources be drained. Water that is needed for human use should be covered, and breeding sites that cannot be effectively drained should be treated with insecticide to kill either adult mosquitoes or their eggs. However, even one overlooked container will attract mosquitoes to breed successfully, so high levels of diligence and training are needed. Thus successful implementation in Cuba has involved frequent indoor inspections of homes [5]. Among the ways community engagement can help is through local knowledge of standing water, and house by house searches for standing water in neighborhoods.

This strategy can be made much more robust by artificially providing multiple opportunities for insects to lay eggs in vessels deliberately placed around homes, and then destroying the eggs by disposing of the water. A toxin may be added to the water to kill either the eggs or adults, or the water may be treated with an appropriate household chemical as a toxin before disposal. Mosquito larvae-killing but human-safe “dunks” are one example. With this approach even if there are unrecognized places with water, their use by the mosquitoes competes with the intentionally placed traps, reducing the probability of mosquitoes reproducing.

Specially designed devices of this sort, called lethal ovitraps, have been developed [4]. However, the essential method can be replicated with common household materials. Field trials of these devices have had remarkable success, including a 92% reduction in mosquito population density in Australia [10] and a 97% reduction in cases of Dengue fever in the Philippines [11]. Specific protocols can be developed for improved effectiveness

but the basic principle can be implemented easily.

2 Reduce exposure to adult mosquitoes

Reducing exposure to bites has the double benefit of lowering disease transmission and starving females of the blood they need to reproduce. This can be accomplished by using proper protection in and out of doors. Existing recommendations include wearing protective clothing that covers the limbs and the (safe) use of insect repellant. The use of screens on windows and doors, especially when treated with insecticides, can be very effective at providing indoor protection. While *Aedes* mosquitoes are most active in the early morning and before dusk, they are aggressive biters potentially feeding at all times of day or night, so bed netting is another option to consider.

Bug screens are not currently in wide use in South and Central America, so their deployment would require major, concerted effort on the part of communities. Another option is to declare community-wide curfews or siestas, to keep everyone indoors for a specific period of time. To account for genetic variability in mosquito activity, the times of these siestas should be at different times each day. In urban areas, existing public structures or businesses like restaurants which have adequate protection can be encouraged to open their doors to the public during siestas. These siestas would require high compliance to be effective.

Since pregnant women experience the brunt of Zika's negative impacts, their homes should be prioritized for mosquito-proofing. They might consider staying indoors for the course of their pregnancy, or a nine month medical vacation to safer areas if they have the financial means.

3 Limit geographical spread

Implement screening of travelers / provide information about the Zika virus at airports and transit hubs. The virus has an incubation period of about a week, followed by another seven days or so of illness in some of the infected. During the period of infection, the virus can be passed from a person to an uninfected mosquito, which can go on to infect more humans. To prevent this transmission, symptomatic individuals traveling from areas of widespread infection to areas without infection should be encouraged to self-isolate in a properly screened home for seven days. To stop the disease effectively, it must be contained within increasingly smaller geographic areas, not spread to new ones. *Aedes aegypti* are found throughout the world's Tropics and Sub-tropics, making the potential range of an unfettered Zika virus significant. Pregnant women in particular should seriously consider the dangers of travel to affected regions.

4 Reduce consequences

The current suggestions from officials of El Salvador, Colombia and Brazil to avoid pregnancy does not solve the disease problem directly, but may contribute to inhibiting the severest effects. Whether this strategy can help improve the effectiveness of other efforts that can halt the disease might be considered.

5 Is it possible to use a natural vaccine

Use the virus itself as vaccine: Since the primary harmed population is identified (pregnant women) and the disease is thought to be otherwise mild (fever, rash, joint pain), consider infecting everyone else so the virus contagion will stop. While superficially sound, this strategy requires careful evaluation of rare cases of disease harm (i.e. link to Guillain-Barre syndrome), the potential role of sexual transmission, and the potential unknown effects of this little-studied disease. Thus, other approaches are preferred.

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