The World Health Organization (WHO) recently declared the Zika virus epidemic a Public Health Emergency thanks to its rapid spread and possible association with microcephaly. Global conditions for spread of mosquito-borne viruses are constantly changing. But spread of Zika would have been unlikely during the 1950s and 60s because of successful mosquito eradication efforts. Today, the virus readily proliferates in urban environments where the primary mosquito responsible for the epidemic, *Aedes aegypti*, thrives.

U.S. policies in the 1940s were helpful in early mosquito eradication efforts. Changes in U.S. policies in the late 1960s however facilitated the subsequent demise of those efforts.

DDT was introduced during WWII to prevent millions of cases of louse-borne typhus and other insect-borne diseases. After the war, it was used to free billions of people from the threat of malaria. In the Americas, DDT was used to control malaria, and also to eradicate *Aedes aegypti*, the mosquito responsible for yellow fever, dengue, and now, Chikungunya and Zika viruses.

Bolivia began *Aedes aegypti* eradication with DDT in 1945, and by 1947 it was eradicated. This landmark event led the Truman Administration to sign an agreement to eradicate the yellow fever mosquito from the hemisphere.

Maps showing the geographical distribution of *Aedes aegypti* (presence shown in red) at different times in the Americas.

But not until 1963, under the Kennedy Administration, did Congress appropriate funds for *Aedes aegypti* eradication, placing the Centers for Disease Control (CDC) in charge. The U.S. program
was justified, in part, as a means of preventing the export of *Aedes aegypti* from the U.S. back into the *Aedes aegypti*-free countries of the Americas.

*Aedes aegypti* is a domestic species and is found almost exclusively in and around houses. For *Aedes aegypti* eradication, DDT was sprayed inside and outside water containers near houses. DDT stopped *Aedes aegypti* mosquitoes from laying eggs in the sprayed containers. If the adult mosquitoes were not repelled by DDT, then DDT killed them when they contacted the sprayed surfaces.

The eradication programs were massively successful. Many said that DDT was so successful that it eradicated the malariologists, as well as malaria. DDT was so successful in *Aedes aegypti* eradication that in the late 1960s a dengue expert opined that dengue would never again threaten the people of the Americas.

The U.S. *Aedes aegypti* eradication program did not start until 1964. Substantial progress was described in a 1967 progress report. However, that progress was short lived. In 1968 David J. Sencer, the CDC Director, expressed opposition to eradication. Sencer had influence over the Global Malaria Eradication program, for which the U.S. provided much DDT and most of the funding.

In July 1969, Sencer accompanied the U.S. Delegation to the World Health Assembly to decide the fate of The Global Malaria Eradication program. The decision was taken to abruptly terminate the program. That fall, Nixon ordered the cancellation of all residential uses of DDT in the U.S. In a separate action, Sencer terminated the U.S. *Aedes aegypti* eradication program too. The malaria and *Aedes aegypti* eradication programs relied completely on DDT. There were no DDT substitutes.

Nixon reported to Congress in January 1970 that We have taken action to phase out the use of DDT and other hard pesticides. Action against DDT didn't end there. Created in 1970, Nixon's Environmental Protection Agency convened a hearing in 1971 to determine DDT's fate. 125 witnesses were called and expert scientific testimony spanned seven months. In the end, the presiding judge (Judge Edmund Sweeney) approved the continued essential uses of DDT, stating that DDT is not a carcinogenic hazard to man. Two months later, the EPA Administrator, William Ruckelshaus, ignored the presiding judge's findings and concluded DDT was a carcinogenic risk to humans. With that he banned all non public health uses of DDT. Even for public health use, he required that each application for public health use undergo EPA review and approval.

In contemplating what could be used instead of DDT, Judge Sweeney had concluded that potential DDT replacements were too dangerous. Ruckelshaus did not let that stop him from banning DDT. He identified methyl parathion as the primary DDT substitute. Years later and after untold deaths of agricultural workers, the EPA banned parathion as being too dangerous, even when protective gear was used.

Ruckelshaus opinion of DDT as a carcinogenic risk to humans was a scientific anomaly. His conclusion stemmed entirely from high dose animal studies. Even today, no expert review of DDT concludes that it is a human carcinogen. Even if it were a human carcinogen, decisions about
public health use of DDT would need to be balanced against the risks of cancer with its use versus the risks of disease, death, and/or infant neurological damage from viral infections without its use. As a final point, the World Health Organization still approves DDT for use in disease control programs.

On a global scale, Sencer’s advocacy against the eradication programs doomed the public health use of DDT. But the EPA’s DDT ban put the final nail in the coffin. After the ban, DDT availability declined and cost went up. *Aedes aegypti* eradication programs quickly failed and by the mid-1970s the mosquitoes were re-invading the Americas. Dengue soon started savaging countries that had been free of the disease for 20 years or more. Severe dengue epidemics and millions of cases became routine annual occurrences in the Americas.

In 2004 the *New York Times Magazine* published Tina Rosenberg’s *What the World needs now is DDT*. She cited South Africa’s stunningly successful return to DDT for malaria control. Since then, South Africa’s continued use of DDT kept malaria at bay. The country’s President just accepted an award from the African Leaders Malaria Alliance for moving South Africa’s malaria program toward the goal of eradication.

Nowhere has environmental extremism against DDT been more successful than in the Americas. Today African countries are free to use DDT, but extremist propaganda has foreclosed on those freedoms for the Americas, perhaps forever.

Uncontrolled dengue epidemics are bad, but in 2013 Chikungunya infections appeared in the Americas, followed in April 2015 by Zika virus infection. All these diseases are spread by *Aedes aegypti*, and complete failures of non-insecticidal approaches to *Aedes aegypti* control ensure the continued spread of those diseases.

Having sowed the seeds of a public health crisis of the three viral diseases listed above, the U.S. must now help to find solutions. New larval control insecticides are needed that combine DDT’s action of repellency, toxicity, and persistence, on or in water containers. Countries should be encouraged to put aside environmental extremism and use DDT if field tests give favorable results.