Zika in Puerto Rico, 2016-2017: II Perspectives on Epidemic Surveillance and Control, Health Communication, Outcomes and Lessons

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The social reaction to the Zika epidemic in Puerto Rico reached a confrontational climax regarding aerial fumigation with an organophosphate insecticide. The public drama has obscured multiple simultaneous controversies. This and a companion paper, based mostly on print and digital news reports, provide a context and description of the major controversies and examine the outcomes and their lessons for the protection of the public's health. Part II covers the questions on disease surveillance (what is going on?); health communication and epidemic control (what is an epidemic? is there a way to control an epidemic transmitted by *Aedes aegypti*?), and the outcomes and lessons from the debates. [*P R Health Sci J 2018;37(Special Issue):S24-S32*]

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Introduction and methods

This is the second of two articles that provide an external observer's perspective on the social and sanitary context and the major controversies during the Zika outbreak in Puerto Rico (PR), 2016-2017, and present the outcomes and their lessons for the protection of the public's health. Both articles examine the development of the epidemic based on what was available to the public through news media. Part I covered the social and sanitary context, a summary of events in the first three months and the discussions related to religious, demographic, economic, political, and health care concerns (1). This article covers the questions on disease surveillance, public communication and epidemic control, and the outcomes from the debates.

Controversies and unresolved questions on disease surveillance, public communication and epidemic control

What is going on with the epidemic?

A fundamental controversy throughout the year centered on the extent and severity of the epidemic. Early on, the government chose to speak only of confirmed cases (which require blood testing), and to present the week-by-week accumulation of cases based on the date of onset of symptoms, rather than on the week that the report (or blood sample) was received (the Informe Semanal de Enfermedades Arbovirales, Weekly Report on Arboviral Diseases). The first decision assured that cases were not caused by other similar diseases, like dengue and chikungunya (CHIK), but minimized the magnitude of the epidemic. The specific periods of virus circulation and antibody production, and the limitations in access to a confirmatory test (which no clinical laboratory performed before 2016) guaranteed that only a fraction of symptomatic cases would get confirmation. For the first month (January 2016), calls for precaution were based on one confirmed case, as officials did not disclose the ongoing investigations. With the announcement of an additional 18 confirmed Zika cases, they declared a concurrent influenza epidemic with almost 5,700 cases, including 492 hospitalizations, 5 confirmed and 6 suspected deaths. The public received no explanation on the difference between an epidemic of 19 cases and another with 5,700. Subsequently, influenza was much less mentioned in the news, and mostly in conjunction with Zika. From February to September, newspapers explored how the limited access to diagnostic tests resulted in an undercount of cases: most of the infected would have no symptoms; clinical laboratories faced (unreimbursed) difficulties to manage the flow, cost, and data processing of referrals to the Puerto Rico Department of Health (PRDH) laboratory; and the PRDH prioritized diagnosis in four population groups (infant, pregnant, immunocompromised, or hospitalized patients) (2).

The use of epidemic ("epi") curves by date of onset also minimized the situation. While an epidemic is ongoing, epi curves by onset suggest the epidemic is disappearing. They always show a decreasing slope in the latest periods and provide a curve that constantly changes, because the numbers for a specific week are not final until all data have been entered at the end of the outbreak. For example (Figure 1), the report for week 33 of

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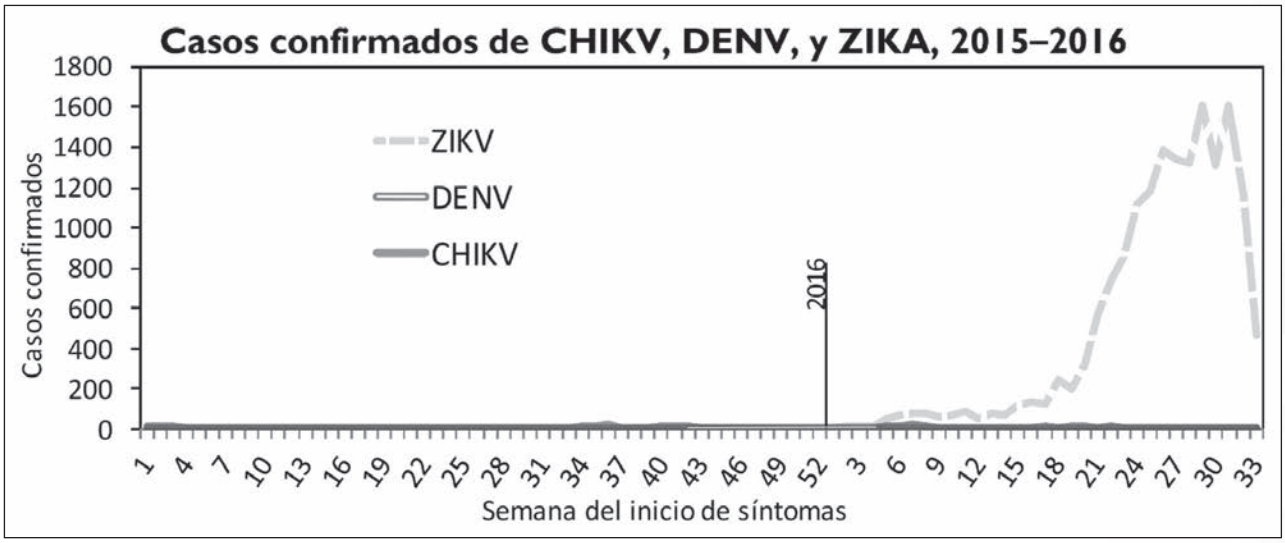

Figure 1. Confirmed cases of dengue, chikungunya and Zika, 2015-2016, by week of onset of symptoms. Departamento de Salud de Puerto Rico, Informe Semanal de Enfermedades Arbovirales; Arboviral disease surveillance report for week 33 (12-18 August) 2016, data as of 1 September. http://www.salud.gov.pr/Estadisticas-Registros-y-Publicaciones/Informes%20Arbovirales/Reporte%20ArboV%20semana%2033-2016.pdf.

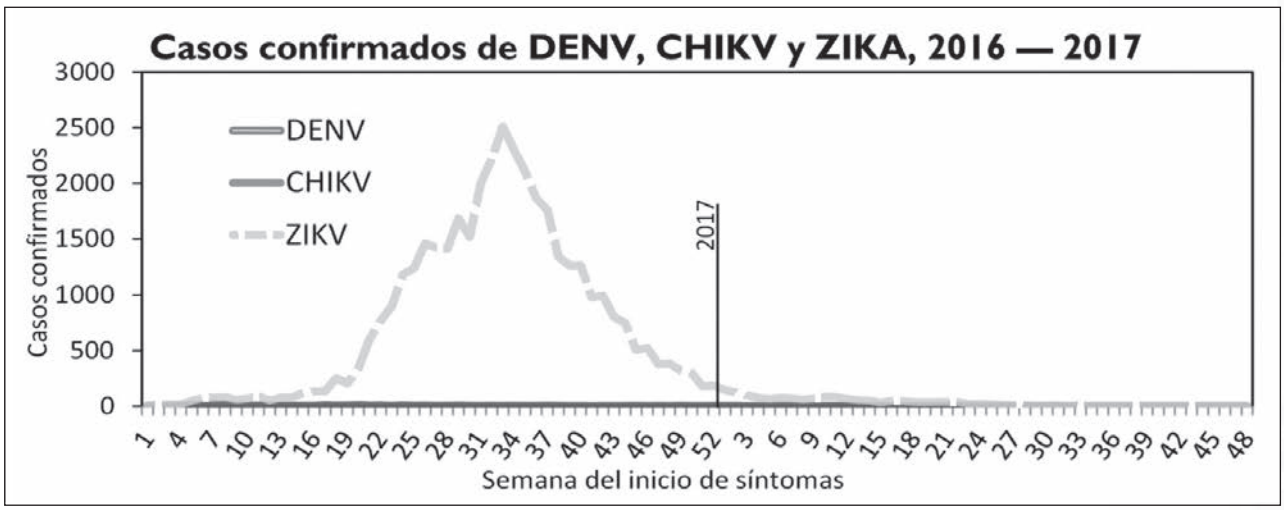

Figure 2. Confirmed cases of dengue, chikungunya and Zika, 2016-2017, by week of onset of symptoms. Departamento de Salud de Puerto Rico, Informe Semanal de Enfermedades Arbovirales; Arboviral disease surveillance report for week 48 (26 November-2 December) 2017, data as of 22 December. http://www.salud.gov.pr/Estadisticas-Registros-y-Publicaciones/Informes%20Arbovirales/Reporte%20ArboV%20semana%2048-2017.pdf

2016 suggests the epidemic had two peaks, at weeks 29 and 31, and cases decreased markedly thereafter, but a report produced over a year later (Figure 2), clearly shows a single, higher peak at week 33. In the middle of an epidemic, the use of epi curves by week of onset provides solid data for past disease activity, not for the current moment. In consequence, the intensity and peak of the Zika epidemic were difficult to detect. The media disregarded the epi curves and focused on the number of cases added each week, a measure related to the activity of laboratories processing samples, not to current disease activity (a week's cases with a positive test result had onset in an unspecified previous week). Apparent "decelerations" were reported in early July and early August. The number of cases added each week reached a peak of 2,574 for week 38 (16-22 September), as reported on 8 October, but did not show a clear decline until the report for week 40 (reported 22 October) (3).

The epi curve by onset, even with the limitations noted above, gave better information than the number of new cases added each week. The peak of the epidemic, now identified as week 33 (12-18 August) 2016, could be reliably interpreted as such in the epi curve of the report for week 37, prepared 29 September. This reading would have provided an indication of the peak of the epidemic at least three weeks before the number of new cases added each week showed a clear decrease (22 October).

On the week the epidemic peaked, and in consideration of the expected temperatures, humidity and rainfall from August to October, the US Centers for Disease Control and Prevention (CDC) forecast a higher number of infected persons before the end of the year (850,000), and the US Department of Health and Human Services declared a public health emergency in PR due to Zika. Surveillance reports for the previous week, no. 32 (5-11 August) showed 14,324 confirmed cases, but a later publication on the incidence of Zika detection in blood donations up to that time (less than half of the duration of the epidemic), estimated that 469,321 persons had been infected. Unexpectedly, for weeks after the epidemic peaked, there was minimal or no incidence of dengue and CHIK by virologic analysis among tested cases. The PRDH declared the end of the epidemic on 5 June 2017, because "there have been only about 10 cases of Zika reported in every four-week period since mid-April." More precisely, the arboviral disease surveillance reports showed 12 or 13 confirmed Zika cases in the four-week periods ending 22 April to 6 May; thereafter, 6-10 cases until the period ending 24 June, 2-3 cases until 12 August, and none to 17 March (week 11) 2018, the last report available at this writing (4).

What is an epidemic?

Skepticism, as shown in Part I for sports fans and the tourism industry, was a widespread response throughout the year. An extended local article on "The politicizing of Zika" placed PR amid the debate in Congress on funding to fight Zika, cited the governor's depiction of a "humanitarian crisis" to obtain federal assistance, and claimed *The New York Times* and *Time* reported incorrect data (using suspected, instead of confirmed, cases). Health messages encountered cognitive obstacles, first among them, the definition of epidemic. The public considers an outbreak ("brote", in Spanish) as something minor, but the defining aspects of epidemics throughout history are "fear and sudden widespread death." Historian Charles Rosenberg proposes that "most communities are slow to accept and acknowledge an epidemic;" due in part to "a failure of the imagination; perhaps even more, acknowledgment would threaten interests" and "the emotional assurance and complacency of ordinary men and women." "Bodies must accumulate, and the sick must suffer in increasing number before officials acknowledge what can no longer be ignored." Preventive health specialists consider "epidemic" and "outbreak" equivalent terms to denote a significant increase in cases over the expected for a specific place, time, and population. A single case of smallpox (an eradicated disease), anywhere, would constitute an epidemic and a global emergency (5).

The public's image of an epidemic is equivalent to the strike of a hurricane – death and destruction. The epidemiologists' definition is like a "hurricane watch," issued in advance of conditions that favor a hazard, so the public can prepare. Sanitary action is taken not only because of what is happening in the moment, but because of what scientific knowledge and experience indicate is likely to happen soon. The public responded to CDC's Zika warnings as if, in perfect weather, meteorologists were reporting hurricane force winds.

Incredulity was also due to misunderstanding of the biologic details underpinning CDC's forecasting. The prediction of "hundreds of thousands of infected persons" seemed ludicrous in comparison with the numbers in official reports of confirmed cases, without an explanation of the dynamics of arboviral epidemics. Also, newspapers frequently used the term "contagiados" ("infected") when referring to confirmed cases. There is a difference, by orders of magnitude, between the number of severe, symptomatic cases, and the number who are infected but asymptomatic (6). In addition, only a fraction of symptomatic cases is confirmed. Arboviral epidemics resemble a hurricane with imperceptible winds and floods, but visible destruction.

A third reason for disbelief and controversy was the novelty of Zika. To assist a patient, a clinician must provide clear information and answer questions as many times as required. Public health officials could draw on limited knowledge and no experience of the disease. It had produced epidemics only recently and elsewhere; there had been no time to set up, analyze and publish cohort studies to provide rich, unbiased descriptions and statistical grounding to the clinical knowledge.

Finally, even if the effects of an epidemic are visible and its mechanism clear, the first human reaction to bad news is denial. The "grief reaction", a progression through denial, anger, depression, bargaining, and acceptance, was initially described by Elizabeth Kübler-Ross (7). The framework, developed through the care of the terminally ill, can be applied to the public response to an epidemic. Rosenberg considered that the fundamental components of the social reaction to epidemics are "fear and sudden widespread death". Denial is another way to explain what he described as "a failure of the imagination" when interests and "emotional assurance" are threatened.

Gradually, indications of denial disappeared from the media, except from a weekly journal dedicated to business affairs. On 5 June 2017, the PRDH declared the epidemic was over. Two weeks later, the magazine reported that the [new administration's] chief epidemiologist had "admitted [...] that the people had been misled into thinking the Zika epidemic was a more serious and dangerous health threat than it really was." A later editorial still deplored the "rhetoric of the damned" of the previous government administration to obtain Congressional relief (8).

Is there a way to control an epidemic transmitted by *Aedes aegypti*?

Epidemic Zika is a new phenomenon, but its vector, which also transmits yellow fever and dengue, has long been studied. Early in the twentieth century, yellow fever was eliminated from Havana, the Panama Canal Zone, and Rio de Janeiro through labor-intensive, meticulous premise-to-premise breeding site eliminations and legal empowerment for house searches and fines. *Ae. aegypti* was nearly eradicated from the Americas, but

by the 1990s, a false sense of security, urban growth, cost-savings in vector control programs, and the development of insecticide resistance resulted in large epidemics in many countries. The mosquito is so adaptable to the human environment, people must maintain constant vigilance to prevent its propagation. Yellow fever outbreaks can be prevented and controlled with vaccination, but there is no dengue vaccine in general use. Dengue epidemics typically last 6-7 months and are rarely controlled. They will appear to be controlled if strenuous government efforts are delayed and coincide with the natural decline in cases. Brazil literally declared war on the mosquito (the biggest military mobilization in its history) on 26 January 2016, long after the start of the Zika epidemic (9). This signifies that mosquito control is costly, cumbersome, and inefficient for governments to carry out routinely, and that mobilization is not inexpensive, simple, or straightforward. If Naled had been sprayed in Puerto Rico at the beginning of August, the decline in the epidemic curve on week 33 (12-18 August) would have seemed to be due to the spraying. Only a carefully controlled study would have differentiated a temporal coincidence from a cause and effect relationship.

Aerial fumigation for Zika was first mentioned in print media in PR, to my knowledge, on 26 May, from a meeting of experts convened by the Science, Technology and Research Trust (an independent, non-profit entity created by government to stimulate a "knowledge economy"). A participant mentioned "chemical controls, aerial application of larvicide, and traps." The number of confirmed cases in PR was then over 1,700 (including 191 pregnancies, one death, and one fetal loss with congenital malformations attributed to Zika). Shortly thereafter, a study showed a sharp increase in possible Zika infection in blood donors from April, up to 1.1% in the first week of June (10). Authorities thereby had evidence of a large arboviral epidemic (experienced in PR many times with dengue, and with CHIK in 2014), combined with the possibility of a powerful viral effect to produce fetal malformations (as suggested by the studies in Brazil). The experience with dengue offered no hope that on-the-ground breeding site elimination could swiftly interrupt transmission.

At the end of June (with 2,162 confirmed cases, including 299 pregnant women), both Dr. Thomas Frieden (CDC director) and Dr. Johnny Rullán (former PR Secretary of Health), separately, advocated expanding control efforts beyond personal protection, mosquito traps, elimination of domestic breeding sites, and government intervention in abandoned houses, car "junkers" and cemeteries. Aerial fumigation of insecticide was expected to rapidly reduce the mosquito population, and therefore, disease transmission. The article mentioned that Rullán's advocacy had provoked an accusation of financial interest, which he forcefully denied. He apparently withdrew from public discussion of fumigation (11).

A rumor that aerial spraying was scheduled for 1 July motivated a protest in front of the local CDC installation. Dr. Frieden, from Atlanta, stated that the choice of method was a PRDH decision. He was quoted to say that the insecticide Naled had been used for aerial fumigation in PR in 1987 with promising results; the US Environmental Protection Agency (EPA) website was quoted as indicating that Naled, and larvicide Bti (*Bacillus thuringiensis israelensis*), used as recommended, presented no threat to human health. The news report was illustrated with a CDC chart of "What works and what does not." "Aerial fumigation used with larvicides" was included among "what works." The governor offered to decide on fumigation by the end of the first week of July, after examining the recommendations of the EPA, the local Environmental Quality Board, PRDH, the federal and local Departments of Agriculture, and the PR Department of Natural and Environmental Resources. The latter had not presented an opinion, but the others supported the measure. Public opposition grew quickly and formed a "United Front Against Aerial Fumigation" with the "colegios" (mandatory guilds) of physicians, engineers, and chemists, the University of Puerto Rico School of Public Health, a prominent oncologist, lawyers, and ecologists from academic and community based institutions. Legislative hearings on aerial fumigation contrasted the support of government agencies with the refusal of professional and community groups. Almost invisible to news media at the time, but undoubtedly a contributor to the disapproval of environmental interference, was the concurrent community activism against disposal of coal ashes in Peñuelas (12).

Fumigation was supported by federal and local officials, who invoked the risk of microcephaly, Naled's speed in reducing adult mosquito populations, and its safety if used as mandated by EPA. These statements were accompanied by mention of its use in PR in 1987, and past and current use in the state of Florida. No metrics were presented on the expected efficacy of Naled air-spraying in PR, and its impact on the size of the epidemic (number of Zika cases or prevented infections in infants). Opponents said little on the need to prevent congenital malformations and insisted on the pesticide's danger for people and the environment. They quoted the EPA website's mention of nausea, dizziness and respiratory difficulty for handlers of the undiluted substance, and its high toxicity for beneficial insects, such as bees. More perceptively, an academician criticized the studies in which EPA based its assertions of low risk because most were industry-sponsored and old (before 2000); besides, in 2012, the European Union had eliminated Naled from its list of acceptable biocides. Others doubted the efficacy of aerial spraying, considering the (indoors) habits of the mosquito and the different climate and topography in Florida. There were allegations of a relationship with cancer and damage to flora and fauna in the Florida Keys. On 8 July, the government, further debasing what it called an emergency, declared a "state of emergency" due to the lack of access to medicinal cannabis treatments. This allowed the immediate promulgation of new, controversial rules, bypassing public input (13).

While the governor listened to "everybody's opinion," federal officials restated their recommendations and the assurance that the decision was in PR's hands. It was Frieden, though, who

described the fumigation process (multiple sprayings the first week, weekly for 2-3 weeks, and if further needed, weekly or every other week, at dawn and dusk to avoid harm to bees) and even the mechanism to select companies. (Three were registered in PR, one in 2011, two as recently as April and June 2016). The government's Steering Committee against Zika indicated that the measures used so far had not contained transmission, and recommended fumigation. Nevertheless, opposition increased, with the addition of apiculturists and planters of crops labeled "organic" (14).

Popular opinion did not accept that Naled fumigation was a standard approach to disease control. After all, it had not been used in PR after its trial in 1987. Some saw it as a bureaucracy's response to keep a foreign virus from its borders. Many voices, in regular columns as well as letters from readers, framed fumigation among well-remembered experiments on PR's environment, and residents used as colonial "guinea pigs" or "cannon fodder": oral contraceptives, agent orange, napalm, transgenic crops. Readers were reminded of the government's investment on a dubious experiment of cloud-seeding with chemicals, justified as an emergency during the 2015 drought. Some texts confused the issues by alluding to the general subject of pesticides, environmental contaminants, and their alleged relation to Parkinson's disease, cancer, and autism (15) .

By mid-July, with nearly 4,500 confirmed cases, there was still debate. It was disclosed that, while the White House asked Congress for emergency funds to fight Zika, a group of Republican Representatives asked the President to work with Congress to liberalize EPA requirements on pesticide fumigation near bodies of water. This reconfigured the PR controversy as a bargaining chip between the Executive, Congress, and large chemical corporations in the US. *Consumer Reports* published an article that referenced the skepticism of experts regarding aerial fumigation and quoted a CDC entomologist who highlighted the advances in aerial spray technology but gave faint praise to aerial fumigation. The governing party's candidates for governor and Resident Commissioner, and the mayors of the municipalities slated for fumigation (of both principal parties) also declared their opposition, (16) but the governor still demurred.

The turning point arrived on 20 July. A morning headline announced that a group of mayors would go to court to oppose fumigation (which they labeled "environmental terrorism"), and the editorial called for dismissal of the Naled option. Another newspaper, under the title "Air-spraying unacceptable," quoted a well-known academic epidemiologist, Dr. Cruz María Nazario, and her critique of the limited data available to justify the predicted risk of microcephaly, which had in turn been used to support the experimental use of Naled. A radio commentator disclosed the unimpressive results of the local 1987 trial of the compound. Even indoor spraying came under fire. Later in the day, the public and the government learned that a cargo of Naled had been transported to PR without the necessary licenses. CDC confirmed the arrival and apologized to the government, which in turn requested a court order to stop distribution and obtain the shipping documents from the importer. The administration called the CDC action "unilateral" and "a breach of respect." On 22 July the governor authorized air-spraying, only with Bti, which seems not to have occurred. The government fined the company that stored it, for keeping toxic substances without a license and in an unapproved location. Conversely, three weeks later, EPA and the US Department of Agriculture warned the PRDH to upgrade its pesticide storage facility, or it would be fined. A one-day clean-up (7 August) organized by some municipalities and civic organizations gathered water-collecting rubbish and tens of thousands of used tires and distributed informational materials and mosquito repellent (17).

On 1 August, President Obama circulated a video message to Puerto Ricans, on the menace of the Zika crisis. Two months later, simultaneous with Congressional approval of additional funding for Zika control efforts, CDC assigned $65 million for the creation and 5-year support of a PR Vector Control Unit (VCU), autonomous from the PRDH, and administered through the Science, Technology and Research Trust. It would be charged with integrated vector surveillance and management, and collaboration with communities. Faced with criticism that the money had not been assigned to the PRDH or the Emergency Management Agency, the Science Trust indicated it had been chosen as "a private, non-profit entity with the agility required to respond to a crisis" (18). The governor's Executive Order no. 2016-37 (30 September) created the Unit, which is now in operation. To provide it with a stronger legal basis, Senate Bill 1720 was proposed in October. An amended version (S.B. 256) was presented again in January 2017, and was referred to a commission.

Aerial fumigation was used in Miami shortly after it was discarded as an option in PR. The situation was concisely described in an October article by Frieden et al.: 13 locally acquired Zika infections were identified in a 6-block area, comprehensive mosquito control efforts were promptly initiated, and within 3 days of documentation of the risk of ongoing Zika transmission, it was decided to also use aerial spraying with Naled and larvicide. In contrast, effective action in PR was "complicated by lingering suspicions related to historical activities, competing priorities, and the speed needed to bring integrated vector management to scale. Misinformation has clouded public understanding of the best ways to protect individuals and communities." The authors perhaps should have added that in PR, aerial fumigation was expected to cover large tracts of a geographically diverse island and would have been used at least seven months after the identification of ongoing transmission. In contrast to the vehement rejection of the fumigation "experiment", announcements of a Zika vaccine trial in PR provoked little or no discussion (19).

Outcomes and lessons

The Zika epidemic caused, as reported so far, more than a hundred severe adverse health outcomes (Guillain Barré

Syndrome - GBS, birth defects, fetal losses, deaths). Each of them affected a family, so that hundreds of people will remember the outbreak with anger and sadness. The epidemic also produced setbacks for public health in PR, beyond the arrival of a new, serious disease that might produce future epidemics. It is incumbent on federal and local agencies to profit from the experience, to reduce the burden of future episodes by a formal analysis of successes and failures.

Recently, the US response to Zika has been described as shaped by two features of the country's politics: polarization and fragmentation (also characteristic of the underfunded, decentralized public health system). In addition, the lessons of the 1976 "swine flu episode" should be remembered. An evaluation of that process highlighted five "critical" actions that should not be omitted from a public health response: program reviews (periodic reevaluations, especially when activities are based on limited scientific data); implementation analyses, anticipating media reactions, maintaining credibility and agency reputations, and "thinking twice about medical knowledge" when dealing with "slippery diseases" (20). Forty years later, they were also necessary in the Zika epidemic.

Government officials were unable to communicate effectively their ideas of risk, and the importance of following recommendations for prevention. This was caused by the inherent complexities of a mosquito-transmitted epidemic with a new disease, but also, to the lack of clarity in official government messages. Confusion was probably bred initially by presenting a 19-case Zika epidemic with the announcement of a concurrent 5,699-case influenza epidemic. The use of only confirmed cases made the Zika epidemic seem minuscule compared to government estimations, and the graphs by date of onset suggested that the disease was disappearing. In addition, government was late and slow to communicate with other services and private entities. Diagnostic laboratories, hospitals, and physicians were unable to reinforce the government's messages to their patients.

Local and federal health officials and agencies lost credibility and the public's trust. The public found no reliable non-politically appointed expert on the subject. The government was accused of "inaction" in part fairly, because there was no effective mosquito control system in place despite years of *Ae. aegypti*-transmitted epidemics, and in part unfairly, because it took time to gather information about a new disease, to develop a plan and the resources to carry out the action (21). The epidemic also left the question of the validity and timeliness of official statistics.

The government must accept the normality of epidemics, just as for hurricanes. Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, recently indicated that all US presidents since 1981 have had to confront epidemics, from AIDS to Zika. In PR, the government must accept the normality of epidemics, just as for hurricanes. The categories for announcements and recommendations should be standardized, to avoid misunderstanding. The public should not be confused with terms such as "outbreak" or "cluster", used with palliative intention. They should be clearly defined to mean an epidemic with a small number of cases. Information must be presented by reliable, technically proficient, experienced spokespersons, trusted by the community. Meteorologists are not politically appointed.

In the absence of details on the expected benefit and the possible risks of aerial fumigation of insecticide, and how the method would be implemented to optimize results, it had to be considered experimental. Its imposition on a protesting community would have been unethical. The public was pleased by the governor's decision against aerial fumigation, because it was a victory of community agency. It appeared to validate the anti-fumigation discourse, but the decision process was so opaque and protracted, that the outcome seemed a political response to popular pressure and incidental events, hardly a fact-driven analysis.

A principle of public health ethics, supported by the American Public Health Association and CDC, maintains that "public health institutions should provide communities with the information they have that is needed for decisions on policies or programs and should obtain the community's consent for their implementation", but the principle does not specify how that consent should be obtained (23). Clinical medicine offers a model for decision-making when all options are hazardous: the "Tumor board." If a patient's condition requires the input of many specialists to define the best course of action, they don't make separate suggestions to the ill person, nor do they communicate only through notes in the medical record. They meet in person, consider the risks and benefits of every measure proposed, and develop a consensus recommendation, which is then presented to the patient, who makes the decision. A similar structure could be contemplated for the discussion of controversial public health issues with the participation of stakeholders, government, academic, and community experts.

Individual choices are ruled not only by logic, but also by context and emotion (such as denial). Public health officials need to explore what to do when scientific logic fails to convince. The question might be approachable through the examination of the use of heuristics in decision-making (a framework which sometimes clarifies how circumstances affect behavior) and of improved "choice architecture" that will open a path to a good decision (24).

The Zika epidemic produced not only the identification, but also the alleviation of accessory health issues, such as mosquito resistance to some insecticides, difficulty of access to contraception, and the need for more standardized neonatal evaluations. It created interest in the disease, the control of its vector, and the government's management of an epidemic. An unprecedented newspaper and billboard advertising campaign, supported at least in part by the CDC Foundation, helped promote community mobilization for disease control. The government, by rejecting the Naled option, implicitly recognized the right of the citizens to participate in agency decisions. The Catholic church and probably other less publicized faith-based organizations joined the fight against the disease. Academic

clinicians from PR gained greater visibility, through local actions and collaboration with their US-based professional organizations (e. g. American College of Obstetricians and Gynecologists, American Academy of Pediatrics). Finally, a welcome surprise was the temporary disappearance of dengue and CHIK for weeks after the peak of the epidemic.

The protracted haggling for an emergency congressional appropriation for Zika control justifies a comment on the difference that exceptional attention and funding seemed to make on the services offered to the public. New scientific methods for diagnostic testing were devised and broadly distributed. Disease surveillance included more refined and detailed reports (such as incidence maps by census tract) and covered multiple manifestations of disease over long periods (acute illness, GBS, pregnancy and delivery). Newspaper and billboard educational advertisements were complemented by multiple presentations at community meetings. For primary prevention, pregnant women in government clinics were provided kits with mosquito repellent, bed nets, condoms, and other materials. Investigation and training improved the availability of contraceptive methods. Clinical guidelines were issued early in the outbreak; perhaps due to the severity of the threat (microcephaly and GBS), but they were sorely missed in 2014 for the treatment of CHIK arthritis. US and foreign experts shared their experience in courses for local clinicians. Funds for aerial spraying were made available, but also, fundamental entomology work was reinforced. Measurement of insecticide susceptibility was applied to field work, online reporting of breeding sites was announced, and new mosquito traps were tested in community trials. The VCU should play an important role in the institutionalization of an effective vector control program, but its time-limited budget and siting outside of PRDH will require quick and politically subtle work from its managers. It is imperative that these advances not be lost when Zika disappears from the list of government concerns.

Days after that sentence was written, Hurricane Maria (19-22 September 2017) aggravated the problems surrounding the epidemic – a broken economy, more poverty (thousands of ruined homes), emigration, a devastated environment, and greater dependence on federal government assistance and decision-making, to the point of militarization of some services (25). Among the devastation there is opportunity, desire and hope that reconstruction will encompass physical and social structures and incorporate the lessons learned from recent misfortunes.

Resumen

La reacción social a la epidemia de Zika en Puerto Rico alcanzó su clímax en una confrontación sobre la fumigación aérea de un insecticida organofosforado. El drama público ha opacado múltiples controversias simultáneas. Este artículo y su primera parte, basados principalmente en informes de prensa en papel y digital, proveen un contexto, describen las principales controversias y examinan los resultados y sus lecciones para la protección de la salud pública. La Parte II cubre los debates sobre vigilancia de enfermedades (¿qué está pasando?); comunicación en salud y control epidémico (¿qué es una epidemia?, ¿hay forma de controlar una epidemia transmitida por *Aedes aegypti*?) y los resultados y lecciones de los debates.

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Abbreviations: ArboV – Departamento de Salud de Puerto Rico, Informe Semanal de Enfermedades Arbovirales (Weekly Report on Arboviral Diseases), available at: http://www.salud.gov.pr/estadisticas-registros-y-publicaciones/informes%20arbovirales/forms/allitems.aspx; CB – Caribbean Business, San Juan (weekly); ND – El Nuevo Día, San Juan (daily); PAM – Parés Arroyo, M.; Vocero – El Vocero de Puerto Rico, San Juan (daily, Monday-Friday)

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