Dengue Outbreak Response in American Samoa, 2015

US Government Outbreak Response Team

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Background

Dengue is the world's most common mosquito-borne viral disease and a leading cause of morbidity throughout the tropics and subtropics. Illness caused by one of the four dengue virus (DENV)-types most frequently results in classic dengue fever, which is characterized by fever, headache, body pain, eye pain, nausea, and rash. Roughly 5% of dengue patients progress to severe dengue of which ~0.5–5% typically succumb. This case-fatality range is due most prominently to both the timing and quality of clinical care that dengue patients receive.

Dengue is endemic throughout the tropics and subtropics, including southeastern Asia, south-central Asia, Indonesia, Malaysia, the Philippines, and northern Australia. Dengue outbreaks have recently been reported in the Pacific islands of Fiji, Palau, the Federated States of Micronesia, the Republic of the Marshall Islands, and Hawaii with rates of infection as high as 25%. Entomologic surveys conducted by CDC staff and others have indicated that the most common mosquito vector of dengue, *Aedes aegypti*, is found throughout the Pacific islands, including in American Samoa. However, the dominant mosquito vector of dengue in American Samoa is *Ae. polynesiensis*, which is present throughout both inhabited and uninhabited areas. Dengue was first described in American Samoa in 1972, and is now believed to be endemic. In support of this assumption, a dengue serosurvey conducted in 2010 following an outbreak of DENV-4 in 2009 demonstrated that 96% of residents of American Samoa had been previously infected with a DENV.

American Samoa is an unincorporated territory of the United States located in the South Pacific Ocean, southeast of Samoa, west of the Cook Islands, and north of Tonga (Figure 1). American Samoa consists of five main islands and two coral atolls, the largest and most populous of which is Tutuila. The 2010 census showed a total population of 55,519 people and total land area is 199 square kilometers (76.8 sq mi).

2015 Dengue Outbreak and Request for CDC Assistance

On 13 July, 2015, the American Samoa Department of Health (hereafter referred to as DOH) requested assistance from CDC to organize a response to an ongoing dengue outbreak associated with a high mortality rate. Since May 5, 2015, a total of 136 suspected dengue cases (~24 per 10,000 population) had been reported, of which 51 (38%) were hospitalized and four resulted in fatal outcome (apparent case-fatality rate [CFR] = 3%; ~0.7 fatal cases per 10,000 population). Of 21 specimens from suspected dengue patients that were tested by rRT-PCR at Hawaii State Laboratory, 16 (76%) were positive for detection of DENV-3, including all four of the fatal cases.

Objectives of the requested outbreak response were:

1) Support DOH's current effort to characterize the epidemiology of the outbreak;
2) Facilitate appropriate laboratory testing for dengue and other acute febrile illnesses, including enhancing dengue rapid diagnostic testing available on-island;
3) Support ongoing community health promotion and risk communication efforts;
4) Provide training for optimal dengue case management.

While organizing the response to the dengue outbreak in American Samoa, CDC was also contacted by officials from the National Parks Service, which operates the National Park of American Samoa (NPAS). The superintendent of NPAS had been notified of dengue cases among employees of NPAS, and expressed concern regarding infection possibly being associated with employees' duties in the Park, where *Ae. polynesiensis* is known to be present, or whether infection was associated with non-occupational risk. The superintendent also expressed a desire to understand the mosquito-avoidance behaviors employed by NPAS employees. Consequently, a further objective of the outbreak response was included, which was:

5) To conduct a knowledge, attitudes, and practices survey amongst US government (USG) employees in American Samoa, including assessment of status of DENV infection.

Four of the six CDC outbreak response team members arrived in American Samoa the evening of 20 July 2015, and the remaining two individuals arrived on 22 July 2015.

Accomplishments

1) *Conducted dengue clinical trainings at Lyndon B. Johnson Tropical Medical Center (LBJTMC) and DOH health care centers.*

Classroom-based clinical trainings were conducted according to existing dengue patient recommendations from the World Health Organization (WHO) and CDC. Trainings conducted included:

a. Clinician training at LBJTMC on 22 July 2015, in which 50 physicians, two nurse practitioners, 1 physicians' assistant, and 2 infection control nurses were trained.
b. Nurses training at LBJTMC on 24 July 2015 in which 36 nurses were trained.
c. Clinician training at DOH on 25 July 2015, in which 7 physicians and 1 nurse practitioner were trained.
d. Nurses training at DOH on 25 July 2015 in which 22 nurses were training.
e. Nurses training at LBJTMC on 29 July 2015 in which 39 nurses and 23 emergency medical services staff were trained.

In total, 57 physicians, 75 nurses, 2 nurse practitioners, 2 infection control nurses, and 1 physicians' assistant from LBJTMC; 7 physicians, 1 nurse practitioner, and 22 nurses from DOH health centers; and 23 emergency medical services staff, were trained in dengue patient management. In addition, clinicians and nurses were provided with dengue pocket guides and CD-ROMs containing the CDC Dengue Clinical Case Management course, which is also available online at http://www.cdc.gov/dengue/training/cme.html.

Following review of medical records of confirmed dengue fatal cases (see below), a follow-up morbidity and mortality case conference was conducted with ~35 physicians at LBJTMC on 28 July 2015 to discuss two fatal cases in which areas for improvement were identified as well as one recent case that arrived in critical condition, was managed according to WHO/CDC recommendations, and survived. This session was a case-based, "lessons learned" teaching exercise that utilized patients in which physicians in American Samoa had been involved to demonstrate potential areas for improvement in recognition and management of dengue patients.

2) *Enhance dengue surveillance at LBJ Hospital and health centers.*

Due to potential deficiencies in case detection and monitoring of epidemiologic trends, enhanced dengue case surveillance was conducted by reviewing electronic medical records from LBJTMC and all six DOH health centers to identify patients that presented with a dengue-like illness and were not reported to DOH. Records were queried for medical records in which: a) "dengue" was used in the patient's discharge diagnosis; or b) signs and symptoms sufficient to complete the dengue case definition.

During 1 April–26 July 2015, a total of 898 suspected dengue cases were identified (Figure 2). Of these, the large majority (>90%) of cases were identified from LBJTMC, and the remainder from DOH health centers. Although few (≤8) dengue cases were detected per week in April, case counts began to increase throughout May. By early June, roughly 50 cases were detected per week, and the apparent peak in the outbreak occurred in mid-July in which 179 suspected dengue cases were identified during the week of 12 July. At the time of writing of this report, the outbreak can be considered to be ongoing.

Additional demographic data was available for 719 (76%) suspected dengue cases. Of these cases, 348 (48%) were male, 371 (52%) were female. Utilizing data from the 2010 census in American Samoa, the highest incidence of suspected dengue cases was amongst individuals aged 15–24 years (171 suspected cases per 10,000 population) followed closely by individuals aged <1-14 years (166 suspected cases per 10,000 population) (Figure 3). Lowest incidence (95 suspected cases per 10,000 population) was among individuals aged 55–64 years. Additional analysis of demographic and clinical data is ongoing.

3) *Review of fatal case medical records at LBJTMC to describe the clinical course of laboratory-confirmed dengue cases and identify potentially unidentified dengue cases.*

Initial statistics suggested a high case fatality (~3%) among identified dengue cases. Potential explanations for the high case-fatality rate included: a) underrecognition of non-fatal dengue cases; b) high frequency in the population of American Samoa of co-morbidities (e.g., obesity, diabetes) that are known to be risk factors for death due to dengue; c) delayed access to medical

care; and/or d) not managing cases according to WHO/CDC recommended dengue patient management strategies. Therefore, medical records were reviewed to assess each of these aspects in an attempt to decipher the reasons behind the apparent high case-fatality rate associated with the outbreak.

a) Lab-confirmed fatal dengue case #1.

The patient was a 9-month old, 11 kilogram male patient that presented in May 2015 to the emergency room with fever, rash, and infected sores on his legs. Laboratory values were normal and blood culture was negative. He was discharged home with antibiotics and instructed to return in 2 days for follow up. Two days later the patient returned and had continued fever in addition to diarrhea, red tympanic membranes, and cough. The patient was hemodynamically stable and was sent home with antibiotics. The patient was brought back to the emergency room the next day with continued fever, abdominal tenderness, and vomiting. He appeared dehydrated and was admitted for sepsis workup and hydration. Lab values revealed mild leukocytosis. A bolus of Normal saline was administered and was followed with a double maintenance rate of IV fluids. At arrival to the pediatric ward the patient appeared edematous and had a distended abdomen, and had decrease urinary output. Vomiting of food content was associated with increased abdominal girth and protruding umbilicus. Approximately 12 hours later, the patient's fever resolved and the patient became hemodynamically unstable with no audible blood pressure, tachycardia, and altered level of consciousness. Following admission to the ICU and respiratory failure, the patient was intubated and mechanical ventilation was initiated. Severe anemia and thrombocytopenia was noted in laboratory values, as well as a prolonged coagulation panel. The patient remained in critical condition for the following 6 hours before becoming unresponsive and experiencing cardio respiratory arrest. The patient was declared dead soon after.

b) Lab-confirmed fatal dengue case #2.

The patient was a 37-year-old male with a history of morbid obesity, smoking, alcohol abuse, and upper GI bleeding on three occasions in the past 15 years. He presented for care in mid-May 2015 due to a dengue-like illness that had begun 3 days prior and also had been experiencing hematemesis of 1-day duration. Sinus tachycardia was evident by EKG. He was given 4.5 liters of Normal saline, but continued with hematemesis and began with evidence of melena. He experienced respiratory failure soon after and was intubated, after which signs of shock were evidenced. He was pronounced dead the following day.

c) Lab-confirmed fatal dengue case #3.

The patient was a 23-year-old female with a history of morbid obesity and diabetes that presented for medical care in mid-June 2015 due to a 1-day history of dengue-like illness. The patient was discharged home after being given a one-liter bolus of Normal saline and Tylenol. She re-presented for care the following day due to continued symptoms, had an episode of hypotension that was resolved after receiving a two-liter bolus of Normal saline, received a prescription for Tylenol with codeine, and was discharged home. Two days later she represented due to fever and disorientation, was hypotensive, had leukopenia and hypotension, and was admitted to the hospital. Soon after she became afebrile and developed several warning signs for severe dengue. Over the course of the following five days the patient developed severe, recurrent hematemesis, fulminant hepatitis, and had evidence of plasma leakage. Following fluid overload,

the patient developed edema and acute respiratory distress. She died on day six of hospitalization following multiple organ failure. A serum specimen collected on day 4 of illness was later positive for detection of DENV-3. In addition, a sputum culture collected on day six of illness was culture-positive for *Haemophilus influenzae*.

d) Lab-confirmed fatal dengue case #4.

The patient was a 72-year-old male with history of chronic schizophrenia, mental retardation, diabetes, obesity, and tobacco use. He presented for medical care in mid-July due to dengue-like illness of one-week duration and melena of 1-day duration, the latter of which was not reported until several hours after initial assessment. Melena continued while in the emergency room. After losing consciousness and apnea that responded to cardiopulmonary resuscitation, the patient experienced hematemesis. After multiple additional episodes of apnea and successful resuscitation except for the final episode, the patient was declared dead <24 hours after arrival to the hospital. DENV-3 was later detected in a serum specimen collected in the emergency room.

Summary of fatal dengue cases These four cases demonstrate that several previously-established risk factors for fatal outcome in dengue patients were also present in the four fatal dengue cases identified in American Samoa. Therefore, delayed access to care, delayed admission, underlying severe co-morbidities, co-infections, and IV fluid management were all likely contributors to the apparently high case-fatality rate.

e) Review of medical records from fatal case-patients with history of fever or bleeding.

During 1 April-15 July, 18 patients were identified that either died during their visit or were brought to the hospital dead upon arrival (DOA). Of these 18 patients, 16 had a clinical course or medical history with no evidence suggestive of dengue (e.g., asthma attack, delayed birth leading to fetal demise, leptospirosis, bacterial infection leading to ruptured peptic ulcer). Two cases were identified with a clinical course consistent with dengue.

The first was a 72-year-old male that presented to the emergency room with a 3-day history of dengue-like illness. He was given a 2-liter bolus of Normal saline after 3 hours in the ER he complained of severe abdominal pain and shortness of breath. He looked diaphoretic, and had tachypnea with shallow breathing and with evidence of low oxygen saturation. Laboratory values revealed hemoconcentration and thrombocytopenia. After an overnight stay in the emergency room, the patient left the hospital against medical advice. He returned the same day ~10 hours after discharge afebrile and with severe shortness of breath, abdominal pain, tachypenia, low oxygen saturation, and cyanosis. Over the next hour patient developed altered mental status and became hemodynamically unstable. The patient was intubated, and suctioning of the endotracheal tube revealed copious amounts of coffee ground content. The patient continued to deteriorate hemodynamically and neurologically, and was transferred to the ICU. The patient continued to deteriorate and after 8 hours in the ICU, the patient experienced unresponsive cardiorespiratory arrest and was declared dead.

The second suspect fatal dengue case was a 77-year-old, wheelchair-bound male with a history of diabetes, hypertension and obesity, who was brought to the emergency room due to a one-day history of dengue-like illness. Upon examination he had evidence of cardiomegaly and

confusion, and was diagnosed with dengue. Laboratory analysis revealed leukocytosis and low serum protein and albumin. He was discharged five days later after fever had resolved, and was brought back to the hospital two days later DOA. Culture of a blood specimen collected during hospitalization revealed infection with *Staphylococcus*. Dengue diagnostic testing collected upon presentation was sent to a private laboratory and was tested for anti-DENV IgM and IgG antibodies, which were negative and positive, respectively. No specimen was available for additional diagnostic testing.

Hence, between 1 April and 28 July 2015, a total of four laboratory-confirmed and two suspected fatal dengue cases were identified through enhanced surveillance.

4) *Develop and evaluate public education materials for American Samoa, including employees and visitors of the National Park of American Samoa, which emphasize the need to seek care early and wear mosquito repellent.*

CDC-Dengue Branch communications personnel met with the public relations and communications officers from DOH and LBJTMC and discussed the current health education materials being used. Both entities have been using the same dengue vector control brochure for the past 11 years. Although the content is still relevant, the format is out-of-date and should be updated. Hence, it was recommended to make the wording more concise and change the format to contain graphic content that is easier for the public to absorb. In addition, CDC health education materials (Homecare for Dengue Patients, Dengue in Pregnant Women, Dengue in Infants, and Control the Mosquito) were shared and were to be translated into Samoan. They immediately started sharing the Homecare for Dengue Patients with clinicians and circulating the information sheet in the hospital and clinics. A "Dengue in American Samoa" key health messages sheet was created as a guideline for when DOH staff conduct community outbreak activities to consistent message to the community.

Dr. Mark Schmaedick at the American Samoa Community College (ASCC) and his media team are currently drafting two public educational videos. The first is intended to update and combine dengue mosquito control and personal protection, and the second will focus on dengue patient homecare. CDC staff gave verbal feedback and recommendations to make modest improvements to the expected content of the videos, and additional support will be provided by email. It was also suggested that focus groups be conducted to evaluate the current and any future public educational materials. Guidelines for conducting focus groups were provided.

Last, DOH staff were recommended to work with ASCC to direct interaction with villages via high chiefs and church congregations. After viewing the video drafts from ASCC, DOH staff proposed creation of a skit that can be performed in villages, schools, and churches to educate the public about dengue, as the Samoan culture is very receptive to storytelling. We discussed sharing resources from ASCC to help with production of the skit.

5) *Establish dengue laboratory support by providing onsite (rapid diagnostic test [RDT]) and confirmatory (RT-PCR, IgM ELISA) diagnostic capacity.*

To improve the capacity for clinicians at LBJTMC and DOH health centers to identify dengue patients, as well as enabling observation of epidemiologic trends in the outbreak, dengue diagnostic capacity was needed to be established in American Samoa at one or multiple sites.

Because there is no capacity to implement molecular diagnostic testing by rRT-PCR or serologic testing by IgM ELISA in American Samoa, dengue rapid diagnostic testing was the only available option to meet clinical and surveillance needs. After recognition of the dengue outbreak, the WHO had donated to DOH several hundred Standard Diagnostic DengueDuo RDTs. Because this RDT has been previously validated by both WHO, CDC, and multiple academic laboratories and shown to be of high specificity (>95%) and moderate sensitivity (60–80% depending on the infecting DENV type), due to the urgent need for diagnostic capacity in American Samoa, CDC and partners supported the continued use of this RDT during the outbreak in American Samoa. In addition, CDC began working with DOH and LBJTMC to ensure continued testing using the Standard Diagnostic DengueDuo RDT, which is not an FDA approved *in vitro* diagnostic test, and that testing would meet CLIA standards. CDC Dengue Branch will provide a panel of known RDT-positive and RDT-negative specimens to DOH for use in the proficiency/validation/consistency testing for CLIA.

To assist in validation of the RDT being used in American Samoa, as well as to perform confirmatory dengue diagnostic testing and identify other causes of acute febrile illness circulating in American Samoa, ~70 specimens will be sent to CDC-Dengue Branch. All specimens will be tested by rRT-PCR and IgM ELISA to detect infection with DENV or CHIKV. Specimens testing negative by both methods to both pathogens will be sent to CDC Bacterial Special Pathogens Branch to be tested for evidence of infection with *Leptospira* species bacteria. A subset of specimens will also be tested at CDC-Dengue Branch with the DengueDuo RDT. Specimens are expected to be shipped to CDC-Dengue Branch on 3 August 2015 and received on 5 August 2015.

6) Assessment of supply inventory at LBJTMC

LBJTMC and DOH reported an increase in demand for supplies during the dengue outbreak. Initial discussions revealed an anticipated two-week supply of intravenous fluids (IVF). Concerns were expressed from LBJTMC and CDC that a two-week supply was likely to be inadequate, given the extent of the outbreak and the growing demand.

After meeting with Procurement Office and LBJTMC laboratory staff to discuss possible supply shortages associated with this outbreak, estimated forecasting of supply needs was primarily dependent upon recent changes in demand, and was projected forward for two months. Hence, a thorough analysis was conducted of basic medical supplies that are frequently exhausted during dengue outbreaks.

a) IVF: A review of the IVF inventory indicated a potential shortage of 1L Normal saline as well as low stocks of other IVF formulations. However, additional shipments were assured the following week. In April and May, the typical weekly IVF usage was ~1,000 bags per week, and this has increased to 1,300–1,500 bags per week since the dengue epidemic. In addition, ER IVF usage had increased dramatically among possible dengue patients, from 500 bags per week to 900 bags per week.
b) Blood Products: Inventory is managed by the laboratory. Current inventory was PRBCs (70 units), whole blood (5 units, only 3 O+) and FFP (12 units). A new shipment from

California was due within 3 weeks with 140 units of PRBCs and 18 units of FFP. Platelets are not available in American Samoa and were not being used during the beginning of the outbreak. The utility of administering platelets to acutely ill dengue cases is marginal hence the need to have platelets on hand was not considered a deficiency. Additionally, the expense ($4000/6-pack) and 4-day shelf-life after shipment to American Samoa makes their usage questionable. Equipment and burettes required for live transfusions was adequate.

c) Lab Reagents: Lab reagents and supplies are ordered from MedPharm (Guam) or Stein (CA) and typically arrive two weeks after ordering. We discussed the need to anticipate increases in CBC and coagulation tests in the coming weeks. In particular, the CBC is used to monitor patient response to fluid challenges (differential not required). Although we were assured that the supplies for these tests was adequate, the current inventory was not available. A request was made for new inventory of reagents and supplies for CBC, coagulation tests, and blood products in the next two days.

Summary of hospital supply inventory assessment: With current epidemiologic incidence data, inputs into the Dengue IVF Projection model (developed for the 2011-12 dengue outbreak in the Republic of the Marshall Islands) was performed (20 cases per day, 5 admits to the hospital, 65% adult – 35% peds, 20% of outpatients require IVF). If we project the current outbreak forward for the next 60 days, an increase of 448 L of IVF per week is estimated. This is roughly matches the reported increase by LBJ Procurement of 400 to 500 L per week over the past month.

7) Dengue KAP and serosurvey amongst USG staff

USG agencies with employees based in American Samoa were contacted to identify employees that would be interested in participation in a Knowledge, Attitudes and Practices survey. Employees were asked to voluntarily participate in the survey and a dengue diagnostic blood test for dengue. The intent of the survey was to measure employees' current knowledge of dengue, mosquito avoidance strategies, and healthcare seeking behaviors, and ultimately to determine the effectiveness of the avoidance strategies by analyzing the survey results in conjunction with the diagnostic tests.

To date, a total of 79 USG employees participated in the KAP survey and blood samples were collected for diagnostic testing from 76 USG employees. Surveyed employees were from Department of the Interior, Department of Commerce, Department of Agriculture, Coast Guard, Veterans Administration, and the US Postal Service. It is anticipated that ~25 additional KAP surveys will be conducted on Friday July 31, for a total of 104 participants.

Due to governmental regulations from the Office of Management and Budget, the KAP and serosurvey was restricted to interviewing only USG employees. However, it is expected that the DOH will conduct interviews throughout the community of American Samoa to better understand the knowledge, attitudes, and practices of residents towards dengue, as well as estimate the island-wide incidence of DENV infection. Aggregate data and a summary report from the USG employee dengue KAP and serosurvey will be analyzed at a future time and the results provided to the DOH as well as all USG agencies. The survey instrument will be provided

to DOH, and assistance remotely provided as needed to conduct the surveys and analyze the data.

Ongoing Activities

1) Establishment of dengue rapid diagnostic testing at LBJTMC and DOH Health Centers, including shipment of specimens from American Samoa to CDC-Dengue Branch as well as shipment of specimens from CDC-Dengue Branch to American Samoa.
2) Continue analysis of epidemiologic and clinical data from electronic medical records.
3) Continue support of DOH and ASCC staff in developing communication materials.
4) Complete USG KAP and serosurvey and ship specimens to CDC-Dengue Branch.
5) DOH has provided a written request to the Navy Marine Corps Public Health Center for assistance from the Navy Environmental and Preventive Medicine Unit Six (NEPMU-6) based on Honolulu, Hawaii to guide and conduct indoor residual spraying in public schools in American Samoa. As of the writing of this report, NEPMU-6 was anticipating deployment of one individual on August 7th for an expected duration of ~10 days.

Recommendations

1) Ensure continued dengue training and education amongst clinicians practicing in American Samoa. This can be achieved by having new and/or junior faculty complete the online Dengue Case Management Course offered by CDC, and also by requiring that clinicians re-take the course on a regular basis (e.g., every two years). This could be supported by having local physicians provide additional guidance to clinicians. Generating such a cadre of physicians experienced in dengue clinical case management at LBJTMC and DOH health centers could be achieved by sending 1–2 physicians to shadow 'Dengue Master Trainers' at a teaching hospital in Puerto Rico and discuss training approaches utilized locally to instill best practices in junior physicians. CDC Dengue Branch is available to assist with this request, should be it made.
2) Implement a dengue-specific case surveillance form that can be used at LBJTMC and DOH health centers to produce consistently collected and comparable surveillance data.
3) Continue surveillance for and routine diagnostic testing of suspected dengue cases presenting to LBJTMC and DOH health centers, even after the current epidemic has terminated, in order to demonstrate the continued burden of dengue in American Samoa and possible endemicity.
4) Write a report to be published in MMWR to disseminate findings to national and international public health officials, and create a permanent record to demonstrate the burden of this dengue epidemic in American Samoa.
5) Summarize findings from the KAP and serosurvey amongst USG partners in American Samoa to improve mosquito avoidance practices.
6) Conduct an equivalent KAP and serosurvey amongst residents of American Samoa. Such information could be utilized not only to obtain a more accurate measure of the true magnitude of the 2015 dengue epidemic, but could also assist in identifying barriers that community members face in seeking medical care for dengue-like illness, employing mosquito avoidance strategies, and areas that need to be strengthened in messaging to the community about dengue prevention activities. Such information would be important to elucidate in order to develop appropriate community interventions to fill knowledge gaps before the dengue epidemic. Although there was strong support and capacity by DOH to

conduct such a survey during the outbreak response, CDC was unable to provide direct assistance in doing so while in American Samoa due to regulatory approvals that could not be obtained from OMB in the requisite time frame.

7) Inventory recommendations
    a. Lab and Procurement should anticipate an increased demand for up to two months. Recent clinical trainings of primary care clinicians will likely result in more referrals for fluid resuscitation and management of mid-acuity patients who will benefit from a 24-hour monitoring period.
    b. Daily attention to inventory of IV fluids will help greatly to prevent shortages and provide adequate lead time for re-ordering if necessary.
    c. Insuring adequate supplies of IVF is not only the task of Procurement. Clinicians and Nursing Supervisors are reminded to check on-hand inventories and report current stocks to the Supply Office. Additionally any remarkable increases in IVF due to suspect cases should be reported to Supply Office as well as Public Health.
    d. The current level of prioritization for procuring supplies is appropriate. Much credit to senior administration for ensuring rapid approval and vendor payment. Continued administrative support from the CEO and CFO is required to maintain uninterrupted supplies.
    e. There is a small possibility that reagents for testing coagulation panels in dengue cases will be inadequate if the outbreak continues unabated for the next two months. Close monitoring of inventory is recommended.

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Figure 1: Map of American Samoa, obtained from http://ian.macky.net/pat/map/as/as_blu.gif.

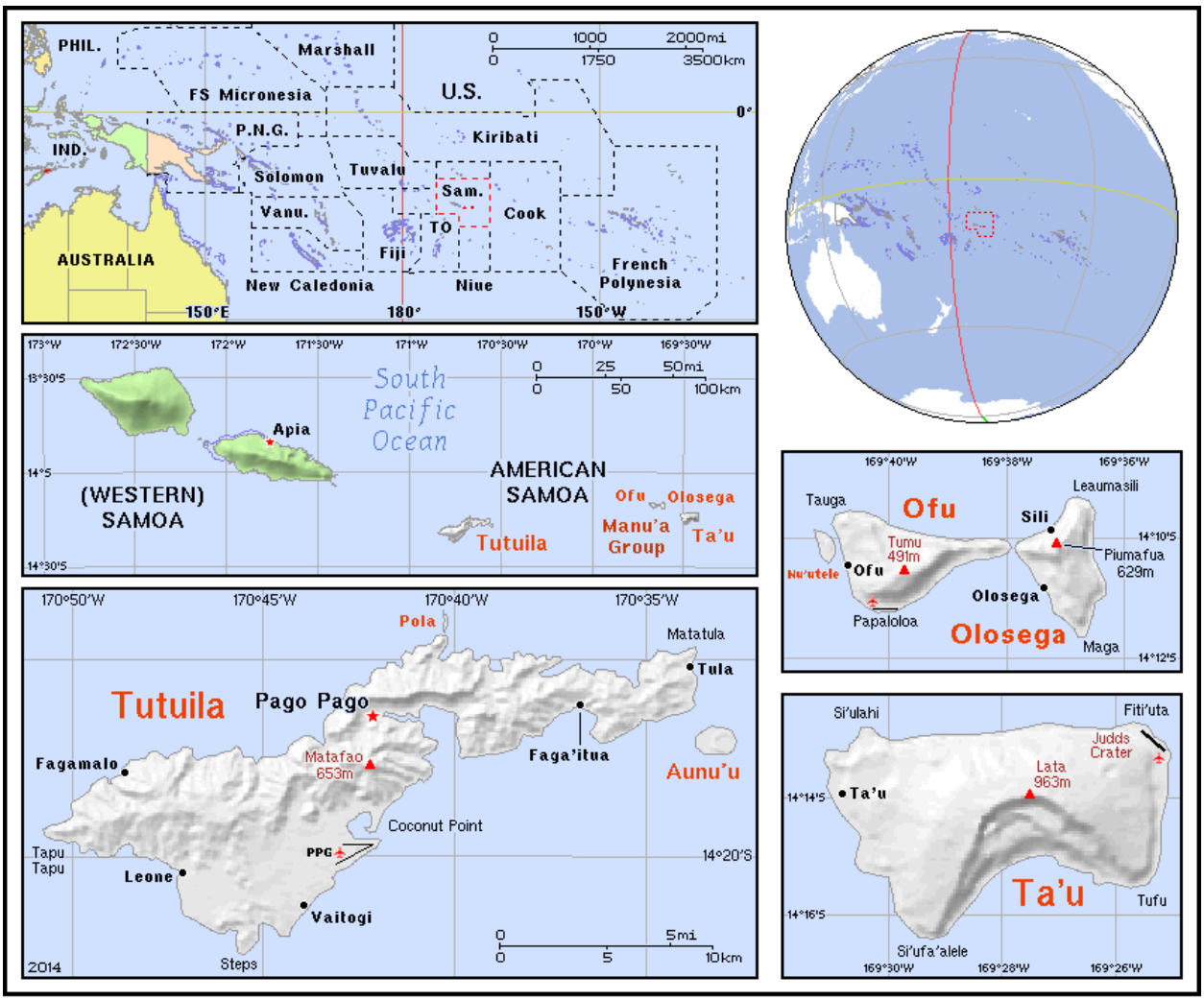

Figure 2: Suspected dengue cases identified through enhanced case surveillance at Lyndon B. Johnson Tropical Medical Center and six Department of Health health centers by week of illness onset, 1 April–26 July 2015, American Samoa.

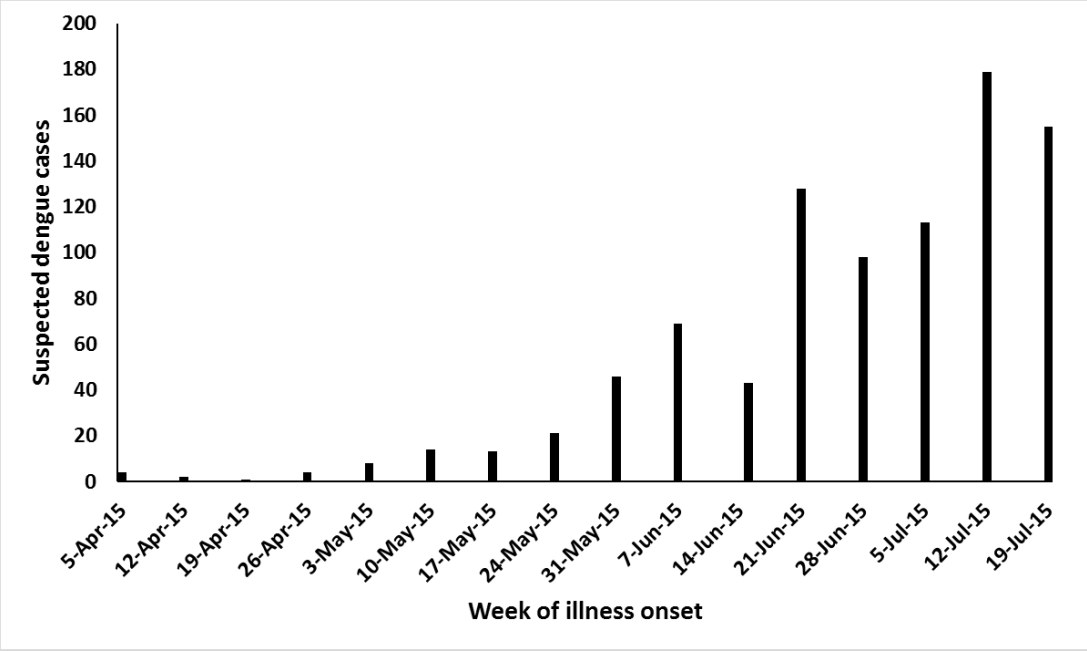

Figure 3: Suspected dengue cases identified through enhanced case surveillance at Lyndon B. Johnson Tropical Medical Center and six Department of Health health centers by age group and incidence per 10,000 residents, 1 April–26 July 2015, American Samoa.