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ORIGINAL ARTICLE

Incomplete surveillance of a Dengue-2 epidemic in Ibagué, Colombia, 1995-1997

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From April 1995 through November 1997 a dengue epidemic occurred in Ibagué (400,000 population), Colombia, where 3,419 cases were reported and DEN 2 virus was isolated from seven patients. A sero-survey conducted in 1996 found evidence of previous dengue infection in 9.6% of the population, indicating that many infections had not been reported. The dengue infections occurred in all age groups, but children under five years of age were most frequently infected. Forty-five percent of this Ibagué population were born after the re-appearance of dengue in Colombia in 1972, but have never been infected with dengue virus. Most of the cases reported as dengue hemorrhagic fever did not fulfill the current case definition. *Aedes aegypti* larvae were found in 19% of dwellings surveyed, most often in uncovered low tanks used for water storage. Many residents were not acquainted with the domestic nature of the mosquito vector. Health workers attributed the failure of the dengue control programs to lack of leadership and other administrative problems.

Key words: dengue, epidemiology, epidemiologic surveillance, evaluation, Colombia.

Vigilancia epidemiológica incompleta de la epidemia de dengue-2 en Ibagué, Colombia, 1995-1997

Desde abril de 1995 a noviembre de 1997 ocurrió una epidemia de dengue en Ibagué, Tolima (400.000 habitantes), Colombia, en la cual se notificaron 3.419 casos y se aisló virus dengue 2 en el suero de 7 pacientes. En una encuesta serológica realizada en 1996 se encontró evidencia de infección anterior por dengue en 9,6% de la población, lo cual indica que muchas infecciones no se habían reportado. Las infecciones recientes del dengue ocurrieron en todos los grupos de edad, pero los niños menores de cinco años fueron más frecuentemente infectados. 45% de éstos, que nacieron después de la reemergencia del dengue en Colombia en 1972, nunca habían sido infectados con virus del dengue. La mayoría de los casos notificados de dengue hemorrágico no satisfacían la definición actual de caso. En el estudio entomológico se encontraron larvas en el 19% de las viviendas examinadas, la mayoría de las veces de *Aedes aegypti* en albercas destapadas, donde muchos residentes no entendían la naturaleza doméstica del mosquito vector. El personal de salud fue entrevistado y atribuyeron la falla de los programas de control del dengue a la carencia de dirección y a otros problemas administrativos.

Palabras clave: dengue, epidemiología, vigilancia epidemiológica, evaluación, Colombia.

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Dengue is the most important arboviral disease in the world, causing 80 million infections annually (1). Classic dengue fever consists of a febrile, undifferentiated illness occasionally with minor bleeding manifestations, usually lasting 3-5 days, often followed by a long convalescent period

characterized by asthenia, depression and bradycardia. Dengue hemorrhagic fever (DHF) is the severe form of dengue and if not treated appropriately can cause high case-fatality rates. Dengue reappeared in 1972 in Colombia, South America, after the successful campaigns that resulted in the elimination of the *Aedes aegypti* vector in 1960 from most infested areas of the country (2). Since 1972 transmission of all four dengue serotypes has occurred in the Americas, becoming increasingly endemic and has produced an increasing number of DHF cases (2). In 1995, local health services from the state or department of Tolima (population 1.2 million), Colombia, in the upper Magdalena river valley reported a twenty-fold increase in the number of recorded cases of dengue compared to 1994. Moreover, an increasing number of DHF cases, approximately 20% of all DHF reported cases in Colombia, were reported in Tolima. The continuing occurrence of dengue-like illness particularly affecting the capital city of Tolima, Ibagué (400,000 population; 1,285 m above sea level; 4° 26' 43" N latitude; 75° 14' 14" W longitude, annual average rainfall of 2.25 mm) led local public health officials to request the technical assistance of the Colombian National Institute of Health in Bogotá to assess local surveillance, to determine the extent of the outbreak and *A. aegypti* infestations in Ibagué, and provide recommendations to improve dengue surveillance and control. It is presumed that dengue-2 was prevalent in Ibagué in years previous to 1952 as it was prevalent in neighboring places where the virus had been demonstrated by neutralization tests performed on human dwellers. Reinfestation of Ibagué by *A. aegypti* was not documented until 1973. By 1975, there was transmission of DEN-3 in Ibagué as part of the second epidemic of dengue after the reinfestation of *A. aegypti*, followed shortly by circulation of DEN-1 in 1978 (3). Two years later DEN-4 cocirculated with DEN-1. Therefore, DEN-2 had not been documented in Ibagué for an interval of 40 years. In this study, we specifically assessed 1) the current outbreak; 2) the occurrence of dengue infections using immunological markers; 3) the occurrence and distribution of *A. aegypti* according to type of breeding sites; 4) the knowledge and practices in the community about dengue and its control; 5) the attributes of the existing dengue surveillance system, and 6) the type and size of resources allocated to the local *A. aegypti* control program. We also assisted in the control of the epidemic and advised local authorities about procedures to improve the isolation and surveillance of dengue virus, and the anti-*Aedes* control program.

Materials and Methods

Outbreak investigation and surveillance evaluation

Field investigations began in April 1995. A passive surveillance system on suspected cases of dengue and dengue hemorrhagic was in place run by the Tolima Health Authority. This system used the case definition recommended by the Colombian Ministry of Health (MOH): for a suspected dengue case, an undifferentiated febrile illness consisting of fever, headaches, myalgias, arthralgias, retro-orbital pain, or rash. A confirmed case of dengue was defined as a suspected case with a positive IgM enzyme-immunosorbent assay (EIA) test. Additionally, a confirmed case of DHF was defined as one having hemorrhagic manifestations, plus a low platelet count ($<100 \times 10^9$/L), and hypovolemia, as measured by a 20% increase in hematocrit, or effusions (4). By mid-1996, a micro-plate EIA IgM test was made available to the local public health laboratory in order to improve local public health surveillance. Data on reported cases included date of onset, residence, age/sex of suspected cases and date of sample collection.

We evaluated the surveillance system in September 1996. Each physician was requested to complete a reporting form for each suspected case and submit serum specimens from their patients for laboratory confirmation. Clinical observations of reported cases were reviewed and data were summarized from these forms. In addition, medical records of a random sample of 20 hospitalized cases in 1996 with discharge diagnosis of DHF were reviewed to evaluate the fulfillment of the PAHO/WHO case definition (4). Hospital administrators and staff working in emergency rooms were interviewed to assess surveillance activities. At these hospitals, weekly disease reporting forms and hospital discharge

records and emergency room logbooks were reviewed and compared to evaluate sensitivity, completeness, and timeliness of reporting (5). Finally, serum samples from patients with an acute (<5 days after onset of illness) dengue-like illness who visited emergency rooms at local hospitals were collected and sent to the Colombian National Institute of Health (NIH) Virology Laboratory for attempted virus isolation.

Interviews, field observations of day-to-day operations and review of records of the anti-*Aedes* program were also conducted as part of a formative evaluation. After describing the program and its objectives, activities, management and resources, we collected data on the number of households visited, and the *Aedes* spp. house index.

Household survey

Serologic data

The epidemic was further evaluated collecting primary data in September 1996. A serologic survey was conducted in a sample of 256 households selected using a random two-stage cluster sampling design (6). Using a standardized questionnaire, and after obtaining informed written consent, we asked informants about their knowledge of dengue, and their practices regarding health care seeking behavior and dengue control. We also collected blood samples for serologic testing from as many household members as possible who were present during the visit and included at least seven serum samples from each sampling cluster. Sera were tested for anti-dengue antibodies using the EIA IgM and hemagglutination inhibition (HI) test described by Clarke and Casals and modified for use in microtitre plates (7). We used DEN-1 and DEN-2 viral antigens.

Entomological data

In the same household survey, we asked informants about availability of water for domestic use, observed water storage practices, recorded the number and types of potential and actual *A. aegypti* breeding sites, and measured *A. aegypti* larval infestations (Bretau, house and container vector indices) following standard procedures (8). Mosquito larvae collected in the field were identified to species at the local Public Health Entomology Laboratory.

Local perception of dengue and dengue control

A rapid qualitative assessment was conducted to learn about the community's perception of dengue. Three types of focus groups were assembled: community leaders, mothers seeking care for their children in public clinics, and health care workers. Results of informal interviews and casual observations were used to develop a guide to collect data on dengue's relative priority among other health problems, to describe how the community perceived dengue and its control and to assess the appropriateness of health education materials. Community leaders were invited through local neighborhood organizations. Sixty-nine percent of participants in the three focus groups were women. The second type of focus group was assembled by direct invitation to mothers bringing their children to health clinics and two focus groups of this type were held. Finally, focus groups composed of health care workers convened by local health managers, including one formed by former malaria control program workers. Invitations clearly stated the purpose of the meeting. Facilitators guided the group discussions, which covered a series of topics. Reporters assisted in the collection and analysis of the data.

Results

Outbreak investigation and surveillance evaluation

In 1995 a total of 651 cases of suspected dengue fever (DF) were reported in Ibagué, of which 321 were tested for IgM antibodies and 232 (72.3%) were positive. In 1996 a total of 629 cases were tested and 290 (46.1%) were positive. In 1997, the number of reported suspect serum tested dengue cases climbed to 2,139 and 1,455 (68%) were confirmed by IgM test (table 1).

A total of seven isolates of DEN-2 from serum specimens of suspect dengue fever cases were obtained at the INS Virology Laboratory. Reported DF cases occurred in all age groups, but attack rates dropped after the fourth decade of life during the outbreak of 1995-1997. Reported cases of

Table 1. Confirmed dengue cases according to serological tests (IgM), Ibagué, Tolima, 1995-1997.

Years	1995	1996	1997
Number of reported cases	651	629	2139
Number of tested cases	321	420	1839
Number of positive cases	232	290	1455
% of cases (positive/tested)	72.3	69.0	79.1

dengue in Ibagué, in 1995-1996, affected people of both genders equally (male to female ratio 1.2:1). Also, reported cases in 1996-1997 showed a twofold-increased incidence in the eastern part of Ibagué where the altitude declines from 1,350 to 900 m above sea level.

During 1995-1997, 658 cases reported as DHF in Ibagué were confirmed by a positive EIA IgM test. A review of 20 randomly selected medical records of patients with discharge diagnosis of DHF during September 1996 indicated that none of these patients fulfilled the PAHO definition described above. More than likely, the diagnosis had been made solely on the basis of minor bleeding manifestations or by a modest decrease in platelet counts. Particularly disturbing was the finding that none of the cases had a 20% change in hematocrit to indicate hypovolemia. DHF cases were reported among school children and adults. We found that the MOH reporting forms did not provide space for more than one hematocrit reading and, therefore, were unsuitable for documenting a significant change in this clinical parameter.

Of the 50 public local health centers and four hospitals (i.e., potential-reporting units) in the city, 89% of the cases were seen and reported from the two largest hospitals and four intermediate-level health care facilities. Review of emergency room logbooks from the local hospitals indicated that only 11% of the suspected DF/DHF cases had been reported to national public health officials. We found that two of the local health services had reported dengue outbreaks in the community, but only one conducted a field investigation. Field work associated with the existing dengue surveillance system consisted mainly of visiting the patient's residence, collection of entomological data at the patient's dwelling and seeking additional cases among household contacts and neighbors visiting them at home. When asked about dengue surveillance and control activities, it was clear that most of the local public health administrators were not sure about the number of reporting units under their jurisdiction. With one exception, the local public health surveillance committees did not meet to discuss the data collected or any relevant findings. There was no dissemination of tabulations nor analysis of dengue laboratory results or other local surveillance data. None of the health care providers interviewed were aware of the case definitions or surveillance procedure documents made available by the MOH to local administrators.

The local anti-*Aedes*-program staff was divided in two groups: one group working in a new office in the newly created municipal health services administration which had three workers and a second group consisted of personnel working for the MOH's vertical vector-borne disease control program and included one full-time supervisor and three full-time-field inspectors; the latter group was supported upon request by 12 sanitation inspectors who had been transferred at the time of the study from the local large hospital to the municipal health service. The estimated manpower allocated to the anti-*Aedes*-program in Ibagué was 4.6 anti-*Aedes* full time staff-personnel per 100,000 inhabitants.

The *A. aegypti* house index ranged from 10% to 40%. A cleaning operation was instituted to clean the streets and houses of Ibagué with the collaboration of 458 year-round volunteers, mostly junior high school students, from a health education program. During 1996, these students visited 15,548 households in areas with a high *A.aegypti* larval infestation, and in 1997 they visited about 27,859 households, approximately 43% of all Ibagué household units. Between October and November 1997, the municipal health services purchased 40 ultra-low volume portable machines for house-to-house space spraying. A month long campaign was launched using 105 newly hired workers to use these machines.

Household survey

Serological data

From 1,320 persons residing in 256 households 538 blood samples were obtained. More women

were available during visits because the majority of them work at home, and thus 66.7% of all blood samples were obtained from females. All age groups were present in the serological study (table 2).

Results of the EIA IgM testing indicated that 52/538 (9.6%; 95%CI: 4.5%-14.8%) were positive, and indicative of recent infection (in the last 2-3 months). Thus, we estimate that there were at least 39,168 dengue infections in Ibagué in the preceding 3 months. Overall dengue infection rates decreased by a factor of two from 15.3% among those aged less than 10 years old to 7.5%, among those aged 60 or older. Recent dengue infection was twice as prevalent among women (11.7%) than in men (5.5%) [prevalence ratio (PR)=2.1 (95%CI: 1.0-4.5)] (table 2). Results of HI tests indicated that 61.4% (95%CI: 54.9-67.9) of the population had experienced dengue in the past (≥1:20 antiviral titer to either DEN-1 or DEN-2) (tables 3-4). Among those who tested positive for IgM antibodies, 48% and 54% also had a titer ≥1:20 for DEN-1 and DEN-2, respectively. Recent infections as indicated by IgM seropositivity slightly declined with age, and the proportion of immune people (≥1:20 HI antibodies) increased with age. Of those under 25 years of age, i.e., born after the reappearance of dengue in Colombia in 1972, 41% (110/269) had apparently been infected by Dengue 1 and 54.6% (147/269) by Dengue 2 viruses.

Entomological data

Most households (86.4%) reportedly had less than 20 (between 8 and 19) hours of running water per day and collected water in low tank deposits ('*albercas*') which were uncovered 96% of the time. *A. aegypti* larvae were found in 18.6% (95%CI: 13.3%, 23.8%) of the water containers, tanks or bottles for domestic use, that were inspected. The inspectors found that only 9.6% of the households had breeding sites in 'junk' containers. Outdoor breeding sites beyond the limits of the dwelling unit were found in 3.0% of the households. We found 57 infested containers per 100 dwellings inspected (Bretau); the house index was 26.1%, and the container index was 14.6%. As expected, there was a moderate association between *A. aegypti* infestation at household level and occurrence of recent dengue infection among individual members of households, and also higher number of larvae found in more permanent water containers (PR=3.7; 95%CI: 1.8-7.7), than those considered 'junk' and discarded in the area around the household (PR=1.7; 95%CI: 0.7-4.0). All larvae collected in Ibagué were identified as *A. aegypti* at the Tolima State Public Health Laboratory.

Data collected in the households clearly indicated that the community knew how dengue was transmitted: 76.5% said it was mosquito-borne by the '*zancudo*', the Spanish name for *Aedes*-like mosquitoes. The community also knew the symptoms of dengue: 87% indicated fever and either headaches, myalgias or retroorbital pain; even a considerable proportion (14.9%) knew the symptoms of DHF. Almost all said that dengue was lethal or severe, but only 30.6% said it was avoidable; 57.6% thought dengue control could be

Table 2. Results of IgM test by age group and gender, Ibagué, Tolima, 1996.

Age groups (years)	IgM female		IgM male		Total IgM	
	n/N*	%	n/N*	%	n/N*	%
0-4	1/10	10.0	0/11	0.0	1/21	4.7
5-9	10/37	27.0	3/33	9.1	13/70	18.5
10-14	5/29	17.2	1/28	3.6	6/57	10.5
15-19	8/44	18.2	2/20	10.0	10/64	15.6
20-29	3/69	4.3	1/18	5.5	4/87	4.6
30-39	3/58	5.1	1/26	3.8	4/84	4.8
40-49	5/42	11.9	1/16	6.2	6/58	10.3
50 - +	7/70	10.0	1/27	3.7	8/97	8.2
Total	42/359	11.7	10/179	5.5	52/538	9.6

* n: number of positives; N: total individuals tested

Table 3. Titers of hemagglutination inhibition antibodies to DEN-1 in a random household survey, by age groups, Ibagué, Colombia, 1996.

Age groups	Titers of HI antibodies to DEN-1															
	0		1:20		1:40		1:80		1:160		1:320		1:640		1:1280+	
	n	%*	n	%*	n	%*	n	%*	n	%*	n	%*	n	%*	n	%*
0-4	17	81.0	0	0.0	3	14.2	1	4.8	0	0.0	0	0.0	0	0.0	0	0.0
5-9	54	77.2	5	7.1	8	11.4	3	4.3	0	0.0	0	0.0	0	0.0	0	0.0
10-14	38	66.6	5	8.8	9	15.8	0	0.0	2	3.5	1	1.8	2	3.5	0	0.0
15-19	27	42.2	14	21.9	9	14.1	9	14.0	1	1.6	1	1.6	2	3.1	1	1.6
20-29	34	39.0	14	16.0	29	33.3	8	9.0	1	1.1	1	1.1	0	0	0	0
30-39	25	29.7	16	19.0	30	35.7	10	11.9	3	3.5	0	0	0	0	0	0
40-49	16	27.1	16	27.1	18	30.5	6	10.2	3	5.1	0	0	0	0	0	0
50-+	32	33.3	18	18.7	30	31.2	12	12.5	3	3.1	1	1.0	0	0	0	0
Total	**243**	**45.2**	**88**	**16.4**	**136**	**25.3**	**49**	**9.1**	**13**	**2.4**	**4**	**0.7**	**4**	**0.7**	**1**	**0.2**

* Percents calculated as n/total of the row

Table 4. Titers of hemagglutination inhibition antibodies to DEN-2 in a random household survey, by age groups, Ibagué, Colombia, 1996.

Age groups	Titers of HI antibodies to DEN-2															
	0		1:20		1:40		1:80		1:160		1:320		1:640		1:1280+	
	n	%*	n	%*	n	%*	n	%*	n	%*	n	%*	n	%*	n	%*
0-4	16	76.2	0	0.0	2	9.5	1	4.8	2	9.5	0	0.0	0	0.0	0	0.0
5-9	46	65.7	3	4.3	6	8.6	3	4.3	2	2.9	6	8.6	2	2.8	2	2.8
10-14	25	57.9	6	10.5	9	15.8	8	14.0	4	7.0	2	3.5	2	3.5	1	1.8
15-19	20	31.2	14	21.9	9	14.1	7	10.9	4	6.3	7	10.9	1	1.6	2	3.1
20-29	23	26.4	14	16.0	25	28.7	14	16.1	2	2.2	4	4.6	1	1.1	4	4.6
30-39	15	17.9	16	19.0	30	35.7	13	15.5	5	6.0	3	3.6	2	2.4	0	0
40-49	9	15.3	11	18.6	18	30.5	11	18.6	7	11.9	1	1.7	0	0	1	1.7
50-+	19	20.8	10	11.0	39	42.8	22	24.2	4	4.4	3	15.8	0	0	0	0
Total	**173**	**32.2**	**74**	**13.8**	**138**	**25.6**	**79**	**14.7**	**30**	**5.6**	**26**	**4.8**	**8**	**1.5**	**10**	**1.8**

* Percents calculated as n / total of the row

achieved through elimination of breeding sites, a similar proportion said that they could eliminate mosquitoes by washing water tanks, but only 6% said that this could be accomplished by placing cover lids on low tanks (i.e., *albercas*). About one-third of respondents said that the dengue vector breeds in temporary water collected in ditches filled after heavy rainfall, but most respondents did not differentiate between *Culex* spp. associated with such outdoor breeding sites, and *A. aegypti* which has more domestic habits. Most householders learned about dengue through the radio (47.4%) and television (53.3%), but campaigns and flyers were also often mentioned. Households visits of high school students were less frequently mentioned (5.1%) as a source of information. Forty percent of respondents mentioned that the community itself was responsible for a long-term solution to dengue; 19.1% indicated that both the government and the community were responsible while only 20% said that the government was solely responsible.

Local perception of dengue and dengue control

During focus groups of community leaders, participants often mentioned that outdoor breeding sites where flies and mosquitoes such as *Culex* spp. occur were important risk factors for dengue. Leaders of community groups showed little motivation to participate in dengue control activities, but were willing to consider initiatives

that might involve them in dengue community control projects. Some leaders indicated that a lack of communication with key public health authorities and the municipal government as reasons for low levels of community participation. Focus groups also revealed that communication obstacles were present in educational flyers and other health education materials about dengue that were prepared or used by local health services. Groups of mothers visiting health care centers consistently mentioned dengue as a problem caused by the lack municipal water services, and solid waste collection service. They also associated dengue with polluted wastewater in urban-suburban environments where *Culex* spp. but not *A. aegypti* would likely be found. Also, these groups clearly identified dengue as a problem to be solved through community participation and asked for more involvement in activities such as fund-raising and clean-up campaigns, but failed to identify that the breeding-sites of the dengue vector were in close proximity to their residences.

Focus groups of healthcare workers identified poor program management and lack of longterm commitment as keys to the continuing dengue problem in Ibagué. Job insecurity perceived by public health workers and deterioration of the Ministry of Health's vertical anti-*Aedes* program dominated discussions of these groups. Most people were expecting the local leadership to take responsibility and develop a municipal program after the malaria and vector-borne disease prevention program was decentralized by the health sector reform in Colombia.

Discussion

As the circulation of dengue viruses in Colombia increases, the risk of occurrence of explosive outbreaks of DHF also increases. Yet, even without the occurrence of a sudden, explosive DHF epidemic, the toll taken by dengue is still quite large. Conservatively we estimate that at least 39,000 new dengue infections occurred during the epidemic in Ibagué. This figure is in sharp contrast with the nearly 500 dengue cases reported in those months. Underreport of dengue cases is also common in other parts of the country and it is believed that the number of dengue cases occurring every year, in the 1990's, is 2-3 times the estimated number of 900,000 cases produced in the first waves of the dengue epidemics when it was first reintroduced in the 1970's (2,9).

One limitation of our investigation was the timing of the sera collected for IgM testing. Our field investigation lagged 5 months behind the peak of the epidemic, according to surveillance data. Because IgM antibodies are generally detectable for 2-3 months the incidence of dengue in our survey was a conservative estimate of the true magnitude of the problem. Although it is widely accepted that DEN-2 IgM-antibodies are longer lasting than those for DEN-1 (6), further complicating the interpretation of the type-specific dengue-virus etiology. Therefore, misclassification of dengue infection status likely weakens the strength of the associations between risk factors and the occurrence of dengue infections. The cross-sectional nature of our household survey data provides only a limited view of a very dynamic process affected by climatic and seasonal variables, like rainfall and temperature, as well as by man-made variables such as anti-vector activities (10). Another potential limitation of the use of anti-dengue antibodies serological surveys derives from the cross-reaction of the different flaviviruses, among them the cross-reactivity with the immunological response to yellow fever vaccine. However, in the study setting, coverage of yellow fever vaccination is nil. Also, the fact that HI antibodies were tittered for only DEN-1 and DEN-2 may have resulted in a reduced sensitivity of our measurement of past infections with dengue viruses (HI antibodies are not serotype-specific for secondary infections). In interpreting the occurrence of the DEN-2 epidemic in Ibagué since 1994 one should bear in mind the lack of documented circulation of DEN-2 since 1952 in the area, leaving a large pool of susceptibles to this-serotype.

As shown by our household survey, existing public health surveillance data is limited by the following factors:

1) The system is low in specificity. Most reported DHF cases were only DF cases (they did not adhere to the WHO case definition), because there

was lack of uniform standardization on the cardinal criteria of hypovolemia to diagnose DHF. Too often clinicians relied on a low platelet count to diagnose DHF in Ibagué and unnecessarily requested too many clinical lab tests. We also found that many reported dengue cases may correspond to other emerging pathogens. By October 1996, our team confirmed the transmission of an influenza virus strain close to the A/Wuhan/359/95, first reported in the Atlantic Coast in July 1995, which was also circulating in Ibagué. Although we alerted the local health providers to treat this new disease as such and distinguish it from dengue and we are certain this influenza A epidemic subsided by December 1996, many cases of influenza may have been reported as dengue from October to November 1996 (11). Influenza and other febrile viral diseases have been reported as dengue in other parts of the world (12).

2) Dengue surveillance in Ibagué also had low sensitivity (i.e., one reported case per 50 infections). Prior to our study, no appropriately selected patient specimens were collected for viral isolation (i.e., <3 days from disease onset) and sent to the NIH Virology Laboratory in Bogotá. Nevertheless, the system was sensitive enough to detect the epidemic in April 1995, when it was first reported. Only one of every nine suspected dengue cases presenting at emergency rooms was reported, indicating that many other cases could have been reported if there were simpler reporting procedures.

3) The main limitation of this dengue surveillance system consists of its very restricted utility, particularly its rich entomological data, which was not analyzed, disseminated and communicated to successfully drive the anti-*Aedes* program. Reporting of outbreaks, and more importantly, timely field investigations of such outbreaks could be more informative (13).

Case reporting of very common diseases such as dengue, influenza, childhood diarrhea and respiratory diseases, may best be served by sentinel surveillance systems, which provide timely, more accurate, etiologic data. In turn, these surveillance systems would make more efficient use of national resources, such as the national laboratories. Nevertheless, the use of existing entomological data to drive the anti-*Aedes* prevention and control program is essential (13, 14).

Dengue control and prevention activities in Ibagué, as in other parts of Latin America, are poorly funded and present some deficiencies in their organization. Whereas the number of anti-*Aedes* workers in Ibagué is one per 20,000 inhabitants, other successful programs have had nearly one full-time anti-*Aedes* worker per 1,000 (4). Key factors identified by health care workers interviewed were lack of leadership, a well structured and staffed program, and the uncertainties brought about by the health sector reform, which has left many health workers previously assigned to preventive programs such as malaria, lost in the midst of institutional chaos. As the health sector reform touches the local service in Ibagué, the need for allocating more resources to the program is as important as finding more innovative approaches to mobilize the community against *A. aegypti*.

It seems that only the simultaneous and appropriate combination of different approaches to *Aedes* control, the so called integrated control, in Latin America could lead to better dengue control, and effectively reduce the risk of DHF epidemics. More often than not, current strategies in Colombia rely solely on clean-up campaigns to dispose of used tires, discarded buckets, tin cans, and plastic containers which are potential breeding sites, and ineffective health education campaigns. This is a common characteristic with other dengue control programs in Latin America where they act on only few of the aspects that compose the complex causal chain of the disease (15).

Our data clearly suggest that the infestation of *A. aegypti* in Ibagué is mostly confined to useful water storage tanks and indicates the need of a more focused mass health education intervention within the anti-*Aedes* program to achieve the participation of the community, for regular cleaning and maintenance of water storage tanks. Recent experiences from other countries in Latin America, showed that well trained health workers can encourage the people to keep their houses free

from *A. aegypti* breeding sites, using only house to house education (16).

Regarding dengue surveillance the epidemiological office should be staffed with enough people in order to carry out sentinel surveillance of dengue periodically to ensure identification of viral and serotype circulation early enough to set appropriated control measures.

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