

Acute Communicable Disease Control Program

## Special Studies Report

# 2015



Los Angeles County  
Department of Public Health



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**ACUTE COMMUNICABLE DISEASE CONTROL  
SPECIAL STUDIES REPORT 2015**

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## **BOTULISM CASE REPORT SUMMARY LOS ANGELES COUNTY, 2015**

Botulism is a rare but serious and potentially fatal paralytic illness caused by a nerve toxin produced by the bacterium *Clostridium botulinum*. The bacterial spores which causes botulism are common in both soil and water and produce botulinum toxin when exposed to low oxygen levels and certain temperatures. There are five main kinds of botulism: 1) Foodborne botulism can happen by eating foods that have been contaminated with botulinum toxin. Common sources of foodborne botulism are homemade foods that have been improperly canned, preserved, or fermented. Though uncommon, store-bought foods also can be contaminated with botulinum toxin, 2) Wound botulism can happen if the spores of the bacteria get into a wound and make a toxin. People who inject drugs have a greater chance of getting wound botulism. Wound botulism has also occurred in people after a traumatic injury, such as a motorcycle accident, or surgery, 3) Infant botulism can happen if the spores of the bacteria get into an infant's intestines. The spores grow and produce the toxin which causes illness. 4) Adult intestinal toxemia (also known as adult intestinal toxemia) botulism is a very rare kind of botulism that can happen if the spores of the bacteria get into an adult's intestines, grow, and produce the toxin (similar to infant botulism). Although we don't know why people get this kind of botulism, people who have serious health conditions that affect the gut may be more likely to get sick, 5) Latrogenic botulism can happen if too much botulinum toxin is injected for cosmetic reasons, such as for wrinkles, or medical reasons, such as for migraine headaches.

Because botulism infections may be fatal, they are considered medical emergencies and suspected cases are mandated to be reported to the Los Angeles County Department of Public Health (LAC DPH) immediately by telephone. The California Department of Public Health's (CDPH) Division of Communicable Disease Control is responsible for the investigation and surveillance of infant botulism cases identified in the county and across the state. LAC DPH is responsible for reporting suspected cases of infant botulism to CDPH's [Infant Botulism Treatment and Prevention Program](#)<sup>1</sup> for their investigation. Specialized antitoxin is used to treat botulism, which can only be released when authorized by LAC DPH or CDPH. Testing for case confirmation can be conducted at the LAC DPH Public Health Laboratory.

The number of confirmed botulism cases in LAC fluctuates from year to year. For the past 5 years, an average of three cases were confirmed annually.

In 2015, two associated cases of suspected botulism were reported in LAC: one was classified as probable (Case 1) and the other as confirmed (Case 2). Both cases had wound botulism, lived in the same sober living house, and reportedly used heroin together including using shared needles. Case 2 had onset of symptoms 11 days after Case 1's symptom onset. Botulinum toxin A was detected by mouse bioassay in a serum specimen from Case 2. The serum for Case 1, collected approximately 3 weeks after initial onset

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<sup>1</sup> Infant Botulism Treatment and Prevention Program. Division of Communicable Disease Control, California Department of Public Health. [www.infantbotulism.org](http://www.infantbotulism.org).



of symptoms, was negative for botulinum toxin. However, because Case 1 had clinically compatible symptoms and was epidemiologically linked with Case 2, Case 1 was classified as a probable case.

In 2015, ACDC also received three other reports of suspected botulism which were ultimately not classified as cases. One had a history of injection drug use; serum testing was negative by matrix-assisted laser desorption/ionization-time of flight (MALDI-TOF), as a result an alternate diagnosis of myasthenia gravis was assigned. Another suspected case had a history of crystal methamphetamine use, but denied injection use. For this suspected case, serum testing by both mouse bioassay and MALDI-TOF were negative. The third suspected case had no identified risk factors. Serum testing by MALDI-TOF and serum/stool testing by mouse bioassay were negative, and EMG results were determined not to be consistent with botulism.

Upon notification and review of case history and symptoms, LAC DPH authorized the release and use of botulism antitoxin for all five suspected botulism cases reported in 2015.



## **MONITORING WEST AFRICAN TRAVELERS FOR EBOLA VIRUS DISEASE IN LOS ANGELES COUNTY: A COMPLETE REVIEW**

### **OVERVIEW**

The outbreak of Ebola virus disease (EVD) in West Africa was the largest outbreak of EVD in history, and the first Ebola outbreak which resulted in transmission of this disease in the US. The outbreak in West Africa began in March 2014. However, implementation of a nationwide monitoring system in the US did not begin until a West African traveler was diagnosed in Dallas, Texas with EVD in September of that year, and EVD subsequently spread to two nurses who treated this patient.

Starting in October 2014, US government officials responded by initiating questioning of airplane passengers from West Africa for possible EVD exposure and screening these travelers for fever. This occurred at five US airports in New York, New Jersey, Illinois, Virginia, and Georgia. Combined, these five airports receive more than 94% of passengers from Guinea, Liberia, and Sierra Leone, the three countries that were most affected during this EVD outbreak. On October 21, the Department of Homeland Security announced that all passengers from Liberia, Sierra Leone, and Guinea would be required to fly into one of those five airports. On October 23, the Centers for Disease Control and Prevention (CDC) announced that all passengers from these countries also would receive 21-day monitoring while in the US [1].

On October 21, 2014, the Los Angeles County Department of Public Health (LAC DPH) was notified of the first traveler to our jurisdiction. Traveler monitoring for EVD ultimately ended on January 4, 2016. This report provides a summary of the entire Ebola traveler monitoring effort in Los Angeles County (LAC).

### **METHODS**

In order to assess traveler risk of developing EVD and to implement daily symptom monitoring, LAC DPH created the EVD Exposure Risk Assessment Form and the EVD Daily Symptom Monitoring Log based on guidance materials released by the CDC. CDC guidance also was used to assign travelers to one of four risk groups: no identifiable risk, low risk, some risk, and high risk [2]. Initial data was collected on travelers by the US Customs and Border Protection and the CDC during a screening process at one of the five airports accepting travelers from Ebola affected countries. Data were then received by LAC DPH through the California Department of Public Health (CDPH). Upon notification, LAC DPH personnel visited the travelers and conducted an interview to complete the EVD Risk Assessment Form. Travelers were then monitored daily by district public health nurses for EVD symptoms for up to 21 days after the travelers' last potential exposure to EVD. The primary EVD symptom assessed was fever, but symptoms monitored also included: severe headache, abdominal pain, diarrhea, vomiting, muscle pain, weakness or fatigue, and unexplained bleeding or bruising (hemorrhage). Low risk travelers were contacted daily by a LAC DPH Public Health Nurse (PHN) by telephone. Travelers that were determined to be at some risk for developing EVD were contacted daily by LAC DPH staff either in-person or through video conferencing. None of the travelers in LAC were determined to be at high risk for developing EVD. Travelers who reported fever or other symptoms of EVD were evaluated by an LAC DPH physician to determine whether further follow-up or



EVD testing was necessary. If the traveler met the criteria, they were tested for EVD by polymerase chain reaction (PCR) at the LAC DPH Public Health Laboratories.

Early in the response, the initial paper based protocol was merged into an electronic surveillance system which centralized the data and allowed for conducting queries. Analyses were performed using SAS® and Microsoft Access. Surveillance data were summarized daily and reports were disseminated to key stakeholders, which described LAC DPH's ongoing traveler monitoring activities and the current health status of those being monitored.

This report covers the entire traveler monitoring period, which started on October 21, 2014 and ended on January 4, 2016.

## RESULTS

Over the full course of the US response, 269 travelers were referred to LAC DPH for monitoring. Of these, 20 travelers were not monitored, either because it was determined that they were never exposed to EVD or because they were not residents of LAC (Figure 2). Of the 249 travelers monitored by LAC DPH, 40 (16%) reported EVD-related symptoms during at least one monitoring event. In nearly all cases, symptoms resolved quickly and without need for further assessment. LAC DPH determined that medical assessment was needed for eight travelers, however only four met the criteria for EVD testing—none of those tested were positive for EVD, and all eight medically assessed travelers had a non-EVD diagnosis (Figure 2).

Most of the travelers that LAC DPH monitored came from Sierra Leone (120, 48%), followed by Liberia (69, 28%), and Guinea (47, 19%). Six travelers (2%) reported travel from two EVD-affected countries. The largest proportion of travelers (82, 33%) were in an EVD-affected area for business, followed by travel for vacation or visiting family (63, 25%). Many of the travelers LAC DPH monitored (49, 20%) were permanent residents of one of the EVD-affected areas (Table 1).

Of the 249 travelers: 193 were monitored for the full 21-day infectious period, 32 were not monitored for the full period either because they left the country or because CDPH authorized ending their monitoring. A total of 24 travelers transferred to other jurisdictions during their monitoring period. Only two travelers to LAC (0.8%) had contact with an EVD case within their incubation period. The majority of travelers in LAC (238, 96%) were low risk for their entire monitoring period, four were some risk, and seven were considered to be some risk for part of their monitoring period and later were downgraded to low risk (Table 1). None of the travelers to LAC were considered at high risk for developing EVD. Travelers were mostly male (144, 58%), only one traveler was pregnant, and 11 (4%) were under age 18.

## CONCLUSION

LAC DPH was able to adapt existing surveillance systems to meet the needs of the Ebola response. Through this system, LAC DPH was able to detect symptomatic travelers, determine need for further assessment and activate a countywide response as necessary. The protocols and data systems that were established were able to effectively monitor travelers over the entire duration of the outbreak. Response staff were also able to effectively transmit timely information to key LAC DPH staff and other stakeholders. Clear and



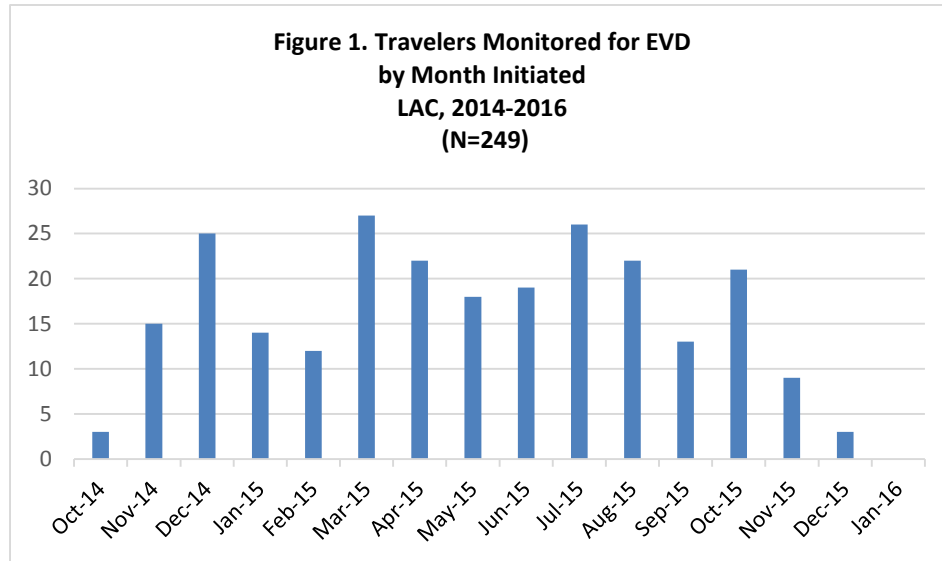
frequent communication between LAC DPH, CDPH, and CDC partners was vital to the success of our response, and allowed for the flexibility necessary to adapt to this quickly changing situation with wide reaching public health implications. In addition, the systems LAC DPH developed and the lessons learned have been instrumental in our response to other emerging diseases, including Zika.

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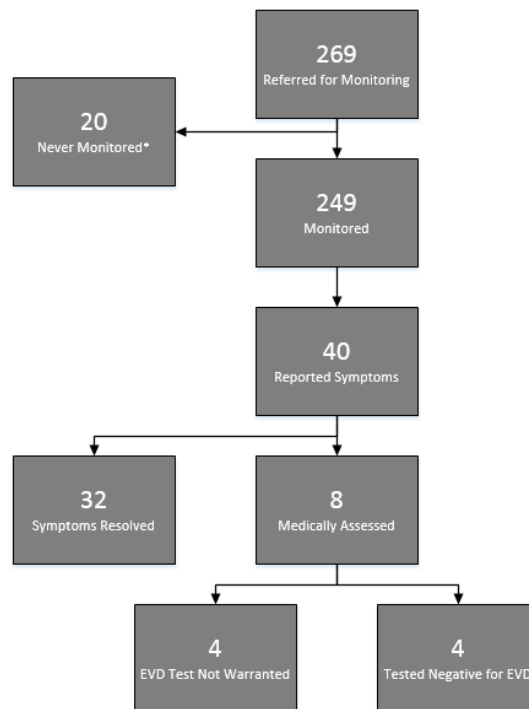
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Table 1. Characteristics of Travelers Monitored for EVD LAC, 2014-2016		
	Frequency	Percent
<b>Gender</b>		
Male	144	58
Female	105	42
<b>Affected Areas Visited</b>		
Guinea	47	19
Guinea and Sierra Leone	3	1
Liberia	69	28
Liberia and Sierra Leone	3	1
Mali	7	3
Sierra Leone	120	48
<b>EVD Risk</b>		
Low	238	96
Some	4	2
Some, Low	7	3
High	0	0
<b>Reason for Travel to EVD-Affected Area</b>		
Business	82	33
Visiting Family or Vacation	63	25
Ebola-Response or Humanitarian Aid	37	15
Permanent Resident of Affected Area	49	20
>1 reason	4	2
Other	14	6





**Figure 2. Number of Travelers Monitored and Assessed for  
EVD by Symptom Outcome  
LAC, 2014–2016**



\* Travelers were not monitored by LAC DPH if they were not residents of LAC, or if risk assessments determined that they did not have exposure to EVD.



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## PREGNANCY, LABOR, AND DELIVERY AFTER EBOLA VIRUS DISEASE AND IMPLICATIONS FOR INFECTION CONTROL IN OBSTETRIC SERVICES, US<sup>2</sup>

### OVERVIEW

Many of the survivors of the 2014–2015 epidemic of Ebola virus disease (EVD) in West Africa were women of childbearing age. Limited clinical and laboratory data exist that describe these women’s pregnancies and outcomes. We report the case of an EVD survivor who became pregnant and delivered her child in the United States (US), and we discuss implications of this case for infection control practices in obstetric services. Hospitals in the US must be prepared to care for EVD survivors.

The 2014–2015 epidemic of Ebola virus disease (EVD), which was centered in West Africa, is the largest EVD epidemic in history. Vertical transmission of Ebola virus (EBOV) from mother to fetus can occur during acute Ebola infection, leading to intrauterine fetal death, stillbirth, or neonatal death [1–5]. Little is known about the risk for vertical transmission of EBOV from women to their neonates outside of the acute infectious period. EBOV has been found in breast milk during acute disease [6], and a study documenting two discordant mother–child pairs postulated that breast feeding of one infant may have led to infection of the infant [7]. EBOV has been found in immune-privileged sites, ocular fluid and semen, many months after onset of infection [8–13]. It is possible that other immune-privileged sites such as the central nervous system (CNS) may also contain EBOV many months after onset of infection. In addition, acutely infected pregnant women have had high amounts of Ebola viral nucleic acid persist in the amniotic fluid following clearance of viremia; however, it is not known whether this amniotic fluid is infectious [2]. Some theoretical concern exists that during labor and delivery or obstetric anesthetic procedures (e.g., spinal anesthesia), contact with products of conception or cerebrospinal fluid from EVD survivors may pose an infectious risk [6,14–18].

As of March 9, 2016, an estimated 17,323 persons worldwide have survived EVD, and among them are ≈5,000 women of childbearing age [19]. Survivors will require medical care for routine illnesses, surgical services, dental work, and management of disease sequelae [20,21]. In addition, many of the female survivors who are of reproductive age will require obstetric care. Some of these survivors may come to the US, and hospitals and healthcare workers must be prepared to provide care in a manner that promotes patient dignity and comfort, prevents stigmatization, and ensures that all patients receive appropriate, high-quality medical care [22–24]. However, limited preparations have been made for follow-up care for EVD survivors, including those needing obstetric care, and minimization of possible stigma and fear. We describe the case of an EVD survivor who delivered a healthy neonate in a community hospital in the US 14 months after acute EBOV infection, and we discuss the implications of the findings from this case for infection control in obstetric services.

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<sup>2</sup> Published as: Kamali A, Jamieson DJ, Kpaduwa J, et al. Pregnancy, Labor, and Delivery after Ebola Virus Disease and Implications for Infection Control in Obstetric Services, United States. *Emerging Infectious Diseases*. 2016;22(7):1156-1161.



## **CLINICAL COURSE**

### **EVD Course**

A 29-year old physician from West Africa became ill with EVD in late July 2014. She had contracted the virus from an EVD patient whom she had cared for from July 20 until his death on July 25. On July 29, the woman began feeling unwell, noting arthralgia and myalgia, which she self-treated with antimalarial medications. On August 1, she had fever, and on August 3, she began vomiting and had diarrhea. The woman was admitted to an Ebola treatment center (ETC) and isolated after results of an EBOV real-time reverse transcription PCR (rRT-PCR) were positive for EBOV RNA (cycle threshold unknown). According to the woman, she spent 13 days in the ETC, where she was treated with oral rehydration fluids, acetaminophen, and a second course of antimalarial medications. She was discharged from the ETC on August 16, after showing negative results on two EBOV rRT-PCRs. After her recovery, the woman noted some fatigue, anorexia, arthralgia, and alopecia; she did not report any sleep disturbances, headaches, or vision problems. Symptoms resolved 2–3 months later.

### **Pregnancy, Labor, and Delivery**

Eight months before her EVD diagnosis, the patient had had a spontaneous abortion at ten weeks gestation. In January 2015, 22 weeks after her last negative EBOV rRT-PCR, she became pregnant again. For this second pregnancy, the estimated date of delivery was established on the basis of an 11.5-week ultrasound that was consistent with the patient's last menstrual period. The patient received routine prenatal care in West Africa. At 25 weeks gestation, she traveled to Kern County, CA, US, and a detailed anatomy ultrasound was performed in Los Angeles County (LAC), CA, which demonstrated normal fetal development.

The hospital identified staff members who were willing to assist during labor and delivery for the patient, and at 40 weeks and one day of gestation, labor was induced to ensure that those staff members were present. The patient was given two vaginal doses of misoprostol, oxytocin was administered, and labor progressed normally. The patient was given epidural anesthesia for pain control and had a normal vaginal delivery of a female neonate (weight 4,128 g) with Apgar scores of 8 and 9 at one and five mins of age, respectively. The patient had a second-degree perineal laceration, which was repaired.

The patient and her neonate were discharged from the hospital at 36 h postpartum. They returned for routine follow-up seven days postpartum and were monitored for six weeks following delivery, after which they traveled home to West Africa.

### **Infection Control and Personal Protective Equipment, Public Health Response**

Two weeks before the patient's delivery date, her US obstetrician contacted the California Department of Public Health (CDPH; Richmond, CA, US) and the Centers for Disease Control and Prevention (CDC; Atlanta, GA, US) to determine if there were any special precautions needed for infection control; the CDPH notified the LAC DPH (Los Angeles, CA, US). Because the patient was healthy and had fully recovered from EVD ~4 months before becoming pregnant, all public health agencies agreed that she presented an extremely low risk for transmission of EBOV. Nevertheless, it was deemed appropriate that public health officials play an



active role in assessing and guiding management of the patient. The LAC DPH and CDC collaborated with the hospital's healthcare providers, nursing directors, laboratory director, environmental services staff, anesthesiologists, and hospital administration to address concerns and review the care plan, including plans for any complications such as the need for cesarean delivery or the development of peripartum fever.

Hospital infection control procedures were reviewed in person with hospital staff. In review of these policies, no additional precautions were recommended above the standard precautions and policies currently used for all deliveries at the hospital. Several hospital staff members not directly involved in patient care expressed discomfort about working while an EVD survivor was admitted. To reassure these staff members, the patient was kept in one room during labor, delivery, and after delivery. No changes were made to the policies for environmental cleaning or waste disposal.

Hospital staff raised concerns about the possibility of EBOV being harbored in immune-privileged sites (e.g., cerebrospinal fluid) in EVD survivors; thus, they expressed their concerns about a theoretical risk for EBOV transmission [6,14–17]. This patient did not show signs or symptoms of CNS involvement during her acute illness or during her pregnancy, which likely indicated a decreased risk of any latent EBOV reservoir in her CNS. Thus, it was considered likely that epidural or spinal anesthesia for this patient would not pose an infectious risk to staff. Hospital staff also noted the often imperfect adherence to use of personal protective equipment (PPE) during labor and delivery; thus, they voiced concern over this patient's history of EVD because large volumes of blood and amniotic fluid are often encountered in typical, uncomplicated vaginal deliveries [25]. As a result of these concerns, many discussions were held regarding what PPE should be used during labor and delivery. Standard precautions should always be applied in all medical settings, including labor and delivery; however, neither CDC nor the American College of Obstetricians and Gynecologists had tailored recommendations for PPE specifically for vaginal or cesarean deliveries for any patients. Thus, CDC and LAC DPH developed a preliminary set of recommendations for the patient's providers regarding the use of PPE (Table 1 and 2) during and after labor and delivery to ensure that standard precautions were implemented. These PPE recommendations were discussed with the providers in the days before the delivery, and staff members were able to ask for clarification and ensure that materials were readily available. These PPE recommendations did not differ from standard precautions, but they explicitly discussed which PPE to use for casual contact, vaginal examinations, labor and delivery, anesthesia, and postpartum care. Routine hand hygiene, use of barriers for mucous membrane protection, and use of double gloves for procedures that involve sharps were emphasized.

### **Laboratory Assessment**

One week before delivery, EBOV rRT-PCR testing was performed on the patient's blood by the LAC DPH laboratory and the CDC Viral Special Pathogens Branch; both results were negative. As expected, EBOV serum antibodies were detected by ELISA (IgG  $\geq$ 1:1600, IgM negative).

After obtaining written informed consent from the patient, healthcare staff obtained the following during and after delivery: vaginal secretions, amniotic fluid (vaginal pool), cord blood, placenta, umbilical cord,



breast milk (colostrum collected 16 h after delivery), and oral and ear swab samples from the neonate. Cord blood, colostrum, amniotic fluid, and swab samples were kept refrigerated until processed or frozen on dry ice for shipment to CDC. A placental sample was frozen in a sterile specimen cup, and samples of placenta and umbilical cord were placed in buffered formalin and shipped at room temperature to CDC. EBOV rRT-PCR testing was performed on all of these specimens at the LAC DPH and CDC laboratories by using assays specific for nucleoprotein and 40 viral protein genes.

Placenta, amniotic fluid, and cord blood samples and ear and oral swab samples from the neonate were negative by EBOV rRT-PCR. Attempts were made to recover virus from placenta, amniotic fluid, cord blood, and colostrum at CDC, but no virus was recovered (Table 3). Amniotic fluid, cord blood, and colostrum were tested by ELISA for IgM and IgG against EBOV antigens [26]. Cord blood was negative for IgM and had an IgG titer of  $\geq 1:1600$ . Amniotic fluid and colostrum were negative for IgM and IgG. The placenta and umbilical cord were histologically normal, and no EBOV antigen was detected by immunohistochemistry [27], including in maternal and fetal endothelial cells and leukocytes.

## CONCLUSIONS

We describe the delivery of a healthy baby to an EVD survivor who became pregnant 22 weeks after clearance of viremia and resolution of post-EVD sequelae (i.e., fatigue, anorexia, arthralgia). At six weeks follow-up, before returning to West Africa, the mother and baby were doing well. Given that the mother did not exhibit any signs or symptoms of post-EVD sequelae during her pregnancy, we did not expect to find any EBOV by rRT-PCR in any specimens obtained, and none was detected. It is somewhat surprising that we did not detect EBOV IgG in the colostrum; however, studies of antibodies for other infections have found that levels of IgG and IgM in colostrum are much lower than those in serum [28], and this might also be true for antibodies against EBOV.

Although we did not detect EBOV RNA in this patient during pregnancy, women who are pregnant during acute EBOV infection usually transmit virus to the fetus and may pose an infectious risk to healthcare providers and others during delivery or abortion [3]. EBOV can readily cross the placenta, and pathologic examination of placental tissues of patients with confirmed EVD have demonstrated EBOV antigen in the trophoblasts, syncytiotrophoblasts, and circulating maternal macrophages [4]. EBOV RNA has been demonstrated in amniotic fluid, fetal meconium, vaginal secretions, umbilical cord, buccal swab samples from neonates, and peripheral blood samples from neonates, including those of mothers with cleared viremia [29,30].

The immune effects of pregnancy in the context of EVD have not been well documented [3]; however, alterations in the immune system do occur during pregnancy [31], which during acute EBOV infection likely increases the risk for a poor outcome including spontaneous abortion and neonatal death. Unlike the CNS, eye, and male testis, the genital tract of a nonpregnant female is not traditionally considered an immune-privileged site [32–34]. Laboratory data that demonstrate the absence of EBOV or the presence of antibodies in post-EVD pregnancies are lacking; however, on the basis of epidemiological evidence in the field of multiple uneventful deliveries in West Africa and of the laboratory-analyzed case reported



here, no evidence currently exists that EBOV can persist in the female genital tract. Any perceived risk must be mitigated to ensure that patients are not stigmatized and receive appropriate care. The authors concur with current guidelines by the World Health Organization, which state that women who have recovered from EVD are not infectious, should receive routine prenatal care, and their labor and delivery should be performed using standard PPE for protection against blood and bodily fluids [35].

The normal pregnancy for the patient described in this study and her delivery of a healthy neonate offer reassurance that women who become pregnant after recovery from EVD pose little risk for transmission of EBOV to the baby or others. Many more EVD survivors will become pregnant and deliver, and some may do so in the US. Many other survivors will require routine medical care, including care for post-EVD syndrome. Lessons learned from this patient, specifically those addressing concerns about potential risks for virus transmission, may be applied to future patients. However, each survivor who seeks medical care will likely need to be assessed individually to determine possible risks for transmitting virus [16,18]. Over the course of the public health involvement in this case, it became evident that, although standard precautions should routinely be used in all labor and delivery settings, written guidelines for labor and delivery may be useful given the heightened concern for a theoretical disease transmission risk. We hope that the preliminary recommendations for PPE use during labor and delivery in the case discussed here will provide a template for other professional organizations to create guidelines for use in all labor and delivery settings.

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**Table 1. Recommendations for use of PPE by healthcare workers during labor and delivery for a woman who became pregnant after surviving EVD, US, 2015\***

Potential exposure	PPE						
	Face mask	Face shield	Gown		Gloves		Fluid-resistant, midcalf boot covers
Isolation			Fluid-resistant or impermeable†	Single	Double		
<b>Casual contact with patient</b>							
Performing duties for patient with intact membranes (e.g., delivering food or water, talking with patient, adjusting external monitors)	No	No	No	No	No	No	No
Performing duties for patient with ruptured membranes; no touching of patient or bedding	No	No	No	No	No	No	No
<b>Noncasual contact with patient</b>							
Touching patient with ruptured membranes or bedding of patient with ruptured membranes	No	No	Yes	No	Yes	No	No
Administering epidural	Yes	Yes	Yes	No	No	Yes	Yes‡
Performing vaginal examination	Yes	Yes	No	Yes	Yes	No	Yes‡
Performing obstetric procedures§	Yes	Yes	No	Yes	No	Yes	Yes

\*These PPE recommendations were developed for this particular patient and do not represent a formal recommendation.

†Impermeable indicates that the material and construction have demonstrated resistance to synthetic blood and simulated bloodborne pathogens; fluid-resistant indicates demonstrated resistance to water (<http://www.cdc.gov/niosh/npptl/topics/protectiveclothing/default.html>).

‡To be used if membranes were ruptured.

§Procedures include placement of fetal scalp electrode or intrauterine pressure catheter; manual removal of placenta; bimanual massage of uterus.



**Table 2. Recommendations for use of PPE by healthcare workers during postpartum care of a woman who became pregnant after surviving EVD and during care of her neonate, US, 2015\***

Potential exposure	PPE						
	Face mask	Face shield	Gown		Gloves		Fluid-resistant, midcalf boot covers
			Isolation	Fluid-resistant or impermeable†	Single	Double	
<b>While caring for mother</b>							
Before bedding/gown change	Yes	Yes	No	Yes	Yes	No	Yes
After bedding/gown change (vaginal exam, perineal care)	No, unless splash likely	No, unless splash likely	Yes	No	Yes	No	No
<b>While caring for neonate</b>							
Before bathing	Yes	Yes	No	Yes	Yes	No	Yes
After bathing	No	No	No	No	Yes‡	No	No

\*These PPE recommendations were developed for this particular patient and do not represent a formal recommendation.

†Impermeable indicates that the material and construction have demonstrated resistance to synthetic blood and simulated bloodborne pathogens; fluid-resistant indicates demonstrated resistance to water (<http://www.cdc.gov/niosh/npptl/topics/protectiveclothing/default.html>).

‡To be used if exposure to fluids is likely.

**Table 3. Laboratory test results for a woman who became pregnant after surviving EVD and for her neonate, US, 2015\***

Source	Time of sample collection	rRT-PCR	EBOV antibodies	Immunohistochemistry
Maternal blood	1 week before delivery	Negative	IgG (1:1,600); IgM not detected	NA
Cord blood	At delivery	Negative	IgG (1:1,600); IgM not detected	NA
Amniotic fluid	At delivery	Negative	IgG; IgM not detected	NA
Vaginal swab sample	At delivery	Negative	NA	NA
Neonate ear swab sample	At delivery	Negative	NA	NA
Neonate oral swab sample	At delivery	Negative	NA	NA
Placenta	At delivery	Negative	NA	Negative for Ebola antigen
Umbilical cord	At delivery	NA	NA	Negative for Ebola antigen
Colostrum	1 day after delivery	Negative	IgG; IgM not detected	NA

\*NA, not applicable; rRT-PCR, real-time reverse transcription PCR.





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## THE UTILITY OF A MOBILE EBOLA ASSESSMENT FOR PERSONS UNDER INVESTIGATION

### OVERVIEW

As hospitals in Los Angeles County (LAC) developed capabilities and were designated by the Centers for Disease Control and Prevention (CDC) as Ebola Assessment and Treatment Facilities, the Department of Public Health (DPH) referred people under investigation (PUI) as suspect Ebola cases to those facilities for evaluation. This process required standing-up special units with dedicated, trained staff and strict personal protective equipment and other requirements to prevent potential spread of infection. As a result, evaluating a PUI substantially disrupted hospital operations, critically ill patients needed to be moved, additional staff needed to be called in, and financial costs were substantial. Because of these challenges, hospitals exhibited some reluctance to evaluate patients. At the suggestion of medical staff at one of the Ebola treatment hospitals, LAC DPH initiated a process to explore the feasibility and plan for a mobile assessment of a PUI. Not only would this approach address the challenges associated with a hospital-based evaluation, it also would be less disruptive and faster for the patient while continuing to ensure an appropriate level of care.

### ACTIVITIES

LAC DPH began by vetting the concept with the California Department of Public Health (CDPH) and CDC. Because no other jurisdictions had developed plans for mobile assessment, a cross-program, multi-disciplinary team met to plan all aspects of the strategy with a primary goal of ensuring appropriate evaluation of the PUI and safety for the evaluation team. Participants in planning included staff from ACDC, Public Health Lab (PHL), Emergency Preparedness and Response Program, Environmental Health, Community Health Services, the Public Information Officer, Emergency Medical Services, fire and police departments, and the Ebola treatment hospital.

### OUTCOMES

Ultimately, through the course of our response to the Ebola outbreak that ended in January 2016, this novel approach was used twice to evaluate PUIs during August 2015. An on-scene incident command post and staging area was established at a fire station near the PUIs' residence. The patients were evaluated by infectious disease staff in their home and specimens were obtained, packaged, and taken to the PHL where (negative) results were available within three hours. Mobile assessment proved to be effective, safe, rapid, and prevented the disruption of hospital healthcare services and provided a model for other jurisdictions in future public health emergency responses.

### BARRIERS

Challenges to implementing mobile evaluation included discomfort of staff in full personal protective equipment (PPE) in Los Angeles summer heat, risks to privacy from neighbors, and adequacy of patients' homes as settings to conduct the evaluation safely and effectively. Because of the care with which planning was done, prior training of all staff who had participated in previous hospital-based assessments,



good collaboration between LAC DPH and hospital staff, and coordination with LAC emergency response agencies, all these challenges were overcome.



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## TOWARD AN INDIVIDUALIZED APPROACH TO DEFINE FEVER AMONG TRAVELERS FROM EBOLA-AFFECTED COUNTRIES OR PERSONS WITH EXPOSURE TO AN EBOLA PATIENT

### OVERVIEW

Early detection of Ebola virus disease (EVD) is critical to preventing its spread. With the occurrence of EVD cases outside of West Africa, the US screened and monitored travelers from affected countries. Because fever is a key indicator of possible EVD among monitored travelers, high sensitivity in defining fever is critical.

We evaluated two novel methods that defined fever as a temperature increase of  $\geq 1^{\circ}\text{C}$  ( $1.8^{\circ}\text{F}$ ) over baseline using data from 45 travelers monitored by the Los Angeles County Department of Public Health (LAC DPH) between October 20 and December 30, 2014. Individual baselines were defined as either the cumulative moving average of all temperatures before the peak measurement or the mean of the first six measurements.

Temperatures measured by travelers ranged from  $33.2^{\circ}\text{C}$  ( $91.8^{\circ}\text{F}$ ) to  $37.3^{\circ}\text{C}$  ( $99.1^{\circ}\text{F}$ ). Individuals' mean temperatures ranged from  $35.3^{\circ}\text{C}$  ( $95.6^{\circ}\text{F}$ ) to  $36.9^{\circ}\text{C}$  ( $98.4^{\circ}\text{F}$ ). Applying our proposed definitions, each individual's fever threshold would be less than the Center for Disease Control and Prevention's (CDC) reference level of  $38.0^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ), and for 62% would be less than that of the Dallas nurse who traveled with a temperature of  $37.5^{\circ}\text{C}$  ( $99.5^{\circ}\text{F}$ ) and later was diagnosed with EVD. While no traveler to Los Angeles County (LAC) developed EVD and sensitivity could not be calculated; nonetheless, a better method for determining a threshold for travelers would be helpful. One monitored traveler who was not diagnosed with EVD had a peak temperature  $1.3^{\circ}\text{C}$  ( $2.3^{\circ}\text{F}$ ) higher than the mean; thus, the specificity of our fever definition was 97.8%.

A limitation of this analysis is the relatively small number of persons monitored in California and for whom data are available. Analysis of data from other health departments would help refine the specificity estimate. This strategy may be useful not only for EVD but also other infectious conditions where temperature monitoring is done.

Early detection of persons with EVD is critical to preventing the spread of infection. As EVD cases have occurred outside of West Africa, screening and monitoring of travelers from affected countries have been implemented in several countries. In October 2014, US health officials began airport screening of travelers from affected countries. Initial screening includes identifying exposures and defining risk-level, measuring temperature and assessing other symptoms that may be compatible with EVD. Subsequent monitoring by the health department at the traveler's final destination includes twice daily temperature measurements and assessment of other symptoms for a 21-day period during which EVD becomes manifest among the large majority of infected people [1,2].



Fever is a key indicator in the detection of EVD as an early and common symptom among ill persons. Among 1,152 EVD patients in the West Africa outbreak, 87.1% had a measured temperature of  $>38^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ) or a history of fever [2]. Among 103 persons in an earlier Democratic Republic of Congo outbreak, 93% were febrile [3]. The threshold for defining fever among travelers arriving from affected countries and for contacts of EVD patients in the US initially was defined as  $38.6^{\circ}\text{C}$  ( $101.5^{\circ}\text{F}$ ) but subsequently was lowered to  $38.0^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ) to increase sensitivity.

The suitability of this definition was questioned, however, when a nurse who cared for a US EVD patient traveled by airplane with a temperature of  $37.5^{\circ}\text{C}$  ( $99.5^{\circ}\text{F}$ ) and was later diagnosed with EVD [4]. For the CDC and state and local health departments monitoring travelers, fever detection is an important component of monitoring to protect public health and to maintain public confidence.

The widely used definition of  $37.0^{\circ}\text{C}$  ( $98.6^{\circ}\text{F}$ ) as normal body temperature and  $38.0^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ) as fever is based on an 1868 study by Wunderlich and Seguin [5]. More recent studies have challenged this definition, finding variation between individuals and systematic differences based on age, gender, time of day, and method of measurement [6-8]. For example, among 148 healthy Baltimore adults ages 18 through 40 years, 700 temperature measurements showed a mean temperature of  $36.8^{\circ}\text{C}$  ( $98.2^{\circ}\text{F}$ ) and a range from  $35.6^{\circ}\text{C}$  ( $96.1^{\circ}\text{F}$ ) to  $38.2^{\circ}\text{C}$  ( $100.8^{\circ}\text{F}$ ); women's temperature was significantly higher than that of men and temperatures in the morning were significantly lower than in the evening [6].

High sensitivity in defining fever is critical for early detection of EVD. An unrecognized case ("false negative" from monitoring) may transmit infection, expose additional persons posing a greater burden for public health agencies, and increase fear of EVD in the community. High specificity also is important given the resources required for diagnosis and the potential disruption of the healthcare system in evaluating a suspected case. Following a report showing low sensitivity of temperature cutoffs of  $38.6^{\circ}\text{C}$  ( $101.5^{\circ}\text{F}$ ) and  $38.0^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ) for Ebola among five patients who had serial temperature measurements, we re-evaluated our approach to defining fever among monitored travelers in LAC [9]. Another example that prompted our re-evaluation is the experience from Spain where an infected nurse assistant had "low-grade fever"  $<38.0^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ) for several days before Ebola diagnosis [10].

Whereas using a single fever threshold is necessary when a person is evaluated for infection *de novo*, in a setting where serial measurements are obtained before illness occurs (e.g. where a person is being monitored), healthcare providers have the ability to refine the definition of fever as a difference from the individual's own baseline. In this report, we analyze data from travelers monitored by LAC DPH and the California Department of Public Health (CDPH) to evaluate two potential definitions of fever that may increase the sensitivity of EVD detection while remaining highly specific.



## METHODS

During the EVD West Africa outbreak, the CDC informed CDPH of all people from an Ebola-affected countries traveling to the state. CDPH then forwarded traveler contact information to the local health department where the traveler would reside, and that health department monitored the traveler for fever and other Ebola-associated symptoms for 21 days following their last possible exposure, generally their departure from West Africa [11]. Travelers were given a digital oral thermometer on their entry to the US and asked to take their temperature twice daily, in the morning and evening, although specific times were not defined. Measured temperatures and other symptoms were recorded on a diary card and reported in a daily telephone call with the local health department. As a public health surveillance and emergency response activity, informed consent was not required to collect these data from persons being monitored. This study used anonymized data that was maintained in encrypted form and was approved as exempt research by the LAC DPH Institutional Review Board.

At the onset of monitoring for persons in LAC, public health nurses provided education to all adult travelers about how to take oral temperatures. At an initial home visit, travelers were asked to demonstrate taking their temperatures orally. Two children, ages 2 and 3 years, had axillary temperatures measured. Because temperatures from these children were low (with some measurements  $<34.0^{\circ}\text{C}$  [ $93.2^{\circ}\text{F}$ ]) and variable, suggesting difficulty with accurate measurement using this method, they are excluded from the analysis.

Between October 20 and December 31, 2014, 47 travelers were monitored by the LAC DPH ( $n=38$ ) and by other counties reporting to CDPH ( $n=9$ ). Data from travelers with at least six temperature measurements are included in this report. For each traveler, we determined the overall mean temperature, the mean temperatures in the morning and evening, and the maximum temperature. We established an individual's baseline temperature in two ways: 1) as the mean of all temperatures before the person's maximum temperature (cumulative moving average, CMA), with a minimum of at least 6 measurements, and 2) as the mean of the first six temperatures recorded (first-6 mean). We calculated the specificity of definitions of fever as  $1.0^{\circ}\text{C}$  ( $1.8^{\circ}\text{F}$ ) higher than a person's CMA or first-6 mean temperatures. While sensitivity could not be assessed as none of the travelers were diagnosed with EVD, we determined individual and overall mean differences between our definitions of fever and that of the CDC ( $38.0^{\circ}\text{C}$  [ $100.4^{\circ}\text{F}$ ]).

Data were entered into a Microsoft Excel 2010 file and analyzed using Excel and SAS software, version 9.3. Associations of temperature with time of day, age group, gender, and gender-specific age groups were assessed using a student t-test.

## RESULTS

Data from 45 travelers who had six or more oral temperature measurements were analyzed. Overall, 1,335 measurements were recorded (mean 29.7 per person). No travelers were identified as having EVD. Ages ranged from 4 to 67 years, and 44 (97.8%) were age 20 years or greater; 66.7% were male. Compliance with measuring temperature was 98.7% (18 of 1,335 potential observations missing).





The temperatures measured and reported by travelers ranged from 33.2°C (91.8°F) to 37.3°C (99.1°F). Individuals' mean temperatures ranged from 35.3°C (95.6°F) to 36.9°C (98.4°F) (Figure 1). The mean and median of the individual mean temperatures were 36.3°C (97.3°F) and 36.4°C (97.5°F), respectively. The morning mean and the evening mean were not different (both 36.3°C [97.3°F]) (Figure 2). Women's mean temperature was higher than that among men (36.5°C [97.7°F] and 36.2°C [97.2°F], respectively,  $p=0.07$ ). Among adults age 20 to 59 years, women had a significantly higher mean temperature than men ( $p<0.01$ ). Individuals' maximum temperatures were on average 0.59°C (1.06°F) greater than their mean temperatures. The mean differences between mean and maximum temperatures for women and men were 0.61°C (1.10°F) and 0.51°C (0.92°F), respectively.

Applying a proposed definition of fever as at least 1.0°C (1.8°F) greater than an individual's mean temperature, using the CMA of all temperature measurements before the maximum value, the temperature cutoff for fever would be from 36.7°C (98.1°F) to 37.9°C (100.2°F). Thus, for all travelers, this threshold would be lower than CDC's 38.0°C (100.4°F) reference level. In addition, for 28 (62%) of 45 travelers, the threshold would be lower than the temperature at the time of travel (37.5°C [99.5°F]) of the Dallas nurse who later developed EVD. For one traveler, the maximum temperature was 1.3°C higher than the mean; thus, the specificity of our fever definition was 97.8%. This 52-year old male's reported temperatures ranged from 33.2°C (91.8°F) to 36.8°C (98.2°F) and eight of his 24 measurements were lower than 35.0°C (95.0°F). His mean temperature of 35.3°C (95.6°F) was lower than that of any other traveler.

Using the first six temperature measurements to define a person's baseline temperature yielded very similar results to defining a baseline as the mean of all measurements before their maximum temperature. Of 45 travelers with more than six measurements, for 23 (51%) the means using the two methods were the same, for 18 (40%) were within 0.1°C (0.2°F), for 3 (7%) were within 0.2°C (0.4°F), and for 1 (2%) was within 0.3°C (0.5°F). Where results differed, for 12 persons the first-6 mean was higher, and for 10 it was lower than the CMA. For two travelers, maximum temperatures exceeded the first-6 mean temperature by >1.0°C (1.8°F): one was the same traveler who exceeded the CMA threshold described above, and the other was a traveler whose maximum temperature was 1.0°C (1.8°F) over the first-6 mean baseline and 0.9°C (1.6°F) higher than the CMA baseline.

## DISCUSSION

Early identification of EVD among travelers and case-contacts is a public health priority. Given the significance of fever as an early sign of illness and recognizing that people's baseline temperatures may substantially vary; it may be beneficial to explore fever definitions other than the classical single threshold identified almost 150 years ago. Based on the range of mean temperatures we observed, the increase among persons monitored in California required to exceed the CDC 38.0°C (100.4°F) threshold, ranged between 1.1°C (2.0°F) and 2.7°C (4.9°F). Where this increment is smaller, the specificity of this definition may be lower whereas where the difference is greater, the sensitivity would be lower. Fever due to infection occurs with the release of cytokines which act at the hypothalamic thermoregulatory center to elevate the temperature set point [12]. Thus, it is plausible that the temperature of people early in their Ebola illness varies with their baseline temperature and the elevation of their own temperature set point.



The temperature increase with infection has been shown to be less among the elderly [13] making a more sensitive fever threshold particularly important in this group.

To our knowledge, there are limited data on serial temperature measurements in persons early in the course of EVD. A description of the first case acquired in Europe associated with the West Africa epidemic noted “low-grade fever” (temperature  $<38^{\circ}\text{C}$  [ $100.4^{\circ}\text{F}$ ]), which continued for three days, but the specific temperatures were not published [10]. A note about five EVD patients who had serial temperature measurements suggested sensitivities of 79% and 53% for cutoffs of  $38.0^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ) and  $38.6^{\circ}\text{C}$  ( $101.5^{\circ}\text{F}$ ), respectively [9]. However, this analysis assessed all temperatures measured during the course of their illness rather than focusing on temperatures at the time of presentation. Reviewing data from the five patients cited shows one of five with temperatures less than  $38.0^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ) during the first two days of their illness [14-16]. Data from the current EVD outbreak in West Africa may be available to better define the sensitivity of different fever thresholds at the onset of illness.

The performance of our two proposed definitions of fever was similar. For one false positive identified by both methods, the variability in temperature measurements and the frequency of temperatures less than  $35.0^{\circ}\text{C}$  ( $95.0^{\circ}\text{F}$ ) suggests measurement error. Intervention by a public health nurse reinforcing the proper way to take an oral temperature and elimination of very low measurements from calculating the baseline may increase accuracy. Applying the first-6 mean method would be easier for nursing staff since this value could be calculated after the first three days of monitoring and daily temperatures compared with this value. Because the CMA method requires recalculating the mean after each measurement, the monitoring process would be more complex. With either method, during the first three days before a baseline is established, using a single threshold for all persons monitored would be necessary. Based on our data and experiences from EVD among nurses from Dallas and Spain, an initial  $37.5^{\circ}\text{C}$  ( $99.5^{\circ}\text{F}$ ) threshold may be reasonable. Importantly, identifying a temperature that exceeds the threshold or identifying other EVD-compatible symptoms only signals the need for more evaluation including a thorough clinical and epidemiological assessment; thus, a “false positive” result for fever would lead to additional evaluation and potentially laboratory testing for Ebola.

A limitation of this analysis is the relatively small number of persons who have been monitored in California and for whom data are available. Further data from travelers we monitor and from those who are monitored by health departments elsewhere can be analyzed to refine the estimate of specificity. Because none of the travelers monitored developed EVD, we cannot quantify the increment in sensitivity of our fever definitions. Necessarily, sensitivity would be similar to or greater than the CDC reference level because each individual’s cutoff would be equal to or below  $38.0^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ). Because we did not observe temperatures being measured and cannot ensure the correct placement of the thermometer, some temperatures may be falsely low, and the mean and range from our population may not be directly comparable with the data from Wunderlich [5] or Mackowiak [6] where temperatures were measured by healthcare personnel. We also did not collect data on the use of antipyretics or assess other factors that may have influenced temperature measurements. Finally, we emphasize that decisions about evaluating



a traveler for EVD should be based on a complete assessment including their exposure history, symptoms, and contextual factors such as ill contacts.

While the focus of this analysis is to develop and test hypotheses that may lead to improved early detection of EVD among travelers from outbreak-affected countries, this approach also may be relevant to other public health settings. It could be used for other emerging infections such as Severe Acute Respiratory Syndrome (SARS) or Middle East Respiratory Syndrome (MERS), for which travelers from specific countries or those who have had defined exposures may be monitored. For hospitalized patients where vital signs are regularly measured, graphing the temperature and identifying increases, which do not exceed an arbitrary cutoff, may trigger further investigation and diagnostic testing, increasing detection of nosocomial infection [17]. Finally, as the current EVD outbreak is likely to continue well into 2015, monitoring and early detection of this illness remain important.

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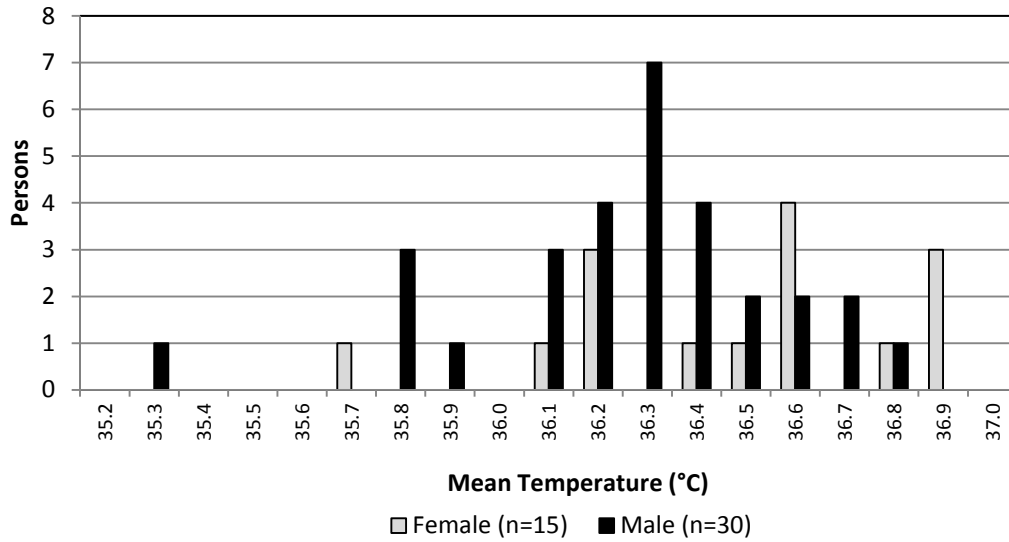


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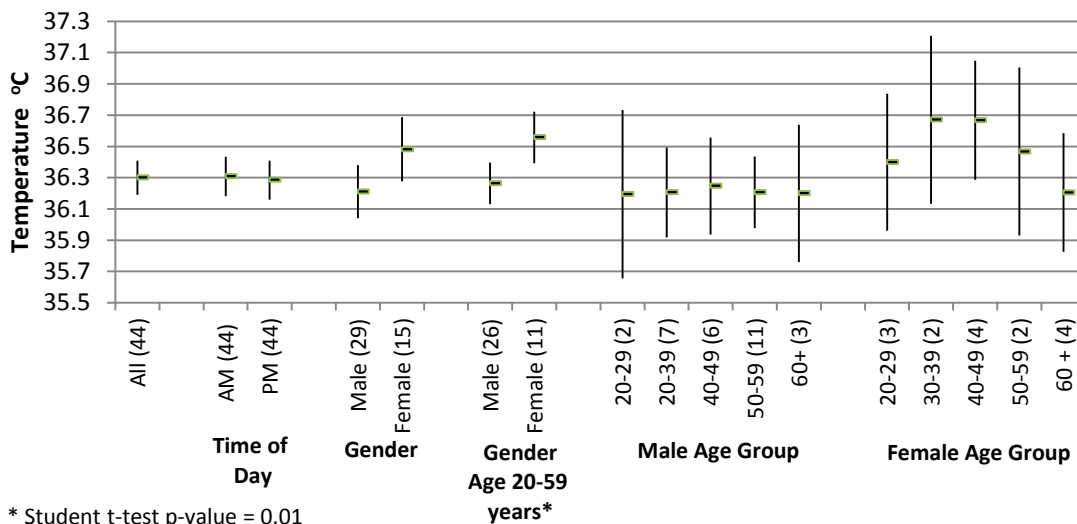
**Acknowledgements:** The authors gratefully acknowledge the Public Health Nurses, Area Medical Directors and Area Health Officers, Division of Community Health Services, Los Angeles County Department of Public Health, for their work communicating daily with travelers to monitor temperatures. We also acknowledge Liora Schwartz whose insistence that she had a fever with a temperature < 37.5°C (97.5°F) because it was higher than her baseline provided the idea for this analysis.



**Figure 1. Distribution of mean temperatures among 45 travelers from EVD affected countries being monitored by the LAC and CDPH**



**Figure 2. Mean oral temperatures and 95% confidence interval (vertical bars) for 44 travelers (adults  $\geq 20$  years old) monitored by the LAC and CDPH**





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## OUTBREAK OF *SALMONELLA* AT A RESTAURANT IN LOS ANGELES COUNTY: PART OF A MULTI-JURISDICTION OUTBREAK

### OVERVIEW

On Thursday, 9/17/15, the Los Angeles County Department of Public Health (LAC DPH) received a foodborne illness report (FBIR) via the web.<sup>3</sup> The initial complainant reported 15 out of 18 ill after eating on Friday, 9/11/15. Initial food items reported were salad, zucchini carpaccio, crostini, bread and olive oil, mushroom truffle croquette, risotto, and an apple tart. Symptoms included diarrhea, abdominal cramps, fevers, body aches, and headaches. ACDC initiated an outbreak investigation to determine the extent of the outbreak, risk factors for the disease, and steps needed to prevent further spread.

### METHODS

- An outbreak-associated case was defined as a person eating at the FBIR-implicated restaurant between 9/6/15 and 9/13/15 who had:
  - 1) a stool, urine, or blood sample taken which grew *Salmonella*, or
  - 2) diarrhea and fever, or
  - 3) diarrhea and two of the following symptoms: nausea, fatigue, chills, fever, headache, body aches, or abdominal cramps.

An outbreak-associated control was defined as a person who ate at the restaurant during the same period of time but did not become ill with any gastrointestinal symptoms.

- LAC DPH Environmental Health Services (EHS) contacted the parties on the FBIR complaints to obtain contact information and preliminary information for all members.
- EHS conducted two inspections of the restaurant on 9/17/15 and 9/18/15.
- EHS requested contact information for all reservations made between 9/1/15 and 9/18/15.
- ACDC contacted the individuals who made reservations for case and control finding.
- ACDC created a food history and illness questionnaire for all the complainants from the FBIRs and interviewed them via telephone.
- ACDC collected data in MS Access and calculated frequency and distribution of symptoms among cases. Analyses of food items and combination of food items were also performed. All analyses were conducted using SAS 9.3 analysis software and MS Excel.
- ACDC sent out a health advisory to hospitals requesting to be notified of salmonellosis patients who could potentially be cases of the outbreak.
- ACDC created a separate questionnaire to interview employees on job duties, food history, and possible illnesses prior to the outbreak.
- ACDC, in conjunction with the District Public Health Nurses (PHNs), conducted a site visit on 9/18/15 to interview employees and initiate the process of stool collection.
- ACDC and EHS discussed food preparation with restaurant management and executive chef and obtained recipes with ingredient lists and invoices.

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<sup>3</sup> [www.visualcmr.net/webvcmr/pages/public/pub\\_FBI\\_Report.aspx](http://www.visualcmr.net/webvcmr/pages/public/pub_FBI_Report.aspx)



- PHNs questioned all routinely reported *Salmonella* cases to determine if they had any connection to the LAC restaurant. Any new cases identified by the PHNs were additionally interviewed over the phone by ACDC with the outbreak food and illness history questionnaire.
- Employee stool samples were collected through the restaurant and received by PHNs at their District Health Centers.
- The LAC DPH Public Health Laboratory (PHL) tested all the employee stool specimens and provided results.
- PHL serotyped and determined the pulsed-field gel electrophoresis (PFGE) patterns for all the employee and case isolates.
- ACDC collaborated with Centers for Disease Control and Prevention (CDC) and Food and Drug Administration (FDA) via conference call and email to investigate the multistate outbreak and product trace back.

## RESULTS

### Setting

On Friday, 9/11/15, a group of employees went to an LAC restaurant for a company luncheon. This restaurant is a dine-in restaurant offering cuisine found in the Riviera and Coastal regions of France, Italy, and Spain. Some food items include ravioli, crostini, salad, lamb chops, risotto, zucchini carpaccio, branzino, truffle mushroom croquettes, and crème brulee. Wine and other alcoholic beverages are additionally available upon order. Patrons typically consume their food at the establishment; however, the restaurant also offers catering services. The restaurant is open seven days a week for lunch and dinner. On Saturday and Sunday, they serve brunch. It is frequented by families and friends who gather to share a meal or to celebrate special events. It is a popular location to hold special events such as weddings, baby showers, birthdays, and work luncheons. Employees are responsible for all the preparation and service of a majority of the food, but some food items come semi-prepared from a commissary in Long Island City, New York.

Among this LAC group, 15 out of 18 people eating at the restaurant reported becoming ill. EHS obtained line lists of the diners and ACDC interviewed luncheon attendees via telephone. Interviews were conducted with 13 of those individuals (87%). During this time, a public health nurse notified ACDC of an employee of the restaurant who tested culture positive for *Salmonella*. Subsequently, all CHS PHNs were notified of a potential outbreak. PHNs soon identified eight additional cases connected to the restaurant. ACDC made contact with all eight cases. In the following week, ACDC received eight more FBIRs identifying individuals who ate at the LAC restaurant and experienced illness between 9/6/15 and 9/13/15. Collectively, food and illness history questionnaires were completed on 81 individuals. Contact information for these individuals were obtained through FBIRs, reservation lists provided by the restaurant, and routinely reported cases PHNs identified as having recently eaten at the restaurant.

Out of the 81 individuals interviewed, 42 cases and 29 controls were identified. The remaining 10 individuals were ill, but did not meet case definition. Out of the 11 laboratory confirmed cases, 10 stool



samples were collected by the private medical facilities the cases visited, and one sample was collected by public health. All isolates of confirmed cases were forwarded to the PHL for serotyping and PFGE testing.

### **Cases: Restaurant Patrons**

The median age of cases was 33 years, ranging from 19-85 years (Table 1). Cases were both male (21%) and female (79%). The controls included males (24%) and females (76%) with a median age of 35 years (range: 23-93 years) (Table 1). Main symptoms of cases included diarrhea (100%), abdominal cramps (98%), nausea (81%), fever (38%), and chills (71%) (Table 2). Illness onsets occurred between 9/6/15 and 9/19/15 (Figure 1). The median incubation period was 30 hours (range: 2 to 139 hours). The median duration was slightly longer than 4 days (range: 1 day to at least 14 days). A total of 11 restaurant patrons had confirmed positive *Salmonella* Enteritidis laboratory cultures with the PFGE pattern JEGX01.0008.

### **Food Analysis**

The results of the statistical analysis of food items eaten by attendees are shown in Table 3. The truffle mushroom croquette (p-value <0.001) was eaten by 86% of cases and the tajine (p-value 0.016) was eaten by 36% of cases. Both food items were found to be significantly associated with illness.

### **Restaurant**

#### Inspection

All patrons interviewed consumed the food at the restaurant. The inspection by EHS on 9/17/15 revealed violations such as an employee eating while preparing food and the absence of gloves while having contact with food. The restaurant voluntarily closed that day for cleaning. The restaurant disposed of all food items and brought in new food stock. A third party food safety consultant was hired to train staff and provide guidance on food safety matters. Also, a cleaning service company was hired to conduct a deep cleaning of equipment in the kitchen.

EHS also conducted a second site visit the next day, 9/18/15, which included a walk-through of the areas that were cleaned the day before. The restaurant was allowed to hold a special pre-booked event on the evening of 9/18/15. Food and employees for this special event were from a sister location not associated with the outbreak.

#### Employees

There were 121 employees reported to ACDC. Contact was made with all 121 employees through in-person interviews or self-administration of interview sheets distributed by upper management at the restaurant. Out of 121, 23 employees admitted to gastrointestinal symptoms. Stool samples were collected from any employee that handled food or reported being symptomatic within the last month. The PHL performed the test for results. A total of 14 employees had positive stool cultures for *S. Enteritidis*, with PFGE pattern JEGX01.0008.





ACDC and CHS worked with the restaurant managers to ensure that these 14 employees were either removed from the restaurant until they were cleared by standard procedures or were placed in duties that did not involve food handling.

## DISCUSSION

This is a laboratory confirmed *S. Enteritidis* outbreak. The PHL, in conjunction with private labs, yielded a total of 25 positive *Salmonella* tests. Patrons and employees had identical serotypes and PFGE patterns. Patrons who tested positive were from separate dining groups and had eaten at the restaurant at different times or dates. Several cases were identified from routine *Salmonella* surveillance rather than foodborne illness reporting. Presumptive cases also reported severe symptoms such as ongoing diarrhea, fever, headaches, and body aches. Truffle mushroom croquettes and tajine were items found to be significantly associated with illness. Although the tajine resulted as significantly associated, 11 of the 12 individuals who ate tajine also ate the truffle mushroom croquette. In other words, the association of the tajine with illness is confounded by the consumption of the truffle mushroom croquette.

According to the CDC, *Salmonella* results in symptoms of diarrhea, fever, and abdominal cramps. Individuals generally become symptomatic 12 to 72 hours after being infected and remain so for approximately 4-7 days [1]. Children, elderly, immunocompromised, and individuals with severe symptoms may require hospitalization. Certain food items and meats are known to cause Salmonellosis when not properly heated. In particular, *S. Enteritidis* infection is most commonly associated with eggs, but other sources include raw milk, pork, beef, sprouts, and raw almonds [2]. In this outbreak investigation, the items mentioned above were not suspected to be the cause of infection.

The spread of *Salmonella* in this restaurant could have been through a contaminated ingredient used at multiple locations. Produce, for example, can be contaminated at the source before it is shipped through dirty irrigation water, manure, or animal contact. If *Salmonella* is able to contaminate one piece of a larger batch of produce, cross contamination would occur throughout the rest of the batch [3]. This restaurant, and its other locations, use ingredients that are pre-prepared in a commissary and then individually shipped out to each location. Particular to this investigation, black trumpet mushrooms were found to be one of those ingredients that are shipped to the commissary, dried, and then sent to the restaurants. The restaurant then prepares a puree by blending the dried mushrooms with oil, and the puree is used to garnish a few dishes including the truffle mushroom croquettes. Due to the absence of a heat kill step, it is possible the mushrooms, and therefore the puree, were contaminated before they were distributed. The CDC and FDA are involved in an ongoing multistate investigation with this restaurant and its commissary.

The cooking of the truffle mushroom croquettes also introduces a possible pathway for the spread of *Salmonella*. This item is partially prepared in the commissary and then finished in the kitchen of the restaurant. The commissary prepares a frozen truffle mushroom croquette mix that is shipped to each location. At the restaurant, the frozen mix is cut into cubes, dipped in flour and eggs, and fried. If the internal temperature of the croquette does not reach a minimum of 165°F, *Salmonella* may still survive.



Another source of the *Salmonella* could have been an infected food handler at the commissary. Infected individuals can excrete the bacteria in their feces for a few days or several weeks, depending on how quickly their bodies are able to rid the gastrointestinal tract of the illness [3]. *Salmonella* can remain in a person's system even after symptoms have resolved. Food handlers are possible sources of *Salmonella* due to the nature of their work [3-6]. Food handlers at the restaurant were most likely infected themselves when eating the contaminated food and were not the source. Food handlers were likely exposed due to the family style meals eaten on site every day. Also, because there was an outbreak of *Salmonella* with the same PFGE pattern at another location of this restaurant chain, it is more likely a food handler at the commissary would be implicated.

### LIMITATIONS

Cases that are found through routine *Salmonella* surveillance occasionally have difficulties recalling when and what they ate. Persons may eat out frequently and the restaurant is one of many exposures. More time has also passed for these cases compared to the individuals who report foodborne illness. As a result, it is also harder to remember the date and time their symptoms first began. These are individuals who have already been diagnosed and may be ascertained several days after resolution of their symptoms.

### PREVENTION

EHS educated restaurant owners and managers about sanitization and ways to prevent future *Salmonella* infections. The PHNs and ACDC educated all the restaurant workers and individual salmonellosis cases on the spread of *Salmonella* and the importance of staying home when ill to prevent spreading sickness.

### CONCLUSION

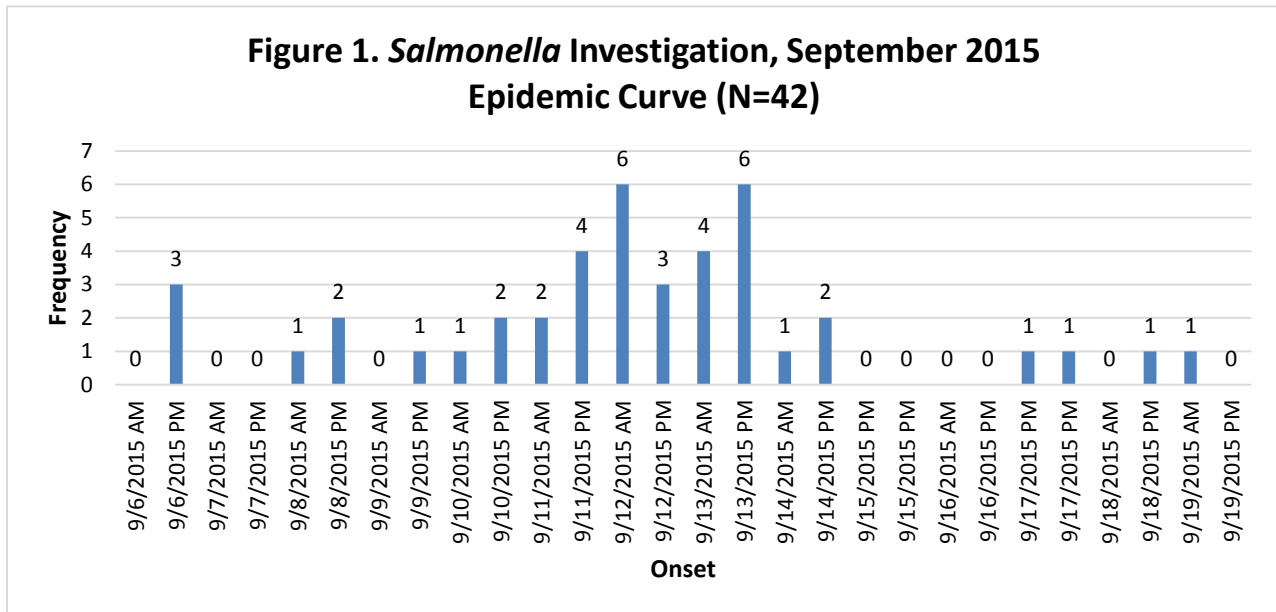
This is a single outbreak that occurred among patrons who dined at this restaurant between 9/6/15 and 9/13/15. This outbreak occurred in a specific restaurant location but is part of a larger cluster nationwide. The agent *S. Enteritidis* was confirmed by laboratory results. No additional complaints or illnesses have been reported for this restaurant location since the restaurant has taken appropriate measures to remove all potential causes of this outbreak. ACDC in conjunction with EHS will monitor for future reports of foodborne illness.

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	Cases (n=42)		Controls (n=29)	
	N	(%)	N	(%)
Male	9	(21%)	7	(24%)
Female	33	(79%)	22	(76%)
Age Group (years)				
<1	0	(0%)	0	(0%)
1-4	0	(0%)	0	(0%)
5-9	0	(0%)	0	(0%)
10-19	1	(2%)	0	(0%)
20-49	31	(74%)	22	(76%)
50-74	9	(21%)	3	(10%)
>74	1	(2%)	1	(3%)
Unknown	0	(0%)	3	(10%)
Median age	33 years		35 years	
Age range	19-85 years		23-93 years	

Symptom	N	%
Fatigue	32	76%
Nausea	34	81%
Diarrhea	42	100%
Bloody Diarrhea	5	12%
Body Aches	25	60%
Abdominal cramps	41	98%
Dizziness	18	43%
Chills	30	71%
Vomiting	12	29%
Headache	22	69%
Fever	16	38%
Fever > 102°F	0	0%
Tingling	2	5%
Median Duration=1.7 days (range 1-5 days)		
Median Incubation=34 hours (range 2-51 hours)		



Food Item	Cases (N=42)			Controls (N=29)			p-value
	Percent	n	N	Percent	n	N	
Salad	17%	7	42	38%	11	29	0.043
Fig & Gorgonzola Risotto	10%	4	42	7%	2	29	0.696
Crostini	67%	28	42	69%	20	29	0.839
<b>Truffle Mushroom Croquette</b>	<b>86%</b>	<b>36</b>	<b>42</b>	<b>17%</b>	<b>5</b>	<b>29</b>	<b>&lt;0.001</b>
Filet Mignon Salad	12%	5	42	14%	4	29	0.814
Caramelized Apple Tart	21%	9	42	10%	3	29	0.221
Zucchini Carpaccio	17%	7	42	10%	3	29	0.452
Lamb	21%	9	42	10%	3	29	0.221
Beef Carpaccio	2%	1	42	3%	1	29	0.789
<b>Tajine</b>	<b>36%</b>	<b>15</b>	<b>42</b>	<b>10%</b>	<b>3</b>	<b>29</b>	<b>0.016</b>
Bread	36%	15	42	38%	11	29	0.849
Olive Oil	38%	16	42	38%	11	29	0.989
<b>Water</b>	<b>60%</b>	<b>25</b>	<b>42</b>	<b>90%</b>	<b>26</b>	<b>29</b>	<b>0.008</b>
Ice	26%	11	42	38%	11	29	0.293
Truffle Risotto	2%	1	42	3%	1	29	0.789
Pot de Cream	10%	4	42	14%	4	29	0.576
Tartufo	7%	3	42	0%	0	29	0.141
Salmon	19%	8	42	10%	3	29	0.319
Paella	7%	3	42	7%	2	29	0.968
Buratta	5%	2	42	3%	1	29	0.787
Octopus	7%	3	42	3%	1	29	0.507
Sea bass	5%	2	42	3%	1	29	0.787



## A CONFIRMED NOROVIRUS OUTBREAK ASSOCIATED WITH OYSTERS

### OVERVIEW

From Friday, 2/27/15, to Tuesday, 3/3/15, the Los Angeles County Department of Public Health (LAC DPH) received three separate foodborne illness reports (FBIRs) via the web<sup>4</sup> all describing illness after at the same restaurant. All three groups reported eating the buffet that includes a variety of raw seafood, sushi rolls, and side dishes. Gastrointestinal (GI) illness symptoms included vomiting, diarrhea, stomach cramps, and nausea. The ACDC initiated an outbreak investigation to determine the extent of the outbreak, risk factors for the disease, and steps needed to prevent further spread.

### METHODS

- An outbreak-associated case was defined as a person eating at the restaurant between 2/22/15 and 3/1/15 who had:
  - a) a positive lab result of norovirus, or
  - b) diarrhea and vomiting, or
  - c) diarrhea or vomiting plus two or more additional GI symptoms including dizziness, nausea, abdominal cramps, fatigue, headaches, body aches, chills, and fever.

An outbreak-associated control was defined as a person who ate at the restaurant during the same period of time but did not become ill with any GI symptoms.

- LAC DPH Environmental Health Services (EHS) contacted the parties on the FBIR complaints to obtain contact information for all attendees.
- EHS conducted three inspections of the restaurant on 2/27/15, 3/4/15, and 3/6/15.
- EHS requested contact information for complaints of illness made directly to the restaurant between 2/22/15 and 3/1/15.
- ACDC created food history and illness questionnaires for all FBIR and restaurant complainants.
- ACDC called all members of the parties on the FBIRs and interviewed them via telephone. ACDC also called those who complained directly to the restaurant and interviewed patrons either over the phone or via a fillable questionnaire.
- ACDC interviewed and collected stool samples from all the restaurant employees.
- Oysters were tested for norovirus by the Gulf Coast Seafood Laboratory, Dauphin Island, Alabama.
- ACDC collected data in MS Access and calculated the frequency and distribution of symptoms among cases. An analysis of food items consumed was also performed. All analyses were conducted using SAS 9.3 analysis software and MS Excel.
- The Public Health Laboratory (PHL) performed laboratory tests for all the employees and patrons who submitted stool samples, checking for norovirus, *Salmonella*, and *Shigella*.

<sup>4</sup> [www.visualcmr.net/webvcmr/pages/public/pub\\_FBI\\_Report.aspx](http://www.visualcmr.net/webvcmr/pages/public/pub_FBI_Report.aspx)



## RESULTS

Different groups (Groups A-D) were established to differentiate complainants based on food that was consumed and method of reporting illnesses. On Tuesday, 2/24/15, Group A gathered for a family dinner at a Los Angeles County (LAC) restaurant. This restaurant is an all you can eat buffet that includes large selections of seafood and sushi. Patrons order selected items from the menu. They then are served their chosen items and are allowed to order more food at no additional cost. Some reported food items included oysters, yellowtail, salmon, halibut, tempura, noodles, edamame, and scallops. EHS obtained a line list, and ACDC interviewed all 13 members of the group (100%) via telephone for their food and illness histories. Six cases and six controls were identified. One ill individual did not meet the case definition.

Group B dined that Saturday, 2/28/2015, and consumed items such as salmon rolls, oysters, tuna, and sashimi salad. This group comprised of friends from separate households. EHS obtained a line list, and ACDC called all the attendees. Interviews were completed for six out of ten (60%) individuals. All six interviewees met case definition. Stool samples were additionally collected from three of the patrons. Multiple attempts were made to contact the four non-respondents.

A member of Group C had reported food poisoning on Yelp.<sup>5</sup> ACDC contacted this individual encouraging a report to the LAC DPH. This complainant complied but chose not to cooperate further with the investigation. As a result, contact information was not provided for this party. Six out of six individuals eating with this party on Saturday evening, 2/28/15, were reported ill. Food items reported were oysters and sushi. These individuals were not included in the analysis because they could not be interviewed.

Other patrons had reported their illnesses directly to the restaurant (Group D). EHS obtained a list of names and phone numbers from the restaurant operator, and ACDC called every person on the list. Phone interviews were completed for those with valid phone numbers. These individuals were then asked to forward an electronic copy of the questionnaire to their eating companions. This method was employed due to unwillingness of patrons to give additional contact information. Nine interviews were completed from this group, and one stool sample was collected. The percentage of interviews completed cannot be calculated because the denominator for many parties were unknown. General food items reported were oysters, fish, and sushi rolls. All nine people were identified as cases.

### Cases: Restaurant Patrons

There were 21 individuals who met case definition. The median age of cases was 29 years, ranging from 24 to 65 years (Table 1). Cases were both male (43%) and female (57%). The controls also included males (50%) and females (50%) with a median age of 9 years (range 2-84 years). Symptoms of cases included diarrhea (81%), nausea (86%), abdominal cramps (76%), fatigue (90%), body aches (76%), chills (67%), vomiting (67%), and other gastrointestinal symptoms (Table 2). Illness onsets occurred between 2/24/15 and 3/2/15 (Figure 1). The median incubation period was 34 hours (range 1.5–51 hours). The median duration was 1.7 days (range 1–5 days). All four stool samples submitted by cases tested positive for the norovirus strains GI (one case) and GII (three cases). Samples were collected on 3/5/2015 and 3/6/2015,

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<sup>5</sup> [www.yelp.com/la](http://www.yelp.com/la)



which were two and three days after onset date (onset date for all four tested cases: 3/2/15). None of the cases tested positive for *Salmonella* or *Shigella*.

### **Food Analysis**

The results of the analysis of food items eaten by the patrons are shown in Table 3. Food analysis was combined for all the groups because several food items were shared across parties. Additionally, since only Group A had controls, these controls could also be compared to the cases from the other groups (Groups B-D). Several food items calculated as significantly associated with illness. These included oysters, salmon, yellowtail, halibut, sea urchin, scallop, tuna, lobster roll, and water. The most significant food items were raw oysters and raw salmon. Raw oysters were consumed by all 21 cases (100%) and 0 controls (0%), and raw salmon was consumed by 20 cases (95%) and 0 controls (0%).

### **Restaurant A**

#### Inspection

Restaurant A is a casual dining restaurant open seven days a week for lunch and dinner. It is a popular spot for family and friends to gather for a relatively inexpensive seafood meal. Items were consumed at the establishment. Patrons also are not able to bring leftover food out of the restaurant. The inspection by EHS on 2/27/15 revealed minor violations such as dirty equipment, improper food storage, and incorrect placement of cleaning chemicals. Two critical violations were noted. These included holding potentially hazardous food at unapproved temperatures and allowing employees to eat and drink in the food preparation area. An office hearing was also scheduled to discuss a plan for correction of violations. The oysters were voluntarily held from service and invoices were obtained for the oysters. At the inspection on 3/4/15, the restaurant voluntarily closed to do a thorough cleaning and sanitation of the restaurant. The remaining box of oysters was red tagged, and the oysters were collected for testing on 3/10/15. The restaurant met the necessary requirements to reopen on 3/6/15.

#### Food testing

Oysters from the suspect lot were obtained from the restaurant and submitted to the LAC PHL for norovirus testing. These were imported oysters from Korea and were shipped frozen. The PHL sent the oysters to the California Viral and Rickettsial Diseases Laboratory where a new test method was unable to detect norovirus. The oysters were then submitted to the Food and Drug Administration (FDA) Gulf Coast Seafood Laboratory where testing resulted in detection of norovirus. Two strains of norovirus, GI and GII, were found in the oysters. These are the same strains of norovirus found in the employees and patrons who tested positive for norovirus. The date and time the two employees actually became ill could not be confirmed.

#### Employees

There were 31 employees reported to ACDC, and ACDC made contact with all 31 employees (100%). One employee admitted to GI symptoms on 2/27/15. All other employees denied symptoms of GI illnesses in themselves and members of their household during the month preceding the outbreak. Stool samples were collected from the entire staff of 31 employees (100%). The PHL performed the laboratory tests for





all the employees. The one employee who reported illness tested negative for norovirus, *Shigella*, and *Salmonella*. For the remaining employees, two tested positive for norovirus and one for *Salmonella*. No employee tested positive for *Shigella*. ACDC and Community Health Services took the appropriate steps to temporarily remove these employees from work until they were cleared by standard procedures. All other workers yielded negative test results for norovirus, *Salmonella*, and *Shigella*.

## **DISCUSSION**

This outbreak is consistent with an etiology of norovirus infection and was confirmed by laboratory testing. Six individuals (four patrons and two employees) tested positive for norovirus. The one employee positive for *Salmonella* was a server who did not touch food or raw fruits and vegetables. There is no evidence that this individual infected any patrons or other employees. While multiple food items were significantly associated with illness, statistical and laboratory evidence implicated the oysters. All ill individuals reported consumption of oysters, while individuals who were not sick did not eat oysters. The restaurant had also recently purchased oysters from a different distributor and started serving those oysters around the same time cases ate at the restaurant. There were no reports of illness from patrons who ate oysters prior to the switch of distributors.

The Centers for Disease Control and Prevention (CDC) cites that “norovirus outbreaks can occur from foods, such as oysters, fruits, and vegetables, which are contaminated at their source.” Norovirus survives at cold temperatures and can easily be transmitted to humans via consumption of high risk foods not properly heated. People infected with norovirus can spread it through their feces and vomit when preparing food or contaminating common surfaces such as door knobs, tables, and restroom sinks. Having contact with a sick individual is another way to pick up the virus. It is highly contagious and can be transmitted even when symptoms are not present [1]. The incubation period for norovirus-associated gastroenteritis is usually between 24 and 48 hours with symptoms such as nausea, diarrhea, vomiting, and abdominal pain lasting 24-72 hours. It most commonly manifests itself from November to April but occurs year round.

## **LIMITATIONS**

The food analysis is limited by the small number of controls included in the analysis. Having few cases and even fewer controls reduces statistical power. Having the responses of more controls would increase the chances of finding a statistically significant association between food items and illness.

## **PREVENTION**

Wholesale Food and Safety, an EHS program, educated restaurant owners and managers about sanitization and ways to prevent future norovirus infections. Some recommendations included following guidelines for hand-washing, maintaining clean surfaces where patrons and employees frequent, and monitoring workers to ensure they are not handling food for at least 48 hours after symptoms have subsided [2]. Employees were educated on the importance of staying home from work when feeling ill. The restaurant was taught about the relationship between raw foods and norovirus as well as other



reservoirs of this virus that could be found in restaurants. ACDC additionally provided education to the restaurant managers and employees during a site visit.

### CONCLUSION

This is a single outbreak that occurred among patrons who dined at Restaurant A between 2/22/15 and 3/1/15. The agent was laboratory confirmed as norovirus. The likely source of the outbreak was the frozen imported oysters, which were found to have two strains of norovirus. These two strains were also found in the patrons. No additional complaints or illnesses have been reported following this investigation. ACDC in conjunction with EHS will monitor for future reports of foodborne illness from Restaurant A.

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	Cases (n=21)		Controls (n=6)	
	N	(%)	N	(%)
Male	9	(43%)	3	(50%)
Female	12	(57%)	3	(50%)
Age Group (years)				
<1	0	(0%)	0	(0%)
1-4	0	(0%)	3	(50%)
5-9	0	(0%)	0	(0%)
10-19	0	(0%)	1	(17%)
20-49	15	(71%)	0	(0%)
50-74	6	(29%)	1	(17%)
>74	0	(0%)	1	(17%)
Median age	29 years		9 years	
Age range	24-65 years		2-84 years	

Symptom	N	%
Fatigue	19	90%
Nausea	18	86%
Diarrhea	17	81%
Bloody Diarrhea	1	5%
Body Aches	16	76%
Abdominal Cramps	16	76%
Dizziness	15	71%
Chills	14	67%
Vomiting	14	67%
Headache	13	62%
Fever	5	24%
Fever > 101°F	3	14%
Median Duration=1.7 days (range 1-5 days)		
Median Incubation=34 hours (range 1.5 -51 hours)		



**Figure 1. Norovirus Investigation, February-March 2015  
Epidemic Curve (N=21)**





Table 3. Food Items Eaten									
Food Item	Cases (N=21)				Controls (N=6)				p-value
	Percent	n	unk*	N	Percent	n	unk*	N	
<b>oysters</b>	<b>100%</b>	<b>21</b>		<b>21</b>	<b>0%</b>	<b>0</b>		<b>6</b>	<b>&lt;0.0001</b>
<b>salmon</b>	<b>95%</b>	<b>20</b>		<b>21</b>	<b>0%</b>	<b>0</b>		<b>6</b>	<b>&lt;0.0001</b>
<b>yellowtail</b>	<b>76%</b>	<b>16</b>		<b>21</b>	<b>0%</b>	<b>0</b>		<b>6</b>	<b>0.0008</b>
<b>halibut</b>	<b>48%</b>	<b>10</b>		<b>21</b>	<b>0%</b>	<b>0</b>		<b>6</b>	<b>0.0332</b>
<b>sea urchin</b>	<b>57%</b>	<b>12</b>		<b>21</b>	<b>0%</b>	<b>0</b>		<b>6</b>	<b>0.0130</b>
<b>scallop</b>	<b>43%</b>	<b>9</b>		<b>21</b>	<b>0%</b>	<b>0</b>		<b>6</b>	<b>0.0495</b>
<b>tuna</b>	<b>57%</b>	<b>12</b>		<b>21</b>	<b>0%</b>	<b>0</b>		<b>6</b>	<b>0.0130</b>
sashimi salad	24%	5		21	0%	0		6	0.1855
avocado crab roll	52%	11		21	17%	1		6	0.1205
<b>lobster roll</b>	<b>57%</b>	<b>12</b>		<b>21</b>	<b>0%</b>	<b>0</b>		<b>6</b>	<b>0.0130</b>
spider roll	33%	7		21	0%	0		6	0.1003
California roll	48%	10		21	50%	3		6	0.918
eel and avocado roll	33%	7		21	0%	0		6	0.1003
caterpillar roll	5%	1	1	21	0%	0		6	0.7345
shrimp tempura	33%	7		21	50%	3		6	0.4559
veggie tempura	33%	7		21	33%	2		6	1.0000
octopus	10%	2		21	0%	0		6	0.4321
tofu	24%	5		21	50%	3		6	0.2153
seaweed	86%	18		21	67%	4		6	0.2895
rice	90%	19		21	67%	4		6	0.1477
udon	10%	2		21	100%	6		6	<0.0001
mussels	14%	3		21	33%	2		6	0.2895
eggs	10%	2		21	33%	2		6	0.1477
edamame	67%	14		21	50%	3		6	0.4559
mochi ice cream	38%	8		21	83%	5		6	0.0505
green tea ice cream	33%	7		21	0%	0		6	0.1003
<b>water</b>	<b>90%</b>	<b>19</b>		<b>21</b>	<b>50%</b>	<b>3</b>		<b>6</b>	<b>0.0244</b>
ice	76%	16		21	50%	3		6	0.2153
soda	10%	2		21	0%	0		6	0.4321
tea	38%	8		21	33%	2		6	0.8313

\*unk=unknown: Number of respondents who cannot recall whether they consumed the food item. This number is subtracted from the denominator to calculate percent.





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## CARBAPENEM-RESISTANT ENTEROBACTERIACEAE INFECTIONS ASSOCIATED WITH ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY PROCEDURES LOS ANGELES COUNTY, 2015

### OVERVIEW

Carbapenem-resistant Enterobacteriaceae (CRE) infections associated with endoscopic retrograde cholangiopancreatography (ERCP) procedures have been reported in the literature, and several outbreaks have been investigated. Previous reports have identified breaches in cleaning protocols, including bacterial contamination of difficult to clean areas [1]. Other investigations report finding no breach in cleaning and reprocessing protocols or defects in the implicated scopes [2]. The scope's design has been implicated as a source of potential contamination due to the complexity of the elevator channel and the difficulty in ensuring adequate cleaning and disinfection [3].

In 2015, the Los Angeles County Department of Public Health (LAC DPH) Acute Communicable Disease Control (ACDC) program investigated three outbreaks of ERCP associated multidrug resistant organism (MDRO) infections at three separate hospitals. Each hospital performs a high volume of ERCP procedures, serves as referral centers for other hospitals, and often sees medically complex, high-risk patients.

### SUMMARY OF INVESTIGATIONS

#### Hospital A

In January 2015, the hospital infection preventionist (IP) notified ACDC of a cluster of patients who were carbapenem-resistant *Klebsiella pneumoniae* (CRKP) culture positive after undergoing an ERCP procedure. In mid-December 2014, an infectious disease physician alerted Infection Prevention and Control (IPC) to an unusual case of CRKP bacteremia in a patient shortly after undergoing ERCP. An investigation was initiated by the IPC, who requested a list of all 2014 CRE isolates identified by the laboratory. The laboratory identified 33 CRE positive patients in 2014, of which 23 were CRKP. Hospital A staff conducted a comprehensive investigation including extensive chart review of each case to identify potential risk factors, room locations, and IPC direct observation of duodenoscope reprocessing. The microbiology laboratory did further molecular testing on a subset of the CRKP isolates to determine relatedness. Molecular results were reviewed by IPC and further investigation was performed to determine the point source. Multiplex real-time PCR assay (rtPCR), which was used to detect carbapenemases, was negative for several CRKP.

A total of 15 patients met the case definition. A case was defined as a patient who was CRKP culture positive, infected or colonized at any site, who had an ERCP procedure between October 2014 and January 2015. Of these cases, three died during their hospitalization.

Initially, eight patients met the case definition, with clinical culture positive sites including blood (n=4), and abdominal sources including aspirate, drainage, or abscess (n=4). Seven isolates had identical sensitivity patterns and were resistant to carbapenems, aminoglycosides, penicillins, cephalosporins, and



fluoroquinolones and susceptible to colistin. One multiplex negative CRKP isolate underwent whole genome sequencing which identified the OXA-232 carbapenemase. Additional molecular testing by repetitive sequence-based polymerase chain reaction (repPCR) and high resolution melt analysis (HRM) was conducted by Hospital A's laboratory on CRE isolates from 17 patients in 2014 to determine relatedness. The unique carbapenemase OXA-232 strain was identified in CRKP isolates from ERCP-related patients (n=8). RepPCR and HRM results showed OXA-232 strains from all cases to be almost identical. When focusing on the strains that were highly related to each other, the only commonality between patients was ERCP during their hospitalization.

An index patient who was CRKP positive prior to their ERCP procedures in October 2014 was identified. This patient underwent multiple procedures with two duodenoscopes (duodenoscope 1 and duodenoscope 2). A total of 14 patients had subsequent ERCP exposure with duodenoscope 1; three additional patients had subsequent exposure to duodenoscope 2. There were no other common exposures identified among OXA-232 positive patients.

Once ERCP with duodenoscopes 1 and 2 was established as a risk factor for transmission of CRKP, patient notification was initiated by Hospital A. One hundred eighty-six (186) patients had ERCP with the implicated duodenoscopes between October 2014 and January 2015. Notification included phone calls and mailed letters informing of possible CRE exposure and offers to screen for CRE by rectal swab of all patients notified; 150 patients were screened, seven (5%) were positive for CRKP. Isolates from the surveillance cases were also identified as OXA-232.

Hospital A implemented many control measures including ceasing all ERCP procedures during the investigation, sequestering the two implicated duodenoscopes (1 and 2), assessing duodenoscope cleaning and disinfection process, culturing all seven adult duodenoscopes, reprocessing following manufacturer's guidelines, and sending duodenoscopes to a private company for additional ethylene oxide (EtO) gas sterilization. A Manufacturer and User Facility Device Experience report was submitted by Hospital A to the U.S. Food and Drug Administration (FDA). All seven duodenoscopes were cultured and all were negative for CRE.

A site visit was conducted by ACDC staff in February 2015, five days after the outbreak was reported. During this visit, duodenoscope cleaning and high level disinfection procedures were observed. Reprocessing was done by GI reprocessing technicians or GI registered nurses (RNs), both trained in reprocessing. Pre-cleaning was performed immediately after the procedure in the procedure room. The facility used an automated endoscope reprocessor. No breaches in technique to prevent infections were observed. Duodenoscopes were stored appropriately according to manufacturer instructions. Several consultations with the California Department of Public Health (CDPH), Centers for Disease Control and Prevention (CDC), and the FDA were conducted.



In late February 2015, ACDC sent an email to all acute care hospital IPs encouraging active surveillance for CRE infections following ERCP procedures, including a retrospective review. Additional clusters were identified and reported to LAC DPH.

### **Hospital B**

In February 2015, the director of IPC at Hospital B notified ACDC of four patients with CRKP infections since September 2014 following ERCP in their facility. In response to recent media attention surrounding the investigation at Hospital A, Hospital B initiated a review of CRE infections following ERCP in their facility and identified the four patients. A case was defined as a patient who was CRKP positive from any site after ERCP at Hospital B. IPC conducted a comprehensive review of patient medical records, ERCP procedures and microbiology review for other CRKP positive patients who may have undergone ERCP.

Five patients met the case definition. All cases underwent at least one ERCP procedure prior to their positive culture; three cases underwent two or more procedures prior to their positive culture. Four cases were CRKP culture positive in clinical specimens including blood (n=2) and bile (n=2); the fifth case was positive in a surveillance rectal swab tested after patient notification was initiated; two cases died.

IPC identified one duodenoscope as having been used by all cases prior to their positive culture. This duodenoscope was used frequently as it was preferred by the gastroenterologist who performed the larger volume of procedures at Hospital B. Reprocessing of the duodenoscopes was performed using an automated endoscope reprocessor.

Isolates for four cases were available for testing, including the case identified through surveillance. RepPCR performed by an outside laboratory identified two cases to be greater than 98% similar and 95% similarity among all four case isolates tested. Pulsed-field gel electrophoresis (PFGE) analysis performed at the LAC DPH Public Health Laboratory (PHL) on the initial three isolates available indicated that two cases were genetically indistinguishable. Isolates from all three cases were identified as genetically related.

Multiple control measures were implemented by the facility, including removing the implicated duodenoscope from use, postponing all elective ERCP procedures, and culturing of all duodenoscopes. Hospital B duodenoscopes were cultured twice using the CDC Interim Sampling Method for the Duodenoscope – Distal End and Biopsy Channel. The 10 scopes cultured were negative for CRE; all but two grew other organisms, including *Bacillus spp.* and coagulase negative Staph. In addition to culturing, Hospital B sequestered duodenoscopes for 48 hours after culture to ensure all samples were negative prior to further use, with the exception of urgent or emergent cases. Additional duodenoscopes were ordered to accommodate the 48 hour wait period after culture, and elective ERCPs resumed two weeks later. Apart from the use of the implicated duodenoscope in their ERCP procedures, no other common suspected source of infection was identified among the five cases.





IPC initiated patient notification for ERCP patients who were exposed to the implicated duodenoscope from August 2014 to February 2015. Notification letters were mailed to patients and included an FAQ on CRE and duodenoscopes as well as the number to a hotline that was established specifically for patients who were notified to call in with questions. Of the 67 patients notified, 34 (51%) requested rectal swab kits, and one patient tested CRKP positive.

ACDC conducted a site visit on February 2015, four days after notification by Hospital B, and observed the method used to reprocess duodenoscopes. No breaches in practices to prevent the spread of infections were noted. We reviewed infection control practices, scope reprocessing manuals, technician training and competency materials, and related policies and procedures. Several consultations with CDPH, CDC, and the FDA were conducted.

### **Hospital C**

In August 2015, ACDC was notified by IPC at Hospital C of three patients who became ill and were multi-drug resistant *Pseudomonas aeruginosa* (MDR-PA) culture positive in July 2015 following ERCP procedures in the facility. Hospital C initiated an ERCP surveillance program in May 2015 in response to two ERCP related MDRO outbreaks in other LAC facilities and identified three patients with blood cultures positive for MDR-PA after ERCP. ACDC notified the appropriate local health jurisdiction (LHJ) who led the investigation, with ACDC participating in a consultative role.

A case was defined as a patient who had received an ERCP procedure, inpatient or outpatient, at Hospital C between January 2013 and August 2015 who presented with a positive MDR-PA culture from any site within 90 days of ERCP. A comprehensive investigation was initiated by IPC staff, ACDC, and the LHJ, including review of ERCP procedure logs, medical records, administrative records, microbiology and culture results from patients, duodenoscopes, and environmental samples.

Sixteen patients met the case definition; eleven cases died. All cases had ERCP procedures performed between January 2013 and August 2015 with one or more of the three duodenoscopes linked to the outbreak. All cases were MDR-PA culture positive from at least one body site, including wound (n=4), blood (n=9), and other sites (4). Isolates were sent to the LAC DPH PHL for PFGE testing. Duodenoscopes were sent to CDC Environmental and Applied Microbiology Laboratory for testing.

A total of 41 MDR-PA isolates from 29 patients, three duodenoscopes, and one environmental site were sent for strain testing by PFGE at the LAC DPH PHL. Test results showed 16 case isolates and 8 duodenoscope isolates from three different scopes were identified as indistinguishable or closely related. One distinct MDR-PA strain was identified by molecular epidemiology. No commonalities other than ERCP procedure were identified among the 16 cases. Per the LHJ request, Hospital C sent the three epidemiologically linked duodenoscopes to the CDC Environmental and Applied Microbiology Laboratory for testing. Using the CDC Interim Duodenoscope Surveillance Protocol as well as more aggressive sampling techniques and sonication, many types of bacteria were identified, including *Pseudomonas*



*aeruginosa*, *Klebsiella pneumoniae*, *Citrobacter freundii*, and others. Sampled sites that demonstrated growth included the instrument channel, distal tip, and elevator.

Control measures recommended by ACDC and LHH included removing the three epidemiologically linked duodenoscopes from service, double high-level disinfection, repairing and maintaining the scope storage room, monitoring and recording temperature and humidity, ceasing use of canned compressed air during drying, and discontinuing use of plastic scope covers during storage. Hospital C initiated periodic culturing of scopes in July 2015 in response to the outbreaks at Hospital A and B. During the outbreak, the recommendation was made to culture each scope after reprocessing. Once control measures were implemented, no further transmission was identified.

Patient notification was initiated at the recommendation of ACDC and LHH. Eighty-eight patients who received an ERCP procedure with any duodenoscope from January 2015 to August 2015 were notified and offered testing. Fifteen patients requested testing, and none were positive for *Pseudomonas aeruginosa*. In addition, ACDC and the LHH recommended Hospital C obtain consent for future ERCP procedures, inpatient and outpatient, including a verbal and written detailed review of the risks of infection and notification of the outbreak.

A site visit was conducted in August 2015, one day after notification by Hospital C, by ACDC, LHH, and CDPH Licensing and Certification staff. Clinical, surveillance, and microbiology data was reviewed with Hospital C staff. Staff also observed duodenoscope reprocessing and storage. Immediate recommendations were made for control measures and patient notification. A second visit was made in mid-September 2015 to observe implementation of initial recommendations regarding storage and reprocessing procedures as well as to obtain environmental cultures. Several consultations with CDPH, CDC, and FDA were conducted.

## CONCLUSION

The epidemiology and lab analyses of these investigations suggest that the cause of these outbreaks is multifactorial, including that the complex design of the scope may impede effective cleaning, disinfection and reprocessing. In January 2016, the duodenoscope manufacturer initiated a recall of one scope model for replacement of the elevator mechanism [4]. In addition, several nationally recognized experts have recommended several options to enhanced reprocessing, including double high-level disinfection with periodic culturing of a sample of scopes and use of ethylene oxide sterilization after high-level disinfection [5]. The CDC, FDA, and CDPH provided guidance to hospitals and providers on duodenoscope reprocessing after ERCP. Professional associations that provide infection prevention and related information, e.g. the Association for Professionals in Infection Control (APIC) and the Society for Healthcare Epidemiology of America (SHEA) also provided reprocessing guidance.

Partnerships between hospitals performing ERCP procedures and LAC DPH are essential to ensuring optimal surveillance and coordination of prevention activities. The facilities experiencing these outbreaks were large, prestigious hospitals with robust infection prevention and control programs. Due to the design flaw of this instrument, hospitals could follow manufacturer guidelines and standard practices correctly



and still experience duodenoscope-related MDRO transmission. In addition, there may be other facilities with duodenoscope-related transmission of MDROs that may not have the expertise to conduct a complex investigation and implement effective prevention and control strategies. The involvement of LAC DPH in this issue is key to address these problems on a larger scale that will improve the safety of the patients these hospitals treat.

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## 2015 SYMPOSIUM ON INFECTION PREVENTION CONTROL IN SKILLED NURSING FACILITIES

### OVERVIEW

On 9/1/15, the Los Angeles County Department of Public Health (LAC DPH) Acute Communicable Disease Control (ACDC) program held a symposium for key county skilled nursing facility (SNF) staff responsible for infectious disease outbreak prevention and control. Representatives from SNFs included directors of nursing, administrators, and infection preventionists. Due to the large number of SNFs in LAC, attendance was limited to two representatives per facility. The goals of the symposium were to improve partnerships between SNFs and LAC DPH as well as to improve understanding, surveillance, and response to many infectious diseases that impact SNFs. In addition, this symposium provided education on the National Healthcare Safety Network and antimicrobial stewardship.

### SUMMARY

A total of 97 attendees from 63 local SNFs attended the day-long event. In addition, the event included 37 attendees from various LAC DPH programs (including ACDC, Community Health Services, and Health Facilities) and four medical representatives from agencies outside of DPH.

The topics for this event focused primarily on the prevention and control of infectious diseases that are common in SNF settings and greatly impact the vulnerable population cared for in these settings. The presenters were representatives from ACDC and Community Health Services, and the agenda was as follows:

PROGRAM	
7:30 am – 8:30 am	Registration Breakfast & Coffee
8:30 am – 9:00 am	Welcome & Introduction Laurene Mascola, M.D., M.P.H., F.A.A.P. Chief, Acute Communicable Control Program  Christine Wigen, M.D., M.P.H. Medical Epidemiologist, Acute Communicable Disease Control Program
9:00 am – 10:00 am	Prevention and Control of Influenza Christine Wigen, M.D., M.P.H. Medical Epidemiologist, Acute Communicable Disease Control Program
10:00 am – 10:10 am	Break
10:10 am – 11:10 am	Prevention and Control of Scabies L'Tanya English, R.N., P.H.N., M.P.H. Acute Communicable Disease Control Program



11:10 am – 12:10 pm	Prevention and Control of Norovirus Rachel Civen, M.D., M.P.H. Medical Epidemiologist, Acute Communicable Disease Control Program  Public Health’s Role in Outbreak Investigations Veronica Caballero, R.N., P.H.N., B.S.N. Monrovia Health Center (SPA 3)
12:10 pm – 1:00 pm	Lunch
1:00 pm – 2:00 pm	National Healthcare Safety Network (NHSN) & Antimicrobial Stewardship Dawn Terashita, M.D., M.P.H. Medical Epidemiologist, Acute Communicable Disease Control Program  Amanda Kamali, MD LCDR US Public Health Service Centers for Disease Control and Prevention Acute Communicable Disease Control Program
2:00 pm – 2:40 pm	Q & A Session
2:40 pm – 2:50 pm	Break
2:50 pm – 3:45 pm	Interactive Activities / Group Discussion
3:45 pm – 4:00 pm	Closing Remarks & Evaluations

In addition to presentations, each attendee received a binder with the following materials and manuals:

- Los Angeles County List of Reportable Diseases and Conditions
- Influenza Outbreak Prevention and Control Guidelines
- Scabies Prevention and Control Guidelines: Acute and Long-Term Care Facilities
- Norovirus Outbreak Prevention Toolkit
- Antimicrobial Stewardship Guidelines Pocket Card
- Health Education Materials for Influenza and Scabies
- Listing of Useful Resources and Websites

Many of these documents and materials were developed specifically for this event. These materials and an archive of the presentations are available on the ACDC website.<sup>6</sup>

Following the presentations, a panel question and answer session was held which provided further clarification on the day’s topics. Next, all attendees participated in interactive activities. The goals of these activities were to provide an opportunity for representatives from the SNFs and LAC DPH to collaborate on issues related to infectious disease prevention and control in SNFs as well as to reinforce the guidance and recommendations that were provided during this meeting.

<sup>6</sup> [www.publichealth.lacounty.gov/acd/SNF.htm](http://www.publichealth.lacounty.gov/acd/SNF.htm)



Overall, the symposium was very well received and the representatives from the SNFs urged LAC DPH to hold additional trainings to provide further guidance on other topics including antibiotic resistant infections. ACDC plans to hold another symposium in 2016, and these trainings might become an annual event.





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## INFLUENZA SURVEILLANCE OVERVIEW: 2015–2016 SEASON SUMMARY

### OVERVIEW

The 2015-2016 influenza season (October 4, 2015-May 21, 2016) in Los Angeles County (LAC) was moderate overall. Peak activity occurred during mid-February, substantially later compared to previous seasons where peak activity usually occurs from December to January. During the week of February 14-20, 2016 (surveillance week 7), percent positive tests for influenza reached a high of 31.4% for the season (Table 1). In addition, syndromic surveillance detected the highest proportion of visits to Emergency Departments for influenza-like-illness (ILI) that same week (Figure 1). The greatest number of influenza-associated deaths (IAD) also occurred during week 7. Overall IADs increased from last season (N=70), however did not surpass the number of deaths during the last A (H1N1) season of 2013-14. While influenza A (H1N1) viruses predominated, overall influenza A and B viruses were almost equally represented in laboratory surveillance testing throughout the season which is uncommon (Table 1).

California data show that influenza activity across the state was similar to what was seen in LAC, in terms of the timing of peak activity and representation of influenza A/B viruses [1]. Conversely, nationwide influenza activity peaked in mid-March (surveillance week 10), almost a month later than in LAC. Influenza A (H1N1) predominated throughout the season followed by a typical later season increase of influenza B viruses [2]. The majority of viruses characterized by the Centers for Disease Control and Prevention (CDC) were similar to the ones included in this season's vaccine, which resulted in an estimated vaccine efficacy of almost 60% [3].

### SENTINEL LABORATORY DATA

Eight sentinel laboratories serving healthcare providers and institutions across LAC reported weekly influenza and other respiratory virus data this season. Although individual cases of influenza are not reportable to the LAC Department of Public Health (DPH), analyzing data from these sentinel labs provides a robust estimate of influenza and other respiratory virus activity in the county. This season a total of 50,640 respiratory isolate tests were reported to LAC DPH (Table 1). Figure 2 shows the distribution of percent positive rates of respiratory specimens by week. Influenza activity began to increase at the end of December, peaked mid-February, then tapered off in April. Other viruses co-circulated with influenza, contributing to the overall impact of respiratory illness in LAC.

### INFLUENZA-ASSOCIATED DEATHS

A total of 70 IADs were confirmed in LAC this season. The majority of deaths (61%) occurred in those under 65 years old (median 59 years old), which is consistent with other A (H1N1) predominant seasons that more severely affect the <65 years old population (Table 2). More deaths overall were reported in LAC this season compared to last season. Of the three pediatric IADs reported this season, two had no past medical history identified, which highlights the potential for severe influenza outcomes in otherwise healthy children.





Figure 3 compares the distribution of LAC IADs by age-specific rates across the past seven influenza seasons. During A (H1N1) seasons, the 20-64 age group accounts for a greater proportion of IADs compared to A (H3N2) predominant seasons. Overall, the CDC estimates that about 90% of all IADs occur among adults 65 years and older [4].

## RESPIRATORY OUTBREAKS

The total number of respiratory outbreaks confirmed in LAC decreased to 48, compared with 58 last season. The majority of respiratory outbreaks this season occurred in schools or pre-schools (46%), followed by skilled nursing facilities (SNFs) (29%) (Table 3). Respiratory outbreak definitions vary by setting; however, in general, clusters of ILI (fever >100° F with cough and/or sore throat) is cause for investigation.

Thirty-two respiratory outbreaks were confirmed in schools, daycare, and assisted living facilities. Of those, influenza was identified as the responsible pathogen in 11 outbreaks, with flu B accounting for the majority of them. In SNFs, influenza was identified in 11 of 14 respiratory outbreaks.

## 2016-2017 SEASONAL VACCINE

The World Health Organization and the Food and Drug Administration's Vaccines and Related Biologics Advisory Committee recommends that next season's influenza vaccine contain the following components:

- A/California/7/2009 (H1N1)pdm09-like virus
- A/Hong Kong/4801/2014 (H3N2)-like virus
- B/Brisbane/60/2008-like virus (B/Victoria lineage)
- B/Phuket/3073/2013-like virus (B/Yamagata lineage) (quadrivalent only)

These components represent a change in the A (H3N2) strain and the influenza B lineage included in the trivalent vaccine from the 2015-2016 vaccine. Influenza vaccination is the best way to protect yourself and others from getting influenza and potentially serious complications. Vaccination is recommended for everyone six months of age and older without contraindications.

The live attenuated influenza vaccine, also known as the "nasal spray vaccine", is no longer recommended and should not be used during the upcoming influenza season. This marks a significant change in the CDC's Advisory Committee on Immunization Practices (ACIP) recommendations for the 2016-2017 influenza vaccine. See the full report here: [ACIP votes down use of LAIV for 2016-2017 flu season | CDC Online Newsroom | CDC](#)

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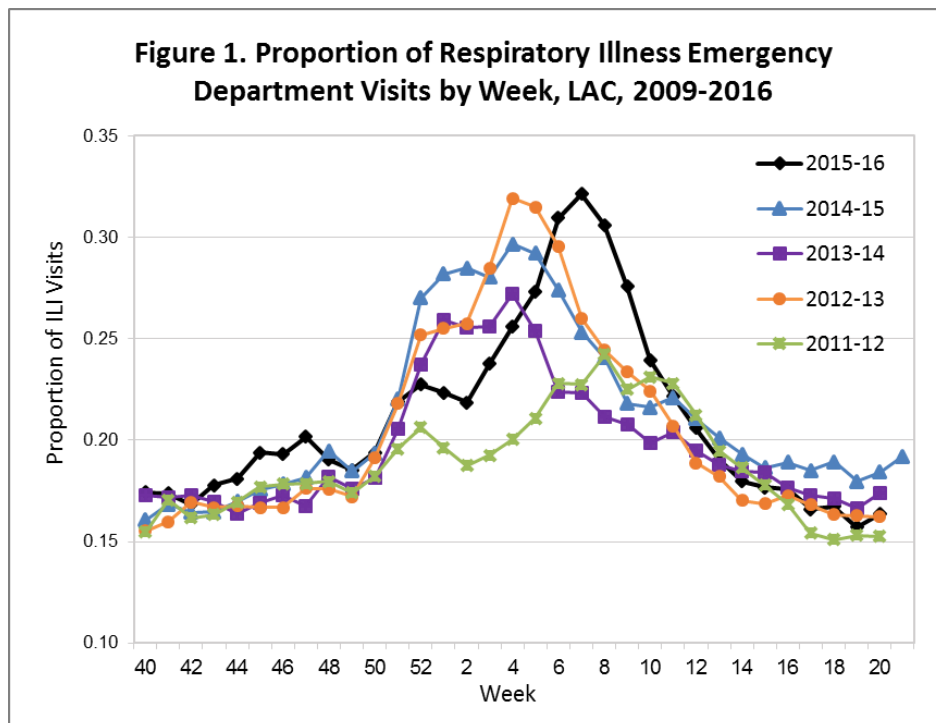
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Table 1. LAC Influenza Surveillance Summary			
	2015-2016		2014-2015
	Peak Week 7*	YTD **	9/1/14-8/8/15
<b>Sentinel Laboratory Data</b>			
Positive Flu Tests/Total Tests (Percent Positive Flu Tests)	960/3,059 (31.4%)	6,702/50,640 (13.2%)	5,752/48,405 (11.9%)
Percent Flu A/B	50/50	51/49	81/19
<b>Outbreaks <sup>†</sup></b>			
Community Respiratory Outbreaks	1	22	21
Influenza Confirmed Outbreaks	0	11	37
<b>Total</b>	<b>1</b>	<b>33</b>	<b>58</b>
<b>Influenza-Associated Deaths <sup>**</sup></b>			
Pediatric Flu Deaths	0	3	3
Adult Flu Deaths	11	67	51
<b>Total</b>	<b>11</b>	<b>70</b>	<b>54</b>

\*Week 7 corresponds to February 14-20, 2016  
 \*\*The influenza surveillance year spans October 4, 2015-May 21, 2016 (surveillance weeks 40-20)  
<sup>†</sup>Numbers are provisional and subject to change  
<sup>\*\*</sup>Confirmed influenza death is defined by a positive lab test, ILI symptoms, and clear progression from illness to death.



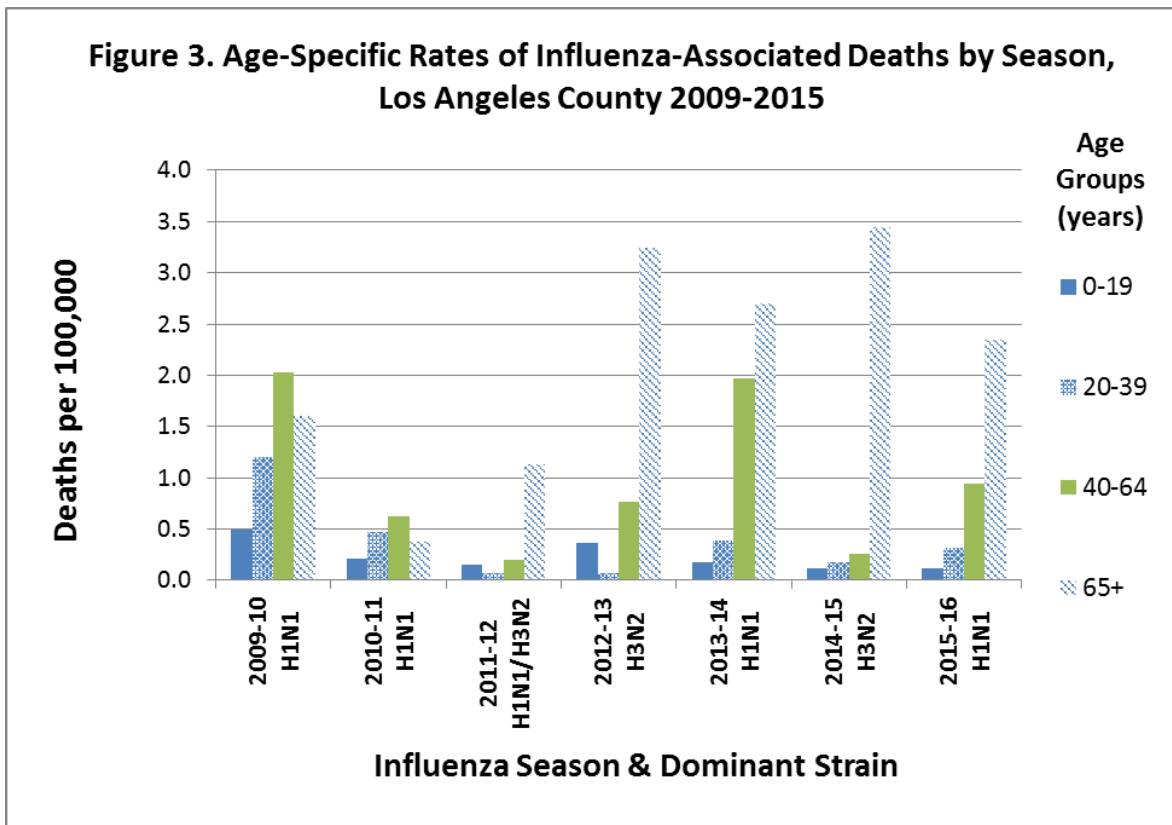
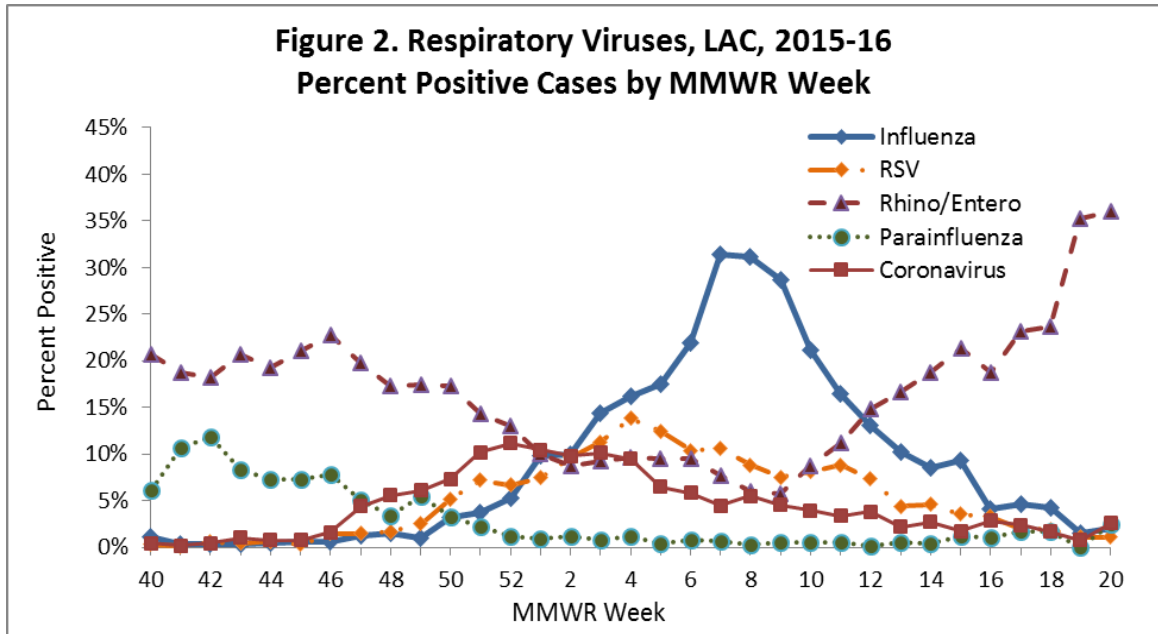




Table 2. Demographic Characteristics of Influenza Fatalities, LAC, 2009-2016								
		2015-16 <sup>†</sup>	2014-15	2013-14	2012-13	2011-12	2010-11	2009-10 <sup>††</sup>
		N(%)	N (%)	N(%)	N (%)	N (%)	N (%)	N (%)
Age (years)	Median	59	82	56	68	64	45	48
	Range	1-103	1-101	0-89	0-100	0-104	0-92	0-94
	0-5	2 (3)	1 (2)	1 (1)	5 (7)	2 (8)	4 (9)	3 (2)
	6-17	1 (1)	2 (4)	3 (3)	3 (4)	2 (8)	2 (5)	10 (8)
	18-40	10 (14)	5 (9)	13 (12)	4 (6)	2 (8)	14 (33)	37 (29)
	41-64	30 (43)	8 (15)	59 (56)	22 (31)	6 (25)	19 (44)	60 (47)
	65+	27 (39)	39 (71)	30 (28)	36 (51)	12 (50)	4 (9)	17 (13)
Gender	Male	38 (54)	29 (53)	67 (63)	35 (50)	10 (42)	20 (47)	57 (45)
	Female	32 (46)	26 (47)	38 (36)	35 (50)	14 (58)	23 (53)	70 (55)
Race	Hispanic	26 (37)	16 (29)	48 (45)	29 (41)	12 (50)	26 (60)	56 (44)
	White Non-Hispanic	21 (30)	26 (47)	41 (39)	25 (36)	5 (21)	9 (21)	39 (31)
	Asian/Pacific Islander	13 (19)	8 (15)	7 (7)	6 (9)	3 (13)	4 (9)	9 (7)
	Black	9 (13)	4 (7)	9 (8)	8 (11)	4 (17)	4 (9)	11 (9)
	Native American	1 (1)	1 (2)	0	0	0	0	0
<b>Total Fatalities</b>		<b>70</b>	<b>55</b>	<b>106</b>	<b>70</b>	<b>24</b>	<b>43</b>	<b>127</b>

<sup>†</sup>2015-16 season missing race data for one case

<sup>††</sup>2009-10 season is missing race data for several cases

Table 3. Characteristics of Confirmed Community Respiratory Outbreaks LAC, 2009-2016							
	2015-16	2014-15	2013-14	2012-13	2011-12	2010-11	2009-10
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
<b>Total</b>	<b>48</b>	<b>58</b>	<b>29</b>	<b>73</b>	<b>39</b>	<b>60</b>	<b>436</b>
<b>Location</b>							
Skilled Nursing Facility (SNF)	14 (29)	25 (43)	12 (41)	23 (32)	12 (31)	7 (12)	25 (6)
School or Pre-School	22 (46)	20 (34)	11 (38)	41 (56)	22 (56)	46 (77)	376 (86)
Assisted Living	8 (17)	12 (21)	3 (10)	6 (8)	2 (5)	3 (5)	20 (5)
Daycare/child care	2 (4)	1 (2)	1 (3)	3 (4)	3 (8)	3 (5)	6 (1)
Other	2 (4)	0	2 <sup>†</sup> (7)	0	0	1 (2)	9 (2)
<b>Etiology</b>							
Influenza <sup>††</sup>	22 (46)	37 (64)	7 (24)	17 (23)	6 (15)	18 (30)	74 (17)
Other Respiratory (RSV, Rhinovirus, Strep)	2 (4)	1* (2)	0	1 (1)	7 (18)	4 (7)	0
Respiratory unknown etiology	24 (50)	20 (34)	22 (76)	55 (75)	26 (67)	38 (63)	362 (83)

<sup>†</sup>Same home for pregnant women and children

<sup>††</sup>Confirmed influenza outbreaks must include at least 1 positive lab test

\*Both influenza and strep were detected in one outbreak





## MEASLES IN A PATIENT WITH PRESUMED IMMUNITY—LOS ANGELES COUNTY, 2015<sup>7</sup>

On February 14, 2015, patient A, aged 17 years, was seen in an emergency department for evaluation of reactive airway disease. In the waiting room at the same time were two siblings, aged six months, presenting with fever and rash; these two children (patients B and C) were later confirmed to have measles. Patient A began a five-day course of oral prednisone (50 mg per day); however, symptoms continued, and patient A returned to the emergency department the next day and received 125 mg of intravenous (IV) methylprednisolone. Patient A had documentation of receipt of two doses of measles, mumps, and rubella (MMR) vaccine at ages 12 months and four years.

A contact investigation was initiated by the hospital to identify all persons who might have been exposed to patient B or patient C. An infant aged 10 days was identified within the first six days of exposure and offered post-exposure prophylaxis with intramuscular (IM) immune globulin. A second infant was identified later and was outside of the window period for immune globulin. Patient A was not identified as a susceptible contact in the investigation because of the documented history of receipt of MMR vaccine. Patients B and C had returned to the hospital on February 17, before receiving a diagnosis of measles, and exposed three other susceptible children (two infants aged <12 months and a child aged three years with leukemia). One infant was offered the MMR vaccine, the other IM immune globulin, and the child with leukemia was offered IV immune globulin. On March 2, 16 days after the first emergency department visit, patient A was hospitalized for vomiting and dehydration. Patient A was also found to be febrile and to have a confluent papular rash that began on the face and spread to trunk and extremities and had small vesicular oral lesions. Measles was confirmed by laboratory testing, and patient A received supportive treatment with anti-emetics and IV fluids.

Patients A, B, and C were part of a measles outbreak originating at the Disney theme park in Orange County, California, in December 2014, which included 28 confirmed cases in Los Angeles County [1]. As of April 17, 2015, a total of 136 measles cases had been documented in California, and among those 10 patients had received at least one dose of the MMR vaccine, 13 had received two doses, and two had received three doses (1; Jennifer Zipprich, PhD, Kathleen Harriman, PhD, California Department of Public Health, personal communication, June 2015). Measles is highly contagious, and high levels of population immunity are required to prevent transmission to susceptible persons. MMR vaccine is highly effective, with a single dose conferring immunity in 92%–95% of persons [2]; however, because vaccine failures do occur, a second dose of measles vaccine has been routinely recommended since 1989 [3]. Complications associated with measles include pneumonia, otitis media, diarrhea, and encephalitis; post-exposure prophylaxis is recommended for all susceptible contacts [2,4]. The MMR vaccine, if administered within 72 hours of initial measles exposure, might provide some protection or modify the clinical course of disease. Persons who are at risk for severe illness and complications from measles who cannot receive the

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<sup>7</sup> Published as: Kamali A, Bagchi CP, Mendoza E, Wilson D, Schwartz B, Mascola L. Measles in a patient with presumed immunity—Los Angeles County, 2015. *MMWR* October 9, 2015 / 64(39);1123.



MMR vaccine, including infants aged <12 months, persons who are severely immunocompromised (including persons taking high-dose steroids for  $\geq 2$  weeks), and persons with leukemia or lymphoma [2,5], should receive prophylaxis with immunoglobulin within six days of exposure.

Patient A had received two doses of MMR vaccine and did not meet criteria for being severely immunocompromised; however, this patient did develop measles after being exposed in the setting of a hospital emergency department to patients with laboratory-confirmed measles. Although it is not known whether patient A developed immunity to measles in response to the two administered doses of MMR vaccine or whether patient A had an unrecognized immunocompromising condition, the recent steroid use might have weakened the patient's immune response and rendered patient A susceptible to a wild measles strain. The diagnosis of measles in patient A highlights the concern that immunocompromised and susceptible persons might be exposed in a health care setting. More information is needed concerning the effect of immunomodulating drugs on vaccine-induced immunity to measles and other vaccine-preventable diseases.

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## INVESTIGATION OF AND RESPONSE TO TWO PLAGUE CASES YOSEMITE NATIONAL PARK, CALIFORNIA, USA, 2015<sup>8</sup>

### OVERVIEW

In August 2015, plague was diagnosed for two persons who had visited Yosemite National Park in California, USA. One case was septicemic and the other bubonic. Subsequent environmental investigation identified probable locations of exposure for each patient and evidence of epizootic plague in other areas of the park. Transmission of *Yersinia pestis* was detected by testing rodent serum, fleas, and rodent carcasses. The environmental investigation and whole-genome multilocus sequence typing of *Y. pestis* isolates from the patients and environmental samples indicated that the patients had been exposed in different locations and that at least two distinct strains of *Y. pestis* were circulating among vector–host populations in the area. Public education efforts and insecticide applications in select areas to control rodent fleas probably reduced the risk for plague transmission to park visitors and staff.

### INTRODUCTION

Plague is a zoonotic disease caused by the gram-negative bacterium *Yersinia pestis*; the organism's reservoir is rodents, and the vectors are fleas [1,2]. Transmission to humans can occur through bites by infected fleas or through handling *Y. pestis*-infected rodents [1,2]. Epidemics of plague still occur on the continents of Africa, Asia, and North and South America [3]. Plague was introduced to California in 1900 [1,4–6] where over the next 25 years it caused occasional outbreaks in rats commensally residing with humans in urban areas [2,4,6]. Shortly after its introduction, *Y. pestis* moved into wild rodent populations, establishing a sylvatic transmission cycle [7,8]. In subsequent decades, plague spread across California and other western states [9] periodically affecting humans [4–6, 10–13].

The California ground squirrel plays a major role in human exposure in California because its predominant flea species *Oropsylla montana* is a competent *Y. pestis* vector [1,2] that is often abundant on this rodent and in its burrows [14] and will readily bite humans [1,11]. Since the 1980s, evidence of *Y. pestis* transmission in rodents in the Sierra Nevada mountains has been generally restricted to locations at elevations >1,200 meters (California Department of Public Health, unpub. data, 1983–2015). Despite ongoing sylvatic transmission, human plague remains rare in the western United States [15–17], including in California where no cases have been confirmed since 2006 [18,19].

During the summer of 2015, the Los Angeles County Department of Public Health (LAC DPH) and the Georgia Department of Public Health reported two cases of plague in persons who had recently travelled to Yosemite National Park (Yosemite). The California Department of Public Health (CDPH), in collaboration with the US Centers for Disease Control and Prevention (CDC) and the National Park Service (NPS), investigated the increased *Y. pestis* transmission in Yosemite. We summarize the epidemiologic, laboratory, environmental findings, and the public health response.

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## RESULTS

### Environmental Findings

Plague risk assessments were conducted for nine locations in Yosemite and the surrounding national forests visited by the patients. Within the park, eight more sites were also evaluated for *Y. pestis* transmission and potential risk areas for transmission to humans.

### Flea Control

Sites with evidence of recent *Y. pestis* transmission and an increased risk for human exposure were temporarily closed, and rodent burrows were treated with insecticide to reduce flea populations and protect wildlife and human health. The following five areas in Yosemite were identified for insecticide treatments: Crane Flat Campground, Glacier Point, Tuolumne Meadows Campground, Tamarack Flat Campground, and the Crane Flat–NatureBridge campus. In total, 16.3 kg of 0.05% deltamethrin was used per label instructions to treat an estimated 3,700 rodent burrows. Although time and logistical constraints precluded pre- and post-treatment flea evaluations at all locations, evidence from limited sampling suggested that the insecticide applications reduced the local flea populations.

### Public Outreach

To further reduce the plague risk for Yosemite visitors and staff, NPS and collaborating agencies initiated an aggressive public education campaign. The campaign included three news releases issued August 6–18, media interviews, and website alerts. The park newsletter, *The Yosemite Guide*, which was given to persons in every entering vehicle, included information about plague. Placards with plague information were posted at park entrances, locations with confirmed *Y. pestis* transmission, all campgrounds, and many day use locations and trailheads. Educational pamphlets were available to visitors at a variety of locations, including affected campgrounds.

## DISCUSSION

In August 2015, these two cases of plague were linked to exposure in the internationally popular Yosemite National Park. The initial public health investigation and response with broad media coverage of the first case led to the rapid recognition and appropriate treatment of the second case-patient.

The investigation found little overlap in the travel itineraries of the two patients, and isolation of distinct strains of *Y. pestis* suggested that at least two *Y. pestis* strains were circulating among vector–host populations in the Yosemite area. In the only area visited by both patients, Yosemite Valley, no evidence of *Y. pestis* transmission in rodents was found, and *Y. pestis* has not been detected in the valley’s rodent populations in recent decades (CDPH, unpub. data, 1984–2015). We were able to connect the exposure of patient 1 to epizootic transmission at the campground on the basis of the visual observations at Crane Flat Campground, the positive results for rodent serology and the pool of fleas collected there, and whole-genome MLST analysis of *Y. pestis* isolates from patient 1 and the flea pool. The most likely exposure site for patient 2 was Glacier Point, 20 km away, on the opposite side of Yosemite Valley. Although *Y. pestis*–



seropositive rodents were found at this location, we did not detect active infection in rodents or fleas and were therefore unable to directly link the patients' exposure to this site by whole-genome MLST.

The environmental investigation found evidence of *Y. pestis* transmission in disparate locations of the park, including epizootic activity in the Tuolumne Meadows area, ≈41 and 25 km from Crane Flat and Glacier Point, respectively. Evidence of *Y. pestis* transmission in rodents was found at 4 of the 5 areas trapped. Of the eight species of rodents live trapped in Yosemite, *Y. pestis* antibodies were detected in only 5 (15.2%) of 33 lodgepole chipmunks and 3 (7.3%) of 41 California ground squirrels. However, *Y. pestis* was also isolated from golden-mantled ground squirrel and Douglas squirrel carcasses and a deer mouse flea, indicating broader zoonotic involvement.

The 2015 findings for Yosemite share some striking similarities with those associated with the only human plague case previously associated with Yosemite [20]. In 1959, a teenage boy became ill after camping along Yosemite Creek trail, ≈5 km from Crane Flat Campground. Subsequent investigation by CDPH and CDC found evidence of a recent epizootic plague event that had decimated the rodent populations near the campsite. During this investigation, *Y. pestis* transmission was also documented in Tuolumne Meadows and at Lake Tenaya.

The rapid interagency investigation and public health response to these cases probably reduced the risk for plague among Yosemite visitors and staff. Critical risk-reduction measures included expanding the investigation to recreational sites beyond those visited by the patients and localized insecticide treatments at sites with *Y. pestis* transmission. Increased educational efforts informing the public about how to reduce their exposure to the cause of this potentially fatal disease contributed to the early diagnosis for patient 2 and to increased reports of finding dead rodents in the park, which led to detection of *Y. pestis* transmission at additional locations.

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## MULTI-AGENCY RESPONSE TO A FLEA-BORNE TYPHUS OUTBREAK ASSOCIATED WITH A MOBILE HOME COMMUNITY

### BACKGROUND

Flea-borne typhus is an acute febrile illness caused by *Rickettsia typhi* or *R. felis*. Persons typically become infected when the feces of a carrier flea enters the body through a bite or other break in the skin [1]. Most infections present as self-limited illness; however, infection for some progress to a more serious febrile illness and require hospitalization [2,3]. Deaths have been documented but are rare [4].

In Los Angeles County (LAC), cats, opossums, and the cat flea (*Ctenocephalides felis*) maintain the suburban life cycle of flea-borne typhus [1,5,6]. The flea acquires the bacteria from small urban mammals such as opossums that can harbor these bacteria. Opossums, a peridomestic animal, carry large numbers of fleas and often inhabit areas near human habitation where there is readily available food and harborage. Fleas may move from opossums to domestic pets (dogs and cats) and then to humans where they cause infection.

Flea-borne typhus is not a nationally reportable condition, so the number of cases occurring in the US is unknown. Cases primarily occur in Texas, Hawaii, and California where typhus is endemic. Providers and laboratories are mandated to report suspect cases to their local public health departments in these places. The majority of California's cases occur in LAC. In 2014, 51 cases were reported in California; 44 (86%) were LAC residents. This number corresponds to an LAC incidence of 0.47 per 100,000 [7].

On June 16, 2015, a local hospital infection preventionist alerted the Acute Communicable Disease Control program (ACDC) of three hospitalized flea-borne typhus cases occurring from April 23, 2015 to June 9, 2015 among residents of a 95-unit mobile home community (MHC). ACDC coordinated a multi-agency investigation of this outbreak in order to identify additional cases, identify and mitigate risk factors, and prevent further cases from occurring.

### METHODS

#### Risk Factor Identification

To assess for risk factors at the MHC, several multi-agency site investigations of the MHC were conducted from June through November 2015. These agencies included ACDC, Environmental Health (EH), Community Health Services (CHS), Veterinary Public Health (VPH), and San Gabriel Valley Mosquito and Vector Control District (SGV).

#### Community Outreach

Printed health education materials (Figure 1) in English and Spanish were distributed to residents, and a community outreach meeting was hosted at a location adjacent to the MHC. Meeting invitations, notification of the investigation, and educational pamphlets were distributed to residents in English and Spanish (Figure 2). The notification letter urged residents to contact ACDC if they had been ill with fever



and headache or rash anytime since March 1, 2015, one month before the earliest case onset. All residents who contacted ACDC were interviewed by an ACDC investigator using a standardized questionnaire, which included information on individual demographics, clinical signs and symptoms, and possible exposures. Those with persisting symptoms were referred to their personal healthcare provider. ACDC consulted these providers and coordinated collection of a serological sample and testing.

### **Case Review and Case Finding**

Outbreak-associated cases were defined as persons with the following criteria and symptom onset between March 1 and August 31, 2015:

- residence within the MHC,
- fever with headache or rash, and
- positive *R. typhi* or *R. rickettsii* laboratory test (immunoglobulin M (IgM) >1:64 and/or immunoglobulin G (IgG)>1:64).

ACDC increased surveillance for additional flea-borne typhus cases linked to this MHC. Disease surveillance staff reviewed all cases reported to DPH from January 1 through August 31, 2015 for possible links to the MHC. ACDC also contacted laboratory directors from four acute care facilities that could have evaluated an MHC resident or persons residing within this geographical area for an acute febrile illness. ACDC requested that laboratory directors review data for positive *R. typhi* or *R. rickettsii* laboratory tests (IgM >1:64 and/or IgG>1:64) and submit results to ACDC. A Los Angeles Health Alert Network<sup>9</sup> (LAHAN) notification was sent to emergency rooms and urgent care providers that served MHC residents and persons within this area. It requested that providers consider the possibility of flea-borne typhus in patients presenting with acute onset of fever, headache, rash, and myalgia. Clinicians were asked to collect serum specimens from suspect cases and to report suspect cases to ACDC.

To confirm etiology, available samples were transported to the LAC Public Health Laboratory (PHL). Samples were tested for *R. typhi* and *R. rickettsii* IgG and IgM via indirect immunofluorescence antibody testing (IFA).

## **RESULTS**

### **Risk Factor Identification**

On June 18, 2015, EH and SGV visited the 95-unit MHC. EH visited cases' residences and provided education regarding risk reduction. SGV inspected the entire grounds and identified multiple sanitation concerns: large numbers of free-roaming cats (>30), cat and dog feces throughout the grounds, pet food and water bowls outside residences, and an abundant flea population. Two opossums were trapped by SGV on June 18 and 22 wherein 615 and 1,087 fleas were identified, respectively, when combed. A pool of five fleas from each opossum was tested for rickettsial organisms by the Orange County Mosquito and Vector Control District. Fleas from the two opossums tested positive for *R. felis* via polymerase chain reaction (PCR), but *R. typhi* was not detected.

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<sup>9</sup> [www.publichealth.lacounty.gov/eprp/lahan/lahan.htm](http://www.publichealth.lacounty.gov/eprp/lahan/lahan.htm)



On June 24, 2015, SGV issued a summary abatement notice to the property owner and property manager but not the residents. The notice required the owner to remove all feces from the grounds, eliminate the availability of pet food outdoors, enforce property rules limiting the number of pets and requiring pet registration with management, provide bi-weekly flea abatement, and remove feral animals.

A follow-up site visit with representatives from ACDC, EH, SGV, VPH, and CHS was conducted on August 13, 2015. Consistent with the June site visit, investigators observed many free-roaming cats, dog and cat feces, and pet food left outside. There were several aspects that likely also increased the presence of feral cats and fleas. First, three community dumpsters were present, uncovered, and overfilled with refuse. In addition, the foundation supporting and surrounding the mobile home was damaged. This offered potential harborage for wildlife. Also, a noticeable flea population persisted despite flea abatement efforts by the management company.

SGV re-contacted management to reiterate the order for bi-weekly flea abatement by a private company. SGV monitored the flea population by placing six glue boards (16 cm x 11 cm in size) throughout the neighborhood on a bi-weekly basis to assess for the presence of fleas. At the start of September, an average of 14 fleas were trapped on the boards. In November 2015, two consecutive visits yielded an average of zero fleas collected, suggesting a sustained reduction in the presence of fleas.

### **Community Outreach**

A total of three residents contacted ACDC in response to the investigation letter. One was referred to his primary care physician due to persisting symptoms consistent with the case definition. However, laboratory results determined that he did not meet the case definition.

The community meeting was held adjacent to the MHC on August 24, 2015 with representatives from ACDC, EH, SGV, VPH, CHS, city council, and the office of a state senator. Approximately 20 residents attended the community meeting. An ACDC physician presented information about flea-borne typhus and advice for reducing its transmission including instructing residents not to leave pet food outdoors. VPH distributed flea collars free of charge to attendees for their pet cats or dogs. CHS public health nurses performed free on-site blood draws and completed the standardized questionnaire for five attendees who reported experiencing symptoms consistent with flea-borne typhus since March 1, 2015. Two additional outbreak-associated cases were identified.

### **Case Review and Case Finding**

Two additional outbreak cases were identified among MHC residents at the community meeting as described. However, no additional cases were identified within the geographic area of the MHC using case finding and provider outreach methods employed during the investigation. Follow up through December 2015 to ensure implemented control measures were effective yielded no additional cases.

A total of five confirmed flea-borne typhus cases were identified within the MHC; three initially reported by the hospital infection preventionist and two additional cases that were identified through



investigational activities and confirmed via IFA (Table 1). Initially, Case A's lab values did not meet the CDPH flea-borne typhus case definitions but was reclassified as a confirmed case due to the epidemiologic link to the MHC. Illness onset ranged over three months, from April through June 2015, but was unknown for the non-hospitalized cases. Cases were primarily female (4/5) with a median age of 48 (range 42-67). All cases owned at least one dog; two cases also owned at least one cat. Of the five cases, three were hospitalized for a total of 15 nights (average = 5). All five cases recovered without complication.

## DISCUSSION

An outbreak of flea-borne typhus occurred in a LAC MHC in the summer of 2015, resulting in a total of five identified cases. It is likely that additional cases occurred as part of this outbreak but remain undetected due to the non-specific, typically mild presentation of this disease and the residents' limited access to health care.

In LAC, the incidence and geographic spread of typhus cases has increased over recent years. Total cases increased from 31 in 2010 (0.3 per 100,000) to a peak of 68 cases in 2013 (0.7 per 100,000), with a slight decrease to 44 cases in 2014 (0.5 per 100,000). Despite this overall increase, typhus clusters remain an unusual occurrence. Prior to this investigation, the last documented cluster in LAC occurred in 2005 [8].

The etiologic agent of flea-borne typhus has received increased debate. *R. typhi* is traditionally considered the etiologic agent of flea-borne typhus. However, *R. felis* was detected in the fleas obtained from opossums in our investigation. This suggests that the causative agent of this outbreak was possibly *R. felis*, a rickettsial agent that is serologically indistinguishable from *R. typhi* in humans due to cross-reactivity [9,10]. PCR testing of samples obtained from acutely ill patients is necessary to make the distinction between the two organisms; these samples were not available during our investigation [10]. *R. felis* serology tests are not commercially available nor is PCR testing for *R. felis* or *R. typhi*. Future efforts should be made to acquire samples in acutely ill persons with suspected flea-borne typhus and tested via PCR for both *R. felis* and *R. typhi* by appropriate laboratories.

Limitations of this investigation included the amount of time required to coordinate the multiple agencies involved, which highlights the need to continually foster relationships with outside agencies. As a result, our on-site testing of residents occurred at a time when cases were no longer acutely ill. However, there was evidence that *R. felis* was still circulating in the community at the time of our involvement. Investigators successfully remediated that risk factor and improved overall environmental conditions.

Overall, this response demonstrated that the implementation of a multi-faceted intervention can interrupt the suburban transmission cycle of flea-borne typhus. Multiple interactions with the management were needed to sufficiently improve site conditions and decrease the flea population. More intimate engagement of community members and provision of pet flea control supplies was ultimately required in order to affect a change in the community. Infectious disease epidemiologists, community health providers, veterinarians, environmental health specialists, vector control experts, and city representatives were required to address the many factors contributing to the outbreak. One year post-





outbreak, we have received no additional reports of cases occurring in the MHC or surrounding area, suggesting that our efforts were successful in mitigating the outbreak.

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Figure 1. Community Meeting Invitation

## Protect Yourself & Your Neighbors from Flea-Borne Typhus

Flea-borne typhus is a disease that infected fleas can spread to humans. Several cases of flea-borne typhus were found recently in your area. Fleas can come from many types of animals including cats, rats, and opossums.

**Follow these steps to keep your family and pets safe from flea-borne typhus.**

		
Use flea control products for your pets, yard, and home.	Do not sleep with your pet. It increases the chance that a flea on the pet may bite you.	Use insect repellent containing DEET when outside.
		
Do not feed stray animals.	Keep stray animals from sleeping or hiding near your home.	Store your trash in cans with secure lids.

**Communities working together to  
get rid of flea-borne typhus.**

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Los Angeles County Department of Public Health  
<http://publichealth.lacounty.gov/acd/VectorTyphus.htm>



CDCP-ACDC-0066-01 (08/18/15)



Figure 2. Community Meeting Invitation

**NOTICE OF  
COMMUNITY MEETING**

**FLEA-BORNE TYPHUS**

**PROTECT YOURSELF AND YOUR PETS**

Flea-borne typhus has been found in your area.  
Come to this neighborhood meeting to learn about this disease and how to prevent it.

**Date:** Monday, August 24, 2015  
**Time:** 6:00pm-7:00pm  
**Location:** [Redacted] Market (parking lot area)

**During this meeting, the LA County Department of Public Health will:**

- Provide information about this serious disease that can be treated with certain antibiotics (medicine that kills bacteria).
- Give a community update about the disease.
- Offer free typhus testing for you and flea protection for your pet.

Have questions?  
Call Chelsea Foo at [Redacted]

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Los Angeles County Department of Public Health  
<http://www.publichealth.lacounty.gov>

Table 1: Case Characteristics

Case	Age Group	Sex	Cat Owner	Dog Owner	Onset Date	Hospitalized	Hospital Nights	R. Typhi		R. Rickettsii	
								IgG	IgM	IgG	IgM
A	45-54	M	Yes	Yes	4/20/15	Yes	6	<64	1:64	N/A	N/A
B	35-44	F	No	Yes	4/9/15	Yes	4	1:128	≥1:256	N/A	N/A
C	65-74	F	Yes	Yes	6/5/15	Yes	5	1:128	1:128	N/A	N/A
D	45-54	F	No	Yes	Unknown	No	0	1:128	<64	1:64	<64
E	45-54	F	No	Yes	Unknown	No	0	1:64	<64	1:128	<64