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Evaluation of Dengue Surveillance System in Vientiane Capital City, Lao People's Democratic Republic, 2010

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Abstract

In July 2010, we evaluated the dengue surveillance system in Vientiane Capital City (VCC) to provide recommendations for improvement of the system. We interviewed 29 stakeholders from the Department of Health, and one central and two district hospitals in VCC. Sensitivity and predictive value positive (PVP) were calculated using dengue data from June to July 2009 and June 2010. In addition, timeliness of reporting and data quality in June to July 2009 were also evaluated. The surveillance system was simple and paper-based, with both passive and active components. There were no designated surveillance officers in the central hospital. In 2010, the Department of Health provided training and frequency of data collection was increased. Overall sensitivity increased from 50% in June-July 2009 to 68% in June 2010. However, sensitivity decreased in the central hospital where higher number of patients was found. PVP was 100% in June-July 2009 and 96% in June 2010. Sixty percent and 32% of patients were reported within one week after diagnosis in the central and district hospitals respectively. Proportion of accurate data was more than 90% for case classification, gender and age. Sensitivity of surveillance improved with training and active surveillance. However, active surveillance only increased sensitivity when the caseload was not high. To improve the system, there should be designated trained surveillance staff in central hospitals and date of onset for each patient should be collected.

Keywords: dengue, surveillance system, Vientiane Capital City, Lao People's Democratic Republic

Introduction

Dengue is the most rapidly spreading mosquito-borne viral infection, with a broad spectrum of illness ranging from febrile illness to fatal outcome.[1,2] Dengue inflicts substantial health, economic and social burden on the population, especially in most tropical and sub-tropical countries.[3-6]

Dengue has been nationally reportable to the National Centre for Laboratory and Epidemiology (NCLE) in Lao PDR since 1998. There are six central hospitals, nine district hospitals and 42 health centers in Vientiane Capital City (VCC), with a population of 783,032 and an area of 3,920 km^2.[7] Among all dengue cases in Lao PDR, the proportion reported in VCC rose sharply from 12% in 2008 to 28% in 2009, according to the data from NCLE.

Surveillance is a critical component of dengue prevention and control program as it provides necessary information for risk assessment, epidemic response and program evaluation.[1] However, since its establishment, the dengue surveillance system in VCC had never been assessed. Therefore, in July 2010, we evaluated the dengue surveillance system in VCC to describe its attributes and provide recommendations for improvement of the system.

Methods

We employed both qualitative and quantitative methods as described in the updated guidelines for

evaluating public health surveillance systems from US CDC.[8] Our study was part of the cross-border dengue surveillance system evaluation program between Thailand and Lao PDR. The study sites in VCC included the Department of Health under Ministry of Health, one central hospital (Mahosot Hospital) and two district hospitals (Sikhottabong and Hadxaifong Hospitals) from the districts that border with Thailand.

Qualitative Study

In the Department of Health, the director and public health officers who were responsible for dengue surveillance and response were interviewed. In three hospitals, the interviewees included directors, clinicians and nurses from emergency rooms (ER), out-patient departments (OPD) and in-patient departments (IPD), and data managers and epidemiologists from two district health offices. Semi-structured questionnaires were used for face-to-face interviews with the stakeholders.

All components of the surveillance process were studied: data collection, reporting, data management, analysis, dissemination, utilization, policies and human resources. The qualitative attributes, including simplicity, acceptability, flexibility, stability and usefulness, were used for designing the questionnaire and interpreting the results. Group discussion was conducted to summarize information from the interviewers.

Quantitative Study

Hospital records of patients from three hospitals during June to July 2009 and June 2010 with a clinical diagnosis of dengue fever (DF), dengue hemorrhagic fever (DHF) or dengue shock syndrome (DSS) were eligible for this study. The study population also included DF, DHF and DSS patients who were reported from the three hospitals to the Department of Health during the same periods.

While sensitivity and predictive value positive (PVP) were evaluated for June to July 2009 and June 2010, data quality and timeliness were calculated only for June to July 2009.

Sensitivity of case reporting was defined as the proportion of reported cases among all patients with clinical diagnosis of DH, DHF or DSS while PVP was the proportion of patients with clinical diagnosis of dengue among reported cases.

Sensitivity of outbreak detection was defined as the proportion of reported dengue outbreaks among all outbreaks detected by reviewing hospital records of dengue patients. To estimate sensitivity of outbreak detection, a dengue outbreak was defined as five or more dengue cases from one village admitted to a hospital within the same week.

Data quality describes the completeness and accuracy of key variables. Five variables were used to calculate proportions of complete and accurate data, including age, sex, date of admission, date of discharge and case classification (DF, DHF or DSS).

The length of time between date of diagnosis and date of reporting, and between date of dengue outbreak reporting and date of response were calculated to evaluate the timeliness of reporting and outbreak response.

Logbooks were reviewed to detect dengue cases in ER, OPD, IPD and intensive care unit (ICU) of the hospitals. Individual data of reported dengue cases were extracted from database in the Department of Health. Data were analyzed using Epi Info version 3.5.1 (US CDC).[9] Descriptive statistics were calculated, including proportions for categorical variables, and medians and inter-quartile ranges (IQR) for continuous variables.

Results

Qualitative Study

We enrolled 29 interviewees, including three hospital directors, six public health officers and epidemiologists, nine clinicians, eight nurses and three data managers.

Description on Dengue Surveillance System

Structures of the dengue surveillance system in VCC and district hospitals are showed in figures 1 and 2 respectively.

Data Collection and Reporting

Officers from the Department of Health visited six central hospitals to collect data every 1-2 weeks in 2009. In June 2010, they collected data every 2-3 days in response to dengue outbreaks. They searched for dengue cases by clinical diagnosis in logbooks and recorded information in a paper notebook. In Mahosot hospital, there were no surveillance officers responsible for data collection and reporting. However, epidemiologists in district hospitals reported individual dengue cases weekly and aggregate data daily to the Department of Health which then reported to NCLE every week.

Data Management, Analysis and Dissemination

Public health officers entered individual data and analyzed using spread sheet, without extensive analysis.

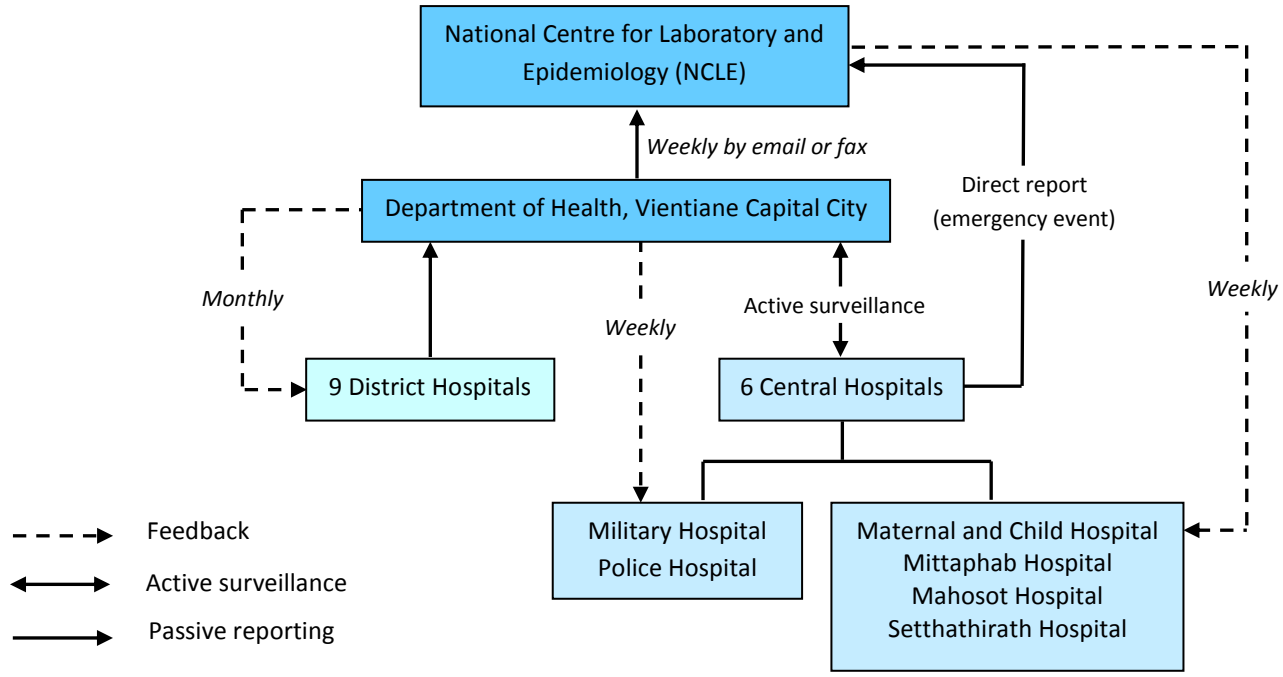

Figure 1. Operating structure of dengue surveillance system in Vientiane Capital City, Lao PDR, 2009-2010

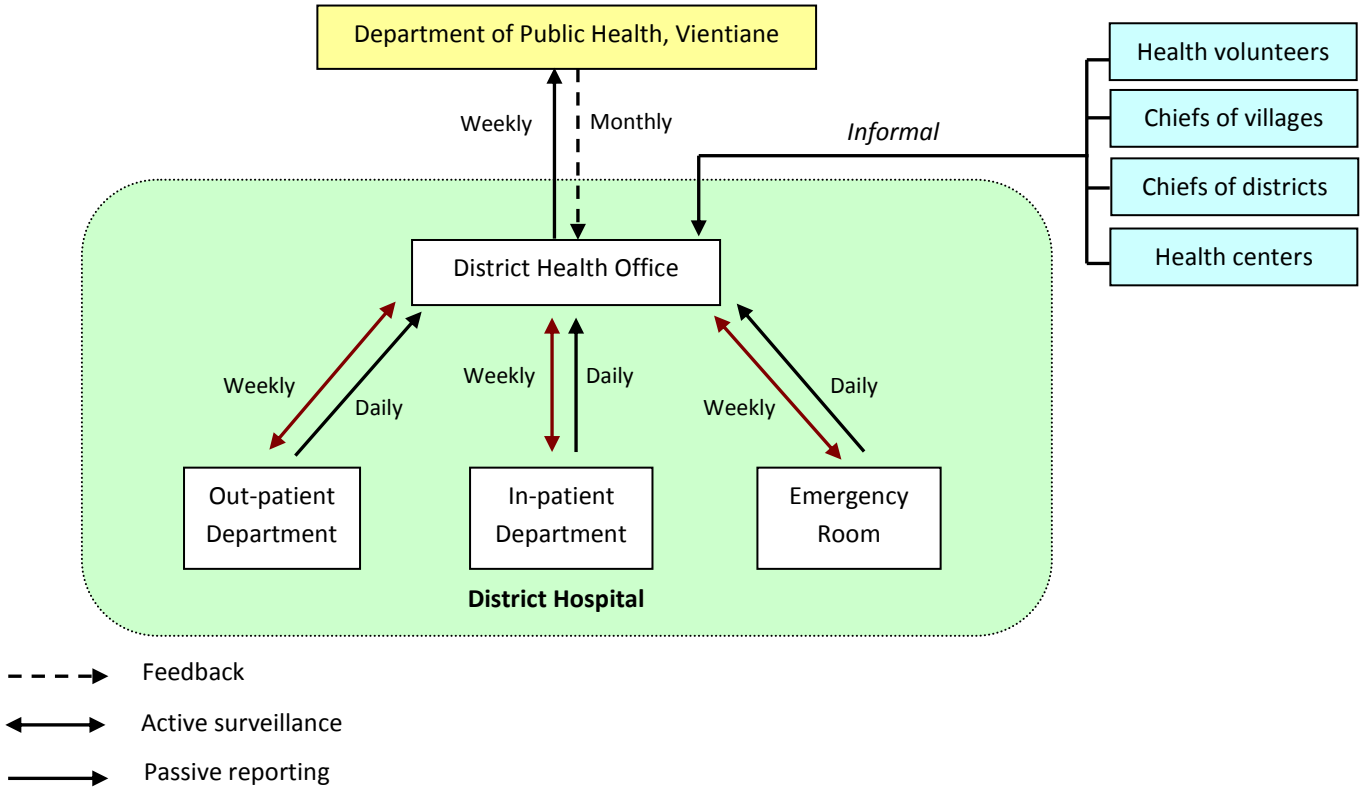

Figure 2. Operating structure of dengue surveillance system at district hospital in Vientiane Capital City, Lao PDR, 2009-2010

Then, they entered aggregate data into the electronic-based national weekly report program, Early Warning Alert and Response Network (EWARN), every week. Basic descriptive analysis could be done with this program, producing an automatic alert for unusual event (number of cases > mean of number of cases in previous three weeks + 2 standard deviation). The NCLE provided feedback to four central hospitals every week, including Mahosot Hospital, while the Department of Health sent to two central hospitals every week and district hospitals every month.

Data Utilization

Data were used to determine trend of dengue and predict the magnitude of outbreak. Epidemiologists utilized data for case investigation, vector control and health education in communities. Once an outbreak occurred, they shared the information with nearby

hospitals and health centers. The clinicians and nurses reported that they expected to receive feedback in time and this would be very useful in preparing medicines and health care equipment, and informing clinicians to raise awareness of the potential dengue outbreak.

Policies and Human Resources

The directors recognized dengue as a priority disease of public health concern. Public health officers were provided trainings twice per year to improve data management, data analysis and outbreak response.

Financial support from WHO was sufficient for routine surveillance activities, but unable to cover expenses for unusual events, such as outbreaks. Regular government budget was used to maintain four public health officers responsible for collecting data from six central hospitals. There was only one epidemiologist in each district health office. These staff also had other duties, such as reporting other diseases, outbreak response and vector control. No one took care of their responsibilities when they were not available.

Quantitative Study

Sensitivity

Of 288 dengue cases identified during June to July 2009, 143 cases (50%) were reported. Hospital-specific sensitivity varied from 23% to 76% (Table 1). In June 2010, 68% (148/218) of cases were reported. Sensitivity of the hospitals ranged from 57% to 96%. Compared to 2009, sensitivity of the two district hospitals increased over 50%; however, there was 25% reduction at the Mahosot hospital.

During June to July 2009, we reviewed hospital data and surveillance data to explore whether dengue outbreaks had occurred in any village. Although it appeared that outbreaks might have occurred in seven villages according to the hospital data, the surveillance system was able to detect outbreaks only in four villages if it was utilized (Table 2).

Predictive Value Positive

PVP for all three hospitals from June to July 2009 was 100%. Although PVP of two hospitals in June 2010 were 100%, it decreased to 60% in Hadxaifong Hospital, resulting overall 96% for this period (Table 1). Although the actual diagnosis of six over-reporting cases in Hadxaifong Hospital was diarrhea, they were mistakenly reported as dengue.

Data Quality

Date of onset was not evaluated as it was not collected. No missing data was identified for all five variables. Proportions of accurate data were the highest for case classification (97%) and gender (97%), followed by age (94%), date of admission (85%) and date of discharge (79%).

Timeliness

During June to July 2009 in Mahosot Hospital, median between date of diagnosis and date of reporting was seven days (inter-quartile range 5-9 days), and 60% were reported within one week after diagnosis. As in Sikhottabong Hospital, Dengue cases were reported with median eight days (inter-quartile range 5-27 days) after diagnosis in and 32% were reported within one week. Timeliness of case reporting was not evaluated in Hadxaifong Hospital because date of diagnosis was not collected. From April to June 2010, there were three reports of dengue outbreak investigation and rapid response was initiated within one day after reporting.

Table 1. Sensitivity, predictive value positive (PVP) and timeliness of dengue surveillance system in Vientiane Capital City, Lao People's Democratic Republic, 2009-2010

Attribute	Year	Mahosot Hospital	Hatxaifong Hospital	Sikhottabong Hospital
Sensitivity	2009	76%	23%	46%
	2010	57%	79%	96%
Predictive value positive (PVP)	2009	100%	100%	100%
	2010	100%	60%	100%
Median duration between diagnosis and report (inter-quartile range)	2009	7 days (5-9)	Not available	8 days (5-27)
Report within seven days after diagnosis	2009	60%	Not available	32%

Table 2. Villages with potential dengue outbreaks by data sources in Vientiane Capital City, June to July 2009

Data source	Mahosot Hospital	Sikhottabong Hospital	Hadxaifong Hospital
Hospital	Sengsavang	Sibounhuang*	Dongphuonhea
		Sibounhuangtha*	Thanaleng
		Thongpong*	
Surveillance	Sengsavang		Dongphuonhea
			Thanaleng
			Thamuoang

**Villages with potential outbreak that could have been detected by the surveillance system*

Discussion

In-depth studies of existing surveillance systems are keys to assure that high quality and most relevant information is available for policy setting and decision making, with the view of making corrections and adding innovations as needed. Our study on dengue surveillance system in VCC represented such an effort to assess the current conditions and make recommendations for future improvement of the system. The flows and methods of this system were simple and flexible. Although operating with limited personnel and budget, we observed supportive policies from all health authorities in VCC and WHO. We also observed satisfactory results of some quantitative attributes, including high sensitivity, and useful PVP and data quality. Surveillance data can be a useful tool for making policy on disease prevention and control, but efforts are needed to continue utilizing this valuable resource.

The sensitivity of case reporting in our study seems higher compared with reports from other studies which showed around 30-40% in both Thailand[10] and Indonesia[11]. The sensitivity in our study improved from 50% in June-July 2009 to 68% in June 2010. The emphasis on active surveillance may contribute to higher sensitivity.[12-15]

A comparison of active and passive surveillance system in Vermont demonstrated that active surveillance of physicians can improve reporting cases of hepatitis, measles, rubella and salmonellosis.[12] However, active surveillance requires much more labor and intensive human resources.[16] Given limited number of public health officers, once caseload increase, it would pose too much work burden for the Department of Health. Active surveillance may not be the most appropriate approach in such situation. Thus, it was not surprising to see lower sensitivity during June 2010 in Mahosot Hospital due to higher workload of data collection (128 cases in June-July 2009 versus 218 in June 2010).

Since thousands of dengue cases occurred in VCC during 2009, some outbreaks should have been expected. We found that 57% of outbreaks would have been detected if extensive analysis of surveillance data was performed; by which the surveillance system demonstrated its usefulness. However, since the public health officers were not very skillful in data management and analysis, no dengue outbreak was detected in the whole city of VCC. This was an aspect that should be improved for the system.

Since early detection of dengue cases and outbreaks is critical for prompt and effective responses, timeliness is an important attribute of the dengue surveillance system. The timeliness of case reporting from June to July 2009 was not adequate, especially in the district hospital. Routine weekly reporting of dengue cases is required according to the standard operating procedures for dengue outbreak.[17] The frequency is recommended to change to daily reporting when dengue outbreaks or large gatherings occur. Such a requirement and recommendation is consistent with the best practices of data reporting in dengue surveillance.[18] Delayed reporting is commonly seen. High workload of paper-based data collection and limited human resources might explain this phenomenon. Timeliness of reporting could be improved if an electronic reporting system is used.

Date of onset is required in almost all disease surveillance systems, which is a very important variable to describe the characteristics of dengue over time. Unfortunately, this variable was not collected for the routine dengue surveillance in VCC. The logbooks with limited information recorded were the single source for public health officers to collect the surveillance data, resulting in unavailability of some important data. It was not practical for public health officers to review each medical record since they have to collect data for 19 diseases in six central hospitals.

Limitations

Our study had some limitations. First, we identified dengue cases using clinical diagnosis rather than case definitions for surveillance in VCC due to limited information in the logbooks and incomplete medical records. However, the clinicians reported that they used the same case definition as that of the surveillance guideline for dengue diagnosis. It was therefore believed that our results were close to the actual values. Second, we did not further explore the

characteristics of those under-reported cases because we had limited time for data collection in the field.

Recommendations

Our findings lead to several recommendations for future development of the dengue surveillance system. Firstly, capacity of data management and analysis should be enhanced for public health officers and epidemiologists so that they can utilize surveillance data for public health policy and action. Secondly, each central hospital needs an epidemiologist to be responsible for collecting and reporting surveillance data. Thirdly, date of onset should be routinely collected in order to monitor the epidemic, seasonal pattern and long-term trend.

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References

1. World Health Organization and the Special Programme for Research and Training in Tropical Diseases (TDR). Dengue guideline for diagnosis, treatment, prevention and control: new edition. France: World Health Organization, 2009. [cited 2013 Mar 13]. <http://whqlibdoc.who.int/publications/2009/9789241547871_eng.pdf>.
2. Hayes EB, Gubler DJ. Dengue and dengue hemorrhagic fever. Pediatr Infect Dis J. 1992 Apr;11(4):311-7.
3. Meltzer MI, Rigau-Pérez JG, Clark GG, Reiter P, Gubler DJ. Using disability-adjusted life years to assess the economic impact of dengue in Puerto Rico: 1984-1994. Am J Trop Med Hyg. 1998 Aug;59(2):265-71.
4. Anderson KB, Chunsuttiwat S, Nisalak A, Mammen MP, Libraty DH, Rothman AL, et al. Burden of symptomatic dengue infection in children at primary school in Thailand: a prospective study. Lancet. 2007 Apr 28;369(9571):1452-9.
5. Suaya JA, Shepard DS, Siqueira JB, Martelli CT, Lum LC, Tan LH, et al. Cost of dengue cases in eight countries in the Americas and Asia: a prospective study. Am J Trop Med Hyg. 2009 May;80(5):846-55.
6. Beatty ME, Letson GW, Margolis HS. Estimating the global burden of dengue. Proceedings of the Second International Conference of Dengue and Dengue Haemorrhagic Fever; 2008 Oct 15-17; Phuket, Thailand.
7. Lao Statistics Bureau. Area and average mid-year population by provinces in 2005-2011. [cited 2013 Mar 13]. <http://www.nsc.gov.la/index.php?option=com_content&view=article&id=37:population&catid=6&Itemid=38>.
8. German RR, Lee LM, Horan JM, Milstein RL, Pertowski CA, Waller MN; Guidelines Working Group Centers for Disease Control and Prevention (CDC). Updated guidelines for evaluating public health surveillance systems: recommendations from the Guidelines Working Group. MMWR Recomm Rep. 2001 Jul 27;50(RR-13):1-35.
9. Centers for Disease Control and Prevention. Epi Info. [cited 2013 Feb 5]. <http://wwwn.cdc.gov/epiinfo/html/prevVersion.htm>.
10. Vatthanasak A, Iamsirithaworn S, Srimongkol Y, Sonthichai C, Jongcherdchootrakul K, Gronsang D, et al. Field study of dengue surveillance in Sa Kaeo Province on Thai-Cambodian Border, 7-16

July 2008. Proceedings of the 58th Annual EIS Conference; 2009 Apr 20-24; Atlanta, USA.

11. Chairulfatah A, Setiabudi D, Agoes R, van Sprundel M, Colebunders R. Hospital based clinical surveillance for dengue haemorrhagic fever in Bandung, Indonesia 1994-1995. Acta Trop. 2001 Oct 22;80(2):111-5.

12. Vogt RL, LaRue D, Klaucke DN, Jillson DA. Comparison of an active and passive surveillance system of primary care providers for hepatitis, measles, rubella, and salmonellosis in Vermont. Am J Public Health. 1983 Jul;73(7):795-7.

13. Schiøler K. Dengue transmission and surveillance in a small-island setting: a case study from Grenada Karin Schiøler [dissertation]. Denmark: St George's University. 2006.

14. Gill J, Stark LM, Clark GG. Dengue surveillance in Florida, 1997-98. Emerg Infect Dis. 2000 Jan-Feb;6(1):30-5.

15. Hafkin B, Kaplan JE, Reed C, Elliott LB, Fontaine R, Sather GE, et al. Reintroduction of dengue fever into the continental United States. I. Dengue surveillance in Texas, 1980. Am J Trop Med Hyg. 1982 Nov;31(6):1222-8.

16. Van Beneden CA, Olsen SJ, Skoff TH, Lynfield R. Active, population-based surveillance for infectious diseases. In: M'ikanatha NM, Lynfield R, Van Beneden CA, de Valk H, editors. Infectious disease surveillance. Massachusetts: Wiley-Blackwell; 2007. p. 32-43. [cited 2013 Mar 13]. <http://goo.gl/xRujg>.

17. Lao PDR. Ministry of Health. World Health Organization. Human cases and larval surveillance: Standard Operating Procedures (SOP) for dengue outbreak. 2009; 3-5.

18. Beatty ME, Stone A, Fitzsimons DW, Hanna JN, Lam SK, Vong S, et al; Asia-Pacific and Americas Dengue Prevention Boards Surveillance Working Group. Best practices in dengue surveillance: a report from the Asia-Pacific and Americas Dengue Prevention Boards. PLoS Negl Trop Dis. 2010 Nov 16;4(11):e890.