

Acute Communicable Disease Control Program

Special Studies Report

2011



Los Angeles County
Department of Public Health



Public Health

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ACDC SPECIAL STUDIES REPORT 2011

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BOTULISM CASE REPORT SUMMARY LOS ANGELES COUNTY, 2011

David Dassey, MD, MPH

Six suspected botulism cases (excluding infant botulism) were reported in 2011 to Los Angeles County Department of Public Health—three were laboratory confirmed, all due to toxin type A. Two of the three confirmed cases were classified as having unspecified botulism, defined as a clinically compatible case that is laboratory confirmed in a patient aged greater than or equal to one year who has no history of ingestion of suspect food and has no wounds.¹ In the first case, a middle aged man with metastatic cancer and history of stroke became ill and ultimately died. His serum was shown to have type A toxin, but tests of stool and gastric specimens were negative for both *Clostridium botulinum* and toxin. Home inspection did not uncover suspicious food items. The second confirmed case was an elderly woman who became ill while out of the country. She was transported home 12 days later, where tests ultimately detected *C. botulinum* producing type A toxin in her stool; her serum was negative for toxin. Tests of suspect food items was not possible since she was exposed while out of the country, but several homeopathic products she was using were screened to rule them out as a source of intoxication.

The third botulism case was an injection drug user with recent skin infection. His serum tested positive for type A toxin, while a culture of his wound was negative; thus his case was classified as wound botulism. According to recently revised botulism surveillance definitions, cases of wound botulism may now be classified as either confirmed or probable. A confirmed case has laboratory evidence of botulism while a probable case is a patient with a clinically compatible illness who has no suspected exposure to contaminated food and who has a history of a fresh, contaminated wound during the 2 weeks before onset of symptoms, or a history of injection drug use within the 2 weeks before onset of symptoms.

The other three suspect cases were eventually diagnosed with Guillain-Barré syndrome (GBS). Two received antitoxin treatment and underwent testing of serum or stool, all of which was negative. One GBS case did not receive antitoxin and was not tested due to the delay in reporting his case; he too responded to GBS-specific therapy.

The California Infant Botulism Treatment and Prevention Program² reported eight confirmed Los Angeles County cases of infant botulism in infants ranging from 18 days to 36 weeks of age. Six were female; five were Hispanic white, one was non-Hispanic white, one was black, and the last was not specified. Three cases were due to type A toxin and five cases to type B toxin. All survived.

The Centers for Disease Control and Prevention (CDC) research study titled Use of an Investigational New Drug, Heptavalent Equine-Based Botulinum Antitoxin³ was ongoing in 2011. Heptavalent botulinum antitoxin consists of equine-derived antibody to the seven known botulinum toxin types (A-G). State and local public health agencies, along with the treating physicians, are monitoring the clinical efficacy and adverse events associated with this product. Botulinum antitoxin for treatment of naturally occurring noninfant botulism is available only from CDC. BabyBIG (botulism immune globulin) is available for treating infant botulism through the Infant Botulism Treatment and Prevention Program. BabyBIG consists of human-derived botulism antitoxin antibodies and is approved by FDA for the treatment of infant botulism types A and B.

¹ Centers for Disease Control and Prevention. Botulism (*Clostridium botulinum*) 2011 Case Definition. http://www.cdc.gov/osels/ph_surveillance/nndss/casedef/botulism_current.htm

² Infant Botulism Treatment and Prevention Program. Division of Communicable Disease Control, California Department of Public Health. <http://www.infantbotulism.org/>

³ Centers for Disease Control and Prevention. Investigational Heptavalent Botulinum Antitoxin (HBAT) to Replace Licensed Botulinum Antitoxin AB and Investigational Botulinum Antitoxin E. MMWR. March 29, 2010. 59(10);299. <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5910a4.htm>





LOS ANGELES COUNTY'S 2010-2011 INFLUENZA SEASON: SUMMARY AND HIGHLIGHTS

Sadina Reynaldo, PhD and Elizabeth Bancroft, MD, SM

OVERVIEW

The 2010-2011 respiratory illness season in Los Angeles County (LAC), occurring approximately 18 months following the emergence of pandemic influenza H1N1 (pH1N1), was a moderate season with a return to LAC's typical cycle of influenza and respiratory illness activity. Unlike pH1N1 which yielded significant peaks in influenza illness at atypical times (late spring and early fall 2009), 2010-2011 returned to a usual respiratory illness season of bimodal peaks: a smaller peak in activity just prior to the New Year, increasing to a more substantial peak in mid-February. Influenza and respiratory syncytial virus (RSV) continued to be the dominant viruses and the unique consequences of pH1N1 virus remained: such as a shift in influenza deaths affecting younger individuals and a high prevalence of obesity among those fatalities.

RESPIRATORY VIRUS SURVEILLANCE IN LAC

Tracking the incidence of influenza, and other respiratory viruses, in LAC is unique and challenging—foremost because identifying all individual cases and requiring that all cases be reported to LAC Department of Public Health (DPH), is not possible. For example, influenza affects numerous individuals each year; on average during a mild season, roughly 10% of the population can contract this disease. Thus in LAC, with a population of roughly 10 million, even light seasons can result in roughly 1 million residents affected by this disease—an amount that would overwhelm any health department. Therefore, without the capability to identify the full gamut of individual cases of influenza, or other respiratory virus infections in LAC, the LAC DPH implements a broad range of surveillance methods that successfully determine the impact these diseases have in our communities. A summary of LAC DPH's annual surveillance activities is updated yearly and posted on LAC DPH's website.¹

The cornerstone to LAC DPH's surveillance is our summary of viral test results sent weekly by several sentinel laboratories throughout LAC. Most laboratories report both influenza and RSV; several laboratories also report results on parainfluenza, adenovirus, entero/rhinovirus, and the emerging pathogen human metapneumovirus. Our participating sentinel laboratories generate and submit thousands of viral test results every year; nearly 22,000 in the 2010-2011 season alone (Table 1). Aggregating the findings from these sentinel sites enhances LAC DPH's ability to determine the onset, peak and decline of influenza and respiratory illness activity. LAC DPH's surveillance is also instrumental in characterizing the prevalent viral strains circulating in our communities (Figures 2-4). LAC DPH also monitors and investigates reports of illness clusters and outbreaks due to respiratory illnesses; a total of 50 respiratory illness outbreaks due to a range of etiologies were confirmed by LAC DPH during the 2010-11 season (Table 1 and 2). In addition, LAC DPH conducts several special studies. For instance, in 2010-2011 LAC DPH initiated a study, funded by the Centers for Disease Control and Prevention (CDC) and the Council of State and Territorial Epidemiologists, assessing rates of influenza-like illness (ILI) among several outpatient facilities across LAC.² This study included viral tests to determine the etiology of the illness. LAC DPH also conducts extensive year-round syndromic surveillance that enhances our influenza surveillance including an assessment of ILI rates among emergency department visits across LAC (Figure 1). These aggregated longitudinal findings further support LAC DPH's assessment of the severity of the season as well as the onset, peak and decline of respiratory illness activity.

CHANGES IN REPORTING FATAL AND SEVERE CASES OF INFLUENZA

While, as described previously, individual reports of influenza cases are not reportable in LAC, there are two exceptions: 1) cases likely to due to a novel strain of influenza should be reported immediately so that

¹ <http://publichealth.lacounty.gov/acd/FluSurveillance.htm>

² See "Overview of Influenza Incidence Surveillance Project" in the 2011 ACDC Special Reports



LACDPH can assist in determining the true cause and etiology of illness, and 2) fatalities that are confirmed to have resulted from influenza. The reporting of influenza fatalities and severe cases has changed over the past several years. In 2003, the California Department of Public Health (CDPH) mandated the reporting of pediatric influenza-related fatalities and cases in intensive care units. As such, LACDPH has been able to track the impact of this disease among our children for several years. In 2009, with the advent of pH1N1, the mandatory reporting of severe cases and fatalities was expanded to all ages. However, as the impact of pH1N1 declined, reporting was streamlined. In October 2010, LAC DPH removed the reporting requirement for cases in intensive care units, but retained the requirement that *all* fatalities, of any age, with confirmation of influenza infection should be reported to LACDPH within 7 days of identification. This reporting standard differs from CDPH which only requires reports for fatalities among those younger than 65 years of age. LACDPH's reporting standard allows for an understanding of the impact of influenza across the full age spectrum and will be especially useful as pH1N1, which tends to affect younger individuals, is supplanted by other strains of influenza.

SEASON SUMMARY: A RETURN TO NORMAL CYCLES OF INFLUENZA

Overall for the 2010-2011 influenza season, LAC experienced moderate and fairly typical flu activity. The advent of pandemic H1N1 in April 2009 produced atypical peaks of activity in the spring and fall of that year,³ but 2010-2011 saw the return to a "typical" influenza season with a peak of positive influenza tests occurring in February. By mid-February nearly one-fourth (24.5%) of all submitted viral tests from our sentinel laboratories were positive for influenza (Table 1). Furthermore, the positive percentage of influenza in March (~10%) was just as high as in December, which illustrates the importance of continuing influenza vaccination past the New Year and into spring.

In addition during this season, there were aspects of LAC's influenza activity that were unique to our jurisdiction as compared to the rest of the nation. While the same three primary influenza strains were identified across the nation, overall, LAC saw significantly more type B influenza than the rest of the US. As shown in Table 1, from the beginning to the end of the season (August 29, 2010 to May 21, 2011) nearly 22,000 respiratory specimens were tested in sentinel laboratories in LAC; of these specimens, 2,122 (9.7%) tested positive for flu, and of these slightly less than half (43%) tested as type B. In contrast, the CDC's national surveillance collected a total of 137,139 specimens throughout the season, yielding 27,186 (19.8%) positive for flu and further identifying only 26% as type B (Figure 2). This season, treatment and prophylaxis recommendations for influenza were identical for all circulating strain types—but this is not always the case. The differences that can occur in LAC as compared to the rest of the nation demonstrate the importance of maintaining local surveillance for influenza and to tailor influenza guidance to match local findings.

OTHER RESPIRATORY VIRUSES

Beyond influenza, several other respiratory viruses were prevalent during 2010-2011, and these viruses contributed to the overall burden of respiratory illness. As shown in Figure 4, RSV peaked several weeks earlier in the season (around week 1) than influenza and yielded similar rates of detection. Levels of enterovirus/rhinovirus, parainfluenza, human metapneumovirus, and adenovirus, did not increase substantially until both RSV and influenza declined; more importantly, these viruses continued to circulate and cause illness long after the "influenza" season was considered over. This expanded viral surveillance illustrates that several viruses, other than just influenza, comprise what is commonly referred to as "flu season," and ILI activity can have a range of causes.

RESPIRATORY OUTBREAKS SUMMARY

Another aspect of LAC DPH's illness surveillance that greatly assists with our understanding of the severity and impact of disease is the reporting and investigation of respiratory illness outbreaks. During 2010-2011, respiratory outbreaks were reported from across LAC. As shown in Table 2, of the 50 confirmed respiratory outbreaks in "community" settings (non-healthcare settings), most (84%) occurred

³ Summarized at http://publichealth.lacounty.gov/acd/docs/Flu/Season09-10/IW_Summary.pdf



in elementary schools. The average duration of the outbreaks was 12 days with a range of 2 to 41 days. Only 30% of the outbreaks had a laboratory confirmed etiology: of those, most (86%) were due to the vaccine preventable viruses, influenza A and B. Of the 48 confirmed outbreaks in schools, only four reported offering the influenza vaccine at the school prior to the outbreak. To prevent outbreaks, it is important to get vaccinated to be protected against influenza, especially for elementary and school-aged children.

CHARACTERISTICS OF CONFIRMED INFLUENZA DEATHS

LAC DPH's monitoring and investigation of influenza-related fatalities provides valuable insight into those who are most affected by this disease. While 2010-2011 was no longer considered a "pandemic" season, and the impact of novel pH1N1 was lessened (Figure 5), the unique groups predominantly affected by this virus continued, as was especially evident in the season's flu fatalities (Table 3).

| Table 1. LAC Influenza Surveillance Summary (2010-2011) | | |
|------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------|
| LAC Surveillance Summary | Influenza Peak Week Week 7 (2/13/11-2/19/11) | 2010-11 Season Summary (8/29/10-5/21/11) |
| Positive Flu Tests / Total Tests (Percent Positive Flu Tests) | 354 / 1,442 (24.5%) | 2,122 / 21,987 (9.7%) |
| Percent Flu A / B | 56% / 44% | 57% / 43% |
| Positive RSV Tests / Total Tests (Percent Positive RSV Tests) | 100 / 730 (13.7%) | 1,304 / 12,720 (10.3%) |
| Community-Based Respiratory Outbreaks* | 3 | 50 |
| Flu Deaths, Confirmed* (Pediatric Deaths, Confirmed*) | 3 (0) | 34 (3) |
| * By date of onset. | | |



Figure 1
Influenza-like Illness ED Visits in LA County (2007-2011)
Surveillance Week 20

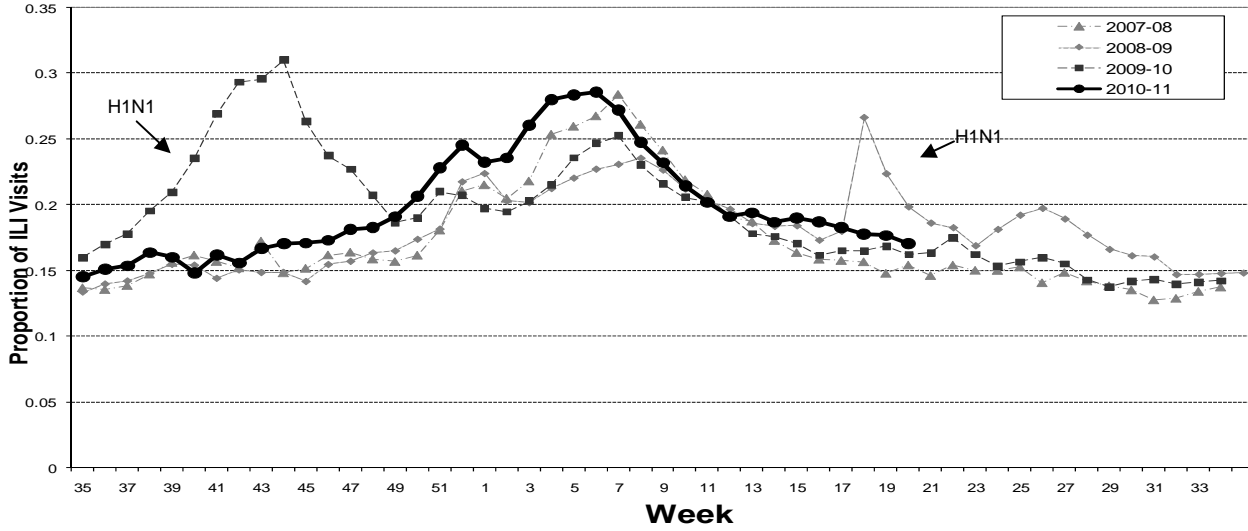


Figure 2
Percentage of Type A versus Type B Influenza
LA County and Nationwide
(2010-2011)

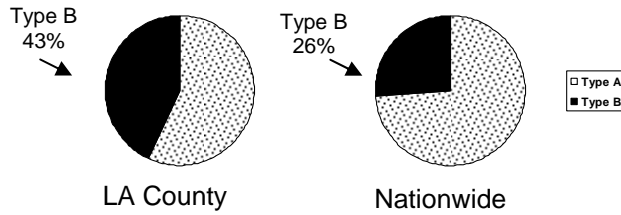


Figure 3
Percent Positive Flu (All Types, Type A, Type B)
LA County (2010-2011)

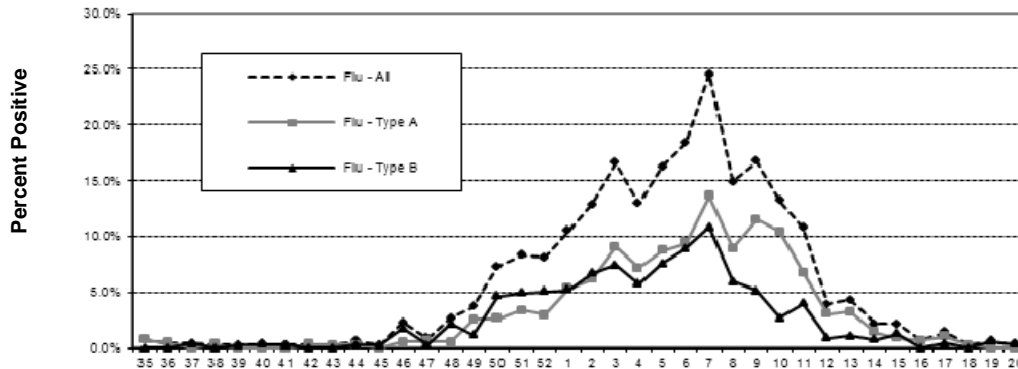
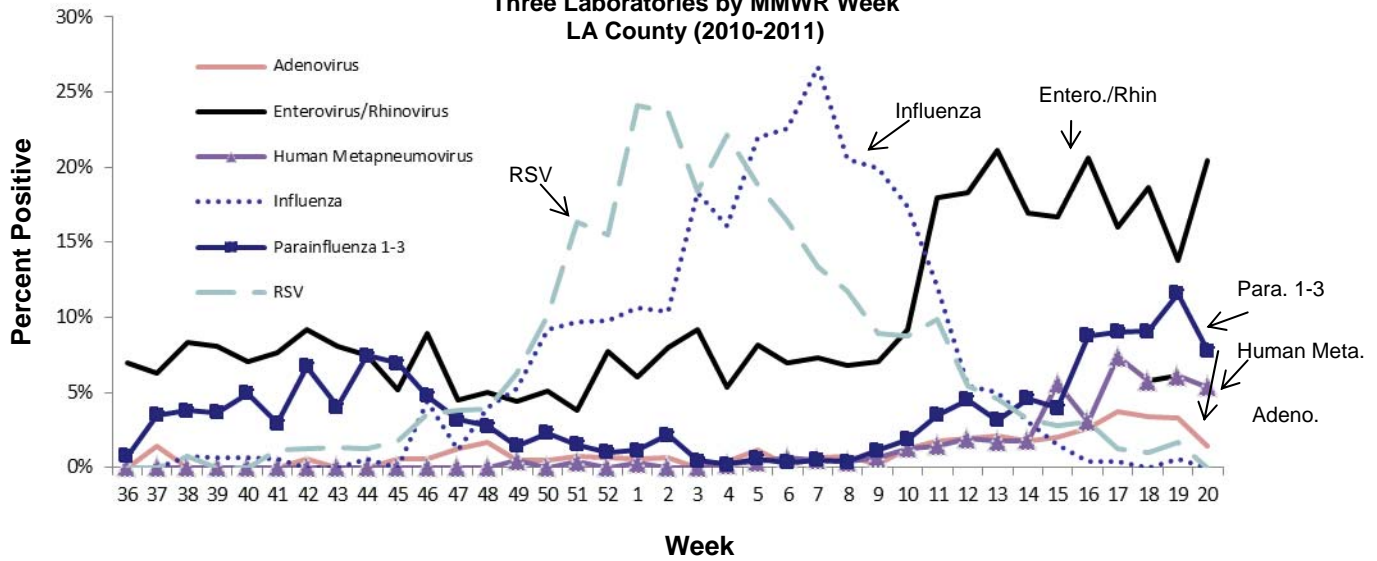




Figure 4
Percent Positive for Seven Respiratory Viruses from
Three Laboratories by MMWR Week
LA County (2010-2011)

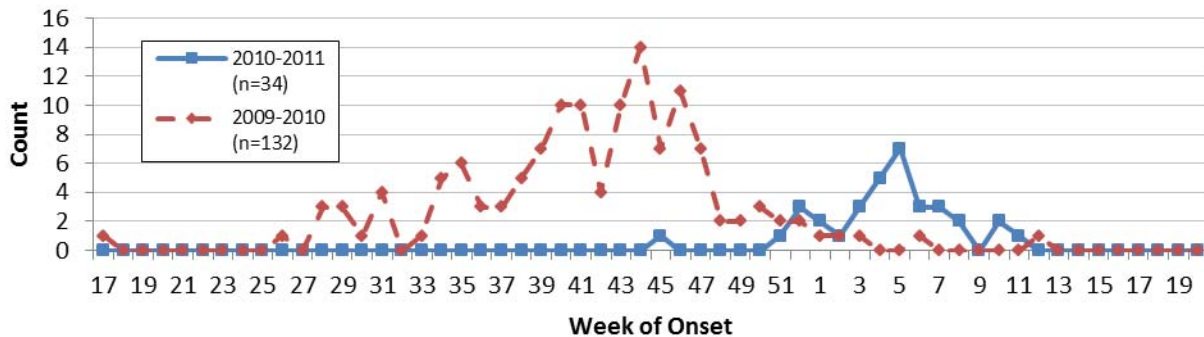


| Table 2. Confirmed Community-Based Respiratory Outbreaks | | |
|-----------------------------------------------------------------|----------|----------|
| LAC 2010-2011 (n=50) | | |
| Location of Outbreak | n | % |
| Childcare | 3 | 6 |
| Elementary School | 42 | 84 |
| High School | 2 | 4 |
| K-12 School | 1 | 2 |
| Assisted Living | 2 | 4 |
| Etiology | | |
| Influenza A | 2 | 4 |
| Influenza B | 7 | 14 |
| Streptococcal | 2 | 4 |
| Mixed * | 3 | 6 |
| Unknown | 36 | 72 |

* All the mixed outbreaks reported involved influenza.



Figure 5
Number of Influenza-Related Deaths by Week of Onset
LA County (2009-2011)



| Demographic Characteristics | | Number (%) |
|----------------------------------------------|--------------------------------------|------------|
| Age Group | 0-18 | 3 (8.8%) |
| | 19-64 | 28 (82.4%) |
| | 65+ | 3 (8.8%) |
| | Median | 46.5 |
| | Range | 4-92 |
| Race | Hispanic | 21 (61.8%) |
| | White Non-Hispanic | 7 (20.6%) |
| | Asian | 4 (11.8%) |
| | African-American | 2 (5.9%) |
| Gender | Female | 18 (52.9%) |
| | Male | 16 (47.1%) |
| Viruses Associated with Influenza Fatalities | | |
| Type A (all) | | 30 (88%) |
| | - pH1N1 | - 15 (44%) |
| | - A (no subtype) | - 14 (41%) |
| | - H3N2 | - 1 (3%) |
| Type B | | 4 (12%) |
| Underlying Medical Condition* | | |
| | Obesity | 18 (52.9%) |
| | Cardiac | 16 (47.1%) |
| | Metabolic (Diabetes, Kidney Failure) | 13 (38.2%) |
| | Overweight | 9 (26.5%) |
| | Pulmonary | 7 (20.1%) |
| | Current Smoker | 6 (17.6%) |
| | Past Smoker | 3 (8.8%) |
| | Acquired Neurologic Disease | 3 (8.8%) |
| | Immunosuppression | 1 (2.9%) |
| | Developmental Disability | |

* Individuals may have more than one condition.

There were only 34 deaths due to influenza in 2010-2011 versus 139 during the pandemic of 2009-2010. Despite the difference in magnitude of deaths, there were some significant similarities between the two respiratory seasons. In both seasons, people older than 65 years represented a very small minority of the reported cases, which may represent pre-existing immunity to the pH1N1 virus and/or decreased testing in the elderly. Another unique and significant continuing risk category is obesity. Obesity (BMI >30) was first identified in 2009 with the advent of pH1N1 as independent risk factor for influenza death, and this condition continued to be highly prevalent this season 2010-2011 among LAC fatalities, occurring in more than half of the deaths—combining both the categories of obesity and overweight (BMI >25) accounted



for almost 80% of LAC's influenza fatalities. However, there were some notable differences between the two seasons: in 2009-2010, the majority of the fatalities occurred early in the flu season (October-December) versus this past year when the majority of the fatalities had onset in February during our normal peak influenza season (Figure 4). Also compared to the previous season,⁴ during 2010-2011 the proportion of severe influenza cases in pregnant women or people with developmental disabilities decreased. Finally, while last season almost all deaths were due to pH1N1, or influenza A which was presumed to be pH1N1, in 2010-2011 additional influenza strains regained prominence; for instance, this season there were several (n=4, 12%) deaths associated with influenza B.

CONCLUSION

The influenza virus is always mutating, always changing—new strains emerge almost every season. As such, influenza, including its impact and severity, is also always unpredictable. This phenomenon was clearly illustrated by pH1N1; not only did it emerge unexpectedly, it yielded significant peaks of illness during atypical times in the year. Another unpredictable consequence of pH1N1 is that this strain tends to predominantly affect, and continued to impact, younger, as opposed to older, individuals.

Despite the unpredictability of influenza, there are several factors illustrated by the 2010-2011 season that should serve as a basis for future education, prevention and policy. First, while LAC DPH urges all residents to be vaccinated to protect themselves and their loved ones from contracting influenza, and LAC DPH urges that vaccination occur as early in the season as possible, LAC's cycle of influenza activity, which persists well into the spring, should encourage physicians and the public to continue to provide and receive influenza vaccination even in January and February. Second, LAC DPH's surveillance also revealed that our influenza activity in 2010-2011 differed from the rest of the nation. As such, our residents, and especially our medical communities, should focus on local guidance and recommendations which might differ from state and federal statements.

Finally, as demonstrated from the findings from 2010-2011, it is also especially important to improve vaccination and other preventive strategies for LAC's children and other high risk groups including people that are obese: the vast majority of LAC's influenza fatalities (80%) were either overweight or obese. While there were limited fatalities in children this season, the predominance of influenza outbreaks in elementary schools is evidence that this virus can circulate in the young and possibly spread the virus to those more vulnerable. Traditional and past influenza campaigns tend to focus mostly on other groups, such as the elderly and those with medical risk factors (such as those with respiratory issues). For future efforts, it is critical to improve outreach, education and policies that can advance vaccination and other preventive strategies for both for people who are at risk for severe consequences of influenza as well as healthy individuals who are likely to spread this disease through our communities.

ACKNOWLEDGMENT

Sovirny Norng, MPH—Acute Communicable Disease Control Program, Epidemiology Analyst
Monica Sovero, MPH—Acute Communicable Disease Control Program, Epidemiology Analyst

⁴ Summarized at http://publichealth.lacounty.gov/acd/docs/Flu/Season09-10/IW_Summary.pdf





DETERMINING INFLUENZA AND OTHER RESPIRATORY VIRUS ACTIVITY IN OUTPATIENT HEALTHCARE SETTINGS: THE INFLUENZA INCIDENCE SURVEILLANCE PROJECT IN LOS ANGELES COUNTY

Brittany Wurtz, MPH

BACKGROUND

During peak weeks of influenza, 5-8% of all outpatient visits in primary care settings are for influenza-like-illness (ILI) [1]. Although difficult to determine at the community level, ILI data help public health officials understand the impact of influenza and other respiratory pathogens on a community. In order to determine the weekly incidence of ILI and the contributions of select respiratory viruses in causing ILI in patients who go to the doctor for illness, in 2009 the Centers for Disease Control (CDC) and the Council of State and Territorial Epidemiologists (CSTE) initiated the Influenza Incidence Surveillance Project (IISP). IISP uses systematic surveillance for medically-attended ILI and laboratory-confirmed infections due to a variety of viral pathogens including influenza in broad geographic areas over several states and major municipal areas in the US. Los Angeles County (LAC) Department of Public Health (DPH) joined IISP in 2010. This report summarizes the LAC IISP from August 2010-April 2012.

METHODS

Acute Communicable Disease Control Program (ACDC) recruited multiple health care providers (HCP) with a moderate patient volume (approximately 100-150 patients per week) whose practices represent all age groups, geographic and socio-economic diversity.

HCPs reported weekly data electronically through SurveyMonkey™ on the total number of patient visits and ILI visits by age groups: <1 year, 12-23 months, 2-4 years, 5-17 years, 18-24 years, 25-49 years, 50-64 years, and >65 years of age. The IISP case definition for ILI in patients aged ≥2 years was: measured or reported fever along with cough or sore throat in the absence of a known cause other than influenza. Among patients aged <2 years ILI was defined as measured or reported fever with at least one symptom including cough, sore throat, coryza, rhinorrhea, anorexia, chills, myalgia, or malaise, in the absence of a known cause other than influenza.

HCPs collected a nasopharyngeal (NP) swab, along with brief demographic and clinical data on a case history form, from the first ten consenting ILI patients seen each week. No names or addresses were collected; patients were assigned unique alphanumeric codes by HCPs when data or specimens were sent to LAC DPH. HCPs received from \$300-\$500 in gift cards per month for their participation in IISP to reimburse them for their time in collecting specimens, filling out paperwork, and reporting results.

Specimens were analyzed by the LAC DPH Public Health Laboratory (PHL) using the Luminex® instrument and xTAG® respiratory viral panel (RVP) which tests for non-specific influenza A (subtypes seasonal H1, H3), influenza B, RSV (A&B), adenovirus, Human metapneumovirus (hMPV), parainfluenza 1-3, and rhinovirus. Influenza A specimens that could not be typed by RVP were analyzed by RT-PCR to determine if the influenza A specimen was the 2009 pandemic H1N1 strain (pH1N1). Final results were sent by PHL to ACDC and to the submitting HCP.

Data were stored in MS® Access 2010 and analyzed using SAS® version 9.2. ACDC sent weekly reports to the CDC using a secure File Transfer Protocol server of aggregate demographic and laboratory data collected. Data were analyzed periodically by ACDC to determine incidence of ILI, influenza, and other respiratory viral pathogens in ILI patients.



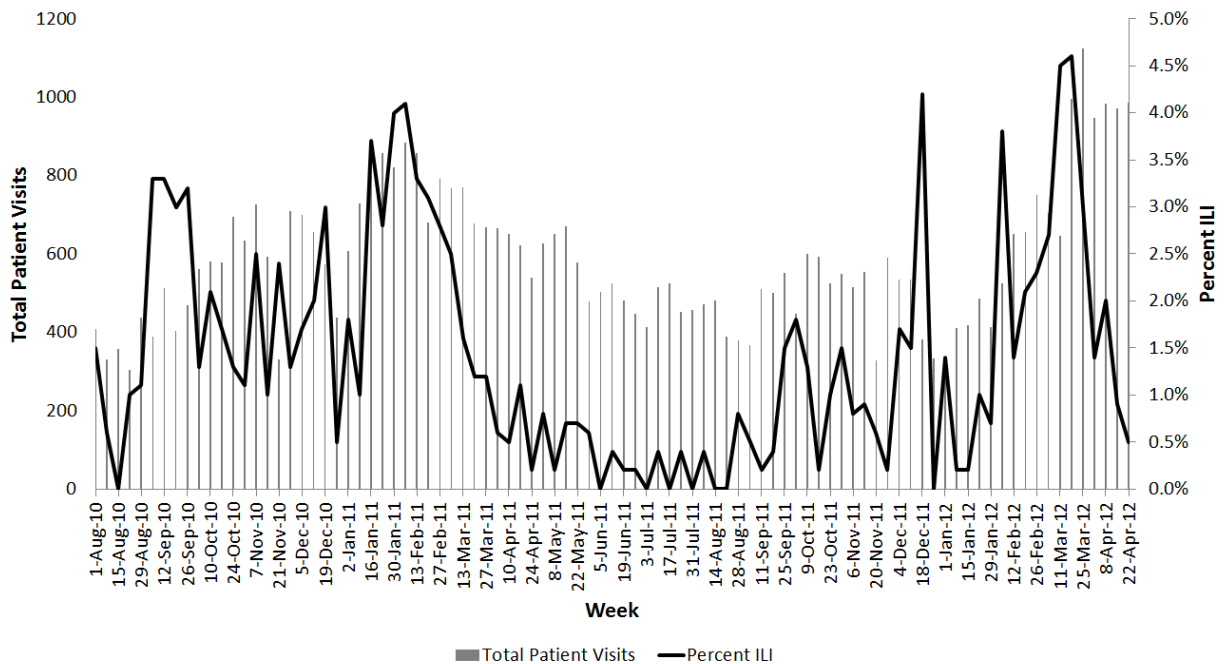
The LACDPH Institutional Review Board reviewed the IISP protocol and deemed the project to be exempt because it was considered routine public health surveillance. All personal health information protections were followed.

RESULTS

In the first year of the project (August 2010-July 2011), ACDC recruited six HCPs to the project (not all of the HCPs participated during the whole surveillance period). By May of the second year of the project there were eight HCPs participating, including five that had participated in the first year (not all of the HCPs participated in the project for the entire second surveillance year). Of the eight HCPs, five served underserved populations in LAC which include four family practice clinics serving predominately minority, indigent populations; a healthcare setting which served the LAC juvenile detention system; and two family practice residency clinics. Other HCPs include two pediatricians' offices and a family practice site in an area of LAC with individuals of a higher socioeconomic status.

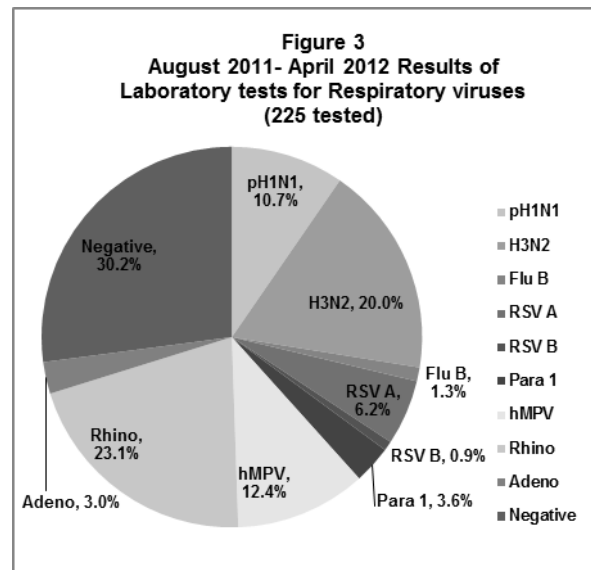
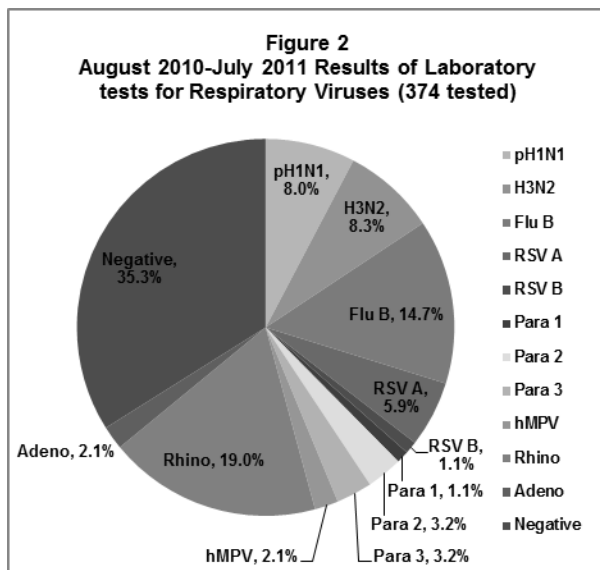
In the first surveillance year (August 2010-July 2011) the proportion of outpatient visits for ILI among HCPs in LAC reached peak activity in the week starting February 6, 2011 with 4.1%. In the second year of surveillance (August 2011-April 2012) the peak week of ILI activity was the week starting March 18, 2012 with 4.6% of outpatient visits for ILI (Figure 1).

Figure 1
Percent of ILI Visits/Total Patient Visits by Week, August 2010-April 2012





From August 2010 to April 2012, a total of 613 specimens were collected, of which 601 have been analyzed by May 25, 2012. Figures 2 and 3 demonstrate the incidence of viral pathogens among IISP specimens tested by Luminex[®]. Overall, more specimens were collected in the first year versus the second year (374 versus 225); the same percentage of specimens from the first to the second surveillance year had a virus detected (64.7% versus 69.7%). Influenza as a whole was the most common pathogen in both years but there were notable differences between the years. The first year saw a much higher incidence of influenza B (14.7%) versus 1.3% in the second year. hMPV in the first year accounted for only 2.1% of positive collected specimens compared to the second year at 12.4%.



Virus incidence by age group for year one of surveillance demonstrates that rhinovirus was the most common cause of ILI in children <5 years. Influenza (all types) was the primary cause of ILI among patients ages 5-17 years old, 18-24 years old, and 50 years and older (Table 1). Rhinovirus and influenza were equally prevalent in those aged 25-49 years. The data from year two are sparser but show the same trend, with rhinovirus being the most prevalent agent causing disease in those < 5 years, and influenza mainly affecting those 5 and older. (Table 2),

Table 1
Top 3 Viruses by Age Group (with at least 15% prevalence), August 2010-July 2011

| | 0-11 mos (n=15) | 12-23 mos (n=37) | 2-4 yrs (n=59) | 5-17 yrs (n=186) | 18-24 yrs (n=25) | 25-49 yrs (n=35) | ≥ 50 yrs (n=14) |
|---|------------------------------------|-------------------------|-------------------|-------------------|----------------------------------|------------------|----------------------------------|
| 1 | Rhinovirus (8) | RSV (8); Rhinovirus (8) | Rhinovirus (17) | Influenza B (43) | Influenza A* (6); Rhinovirus (6) | Rhinovirus (9) | Rhinovirus (2); Influenza A* (2) |
| 2 | Influenza B (2); Parainfluenza (2) | Parainfluenza (4) | RSV (9) | Influenza A* (41) | | Influenza A* (5) | |
| 3 | | | Parainfluenza (6) | Rhinovirus (21) | | Influenza B (4) | |

* Includes both Influenza A pH1N1 and H3N2

Table 2



Top 3 Viruses by Age Group (with at least 15% prevalence), August 2011- April 2012

| | 0-11 mos (n=9) | 12-23 mos (n=24) | 2-4 yrs (n=67) | 5-17 yrs (n=100) | 18-24 yrs (n=1)** | 25-49 yrs (n=14) | ≥ 50 yrs (n=10) |
|---|------------------------------|------------------------------|------------------------------|-------------------------------|-------------------|------------------------------|-------------------------------------|
| 1 | Rhinovirus (3) | Rhinovirus (10) | Rhinovirus (18) | Influenza A* (44) | | Influenza A* (5) | Rhinovirus (3); Influenza A* (3) |
| 2 | Human Metapneumovirus (2) | Human Metapneumovirus (4) | Influenza A* (14) | Rhinovirus (17) | | Human Metapneumovirus (2) | Human Metapneumovirus (1) |
| 3 | Influenza A* (1); RSV (1) | RSV (3) | Human Metapneumovirus (9) | Human Metapneumovirus (10) | | | |

* Includes both Influenza A pH1N1 and H3N2

** Specimen Tested Negative

DISCUSSION

IISP uses outpatient healthcare settings to estimate influenza and other respiratory viral pathogens at the community level. In LAC, IISP data demonstrated variability in the incidence of ILI throughout the year and the difference in the incidence of viruses from year to year. Trends found in IISP data are consistent with LAC wide surveillance. Each month during influenza season the LAC *Influenza Watch* report demonstrates county-wide trends on influenza and other respiratory viruses [2]. IISP data consistently showed similar trends of peak ILI activity and incidence of viruses causing such activity although pulling from a smaller number of sentinel providers. During the second year of surveillance both IISP and LAC wide data showed ILI activity peaking later in the season. Both systems showed that influenza was the predominant virus causing illness and that there was a higher level of hMPV in 2011-2012 than 2010-2012. The benefit of IISP is that it permits analysis by age group, demonstrating that rhinovirus is of particular concern in those <5 years.

Of note, more than 60% of patients who presented to an outpatient healthcare setting with ILI have a virus identified that could have been the cause of their illness. Upper respiratory infections are the single most common condition for which antibiotics are prescribed. Most medical societies counsel against using antibiotics for these infections because most are presumed to be due to viral causes where antibiotics are not useful [3]. Data such as these from the LAC IISP may convince healthcare providers locally that most ILI is due to a viral cause and may help reduce the prescription of unnecessary antibiotics.

There are limitations to our data. In recruiting HCPs to participate in IISP we strove to have an accurate representation of LAC residents but we preferentially recruited clinics caring for underserved populations. This may contribute to an IISP population with a large number of influenza unvaccinated individuals which would result in a higher incidence of influenza than the general population. However, the IISP data tracked well with the sentinel laboratory data used for standard surveillance in LAC so it is unlikely that this was a significant bias. Until the spring of 2012, when several more family practice HCPs were recruited, there was a disproportionate number of pediatric HCPs in the LAC IISP cohort. Generally, different age groups are susceptible to different viruses. Thus we presented both the overall incidence of viruses and the age stratified incidence of viruses. Those data clearly show that rhinovirus is more prevalent in those <5 years whereas influenza is more prevalent in those >5 years. Only recently, in 2010, has the Advisory Committee on Immunization Practices recommended influenza vaccine for all ages in the US. As more adults become vaccinated against influenza, we might start to see the role of influenza in outpatient ILI decline [4].

Overall, the ability of IISP to successfully collect surveillance in outpatient healthcare settings demonstrates for future studies the opportunities provided public health researchers to use these settings for other surveillance.



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SHIGA TOXIN-PRODUCING *ESCHERICHIA COLI* IN LOS ANGELES COUNTY, 2006-2011: AN EXAMPLE OF THE GROWING ROLE OF NONCULTURE METHODOLOGIES IN DISEASE SURVEILLANCE

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Shiga toxin-producing *Escherichia coli* (STEC) is a gram-negative bacteria responsible for approximately 175,000 illnesses and 20 deaths per year in the United States¹. It is associated with a wide variety of exposures that have in common contact with feces, including eating undercooked ground beef, unpasteurized milk and juice, and contaminated produce, as well as direct contact with animals or fomites contaminated with STEC. STEC can cause a spectrum of illness, ranging from asymptomatic infection to the classic presentation of bloody diarrhea and abdominal pain. Approximately 5-10% of STEC infections may lead to hemolytic uremic syndrome (HUS), a severe complication characterized by hemolytic anemia and acute renal dysfunction that may be fatal.

Historically, STEC illness, especially with severe complications such as HUS, has been associated with the STEC serotype O157:H7. However, increasing attention has been paid to the non-O157 serogroups of STEC in human illness. To better study this, non-O157 STEC was made nationally notifiable in 2000. In California, Shiga toxin in feces, even without further characterization, is also reportable. The widespread STEC outbreak in Germany in 2011 was due to a non-O157 serotype, O104:H4. This outbreak, linked to fenugreek sprout consumption, caused illness in over 4000 people, with development of HUS in over 800 patients, highlighting the pathogenic potential of non-O157 strains². Furthermore, reflecting growing recognition of non-O157 serotypes in human illness, the U.S. Department of Agriculture added to its longstanding ban on O157:H7-tainted ground beef by imposing a similar ban on the "Big Six" group of non-O157 strains (specifically, O26, O111, O103, O121, O45, and O145), effective sometime during 2012.

Los Angeles County (LAC) has historically had lower rates of STEC than rates seen nationwide, although the reasons for this are unclear. This study was undertaken to better characterize the epidemiology of O157 versus non-O157 STEC in the LAC community.

METHODS

A reportable case of STEC in LAC is defined as laboratory confirmation of any STEC serogroup by culture or detection of Shiga toxin in feces by enzyme immunoassay (EIA) or polymerase chain reaction (PCR) for Shiga toxin genes; positive specimens are forwarded to the LAC Public Health Laboratory (PHL) for further testing. For those cases for which only Shiga toxin-positive stool is received, LAC PHL confirms the positive result by EIA and initiates serogroup identification by culture. LAC PHL is equipped to identify O157 and four of the most prevalent non-O157 serogroups: O26, O103, O111, and O126. Any specimens that cannot be identified are forwarded to the California Department of Public Health Microbial Diseases Laboratory (CDPH MDL) or to the Centers for Disease Control and Prevention (CDC) for further testing, if the clinical history is compatible with likely STEC illness.

Cases included in this study are LAC residents with illness reported to LAC Department of Public Health (DPH) between January 1, 2006, when a systemic database for non-O157 STEC data was initiated, through June 30, 2011. Of note, clinical suspicion for HUS is also reportable in LAC, while confirmatory tests for STEC are underway. However, HUS cases that were ultimately not confirmed to be related to STEC infection were not included in this study. Data was stored in Microsoft Access and Excel, and Fisher's exact test and chi-square analysis comparing O157 to non-O157 cases was performed using SAS® v9.2. National STEC rates were obtained from the CDC FoodNet website³.



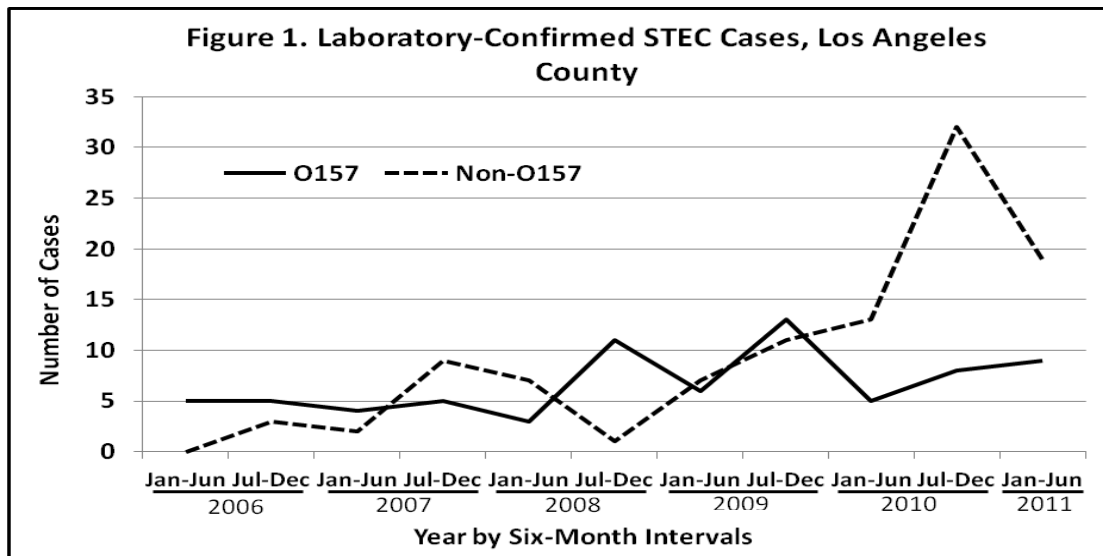
RESULTS

Between January 1, 2006, and June 30, 2011, there were a total of 217 reported STEC cases in LAC; 178 are included in this study due to incomplete reporting of data. Of these 178, 74 were O157 and 104 were non-O157. Overall, 86 cases (48.3%) were female; among non-O157 patients only, 47 (45.2%) were female, but a slight female predominance was noted among O157 cases, with 39 (52.7%) females (Table 1). Children under the age of 6 represented the largest age group among both O157 and non-O157 cases, although this was most dramatic among non-O157 cases where children under 6 years of age represented 61.5% of all non-O157 patients (versus 37.8% in O157).

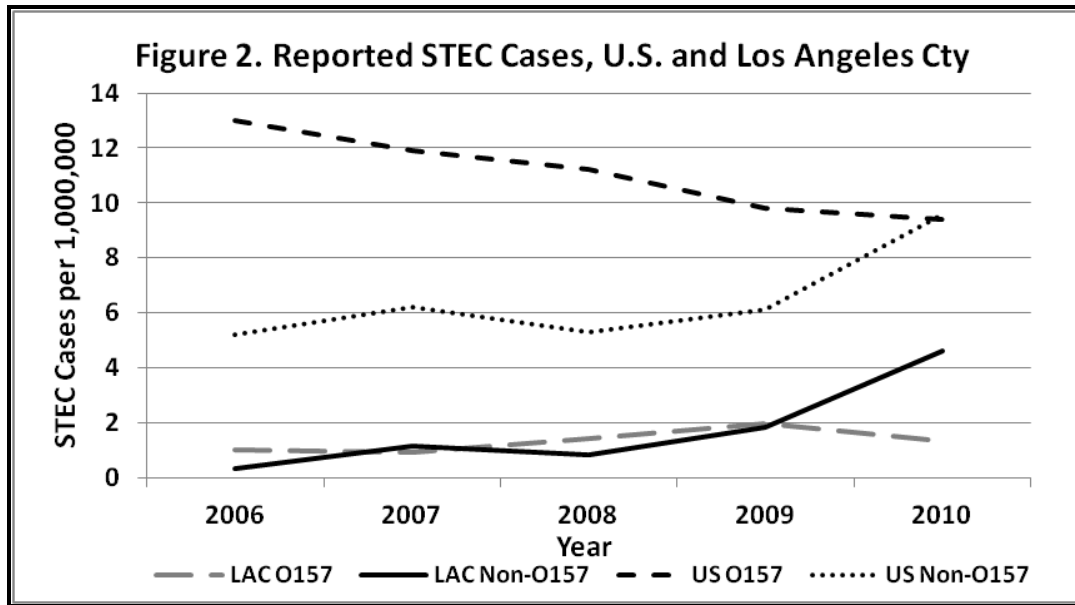
TABLE 1. Demographic Data of STEC Cases, Los Angeles County, Jan 2006-Jun 2011.

| STEC serotype | Total | Age | | | | |
|---------------|-------|-----------------|-------------------|---------------------|----------------------|--------------------|
| | | Female n (%) | <6 years n (%) | 6-18 years n (%) | 19-64 years n (%) | >64 years n (%) |
| O157 | 74 | 39 (52.7) | 28 (37.8) | 19 (25.7) | 20 (27) | 7 (9.5) |
| Non-O157 | 104 | 47 (45.2) | 64 (61.5) | 13 (12.5) | 22 (21.2) | 5 (4.8) |

Figure 1 displays the trend in laboratory-confirmed STEC cases from January 2006 through June 2011. While O157 cases have remained relatively stable during this time period, the number of diagnosed and reported non-O157 cases has overall steadily increased, with a dramatic increase in the second half of 2010.



Both national and LAC rates of reported STEC cases are depicted in Figure 2. Even with the marked increase in non-O157 STEC reporting in LAC in 2010, rates of both O157 and non-O157 in LAC are still markedly lower than the respective rates seen nationwide, with rates of 1.3 cases/million and 4.6 cases/million, respectively, compared to nearly 10 cases/million for both O157 and non-O157 nationally.



Clinical characteristics of illness severity, including presence of bloody diarrhea, hospitalization, HUS, and death are listed in Table 2. More severe illness overall was noted among O157 STEC infections, with significant differences noted with respect to all of these parameters except death. Two deaths in patients with STEC illness were reported during this time period: a 57 year old man with O157:H7 illness who developed HUS in 2011, and a 66 year old woman with non-O157 illness (specifically, O118:H16) in 2008.

TABLE 2. Clinical Characteristics of Illness Severity, O157 vs Non-O157 STEC, Los Angeles County, Jan 2006-Jun 2011.

| STEC serotype | Total | Bloody Diarrhea | Hospitalized | HUS | Death |
|---------------|-------|-----------------|--------------|-----------|---------|
| | | n (%) | n (%) | n (%) | n (%) |
| O157 | 74 | 64 (86.5)* | 28 (37.8)* | 5 (6.8)** | 1 (1.4) |
| Non-O157 | 104 | 30 (28.8) | 5 (4.8) | 0 (0) | 1 (<1) |

* $P < 0.0001$

** $P < 0.01$

Table 3 lists risk factors associated with illness in O157 versus non-O157 STEC cases in LAC during this time period. Examined risk factors include those associated with recent STEC outbreaks or associated with disproportionate illness in other studies. However, in this study population, there were no significant differences between O157 and non-O157 STEC cases who ate ground beef, ate sprouts, drank raw milk or unchlorinated water, visited a farm, or recently traveled.



TABLE 3. Risk Factors Associated with Illness, O157 vs Non-O157 STEC, Los Angeles County, Jan 2006-Jun 2011.

| STEC serotype | Total | Ate ground beef | Ate sprouts | Drank raw milk | Drank unchlor. water | Visited farm | Recent travel |
|---------------|-------|-----------------|-------------|----------------|----------------------|--------------|---------------|
| | | n (%) | n (%) | n (%) | n (%) | n (%) | n (%) |
| O157 | 74 | 33 (44.6)* | 1 (1.4)* | 1 (1.4)* | 1 (1.4)* | 2 (2.7)* | 7 (9.5)* |
| Non-O157 | 104 | 43 (41.3) | 4 (3.8) | 4 (3.8) | 5 (4.8) | 6 (5.8) | 16 (15.4) |

*P>0.05

DISCUSSION

Overall, LAC experiences a lower rate of STEC illness than that seen nationally, although other studies have not identified a clear explanation. STEC illness occurred in an approximately equal frequency among males and females. Many cases are noted among children for both O157 and non-O157. Most striking about the age profile is the large proportion of non-O157 STEC seen among young children under the age of 6 years, much greater than the proportion of O157 diagnosed in this age group. This likely reflects increasing usage of Shiga toxin screening in a population who is already more apt to undergo diagnostic testing, with concerned parents bringing their ill children for medical evaluation more often than adults might self-present.

The advent of diagnostic testing methods for Shiga toxin in 1995 is the key change in testing practices that led to the recognition of non-O157 STEC serotypes in human illness. These rapid assays, which include both EIA for Shiga toxin or PCR for Shiga toxin genes, are highly sensitive and designed to detect the presence of Shiga toxin from any STEC serotype, unlike traditional culture methods used to identify O157 that were the prior mainstay of STEC surveillance. However, although much faster than culture, Shiga toxin testing is unable to provide specific STEC serogroup or molecular data necessary to identify an outbreak. Thus, despite the rapidity of these assays, reliance on Shiga toxin testing as a diagnostic tool may actually delay the detection of an outbreak because it defers serogroup testing to a later stage.

In response to this, in 2006⁴ and 2009⁵ CDC issued formal laboratory diagnostic guidelines for STEC detection, recommending that stool specimens from patients suspected to have STEC undergo concurrent Shiga toxin testing (via EIA or PCR) plus culture for O157. Subsequent culture for non-O157 from a Shiga toxin-positive specimen may occur at a higher-level public health laboratory, such as LAC PHL, as smaller laboratories may not be equipped for these tests. However, the implementation of these guidelines has not proceeded smoothly. In LAC, two commercial reference laboratories are responsible for the majority of local STEC testing. One laboratory began testing all suspected stool for Shiga toxin by EIA in 2005; the other followed suit in mid-2010. This increased capability for Shiga toxin testing is the likely explanation for the increase in non-O157 STEC cases seen in LAC during the second half of 2010, rather than a true increase in incidence. However, neither laboratory routinely performs simultaneous O157 culture in accordance with CDC guidelines; O157 culture often only occurs if specifically ordered by the healthcare provider. Experience has suggested that inconsistent O157 culture practices are prevalent throughout all laboratories in LAC, forcing LAC PHL to take on a greater proportion of initial diagnostic screening when adherence to CDC best practice guidelines would require LAC PHL to perform just focused confirmatory testing and wide screening only on uncharacterized Shiga toxin-positive broths forwarded from reference laboratories. On a national level, in 2007, one year after initial publication of CDC guidelines, researchers from the FoodNet Working Group surveyed FoodNet catchment-area laboratories for adherence to testing protocol, finding that only 2% of surveyed laboratories were using both culture and non-culture methods simultaneously, with over one-third (36%) referring their specimens to off-site laboratories for STEC testing, practices that can delay STEC detection⁶. The Association of Public Health Laboratories and the Council of State and Territorial Epidemiologists are meeting this year to discuss the impact of these nonculture methodologies on disease surveillance and outbreak detection, not only for STEC but for other enteric organisms as well.



The growing use of Shiga toxin testing has had the positive effect of exposing the prevalence of illness due to non-O157 STEC, affording an opportunity to better characterize the epidemiology of these infections. Recent studies in both Minnesota⁷ and Connecticut⁸ comparing statewide non-O157 and O157 STEC cases from 2000 through 2006 (Minnesota) or 2009 (Connecticut) noted similar decreased disease severity trends among non-O157 cases to those trends observed in LAC. Interestingly, both the Minnesota and Connecticut studies found a greater frequency of international travel among non-O157 STEC cases than O157, although this was not observed in our population. Additionally, in Connecticut, some non-O157 STEC strains were noted to have exposure profiles more similar to O157 than the other non-O157 strains under study, but our small numbers of STEC cases in LAC do not allow for closer examination of individual strains in this manner. Nevertheless, these studies, which all capitalize on the increasing use of Shiga toxin testing, collectively add to the growing body of knowledge of the epidemiology of non-O157 STEC. Further study of STEC trends in LAC will be facilitated by greater implementation of CDC testing guidelines, which will also allow for timely, thorough disease reporting crucial in outbreak detection and response.

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CLINICAL PRESENTATION AND VARICELLA VACCINATION HISTORY IN LABORATORY CONFIRMED VARICELLA CASES USING PCR-BASED TESTING FROM AN ACTIVE SURVEILLANCE PROJECT

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BACKGROUND

The Varicella Active Surveillance Project (VASP) of Antelope Valley (AV) in Los Angeles County has conducted population-based active surveillance for varicella disease since January 1995 when the one-dose childhood varicella vaccination program was initiated in the US [1]. One-dose varicella vaccine effectiveness is approximately 85% [2] such that vaccinated persons may still develop varicella and may cause outbreaks of natural disease in both unvaccinated and previously vaccinated persons. However, varicella in vaccinated persons is generally mild with fewer lesions, shorter duration of illness and characterized by maculopapular rather than vesicular rash [2].

From 1995 to 2005, varicella incidence in the AV declined by 89.8% from 10.3 cases per 1000 population to 1.1 cases per 1000 population ($P < 0.001$) [3]. In June 2006 the Advisory Committee on Immunization Practices (ACIP) recommended administration of a second varicella vaccine dose to children 4 to 6 years of age and second dose catch up varicella vaccination to older children who had received one varicella vaccine dose [4]. From 2006 to 2011 varicella disease incidence in the AV declined by 81.8% from 1.1 cases per 1000 population to 0.2 cases per 1000 population ($P < 0.01$). By 2005, one-dose varicella vaccine coverage among children 19 to 35 months of age in the AV had reached 92% [3]. In 2010, two-dose varicella vaccine coverage in the AV was approximately 84% in entry level kindergarten children within AV [5]. With declines in disease incidence and milder clinical presentation of varicella, the clinical diagnosis of varicella became increasingly challenging.

In 2003, Polymerase Chain Reaction (PCR) laboratory testing of varicella skin lesions for confirmation of varicella cases, particularly among vaccinated children and others, was emphasized in the AV surveillance site and another VASP site in West Philadelphia to help with diagnosis of vaccinated varicella cases. PCR assay is the most sensitive and specific method for detecting varicella-zoster virus (VZV) DNA [6-9]. In this report, we summarize our PCR-based testing results of varicella cases with symptom onset from January 1, 2003 through December 31, 2011.

METHODS

Varicella cases were reported to VASP on a bi-weekly basis from over 300 surveillance sites which included daycare, schools, households, public health clinics, hospitals, skilled nursing facilities, private practice physicians, health maintenance organizations and correctional facilities. Details of the active surveillance for VASP have been described elsewhere [6].

A standardized telephone interview was conducted with each varicella case age 18 years or older or with the case's parent/guardian to collect demographic, clinical and health impact data and to determine if additional cases or susceptible contacts resided in the household. If the parent/guardian was not available for the interview, medical charts were used for verification of varicella diagnosis. Vaccination information was confirmed by immunization records, parents/guardians, schools or healthcare providers (HCPs). Susceptible household contacts of varicella cases were re-interviewed four weeks after the initial contact to identify additional cases.



Laboratory Testing

Since 2003, specimen collection kits have been distributed to all HCPs participating in the project to encourage and facilitate specimen collection. Prior to 2009, skin scrapings for PCR-based testing were collected only by participating HCPs. VASP staff have also collected specimens since 2009 to increase laboratory confirmation of varicella disease. PCR-based testing was conducted by the Centers for Disease Control and Prevention (CDC)'s National Varicella Zoster Virus (VZV) Laboratory in Atlanta, Georgia. PCR-based testing methods were conducted using standardized methodology [10 -16]. A β -Actin test was used as a control on all skin lesion specimens. A negative β -Actin test indicated undetectable actin DNA and an inadequate specimen.

Case Definitions

A verified varicella case was defined as an illness in a child or adult residing in the AV with an acute onset of a diffuse maculopapulovesicular rash without other known cause diagnosed by a licensed HCP, school nurse or parent. Cases had a completed varicella case report confirming the diagnosis of varicella disease. Breakthrough (BT) disease was defined as a varicella-like rash in a child or adult vaccinated at least 42 days before rash onset [2]. A PCR-positive varicella case was defined as a clinically diagnosed varicella case that had a lesion specimen positive for VZV DNA and a positive β -Actin gene. PCR-negative varicella case was a clinically diagnosed varicella case with a skin lesion specimen with a negative VZV DNA and positive for the β -Actin gene. If a varicella case tested negative for both VZV DNA and the β -Actin gene it was considered as having an inadequate specimen [17][10][18]. Varicella cases were categorized as clinically diagnosed did not have diagnostic testing or had a skin lesion specimen with an inadequate specimens.

Data Analysis

Data were entered into Microsoft Access and data analysis was performed using SAS 9.2. All verified varicella cases with symptom onset from January 1, 2003 through December 31, 2011 with and without PCR testing were included in the analysis.

RESULTS

From January 1, 2003 through December 31, 2011, 2679 verified varicella cases were reported in AV. Two hundred and fifty-three or 9% of all verified cases had skin lesions tested using PCR. The proportion of verified varicella cases with PCR testing increased from 1% in 2003 to 24% in 2011. From the 253 verified cases, adequate specimens were collected from 228 (90%) for PCR testing; 196 (79%) were PCR-positive, 32 (11%) were PCR-negative.

Of the 226/228 (99%) PCR tested cases with adequate specimens, 78 (34%) were unvaccinated, 126 (60%) were one-dose BT cases, and 12 (5%) were two-dose BT cases. Ten PCR- positive cases with one-dose of vaccine were classified as non-breakthrough and were excluded from this analysis. Nearly all 77 of 78 (99%) of the unvaccinated cases were PCR- positive. Of the 138 BT varicella cases, one-dose cases were primarily PCR positive, with 104 (83%) one-dose cases and five (42%) two-dose BT cases compared with PCR-negative cases which comprised 22 (17%) one-dose cases and seven (58%) two-dose cases (Table 1).



Table 1. Varicella disease occurring 0-42 days and >42 days after vaccination, Antelope Valley, VASP, 2003 - 2011 , N=226

| Vaccination Status | PCR+ | PCR- | Total |
|--------------------|---------|--------|----------|
| | N=194* | N=32 | N=226 |
| | N(%) | N(%) | N(%) |
| Unvaccinated | 77(99) | 1(1) | 78(100) |
| 1-dose | | | |
| 0-42 days | 8(80)** | 2(20) | 10(100) |
| >42 days | 104(83) | 22(17) | 126(100) |
| 2-dose | | | |
| >42 days | 5(42) | 7(58) | 12(100) |

* Two vaccinated cases were excluded from analysis as vaccine doses were unknown

** 5 cases were vaccine strain and 2 were wild type strain

Specimen Collection Time

The median time of specimen collection and symptom onset was two days (range: 0-34 days). Of 195 specimens collected within five days of symptom onset, 172 (88%) were PCR-positive while 23 (12%) were PCR-negative. Of 24 cases whose specimens were collected within six to ten days of symptom onset, 17 (71%) were PCR-positive and seven (29%) were PCR-negative. Most of the cases, tested after five days of symptom onset were unvaccinated 11 (65%). Five (71%) of seven cases that had specimens collected more than ten days after rash onset were PCR-positive and two (29%) were PCR-negative. Of five PCR-positive cases collected over ten days after rash onset, two were unvaccinated and three were one-dose BT cases (Table 2).

Table 2. Time of Specimen Collection after rash onset by PCR Result, Antelope Valley, VASP, 2003-2011, N=226

| Days from rash onset | ≤ 5 (n=195) | | 6 to 10 (n=24) | | >10 (n=7) | |
|----------------------|-------------|--------|----------------|-------|-----------|--------|
| | n (%) | n (%) | n (%) | n (%) | n (%) | n (%) |
| | PCR+ | PCR- | PCR+ | PCR- | PCR+ | PCR- |
| Vaccine Status | | | | | | |
| Unvaccinated | 64(37) | 1(4) | 11(65) | 0 | 2(40) | 0 |
| 1-dose | 104(60) | 17(74) | 5(29) | 5(71) | 3(60) | 2(100) |
| 2-dose | 4(2) | 5(22) | 1(6) | 2(29) | 0 | 0 |
| Total tested | 172(88) | 23(12) | 17(71) | 7(29) | 5(71) | 2(29) |

* 2 cases were not included in the analysis as vaccine status was unknown

Demographic Information and Vaccination History

Most (193/226; 89%) of the PCR-tested cases were in the 1 to 14 year age-group. Of the 126 PCR-tested cases that received one-dose of varicella vaccine, 56 (44%) cases were in the 5-9 year of age group had PCR- testing completed, of which 47 (84%) were PCR-positive and 54 (43%) were 10-14 years of age had PCR-testing completed, of which 50 (93%) were PCR-positive. Of the five PCR-positive cases with two-doses of vaccine, 4 (80%) were in 5-9 years and one (20%) was in the 10-14 year age group.



The median age of PCR-positive unvaccinated cases was younger than that of cases clinically diagnosed cases, 10 (range: 0-39) versus 11 (range: 0-69) years, respectively. The median ages of PCR-positive cases with a history of one or two doses of varicella vaccination were similar to clinically diagnosed cases, nine (range: 2-15) for PCR-tested cases versus for clinically diagnosed cases 8 years (range: 1-45) . The gender, race and age distribution of the cases that had PCR-testing were similar to that of cases that were clinically diagnosed for case category (unvaccinated, one- and two-dose recipients).

Clinical Presentation

Cases with greater lesion counts were more likely to be PCR-positive. Among the cases reporting < 50 lesions, 78 (77%) were PCR-positive and 23 (23%) were PCR-negative, whereas those presenting with >50 lesions had a much higher proportion of PCR-positivity; 102 (94%) were PCR-positive. Additionally, 75 (95%) of cases presenting with vesicular lesions were PCR positive compared with 106 (82%) of those presenting with macular/papular lesions (Table 3).

| PCR Lab Result | Lesion Grading** | | Character of Lesions*** | |
|--------------------|------------------|---------|-------------------------|-----------|
| | < 50 | > 50 | Macular/Papular | Vesicular |
| | N=101 | N=108 | N=129 | N=79 |
| | n(%) | n(%) | n(%) | n(%) |
| PCR+ | 78(77) | 102(94) | 106(82) | 75(95) |
| PCR- | 23(23) | 6(6) | 23(18) | 4(5) |
| Vaccine Status | Lesion Grading | | Character of Lesions | |
| | < 50 | > 50 | Macular/Papular | Vesicular |
| | n(%) | n(%) | n(%) | n(%) |
| | N=78 | N=102 | N=106 | N=75 |
| Unvaccinated Cases | 14(18) | 61(60) | 32(30) | 40(53) |
| Vaccinated Cases | 64(82) | 41(40) | 74(70) | 35(47) |
| PCR- | N=23 | N=6 | N=23 | N=4 |
| Unvaccinated Cases | 0 | 1(17) | 1(4) | 0 |
| Vaccinated Cases | 23(100) | 5(83) | 22(96) | 4(100) |

*Excludes 10 non breakthrough cases

**7 cases excluded from the analysis as lesion grading was unknown

***8 cases excluded from analysis as character of lesions was unknown

The majority of PCR-tested cases were vaccinated, had <50 lesions and presented with macular/papular lesions, with 64 (82%) and 74 (70%) for PCR-positive cases and 23 (100%) and 22 (96%) for PCR-negative cases. For PCR-positive cases, vesicular lesions comprised 40 or 53% of unvaccinated cases and 35 or 47% vaccinated cases while all PCR-negative cases four (100%) were vaccinated and had vesicular lesions.

DISCUSSION AND CONCLUSION

In 2004, following an increase of the number of outbreaks of varicella disease in schools in the AV, it became increasingly challenging to clinically diagnose vaccinated cases. Specimen collection was strongly encouraged for laboratory confirmation of varicella disease in previously vaccinated children. Of 9% of reported varicella cases between 2003 through 2011 (n=253), PCR-based laboratory testing was completed in 65% of previously vaccinated cases of which >90% of those were between 1-14 years of



age. Most PCR-positive cases presented with vaccine modified varicella which characteristically presents with a macular papular rash and < 50 lesions [19].

Overall 77% of PCR- tested cases with <50 lesions were PCR-positive confirming the clinical suspicion of the medical provider. While most of the varicella cases with PCR testing were PCR-positive and supported the clinical diagnosis, a smaller proportion was either PCR-negative or had inadequately collected specimens. Cases that presented with <50 lesions and had macular/papular rash were more likely to be PCR-negative compared with cases that had ≥ 50 lesions and vesicular lesions, most likely because less VZV DNA was present and could not be detected in the laboratory testing. A PCR-negative result produces questions about the accuracy of the clinical diagnosis of varicella and the timing of specimen collection.

Timely and adequate specimen collection is challenging for confirmation of varicella cases because of delays in reporting, delays in seeking medical attention, cases not seeking medical attention and inexperience with proper specimen collection. The sensitivity and specificity of PCR testing is optimized if specimens are collected early in the course of rash [17]. In our study, specimens collected >5 days after symptom onset were generally PCR-negative, making it difficult to ascertain whether they were true varicella cases. Earlier testing of varicella lesions may not be feasible in real world situations as specimen collection depends on when HCP follow-up is sought. Additionally, specimens that were inadequately collected were not useful since varicella could not be laboratory confirmed. Training is needed to inform HCP's on adequate specimen collection from two or more different lesions for a better chance of VZV DNA detection.

In addition to documenting that varicella infection occurs after one varicella vaccine, we also confirmed that varicella can occur in persons with two documented doses [20][21]. Of five cases with two documented varicella vaccine doses, four cases were in the 5-9 year and one was in the 10 to 14 year age-group. From 2007 to 2011, our surveillance program investigated 88 (10%) two-dose BT varicella cases of 869 verified cases. Laboratory testing was completed on 15 (17%) of two-dose BT cases of which five cases were PCR-positive with wild type VZV.

There are several limitations to our study. The most severe limitation was that only 9% of all verified varicella cases had PCR based testing compared with cases clinically diagnosed and not PCR-tested cases. Most cases were reported by schools and represented school age children so the results may not be generalizable to older varicella cases. Most varicella cases had HCP follow-up for PCR testing, so the results may be less representative of milder varicella cases that did not seek HCP follow-up. Biweekly surveillance usually resulted in cases being reported after initial symptom onset and by the time project follow-up of report, the rash had resolved. In cases where rash was still present, this resulted in specimen collection being attempted in a less optimal period after five days unless specimen was obtained by HCP within five days of symptoms onset. Since additional testing for other viral etiologies was not conducted for PCR-negative specimens, we could not determine the causes of these cases. Additionally, varicella diagnostic test such as serology or other PCR-based tests of other specimen types such as saliva or buccal mucosa were not completed.

PCR-based laboratory testing for VZV is primarily available at state public health laboratories and CDC, with limited availability at commercial laboratories. For our study, all laboratory testing was conducted at the CDC National VZV Laboratory which is highly specialized and dedicated to accurate VZV DNA PCR-testing. However, the turn-around time for laboratory results was five or more days and thus not optimal for helping HCPs with the clinical management of the case. Therefore, it is important to make PCR testing available to commercial laboratories to increase its use and utility. Although, a greater proportion of PCR tested cases were positive within five days of collection time, our findings suggest that it is



possible for varicella cases to be laboratory confirmed when specimens are collected ten days after rash onset. HCPs should consider specimen collection for VZV for unresolved rash whenever varicella disease is suspected, in settings where a varicella outbreak is considered, and in hospitalized cases of varicella as it may still be possible to detect the VZV DNA. With the documentation that varicella disease is still possible in persons with two documented vaccine doses, additional surveillance will be required to determine how effectiveness of the second dose in preventing varicella.

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A CASE OF *VIBRIO CINCINNATIENSIS* SEPTICEMIA

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ABSTRACT

A Los Angeles County woman was hospitalized in January 2011 with septic shock and altered mental status. *Vibrio* was identified in blood cultures and eventually confirmed as *Vibrio cincinnatiensis* by the California Department of Public Health Microbial Diseases Laboratory (CA-MDL). Because *Vibrio* infections (vibrioses) are reportable conditions in California, Los Angeles County Department of Public Health Acute Communicable Disease Control Program (ACDC) opened an investigation of this case. Previously, only one other case of *V. cincinnatiensis* human infection had been described in the literature: a man diagnosed with vibrio meningitis caused by this rare organism. The purpose of this report is to add to the scant body of literature describing this pathogen.

CASE HISTORY

On January 5, 2011, a 50-year-old Latina woman with altered mental status was admitted to a Long Beach hospital. She was found on a commuter train, having failed to exit at the final stop. When Emergency Medical Services (EMS) arrived on the scene, she was on the sidewalk, confused and unable to respond to the medics' questions. She had no signs of visible trauma. Physical examination found elephantiasis of the lower extremities, with erythema, blue-black discoloration, and lichenification of the skin. Her blood pressure was 76/32, pulse 102 beats per minute, and temperature 92.2°F. Gross appearance was described as "disheveled, foul-smelling, and altered (mental status)." The patient was capable of opening her eyes on command, but was nonverbal.

The patient was sedated, intubated and admitted to the intensive care unit (ICU). She was given pressors and intravenous hydration to correct her hypotension. She was also given broad-spectrum antibiotics (piperacillin/tazobactam and vancomycin) to treat sepsis. Her legs were elevated to reduce edema.

Blood chemistry was normal at admission except for elevated BUN and creatinine. Liver function tests were elevated, but toxicology found minimal amounts of alcohol in her bloodstream. Toxicology was positive for THC (marijuana). Cultures were taken from multiple sites on the patient's body. Wound cultures from her legs yielded β -hemolytic *Streptococcus*, MRSA, VREF and multiple Gram-negative organisms. Urine cultures yielded *Pseudomonas* and heavy growth of yeast. Blood cultures yielded *Vibrio* species resembling *V. parahemolyticus*.

In addition to septicemia, cellulitis, and urinary tract infection, the patient was found to have insulin-dependent diabetes with acute renal failure. Doripenem was added to the previous antibiotics to treat her leg wounds and necrotic cellulitis (*Vibrio* species are susceptible to these antibiotics). Amphotericin B was used to treat the patient's funguria.

The patient was extubated on January 11, 2011 and transferred out of the ICU. She underwent cranial CT and MRI; no evidence of stroke or cardiovascular accident was found. Her altered mental status improved, but her condition was found to be compounded by previously undiagnosed schizophrenia, for which treatment was initiated. Nonetheless, a psychiatric evaluation on March 4, 2011 determined that the patient was not capable of making informed independent medical decisions. On March 17, 2011, the patient was transferred to a nursing home. She recovered from the cellulitis and elephantiasis, and the schizophrenia was controlled with drug therapy. She was discharged from the nursing home to her home six months after initial admission.



CASE INTERVIEW

Because the patient was hospitalized with a rare presentation of vibriosis, ACDC interviewed her in person to obtain food and environmental exposure history. During the interview, the patient mostly spoke Spanish, but insisted she could understand English adequately. She denied having any exposure to seawater or brackish water. She denied eating any seafood in the week prior to her onset of illness. The patient stated that she mostly eats pre-packaged foods at home, but occasionally buys food from street vendors. She was unemployed, living in a house with two other people, and then mentioned that she had an ongoing dispute with her neighbors, whom she accused of trying to harm her. The patient exhibited increasing paranoid and anxious behavior over the course of the interview. On the day she was picked up by EMS, the patient stated she had taken the commuter train to a local store. She had no recollection of being helped by paramedics or her arrival at the hospital.

LABORATORY

The hospital laboratory identified probable *Vibrio parahæmolyticus* in the original blood specimen on January 18, 2011. The isolate was sent to the Los Angeles County Public Health Laboratory (LAC-PHL) for confirmation. LAC-PHL could not positively identify the isolate, so it was forwarded to CA-MDL. On March 25, 2011, the CA-MDL confirmed the identity of the organism as *Vibrio cincinnatiensis*.

LITERATURE REVIEW

Only one case of vibriosis due to *Vibrio cincinnatiensis* had been reported in the English literature prior to our findings. The report was published in the Journal of Clinical Microbiology in 1986. That case occurred in a 70-year-old white male who presented to the University of Cincinnati Hospital with fever and altered mental status. A novel species of *Vibrio* was isolated from the patient's cerebrospinal fluid; it was named for the university where it was isolated. The man was treated with moxalactam and recovered with no complications.

DISCUSSION

The case described in this report bears some similarities to the first case report. Both cases presented with altered mental status and absence of diarrhea. Neither case had reported a previous history of seafood consumption or exposure to seawater or brackish water. Neither case had recent history of foreign travel. It was not possible to discern the sources of the patients' infections in either of these cases.

The current case was afflicted with multiple co-morbid conditions that are known to predispose people to vibriosis. At the time she was admitted to the hospital she had elevated liver enzymes, renal failure and anemia. She also has diabetes, history of previous cholecystectomy and cardiomyopathy. While these conditions were not present in the other previously documented case, they were possible contributing factors to this patient's *V. cincinnatiensis* infection.

One significant difference between this case and its predecessor was the omission of a cerebrospinal fluid culture. The CT and MRI did not detect any signs of intracranial vascular accident. A lumbar puncture could have been done to confirm or rule out infectious encephalitis.

CONCLUSIONS

This is the third known report of a confirmed case vibriosis due to *V. cincinnatiensis*. The patient was septicemic, but it is not known whether she also had vibriosis meningitis. It was difficult to discern the true presentation of disease due to a multitude of severe comorbidities. It was also impossible to properly interview the case for exposure history as she had altered mental status with paranoid delusions. Despite the complications surrounding the investigation of this case, it is important to document this case because of its obscurity in the medical literature.



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ARTIFICIAL KIDNEYS, O-RINGS AND *STENOTROPHOMONAS MALTOPHILIA*: AN OUTBREAK IN A DIALYSIS CENTER, LOS ANGELES COUNTY, 2011

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BACKGROUND

Hemodialysis is a life-saving procedure that utilizes an artificial kidney, or dialyzer, to remove waste from the blood. It is most often a treatment for end-stage renal disease (ESRD). Reuse of dialyzers is a common practice, and is thought to result in economic and waste savings. As of 2005, roughly 40% of dialysis centers reuse dialyzers in some capacity.¹ Use of reused dialyzers has been associated with an increase in hospitalization rates when compared to use of single-use dialyzers in free-standing dialysis centers using peracetic acid for reprocessing.² Of the 16 outbreaks investigated by CDC of bacteremia or pyrogenic reactions in hemodialysis patients between 1980 and 1999, eight were related to dialyzer reuse, and half of those resulted from errors in dialyzer disinfection.³

On August 2, 2011, an infectious disease (ID) physician at Hospital Y, contacted Los Angeles County (LAC) Department of Public Health (DPH), Acute Communicable Disease Control Program (ACDC) to report four patients diagnosed with *Stenotrophomonas maltophilia* and one patient diagnosed with *Achromobacter anthonpi* bacteremia among hemodialysis patients who receive services from Dialysis Center A. One of the patients with *S. maltophilia* also had *Candida parapsilosis* in the blood. Four patients were admitted to Hospital Y between July 1, 2011 and July 27, 2011 and one case was evaluated as an outpatient in May 2011. The ID physician notified the medical director at Dialysis Center A, of the cluster on July 29, 2011. On August 3, 2011, the facility voluntarily suspended the reuse program and all patients were switched to single-use dialyzers. A joint site investigation with LAC DPH Health Facilities Inspection Division (HF) was conducted on August 10, 2011, and a second site investigation was done on November 29, 2011. ACDC consulted with the California Department of Public Health (CDPH) and the Centers for Disease Control and Prevention (CDC) during the investigation.

This report describes an outbreak investigation of *S. maltophilia* infections among patients who underwent hemodialysis in Dialysis Center A, the measures taken to enhance patient safety, and collaborations between the DPH and Dialysis Center A to understand the importance of proper cleaning and disinfection of dialyzers to prevent healthcare associated infections.

METHODS

Dialysis Center Characterization

Information on patients, staff, and practices at Dialysis Center A were ascertained from the facility's Director of Clinical Services.

Case Definition

A case was defined as a patient undergoing hemodialysis using a Hemoflow™ Fresenius Polysulfone® F8 multiple use low-flux dialyzer (Fresenius F8) from May 1 to July 31, 2011, who was *S. maltophilia* blood culture positive with isolates indistinguishable by pulsed-field gel electrophoresis (PFGE).



Case Characterization and Finding

ACDC staff conducted a comprehensive review of case medical and microbiologic records. The facility's hospitalization and adverse event logs were evaluated for additional cases.

ACDC also initiated a summary report that was submitted to the CDC's epidemic information exchange (Epi-X) nationwide network on August 17, 2011 for additional case finding. The report notified public health professionals of the cluster and sought to identify other cases and clusters nationwide.

Molecular Epidemiology

Blood culture reports were reviewed for the five patients initially reported. PFGE DNA fingerprinting was conducted by the LAC Public Health Lab (PHL) on all patient blood culture isolates (n=3), patient 4 blood culture, and dialyzer isolates from patient 2 and patient 3 (dialyzer isolates were not available for patient 1). Dialyzer isolates were collected after reprocessing. PFGE DNA fingerprinting produces individual DNA fingerprint patterns using the restriction enzymes *Xba*I. Individual band differences were interpreted using the Tenover criteria: if PFGE resolves at least ten distinct fragments, PFGE patterns are considered indistinguishable if there are zero fragment differences between the fingerprint patterns, closely related if there are two to three fragment differences, possibly related if there are four to six fragment differences, and different if there are over seven fragment differences.⁴ Isolates possessing indistinguishable DNA fingerprint patterns are more likely to have originated from a common source.

Antibiotic Susceptibility

The antibiotic susceptibility pattern was reviewed for all case patient and patient blood isolates.

Dialyzer Reuse and Reprocessing History

The dialyzer reuse history was analyzed and included the last reuse date, the number of times the dialyzer was reprocessed, and the number of times the dialyzer was reused. We reviewed the dialyzer failure log which describes the reprocessing history for each case to determine the length of time between termination of treatment and initiation of sterilization.

Background Surveillance

The background rate of bacteremia among hemodialysis patients in Dialysis Center A was calculated for the time period of January 1, 2009 to December 31, 2010.

Epidemiologic Analysis

Dialysis post-treatment flow sheets for the three months prior to positive blood culture were reviewed for all case patients and patients. The flow sheets were evaluated for date and time of treatment, staff assigned during the session, station assigned, and dialysis machine used. We calculated the monthly rate of bacteremia among dialysis patients from January 1, 2009 to December 31, 2010. Dialysis machine logs and staffing records were analyzed for any association.

Control Measures

Actions taken by Dialysis Center A following the identification of the outbreak were recorded and summarized by ACDC.



CDC Water Testing

On August 11, 2011, the PHL submitted six water samples and three dialysate samples to CDC for endotoxin testing.

Site Investigation

On August 10, 2011, a joint unannounced site investigation with LAC HF was conducted. Entrance and exit conferences were held in addition to a walk-through of the facility. Participants included representatives from administration, infection control, nursing, and the medical director. Reprocessing and infection control policies and procedures, and the hospitalization and adverse events logs were examined by ACDC staff. The medical records of the five bacteremia cases were also reviewed. Cleaning and disinfection of the dialysis machine was observed as well as staff interaction with patients.

ACDC conducted a second unannounced site investigation to observe dialyzer reprocessing on November 29, 2011. Entrance and exit conferences were held in addition to a unit walk through. During the entrance conference we discussed changes that were implemented since the first visit. The complete reprocessing procedure was observed, from removal of the dialyzer from the dialysis machine to dialyzer cleaning, disinfection and storage.

Reprocessing Quality Assurance Audits

ACDC requested the reprocessing quality assurance audits for 2010 and 2011.

ACDC Environmental Cultures

On August 10, 2011, ACDC collected 26 environmental cultures from treatment area Pod 5 and the dialyzer reprocessing room.

Facility Environmental Cultures

The facility cultured all dialysis machines and dialysate solutions (n=28), 28 machine water endotoxin levels, eight water sites and two reprocessing machines on August 3, 2011, which were analyzed by the Dialysis Center A laboratory.

RESULTS

Dialysis Center Characterization

Dialysis Center A sees, on average, 45 to 65 patients per day, and has 109 patients monthly. Typically, patients receive dialysis treatment 3 days per week, for 3 to 4 hours. The center is open 6 days per week, from 5:00 am to 6:00 pm. The treatment floor has 25 beds, divided into six treatment areas, or PODs. There are two nursing stations and one reprocessing room in the facility. There are 28 dialysis machines in the center, and 83 preprocessed dialyzers in stock. The staff includes two Registered Nurses daily, one License Vocational Nurse every other day, and one reprocessing technician daily. Five to six patient care technicians are present daily.

Case Definition

Three patients met the case definition. Two patients who were initially reported did not meet the case definition. Patient 4 was *S. maltophilia* culture positive but did not match by PFGE and patient 5 was culture positive for *A. anthropi*, not *S. maltophilia*.



Case Characterization

All case patients were male, diagnosed with ESRD, had an arterio-venous (AV) fistula for dialysis access and received hemodialysis services ≥ 6 years. All were dialyzed using a Fresenius F8 reprocessed dialyzer with an O-ring header (end) cap. The cases were the only patients using the Fresenius F8 reprocessed dialyzer in the facility. Ages ranged from 31 years to 65 years with a mean of 45 years. In addition, all case patients were assigned to the same treatment area, Pod 5, during the time period reviewed. Of note, case patient 2, was previously diagnosed with *S. maltophilia* bacteremia in 2009; this case patient was considered chronically infected/colonized with *S. maltophilia*.

The two bacteremic patients who were not cases, patients 4 and 5, were both male, ages 58 and 67 years. Both had a catheter dialysis access. One patient used a Gambro Revaclear dialyzer; the other used a Polyflux 21R dialyzer until July 18, 2011, then switched to a single-use dialyzer on August 5, 2011. Patient 4 was treated in POD 5, and patient 5 was treated in POD 2.

Figure 1. Fresenius F8 dialyzer, intact and with header and O-ring removed.



Case Finding

In addition to the five patients initially reported, nine other patients became symptomatic with fever and/or chills during or after dialysis from January 1, 2011 through August 10, 2011. Blood cultures were drawn per policy; all were assessed and subsequently hospitalized. Blood culture results indicate that seven cultures were negative and two cultures were positive, both in April 2011 (positive *Enterococcus faecalis* and positive group A *Streptococcus*).

No responses to the Epi-X report were registered.



Molecular Epidemiology

All case patients were blood culture positive for *S. maltophilia*. Blood cultures from case patient 2 were also positive for *C. parapsilosis*. Patient 4 was culture positive for *S. maltophilia* and *Klebsiella oxytoca* and patient 5 was culture positive for *A. anthropi*. Dialyzers for all cases were cultured by the Dialysis Center A laboratory. The dialyzers for case patient 2 and case patient 3 were culture positive for both *S. maltophilia* and *C. parapsilosis*. The dialyzer for case patient 1 was culture negative. Test results indicated that the three case blood isolates and dialyzer isolates from case patient 2 and case patient 3 had indistinguishable pulse-field gel electrophoresis (PFGE) fingerprint patterns with zero band differences and were designated Type A, indicating origin from a common source.

DNA fingerprinting was also performed by the CDC Mycotic Diseases Branch on the *C. parapsilosis* positive blood and dialyzer isolates for case patients 2 and 3 and a *C. parapsilosis* positive environmental isolate from the reprocessing room blood rinse reverse ultra filtration (RUF) faucet. The results indicated that the blood and dialyzer isolates for case patient 2 and the positive environmental isolate had the same DNA pattern. The dialyzer isolate for case patient 3 did not match the dialyzer isolate from case patient 2 or the environmental isolate and was unrelated to the other isolates.

Antibiotic Susceptibility Pattern

All case blood isolates were susceptible to trimethoprim/sulfamethoxazole and levofloxacin and had different susceptibility patterns for other antibiotics. The susceptibility pattern for patient 4, who was *S. maltophilia* culture positive, had a different susceptibility pattern and was resistant to trimethoprim/sulfamethoxazole but susceptible to levofloxacin.

Dialyzer Reuse History Analysis

All dialyzer reuse was in compliance with Dialysis Center A policy. As per Dialysis Center A policy, the maximum number of reuse for dialyzers is set by the facility.

Dialyzer Reprocessing History

As noted previously, all case patients used the same multi-use dialyzer with removable O-ring header. Reprocessing logs for the most recent multi-use dialyzer were available for case patient 2 and case patient 3; case patient 1 did not have a log available as this patient was starting a new dialyzer at the time we recommended they discontinue use of reusable dialyzers. Reprocessing logs for case patient 2 and case patient 3 revealed a mean time to reprocessing of 72 minutes (range: 24 to 135 minutes) and 33 minutes (range: 26 to 54 minutes) respectively.

Background Surveillance for *S. maltophilia*

The monthly rate of bacteremia among dialysis patients from January 1, 2009 to December 31, 2010 ranged from 0 to 2.4 events per 1000 procedures, with a mean rate of 0.07 events per 1000 procedures.

Epidemiologic Analysis

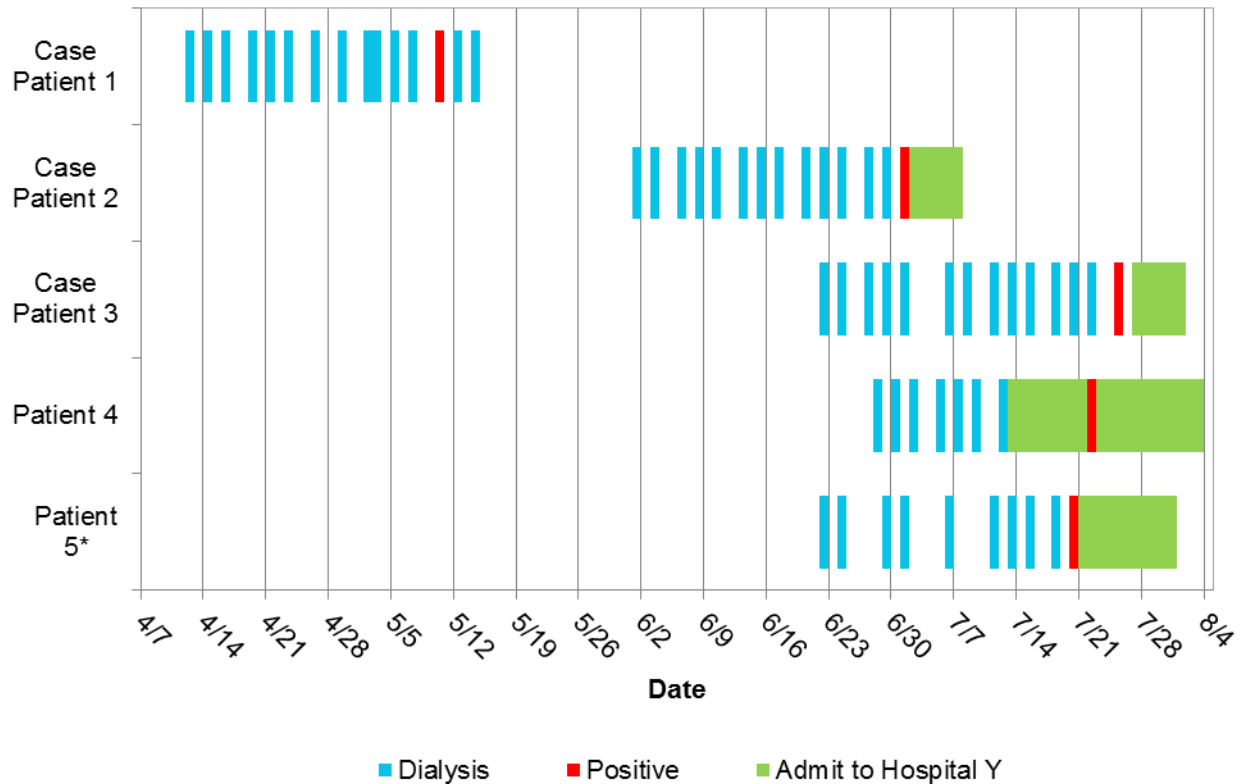
Evaluation of patient dialysis schedules showed that both case patient 2 and case patient 3 received dialysis treatment on the same daily schedule (Monday, Wednesday and Friday), in the same treatment area (Pod 5) but not at the same time/shift or station. Case patient 1 was consistently scheduled on opposing days, but in the same treatment area. Of note, both case patient 2 and case patient 3 received dialysis treatment on July 1, 2011. Case patient 2 was dialyzed on the first shift, experienced fever, chills and hypotension at the end of treatment, was admitted to the hospital with a diagnosis of fever of



unknown origin and was positive for *S. maltophilia*. Case patient 2 was dialyzed the same day on the second shift, using the same machine as case patient 3, which was also consistently used by the case patient 1, who was positive for *S. maltophilia* in May 2011.

Analysis of the dialysis machines used by the three case patients during the outbreak period revealed that dialysis machines were not consistently located in the same station as described by facility staff during the initial site investigation.

Figure 2. Epidemiologic curve, including case patients and patients.



*Positive for *Achromobacter anthropi*; others positive for *Stenotrophomonas maltophilia*

Control Measures

On August 3, 2011, the facility voluntarily suspended the reuse program and all patients were dialyzed with single-use dialyzers. All dialysis machines and dialysate solutions (n=28) were cultured by the facility per policy the same day. Physicians were notified of cluster. Daily management meetings were held to review policies to ensure staff compliance and safe practices. Enhanced staff education was also conducted, including retraining of reprocessing staff on dialyzer header cleaning. A letter was posted in the facility notifying patients of cluster of infection.

CDC Water Sampling

All water and dialysate samples were determined to be within acceptable limits for endotoxin.



Site Investigations

During the first site investigation on August 10, 2011, several lapses in staff infection control practices were noted, including issues with hand hygiene and safe injection practices, and improper environmental cleaning technique. The facility informed ACDC that dialyzers can be refrigerated for up to 36 hours before being reprocessed.

The second site visit on November 29, 2011 found that the facility was no longer using the Fresenius F8 O-ring header multi-use dialyzer. Multi-use dialyzers with no O-rings and/or single-use dialyzers were being used. All cultures will be sent to the dialysis center main laboratory Monday through Friday and to the Hospital A laboratory on Saturday. Culture results will be entered manually in a log book to identify clusters of disease and ensure timely follow-up. During the walk-through, the treatment room floors were clean and the unit was less cluttered. The reprocessing procedure was observed and documented: first, the patient care technician unhooked and capped the used multi-use dialyzer on the treatment floor, walked it to the reprocessing room, bagged the dialyzer and labeled the bag with the date and time, and placed it in the refrigerator with the other used dialyzers. Dialyzers can be stored in the refrigerator up to 36 hours before being reprocessed. Then dialyzer is then manually cleaned to remove excess blood, refilled with a high-level disinfectant, tested for adequate disinfectant application, inspected, labeled, and stored. The procedure was in compliance with facility policy but had one lapse in step: the dialyzer was not bagged prior to transport to the reprocessing room. Cleaning of a multi-use dialyzer with an O-ring was not observed because those dialyzers were no longer in use at the time of the site visit.

ACDC provided recommendations which included detailed instructions on cleaning, disinfection, and documentation.

Reprocessing Quality Assurance Audits

There was no documentation of the reprocessing quality assurance audits available, which is not compliant with state mandates.

ACDC Environmental Cultures

Four reverse osmosis (RO) water samples were *Burkholderia cepacia* (*B. cepacia*) positive. The prime bucket from one machine in Pod 5 also tested positive for *B. cepacia*. Microbiologic analysis of the blood rinse RUF faucet in the dialyzer reprocessing room was positive for *C. parapsilosis*. A specimen from the RUF faucet to dialysate in the dialyzer reprocessing room revealed *Ralstonia pickettii*. Of the remaining cultures, 16 were negative and four were not tested because they were not epidemiologically linked.



Table 1. ACDC environmental cultures results.

| Location | Source | Sample Type | Date of Collection | Results |
|----------------------------|------------------|--------------|--------------------|------------------------|
| Station 12, machine 26 | Water | 50 ml bottle | 8/10/11 | <i>B. cepacia</i> |
| Station 11, machine 25 | Water | 50 ml bottle | 8/10/11 | <i>B. cepacia</i> |
| Station 12 | Prime bucket | Swab | 8/10/11 | <i>B. cepacia</i> |
| Station 13 | Water | 50 ml bottle | 8/10/11 | <i>B. cepacia</i> |
| Dialyzer reprocessing room | RUF to dialysate | Swab | 8/10/11 | <i>R. pickettii</i> |
| Dialyzer reprocessing room | Blood rinse | Swab | 8/10/11 | <i>C. parapsilosis</i> |

Facility Environmental Cultures

All cultures were negative. Dialysate and water endotoxin levels were within acceptable levels (total viable microbial count lower than 200 colony forming units (CFU)/mL).

DISCUSSION

This report describes an investigation of a cluster of bacteremic and fungemic patients in a dialysis center infected with *S. maltophilia* and other pathogens. Analysis of the DNA strain testing for *S. maltophilia* results indicate that a common source likely served as the mode of transmission between patients. Blood culture isolates from the three case patients and dialyzer isolates from case patient 1 and case patient 2 shared an indistinguishable PFGE pattern denoting a common source. Additionally, blood and dialyzer isolates from case patient 2 were genetically related to the environmental isolate from the reprocessing room faucet for *C. parapsilosis*.

S. maltophilia is a gram-negative bacillus characterized by its ability to colonize nosocomial water sources and aqueous environments. Greater risk of infection is associated with immunocompromised health status, long hospital stays, and medical treatment with indwelling devices.⁵ A recent increase in the number of *S. maltophilia* infections can be ascribed to the resistance of the organism to common antibiotics and newer antibiotics.⁶ *S. maltophilia* bacteremia has an attributable mortality rate of 27%, indicating its severity, especially in a nosocomial setting.⁷

We hypothesize that transmission of *S. maltophilia* most likely occurred due to cross contamination and improper cleaning and disinfection of dialyzer header in the reprocessing room. The results of the environmental samples support that the contaminated environment in the reprocessing room was a possible source of infection. As suggested by facility staff during the site investigation and as supported by the literature, reused dialyzers and the reprocessing process have been implicated in a number of bacteremia clusters in dialysis centers.⁸ In California specifically, a study of dialysis centers found a strong association between *S. maltophilia* bloodstream infections and clusters and both reprocessing dialyzers and refrigerating dialyzers before reprocessing.⁹ O-ring contamination of the reprocessed dialyzer may occur when disinfectant cannot reach portions of the O-ring that are compressed against the



header or fiber bundle of the dialyzer. Fresenius F8 dialyzers utilize an O-ring that needs to be cleaned using a complex twelve step process, unlike other multi-use dialyzers without O-rings. Further, past outbreaks and mock dialyzer trials have demonstrated that during dialysis, organisms from the O-rings are able to enter the bloodstream.⁸ *S. maltophilia* is known for its ability to adhere to plastic materials such as the walls of the dialyzer.¹⁰ Other routes of transmission are possible.

The ability of *C. parapsilosis* to adhere to and form biofilm on implanted devices is acknowledged as a potential pathway for infection.¹¹ Because the patient blood cultures and dialyzers were genetically related to the environmental sample, it is hypothesized that a lapse in infection control during the reprocessing process may have contributed to this infection. Outbreaks in acute care settings of *C. parapsilosis* have been documented and present a serious concern, especially in immunocompromised patients.¹²

The multiple infection control lapses that were identified during the initial site visit denotes an overall lack of understanding of basic infection control principles and indicates a considerable issue with staff compliance with facility infection control, handwashing, and medication policies.

Given the reprocessing policy in which dialyzers may be refrigerated for up to 36 hours, *S. maltophilia* and *C. parapsilosis* and other cold-tolerant organisms may be allowed to grow and accumulate biofilm. Though dialyzer logs that were available for review did not demonstrate long periods of refrigeration, refrigeration should be minimized and reprocessing should occur as soon as possible after dialysis. Use of multi-use dialyzers with O-rings is strongly discouraged.

In summary, ACDC investigated an outbreak of bloodstream infections in a dialysis center and concluded the source to be related to the reprocessing of multi-use dialyzers with O-rings. Final recommendations included adherence to hand hygiene, medication, and infection control policies as outlined in facility, CDC, and Centers for Medicare & Medicaid Services guidelines. Additionally, a system of physician notification of positive cultures to facility staff should be maintained and refrigeration should be minimized and instead, reprocess dialyzers as soon as possible. Fresenius F8 dialyzers are no longer used by the center. The facility continues to reuse dialyzers.

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RESPIRATORY OUTBREAK OF UNKNOWN ETIOLOGY ASSOCIATED WITH EVENT AT VENUE A, FEBRUARY 2011

Patricia Marquez, MPH, Caitlin Reed, MD, MPH, Dawn Terashita, MD, MPH

BACKGROUND

On February 11, 2011, the Los Angeles County Department of Public Health (LAC DPH) was notified of a possible outbreak of legionellosis among attendees of a recent conference in LAC. LAC DPH was notified of the possible outbreak by the California Department of Public Health (CDPH) who was notified by CDC based on inquiries from a media outlet in New York City. Through blogs and social media posts, the reporter became aware of a cluster of persons with respiratory illness among attendees of a conference held February 1st–3rd. The conference was held at Hotel A, where the majority of attendees stayed; there were parties at various locations on each night of the conference, concluding with a large gathering at Venue A on February 3, 2011.

The conference had 715 registered attendees who came from 30 countries, most of whom returned to their homes on February 4, 2011. Conference attendees who fell ill began discussing their respiratory illness on Facebook and other social media sites in the week following the conference. Several reported that they had been diagnosed with legionellosis. At the time of DPH notification, the Wikipedia entry for legionellosis had already been updated to include a detailed description of the outbreak associated with Venue A.

METHODS

Epidemiologic Methods

Case Definitions

From the outset of the investigation, legionellosis was considered a possible etiology for the cluster of illnesses. Initial reports from attendees suggested that most had an influenza-like illness compatible with Pontiac fever. We used case definitions based on prior CDC *Legionella* investigations. A Pontiac fever case was defined as a conference attendee with onset of illness on or after February 1, 2011, and within 10 days of last exposure to Hotel A and/or Venue A, with fever (measured or subjective), and at least one of the following symptoms: headache, cough, shortness of breath, myalgias, vomiting or diarrhea. A Legionnaires disease case was defined as a person with respiratory illness, radiographically-confirmed pneumonia, and laboratory evidence of *Legionella* infection on or after February 1st in a person exposed to the conference at Hotel A and/or party at Venue A.

Case Finding

We conducted an online survey of conference attendees who attended the party at Venue A. A list of all registered conference attendees was obtained from the organizers of the event, including names and email addresses. An online survey was emailed to all attendees, who were asked to complete the survey whether they became ill or not. Questions included attendance at other conference events, hotels attendee stayed in during the conference, as well as prior illness. DPH also contacted the event coordinator who hired hostesses for the event for a list of all hostesses who worked that evening. Incomplete contact information was available for the hostesses; of an estimated 150–180 hostess attending the Venue A event, only 99 email addresses were provided to invite them to participate in the survey. A separate online survey was emailed to hostesses, who were also asked to complete the survey whether they became ill or not. Questions in this survey included specific questions regarding locations at the party they spent the most time, as well as if they participated in other Venue A events prior to the February 3rd party. In addition to event hostesses, DPH interviewed 41 of the 67 Venue A employees who worked on February 3rd.



Exposure Assessment

Details of the conference schedule and activities were obtained from the conference schedule and from interviews with the conference organizers. All conference sites were inspected by LAC DPH and CDC for water features and aerosol-generating devices that could lead to increased growth and transmission of *Legionella*. The environmental assessment was completed using the Environmental Assessment Form from CDC (1).

The conference opened on February 1st. Sessions and activities were held from 7:00 am to 6:00 pm daily at Hotel A. Breakfast was served at Hotel A in a ballroom. Lunch was served outdoor at Hotel A next to a decorative fountain. Each evening the conference ended with a party. On February 1st, the party was next to the pool of Hotel A and consisted only of conference attendees. In addition to the decorative fountain mentioned above, potential aerosol-generating water features included a hot tub and three cooling towers on top of the building. Two smaller additional parties were held on February 1st by other sponsors, one directly across the street from Hotel A at Hotel B and one at a private residence nearby. The February 2nd party was held at the outdoor bar of Hotel C, and consisted only of conference attendees. No aerosol-generating water features were identified at Hotel C.

The event at Venue A was held on February 3rd from 8:00 pm to 1:00 am. Conference attendees were shuttled by bus from Hotel A to Venue A. In addition to conference attendees, an estimated 150 to 180 hostesses from Southern California were invited to attend, for approximately 700 guests on site. Hostesses did not attend any other conference functions or events. Shuttle buses circled the main driveway of Venue A and unloaded passengers near the entrance to the back lawn and pool area of the property. To enter the main party tent, guests had to pass by the pool and waterfall. In the tent, there was a band, dance floor, food, bar and hazer ("fog machine"). The pool extended into a cave-like structure containing interconnected hot tubs. No guests or facility staff used the pool or hot tubs. A few hostesses were paid to swim in the pool during the party, but none used the hot tubs. Behind the tent was the animal area with peacocks, tropical birds, and monkeys. Most animals were in cages; a few tropical birds were out and accessible to guests. Guests were not allowed inside the main building (the private residence of the owner) at Venue A during the party. Restrooms were located in a pool house, and port-a-potties were available on the driveway.

Environmental Sampling for Legionella and Laboratory Methods

Environmental samples for *Legionella* were collected from Hotel A and Venue A according to previously published standard procedures (2). Bulk water samples and biofilm swabs were collected from all areas identified on environmental assessment that could lead to *Legionella* transmission. Water samples were collected in one-liter sterile bottles with 0.5 ml of 0.1N sodium thiosulfate added to neutralize chlorine. Biofilms were sampled with a polyester swab and then placed in 3 to 5 ml of water taken from the same source (to prevent drying during transport) with one to two drops of sodium thiosulfate solution. Water temperature, pH, and free chlorine concentrations were measured at the time of sample collection. The free chlorine levels were assessed using N,N-diethyl-P-phenylenediamine.

Because of initial concern that the hazer machines used in the main tent might have been a water aerosol-producing source, both machines were collected by LAC Environmental Health from the lighting and effects company hired by party planners. The machines were taken to the LAC Public Health Laboratory (PHL) for environmental sampling. The owner was interviewed and stated that the machines were refurbished machines, recently purchased, and used only once previously for a holiday party in another county. The operator used "Haze Juice," a commercially available pre-packaged mineral oil solution, to produce a mist effect. No water had been used in the machines; according to the manufacturer's directions, the device was not intended to handle water. Although mineral oil is not known to support the growth of *Legionella*, ten swabs were collected from each hazer machine on February 19th at the LAC PHL. Both hazer machines were disassembled in order to collect swabs from all parts of the machine.



Samples were collected from both locations on February 11th and 15th by LAC DPH and on February 22nd and 23rd by CDC. Samples collected by LAC DPH were transported to LAC PHL. Samples collected by CDC were shipped overnight to CDC.

Clinical Laboratory Methods

All cases among attendees, hostesses and staff who reported respiratory illness were invited to submit clinical specimens for testing. In total, 122 individuals in LAC were contacted via phone and email to inquire if they were still symptomatic and willing to submit specimens for testing. Those willing to submit specimens were directed to their primary care physician or their local public health clinic for collection. Specimens requested included nasopharyngeal swabs, sputum if still symptomatic with productive cough, as well as urine and blood specimens for *Legionella* urine antigen and acute serological testing respectively. Several specimens were collected and tested by private physicians. Other specimens collected from LAC cases were submitted to the LAC PHL for testing and out-of-county or out-of-state cases submitted specimens through CDC.

RESULTS

Among 715 registered conference attendees, 465 (65%) began the survey and 441 completed it. Of these, 235 (53%) self-reported illness by responding ‘yes’ to the survey question: “Did you become ill during or after the conference?” For hostesses, of the 99 emails available, 81 started the survey and 47 (58%) completed it. Of those, 40 (85%) self-reported illness by responding ‘yes’ to the survey question “Did you experience any illness after the date(s) you worked at (Venue A)?” Because of the unknown denominator of hostesses, our inability to contact many of them, and their poor response rate to the survey, hostess responses were not used in the exposure assessment or calculations of relative risk of illness by exposure.

Analysis of self-reported illness among attendees showed a range of symptom onset from February 1st to 15th, with peak onset on February 5th, two days after the event at Venue A (Figure 1). Among 235 persons who reported experiencing illness, the predominant symptoms reported were fever (56%), fatigue (67%), myalgias (52%), and productive cough (58%) (Figure 2). Of the respondents who indicated illness after the event, 52 (22%) sought medical care through visits to primary care physicians or urgent care centers. None were hospitalized. Many were given clinical diagnoses of acute respiratory illness and a few were sent home with prescribed antibiotics. None were given a laboratory confirmed diagnosis.

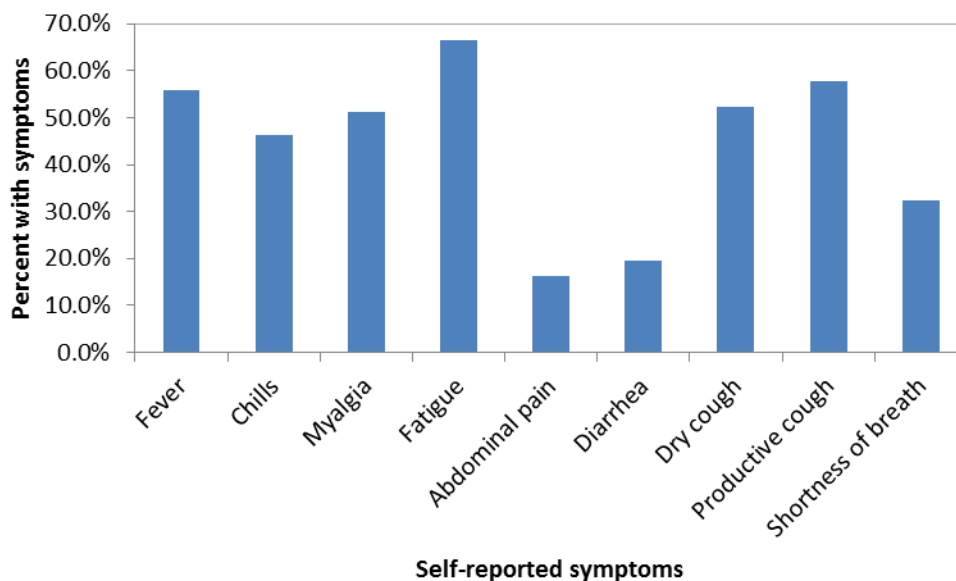


Figure 1. Self-reported Symptoms Among Ill Conference Attendees (N=235)

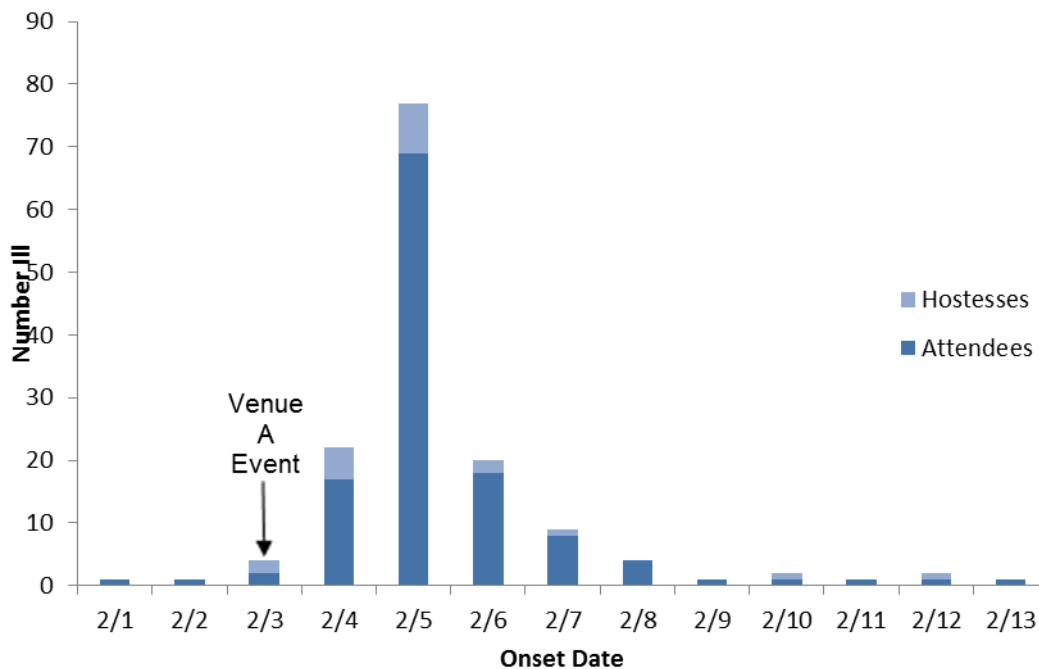


Figure 2. Epidemic curve of respiratory illness among conference attendees and hostesses (N=145).

Risk of Illness by Exposure

Among the 432 conference attendees who responded to the survey, 235 self-reported illness and of these, 123 met the case definition (fever and at least one other symptom). Among the persons who did not meet the case definition, 30 had a missing date of illness onset, 25 did not report whether or not they attended the Venue A event, and 80 had symptoms that did not meet the case definition (for example, respiratory symptoms without fever). In an additional analysis, 110 of the conference attendees met the CDC influenza case definition of fever and cough or sore throat.

We surveyed 47 hostesses, of whom 22 (46%) met the case definition for febrile illness. Hostess duties varied from lounging in the pool to posing for photos with guests. We also interviewed 41 of the 67 employees of Venue A who worked on February 3rd. Of these, only three reported illness meeting the case definition with onset in the week after working at the Venue A event; two of the three had direct contact with party guests bartending and passing drinks, and the third worked as a cleaner. Finally, the Venue A staff stated that they hold major events approximately two to three times a month, with 500–1,500 guests, and they had not been informed of any other cluster of respiratory illness associated with these events prior to the outbreak under investigation.

We evaluated exposures to several conference events, including staying at Hotel A, attending evening parties at Hotels A, B, and C on February 1st and 2nd, and attending the event at Venue A on February 3rd. The only statistically significant association with illness was attending the Venue A event, 3.8 RR (2.0–7.5 95% CI).

Clinical Specimen Results

Of 148 total cases among conference attendees, hostesses, and staff, 45 provided at least one clinical specimen (urine, serum, sputum, or nasopharyngeal swab) for testing. Persons submitting specimens exhibited symptoms of myalgia (69%) and shortness of breath (51%) in slightly higher proportions compared to the total cohort of cases. Persons submitting specimens did not differ by proportion reporting all other symptoms, compared with cases who did not submit specimens. Dates of onset peaked on Feb



5th for both those who submitted specimens and those who did not, and reported duration of illness was greater than five days in both groups. Clinical specimens for *Legionella* testing were collected from February 14th to March 1st, 2011. No case-patients tested positive for *L. pneumophila* by any testing method.

Four (17.4%) of 23 persons tested by nasopharyngeal PCR for influenza tested positive for influenza A, one of whom also tested positive for influenza A by multiple respiratory pathogen PCR. Of the four persons who tested positive, three had illness onset on February 7, 2011, two days after the peak of the epidemic curve. The fourth person who was positive for influenza had onset on February 10, 2011. All four patients had NP swabs collected seven days after the onset of symptoms. Among the four persons testing positive for influenza A, three were confirmed as 2009 H1N1 influenza A. The other person tested positive for influenza A, not H1N1, but because a personal physician ordered the tests no further documentation of testing methodology or results were available to the outbreak investigation team. Of note, no patients tested positive by PCR for other respiratory pathogens including RSV, parainfluenza, human metapneumovirus, rhinovirus, and adenovirus.

Upon medical record review of 13 persons who had chest radiographs performed, no persons were diagnosed with radiographically confirmed pneumonia, and thus no persons met the case definition for LD.

Environmental Sampling Results

Multiple samples were collected on two separate visits from Hotel A and Venue A by LAC DPH. Of the 24 samples collected from Venue A and two samples from Hotel A, only two samples from Venue A were positive for *L. pneumophila* – one from a hot tub water sample and another from diatomaceous earth pool filter water. In the sample collected from the hot tub, seven isolates of *L. pneumophila* were identified. In summary, Monoclonal antibody and Sequence-Based Typing analyses identified three different types of *L. pneumophila* in these hot tub isolates, serogroup 3 sequence type 6, serogroup 1 sequence type 1, and serogroup 1 sequence type 154. Another isolate, *L. pneumophila* serogroup 6, was found in the diatomaceous earth filter from the pool. None of the samples from Venue A, Hotel A or the hazer that were collected by and tested at the CDC laboratory were positive for *L. pneumophila*.

DISCUSSION

We found that among attendees of the conference, a large outbreak of respiratory illness occurred with the peak of the epidemic curve occurring on February 5, 2011. One hundred and twenty three individuals met the case definition. Predominant symptoms reported include fever, chills, myalgias, and cough; although not directly asked, 7% of ill persons reported sore throat. Hostesses from the local area who only attended the party at Venue A reported similar influenza-like symptoms. However, only 3 Venue A staff of 41 interviewed reported illness. The attack rate among conference attendees was 29% (123 who met the case definition for respiratory illness among 432 survey respondents). Among conference attendees, attendance at the Venue A party on February 3rd was associated with a 3.8 times increased risk of respiratory illness. No other exposure to the other hotels and conference venues was significantly associated with illness.

Although the epidemic curve appears consistent with a point-source outbreak, which could be compatible with an environmental exposure such as *Legionella* presenting as Pontiac Fever, it is important to note that the conference attendees departed on February 4th, thus immediately limiting the possibility of ongoing transmission of a communicable infectious agent within this closed group. Due to the media circulating around the purportedly confirmed *Legionella* outbreak, all initial surveys assessed typical exposures for *Legionella*. In addition, initial reports also implicated a hazer (fog machine) that was in use in the main tent; many of the exposure questions assessed how much time was spent near this hazer. We did not survey conference attendees for secondary illness, or ill contacts prior to the conference. It was not until we contacted ill attendees for specimen submission that we assessed influenza vaccination status and secondary illness. In communities with extensive close contact, and low prevalence of immunity to influenza, such as schools and universities, similar explosive epidemic curves have been



described in the setting of influenza outbreaks. For example, a 2009 H1N1 influenza outbreak in a high school in New York City showed an epidemic curve with a high peak and rapid decline (3). Although this definition has been used for Pontiac Fever, there is considerable overlap with other respiratory illnesses, including influenza, due to non-specific symptoms

A bulk water specimen collected on February 15, 2011 from a hot tub at Venue A tested positive for multiple *Legionella* serotypes. Another specimen collected from the pool diatomaceous earth filter on February 22, 2011 tested positive for *Legionella pneumophila* serogroup 6. Of these, only serogroup 1 is a typical human pathogen, although the monoclonal antibody (MAb) type identified was not the most pathogenic of the serogroup. None of the other samples collected by LAC DPH or CDC from Venue A grew *Legionella*. As CDC guidelines have a zero tolerance for *Legionella* in water systems, we felt it prudent to recommend remediation to reduce any future risk of *Legionella* transmission after *Legionella* was isolated from the hot tub. Though Venue A is a private residence, it also functions as a commercial establishment with many large events that potentially expose hundreds of people. In light of the isolation of *Legionella* from an aerosol-generating water feature, we recommended remediation of the pool system and filters to prevent any future risk to public health. *Legionella* remediation recommendations based on national guidelines were provided to the facility managers.

Overall 45 case-patients provided at least one clinical specimen (urine, serum, sputum, or nasopharyngeal swab) for testing. None of the submitted specimens tested positive for *Legionella* by multiple methods including *Legionella* urine antigen, sputum for *Legionella* DFA, sputum for *Legionella* culture, and *Legionella* serology. Previous outbreaks have shown that Pontiac Fever is difficult to diagnose. In one study, only 8 % of those tested for urine antigen were positive, and serology has been shown to have an even weaker sensitivity (4). In addition, the large lag time between onset of symptoms and collection of specimens could contribute to the lack of positivity. Among the case-patients, four persons tested positive for influenza A by PCR on nasopharyngeal swabs, three of which were found to be 2009 H1N1. It is notable that the four persons who tested positive for influenza A had slightly later onset of illness and shorter time from symptom onset to specimen collection (seven days) than the other case-patients (median 12 days, range 8-17 days). Because influenza shedding can occur up to 5–10 days after onset of symptoms it is possible that other persons who had influenza no longer had detectable virus in nasopharyngeal secretions by the time specimens were collected (5). Given the positive clinical specimens, pandemic H1N1 influenza A is the most likely etiology of this outbreak.

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**MEASLES OUTBREAK ASSOCIATED WITH AN ARRIVING REFUGEE
LOS ANGELES COUNTY, CALIFORNIA
AUGUST-SEPTEMBER 2011**

Michelle T. Parra, PhD, Laurene Mascola, MD, David Dassey, MD, et al.

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INVESTIGATION OF INVASIVE MENINGOCOCCAL DISEASE OUTBREAK AMONG THE HOMELESS COMMUNITY IN LOS ANGELES COUNTY

Mopelola Adeyemo, MPH, Van Ngo, MPH, and Rachel Civen, MD, MPH

INTRODUCTION

Meningococcal disease is a life-threatening infection of the cerebrospinal fluid or the bloodstream caused by the bacteria *Neisseria meningitidis*. It is transmitted via direct or droplet contact with nose or throat secretion of persons colonized with the bacteria. There are 13 serogroups, however, serogroups A, B, C, Y, and W-135 are the most common, of which, all but B are preventable by vaccination.¹ Serogroup C meningococcal infections account for the greatest proportion of outbreaks in the United States (US). Invasive meningococcal disease (IMD) most commonly presents with symptoms that include sudden onset of fever, headache, petechial rash, altered mental status, lethargy, and unstable vital signs. Advanced sepsis can cause disseminated intravascular coagulation leading to thrombocytopenia and embolic phenomenon, resulting in severe neurologic and/or orthopedic complications.² IMD remains a rare communicable disease which has shown declining incidence in Los Angeles County (LAC) and nationwide.³ The annual incidence of meningococcal infection in the US ranges from 0.5 to 1.1 per 100,000 population.⁴ In LAC from 2006-2010 the annual incidence rate of meningococcal infection was 0.30 per 100,000 population.³

On March 13th, 2011 the LAC Department of Public Health Acute Communicable Disease Control Program (ACDC) received a report of MD in a 61 year old black female who was a resident of homeless shelter A in downtown Los Angeles. On March 24th 2011, a second case of IMD was reported in a 43 year old African American male who also resided at shelter A. On March 25th an investigation was initiated and both the California Department of Public Health (CDPH) and the Centers for Disease Control (CDC) were informed of the situation. From March 1 through July 31, 2011, a total of 20 MD cases were confirmed and investigated, compared to an annual average of 12 cases over 2006-2010 for the same period. This report describes the investigation of an outbreak of four cases and a separate cluster-related cases during this hyper-endemic period from March 1 to July 31, 2011.

METHODS

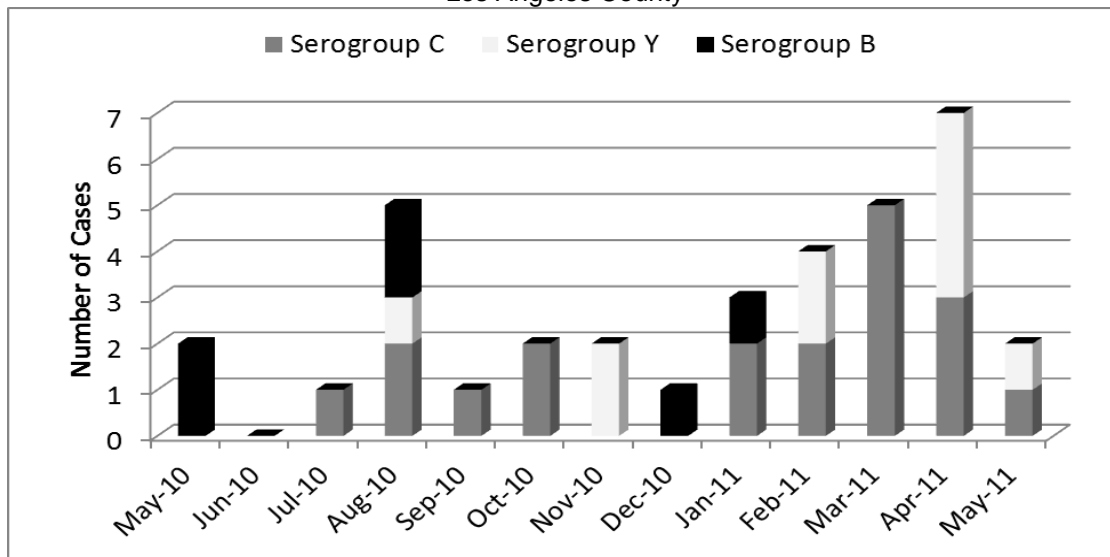
Following the report of three serogroup C cases within the first three weeks of March 2011 (Figure 1), two of which were epidemiologically linked, a supplemental questionnaire was developed to identify common risk factors among all reported MD cases. This questionnaire obtained case history information about housing, homelessness, drug use, public transportation use, and other behavioral risk factors. Additionally, the standard CDPH MD case report form was used to collect case demographics, laboratory results, and contact information. For each new MD suspect case reported, ACDC staff and Community Health Services Public Health Nurses (PHN) performed a joint interview with the case or next of kin (if case unavailable) in the hospital setting.

Case Definitions

A confirmed case of IMD was defined as a resident of LAC with positive culture for *Neisseria meningitidis* from a normally sterile site occurring between March 1st and July 31st, 2011. IMD cases were clinically diagnosed as meningitis and/or sepsis due to *Neisseria meningitidis*. A cluster-related case was defined as any confirmed MD case with an epidemiologic link and >80% pulse field gel electrophoresis (PFGE) similarity to another case. An MD outbreak was defined as three or more confirmed cases of MD in ≤ 3 months with an epidemiologic link and whose isolates shared >80% PFGE similarity to the outbreak strain.⁴ An investigation period of March 1st through July 31st was selected in which all confirmed MDs were investigated for risk factors and PFGE analysis was performed.



Figure 1. Meningococcal disease cases by week of onset and serogroup, March – July 2011, Los Angeles County



Case Finding and Ascertainment

CDPH was notified to determine if neighboring public health jurisdictions were experiencing a similar increase in MD. An advisory was sent by Community Health Services (CHS) to all LAC homeless shelters and the LAC Sheriff's Department Medical Unit, advising them to be alert to signs of meningitis in residents and to report suspected cases to ACDC. A similar advisory was released to infection preventionists of all acute care facilities and all DPH service planning area (SPA) health officers to notify them of the cluster and the actions taken. Following the report of the third MD case, a second advisory was sent to all emergency departments, hospital infection preventionists, and laboratory directors in LAC instructing them to be on heightened alert for patients with meningitis and to report all suspected meningitis cases to ACDC. The notice also stressed the importance of collecting patient risk factor information and providing prophylaxis to close contacts. Following the 6th case of MD, a report was posted on Epi-X, the CDC's emergency communication network, in order to inform public health officials nationally of the cluster. Following the 7th case, a health advisory was released to the public and posted on the department web site in order to provide information regarding the signs and symptoms of meningitis, mechanism of transmission, and preventative measures.

A retrospective chart review of all reports of viral, aseptic, and/or bacterial meningitis to LAC DPH in the three months prior to the outbreak period (December 1st, 2010 to March 1st 2011) was conducted to identify epidemiologic links among previously investigated MD cases and to identify additional cases. We re-interviewed the earlier MD cases reported from January 1 through March 13th with the supplemental questionnaire for factors not available in the standard investigation process to obtain comprehensive risk factors for all cases beginning January 1, 2011. Specimens and isolates from all individuals with a clinical presentation suggestive of IMD were actively sought and forwarded to LAC Public Health Laboratory (PHL). Similar prospective surveillance was conducted throughout the investigation period for all reported meningitis cases.

Laboratory testing

The PHL performed serogrouping by bacterial slide agglutination for serogroups A, B, C, W135, and Y. The PHL also performed PFGE genotyping on all case isolates using the Nhe-I restriction enzyme; PFGE was replicated by the CDC in Atlanta, Georgia. Additionally, the CDPH Microbial Diseases Laboratory performed genotyping by multiple-locus variable number tandem repeat analysis (MLVA).

Prevention of secondary cases



Antibiotic prophylaxis was offered by PHNs to individuals who were found to be close contacts to each case. Healthcare facility infection control staff oversaw prophylaxis of their hospital workers and ensured first responders (e.g., paramedics, firefighters) were notified of MD exposure and potential need for prophylaxis.

RESULTS

In total 20 cases of IMD were identified with onset from March 1st through July 31st, 2011. We reviewed records of eight MD cases that were previously identified in the three months prior to March 1, 2011. We re-interviewed all the eight cases with the supplemental questionnaire. No additional MD cases were found from retrospective review of aseptic/viral and bacterial meningitis cases passively reported during the three months prior to the onset of the first outbreak case. Among the investigated cases, PFGE and risk factors identified two distinct clusters and one outbreak. Compared to the previous five-year average incidence rate of 0.10 cases per 100,000 between March and July, the IMD incidence rate doubled to 0.20 cases per 100,000 populations for the same time period in 2011. By July 2011, the annualized cumulative incidence rate was 0.28 cases per 100,000, which approached the previous five-year annual average of 0.30 cases per 100,000.

Epidemiological Characteristics

During the investigation period, three cases died due to complications of MD, for a case fatality rate of 15% (Table 1). A majority of the cases were black (n=9, 45%) or Hispanic (n=8, 40%). This differs from the previous five years (2006-2010) in which Hispanics and whites consistently made up the greatest proportion of meningococcal cases. The mean age of the 20 cases was 41 years old and ranged from ten to 80 years old. There was a 3:2 ratio of male to female cases. Five of the 20 cases (25%) smoked marijuana, four of which were in the 18-25 age group. Forty percent of cases (n=8) were cigarette smokers. Seven (35%) of the cases used public transportation. A majority of cases resided in either the San Fernando-SPA 2 (n=6, 30%) or South Bay-SPA 8 (n=5, 25%) (Figure 2). Six MD cases were determined to have associations with homeless persons or shelters.

Table 1. Invasive Meningococcal Disease Cases, Los Angeles County, March – July 2011

| | All cases (%) | Outbreak cases (%) | Non-outbreak cases (%) |
|-----------------------------|---------------------------------|--------------------|---------------------------------|
| N | 20 | 4 | 16 |
| Age | 41 ± 20 | 46 ± 11 | 40 ± 22 |
| Sex (M:F) | 3:2 | 3:1 | 9:7 |
| Deaths | 3 (15) | 1 (25) | 2 (13) |
| Serogroup | 13 C/6Y/ 1 W-135 | 4 C | 9 C/6 Y/ 1 W-135 |
| MLVA patterns | 4 serogroup C/ 6 serogroup Y | 1 serogroup C | 4 serogroup C/ 6 serogroup Y |
| PFGE patterns | 4 serogroup C/ 5 serogroup Y | 1 serogroup C | 3 serogroup C/ 5 serogroup Y |
| Race | | | |
| Blacks | 9 (45) | 3 (75) | 6 (38) |
| Hispanics | 8(40) | 1 (25) | 7 (44) |
| Whites | 3 (15) | 0 | 3 (19) |
| Resided in Shelter/Homeless | 4 (20) | 3 (75) | 1 (6) |
| Share marijuana | 5 (25) | 0 | 5 (31) |
| Smoke cigarettes | 8 (40) | 1 (25) | 7 (44) |
| Public Transportation | 7 (35) | 1 (25) | 6 (38) |
| SPA | | | |
| San Fernando (SPA 2) | 6(30) | 0 | 6 (38) |
| Metro (SPA 4) | 3 (15) | 2 (50) | 1 (6) |
| West (SPA 6) | 4 (20) | 0 | 4 (25) |
| East (SPA 7) | 2 (10) | 1 (25) | 1 (6) |
| South Bay (SPA 8) | 5 (25) | 1 (25) | 4 (25) |



MD Outbreak - Epidemiological Characteristics

Four of the six individuals reported to have association with homeless persons and/or shelters met the outbreak case definition (Table 2). The first two reported outbreak cases (cases #1 and #2) resided in the same homeless shelter A in downtown Los Angeles. The 3rd case spent time in shelter B in West Los Angeles prior to symptom onset. The final outbreak case was a bus driver whose route passed in front of shelter A. No other epidemiological ties were discovered among the outbreak cases.

The four outbreak-related cases consisted of three blacks and one Hispanic. The identified residences of the four outbreak cases included two in central Los Angeles, one in the South Bay, and one in the East Los Angeles Area. Outbreak case ages ranged from 37-61 years old. Three of the four MD cases had underlying chronic medical illnesses, including two with hepatitis C infection and one case with diabetes. The case with underlying diabetes died of sepsis secondary to IMD.

Table 2. Epidemiologic characteristics of outbreak and cluster cases in Los Angeles County (LAC), March 2011-July 2011

| Case #* | Date of onset | Age | Sex | Race | SPA | Homeless | Public transit | Tobacco use | Exposure to children | Jail | Underlying Chronic Disease |
|----------------|---------------|-----|-----|------------------|----------------------|----------------|----------------|-------------|----------------------|------|----------------------------|
| Outbreak cases | | | | | | | | | | | |
| 1 | 03/8/2011 | 61 | F | African American | Metro (SPA 4) | Y [†] | N | Y | N | N | Y- HCV |
| 2 | 03/23/2011 | 43 | M | African American | Metro (SPA 4) | Y | U | U | N | N | Y- HCV |
| 4 | 03/25/2011 | 37 | M | African American | South Bay (SPA 8) | Y | N | N | N | Y | N |
| 5 | 03/29/2011 | 42 | M | Hispanic | East (SPA 7) | N | Y | Y | N | N | Y- Diabetes |
| Cluster #1 | | | | | | | | | | | |
| 3 | 03/24/2011 | 21 | F | Hispanic | San Fernando (SPA 2) | N | N | N | N | Y | N |
| 13 | 04/30/2011 | 20 | F | Hispanic | San Fernando (SPA 2) | N | Y | N | N | N | N |
| Cluster #2 | | | | | | | | | | | |
| 6 | 04/01/2011 | 44 | F | African American | South Bay (SPA 8) | N | N | N | Y | N | N |
| 11 | 04/21/2011 | 37 | M | African American | West (SPA 6) | N | Y | Y | Y | N | N |

* Cases are numbered according to onset date; [†]Y=yes, N=no, U= Unknown

MD Clusters - Epidemiologic characteristics

Two MD clusters that did not meet the definition of outbreak were identified as having greater than 80% matching by PFGE. Cluster #1 was identified between two Hispanic females in the 20-25 year old age group (cases #3 and #13). They also shared a geographic link; both live within five miles of each other in the San Fernando area, SPA 2. PFGE patterns of the two case isolates had a match of >80%.

The second cluster was identified between two black cases whose isolates had an indistinguishable PFGE pattern and who shared a geographical link. Case #6 was an elementary school teacher at a school within five miles of the residence of case #11 who did volunteer work with children. Additional commonalities were not identified.



Laboratory Results

Serogrouping was completed on all 20 isolates and included 13 (65%) serogroup C, 6 (30%) serogroup Y, and 1 (5%) serogroup W135. By comparison, during the same time period in 2010, a total of 14 cases were seen including 5 (35%) serogroup C, 3 (21%) serogroup Y, 4 (29%) serogroup B, and 2 (10%) serogroup W-135.

Among the serogroup C cases, one outbreak and two clusters were identified. Of the 13 serogroup C cases, four MLVA and four PFGE patterns were identified. All four outbreak cases had indistinguishable PFGE and MLVA patterns. Cluster #1 consisted of two cases who shared the same PFGE and MLVA pattern. Cluster #2 consisted of two additional cases whose isolates shared the same MLVA pattern and a >80% PFGE match.

Of the six serogroup Y cases, six distinct MLVA and PFGE patterns were identified.

DISCUSSION

Cluster cases

From March 1- July 31, 2011, reported IMD incidence and cases doubled in comparison to the previous five-year average from the same time period. A supplemental case report form enabled collection of additional risk factors for MD and PFGE analysis and identified one outbreak and two clusters. In general, MD cases were distributed throughout the county, making it difficult to identify a specific population at risk. Among the 20 cases described, the most predominant risk factors were black race (9, 45%), cigarette smoking (8, 40%), and use of public transportation (7, 30%) (Table 1). Over the previous five-years blacks made up an average of 16% of the meningococcal cases in LAC; however this number has gradually increased since 2006.³ Thus the high proportion of blacks in the cluster may be attributed to this overall trend. Cigarette smoking was the second most prevalent risk factor. Several studies have reported that tobacco smoking increases risk of bacterial infections, such as MD.⁵ Though the exact mechanism is unknown, this may explain the high proportion of cigarette smokers among the cluster. Also, several studies have reported exposure to congregated and crowded environments, such as homeless shelters and public buses to be a risk factor for acquiring respiratory infections, such as bacterial meningitis, due to the potential for droplet transmission between close contacts.⁶ Furthermore close contact with persons of low socioeconomic status who have higher rates of MD and are more likely to use public transportation, may also have compounded the risk of MD.^{7,8} The tendency for overcrowding and exposure to persons of low socioeconomic status on public transportation may explain the large proportion of public transportation users with MD among the investigated cases.

Outbreak cases

Within LAC, there are an estimated 51,340 homeless individuals on any given day⁹. Sixty-three percent of these individuals are unsheltered. This number has risen by 7% in the past 2 years, which may be partly attributed to the current economic state of California. Because of some behaviors associated with homelessness, these individuals are at greater risk for diseases such as hepatitis and infections such as meningitis.¹⁰ Three of four outbreak-related cases resided in a shelter, making these cases at compounded risk of infection due to their congregate living situation.^{8,11} The fourth outbreak-related case, a public bus driver whose route passed by a homeless shelter, may have been at a higher risk for meningococcal infection due to occupational exposure to the homeless population and the potentially crowded environment.

Several immunocompromising chronic diseases have been implicated in increasing susceptibility to MD. Among the outbreak-related cases two had hepatitis C infection and one had diabetes mellitus. Advanced hepatitis C infection can lead to decreased hepatic synthetic capacity and complement deficiency leading to immunosuppression. As a result, the outbreak-related cases with hepatitis C were likely at increased risk for MD.^{12,13,14} In regards to diabetes, several studies have shown a level of immunodeficiency in these patients due to polymorphonuclear leukocyte defects^{15,16}. As a result, the diabetic outbreak case was likely at increased risk for bacterial infections such as MD.



Prevention Activities

The limited number of outbreak cases and three-week duration of the outbreak suggest that preventative measures such as health alerts to local shelters and early prophylaxis dissemination to homeless shelter staff and close contacts may have been successful in controlling the outbreak. Time between the onset of case #2 and #4 was 6 days. Since 7 to 10 days are required following vaccination to develop protective levels of anti-meningococcal antibodies, a vaccination campaign targeting homeless populations following case #2 would not have been effective in preventing infection in any of the subsequent outbreak-related cases.

The decision to not initiate a vaccination campaign was made after discussions with the CDC and CDPH. Issues that were considered in this decision were inability to define a target group, potential panic that may ensue among the public, marginalization of an already downtrodden social group, availability of vaccine, vaccine efficacy, and cost. The final decision was based on the inability to define a clear target group due to the lack of substantial epidemiologic links with supporting molecular epidemiologic matches among non-outbreak cases.

SUMMARY

During our investigation period of March 2011 to July 2011 we identified one outbreak of serogroup C meningococcal infection among individuals with links to the homeless; this outbreak was limited to four individuals over three weeks. The rapid response of LAC Department of Public Health in disseminating health alerts and education and providing prophylaxis treatment to close contacts likely played a part in controlling the spread of the outbreak.

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“THE SCOMBROID, IT BURNS!” SCOMBROID FISH POISONING OUTBREAK

Susie Tangpraphaphorn, MPH

The Acute Communicable Disease Control Program (ACDC) at Los Angeles County (LAC) Department of Public Health (DPH) received a foodborne illness complaint regarding a fine-dining restaurant in Los Angeles. The complaint stated that a customer ate a tuna burger for lunch at the restaurant and fell ill with rashes, facial flushing and swelling within minutes, followed by gastrointestinal distress. The symptoms and alleged food source are commonly associated with scombroid fish poisoning. Scombroid fish poisoning is an intoxication caused by an overabundance of histamine in food, usually scombroid-type fish like tuna. The histamine accumulates when bacteria in the food proliferate and decompose the amino acid histidine into histamine. Because the food was produced and served in a commercial establishment, and because scombroid fish poisoning is a reportable condition, ACDC initiated an investigation.

METHODS

ACDC reviewed the foodborne illness report and interviewed the person who filed the complaint to get additional information about his illness. ACDC contacted LAC DPH Environmental Health Services (EHS) Food & Milk Program (F&M) to notify them of a probable scombroid fish poisoning case, stating the name and location of the restaurant, as well as the food implicated in the complaint.

F&M inspected the restaurant that served the tuna, requested information regarding number of tuna sandwiches served, additional complaints about the tuna, and invoices for the restaurant's tuna supplier(s).

ACDC created a standardized questionnaire to interview suspected additional cases. Then ACDC called people whose names and telephone numbers were on a list of complaints collected by the restaurant and given to F&M. ACDC used a cohort study design to analyze data collected in the questionnaires. MS[®] Excel was used to process the data.

F&M traced the origin of the tuna from the restaurant back to its original suppliers. F&M requested copies of purchase and sales invoices to determine whether the purveyors were following appropriate procedures.

RESULTS

ACDC spoke to the original complainant and asked him to verify his symptoms. He stated that 45 minutes after eating an ahi tuna burger, he had onset of facial flushing, itching and upper-body rashes which were followed by diarrhea. He searched his symptoms online and decided it was probably scombroid fish poisoning, so he self-medicated with Benadryl[®] and did not seek medical attention. He also stated that he had lunch with a friend. She did not order any items made with tuna, and she did not become sick.

F&M sent an inspector to the restaurant on the same day of the complaint. The restaurant demonstrated its process for making tuna burgers: the cook minces tuna trimmings in a mechanical grinder, then shapes the tuna into flat, circular patties, which are seared rare and served on a bun with greens and aioli. F&M noticed the grinder had traces of food debris on the cutting surfaces. However the grinder was being cleaned at the time of inspection, therefore it was difficult to ascertain how long the food debris had been on the cutting blades. The refrigerator that housed the tuna was operating at an appropriate temperature. There was no tuna leftover from that day's lunch service; the manager had removed and discarded the tuna following initial complaints of foodborne illness. The restaurant manager provided invoices and receipts for the seafood they had served that day. The restaurant manager also compiled a list of people who had filed complaints pertaining to the ahi tuna burger; the list was given to F&M and forwarded to ACDC.



There were seven people on the list, including the person who filed the initial foodborne illness complaint; ACDC interviewed each person listed. All seven people had eaten the ahi tuna burger for lunch on November 10, 2011. The burger is only served at lunch. None of the people interviewed reported eating any other ahi tuna items that were on the menu. Five people fit the case definition, while two described symptoms not compatible with scombroid fish poisoning (Table 1). Four cases were male, one was female. Ages ranged from 32 to 68 years, with an average of 47 years (Table 2). Symptom onsets ranged from 30 to 75 minutes after eating. Durations of symptoms lasted from 3 to 4 hours. One person sought medical care who was hospitalized overnight at a local hospital. Three people self-medicated with over-the-counter antihistamines.

| Table 1. Reported Symptoms (N=5) | | |
|-------------------------------------------|---|---------|
| Symptom | n | Percent |
| Body Rashes / Itching | 4 | 80% |
| Facial Flushing / Redness | 5 | 100% |
| Oral Swelling | 1 | 20% |
| Oral/Peri-Oral Burning Sensation | 2 | 40% |
| Shortness of Breath | 2 | 40% |
| Tachycardia | 2 | 40% |
| Headache | 2 | 40% |
| Dizziness | 2 | 40% |
| Nausea | 1 | 20% |
| Vomiting | 0 | 0% |
| Abdominal Cramps | 2 | 40% |
| Diarrhea | 2 | 40% |
| Fever | 0 | 0% |
| Duration=3.6 hours (range 3 to 4 hours) | | |
| Incubation= 47 mins (range 30 to 75 mins) | | |

| Table 2. Case Demographics (N=5) | | |
|----------------------------------|----|------------------------|
| | n | Percent |
| Male | 4 | 80% |
| Female | 1 | 20% |
| Age Group | | |
| 1-4 | 0 | 0% |
| 5-19 | 0 | 0% |
| 20-49 | 2 | 40% |
| 50+ | 1 | 20% |
| Unknown | 2 | 40% |
| Mean age | 47 | range = (32 to 68 yrs) |

F&M used the purchase invoices and receipts provided by the restaurant to trace back the origins of the ahi tuna. F&M contacted Seafood Broker "O" who supplied fish to the restaurant. The invoices from Broker "O" showed an address and phone number based in Orange County. The owner of Broker "O" stated they purchased the ahi tuna trimmings from Seafood Processor "U" but that all related invoices were not available and could be provided by the next business day. F&M inspected Processor "U". Processor "U" was unable to provide F&M with any invoices or evidence of sales to Broker "O." Processor "U" denied selling ahi trimmings, stating that the trimming were byproducts to be discarded. However, the manager at Processor "U" mentioned that workers are permitted to take home leftover fish portions not sold to market.



Seafood Broker "O" was again contacted for related invoices. Seafood Broker "O" explained that they were still working on gathering the invoices. Upon inquiry regarding their location of any processing and storage facilities, Broker "O" replied they did not process food, but had a storage facility in Los Angeles. It was then discovered that "O" was operating without a current public health license and was working within the facility of another seafood processor "C" in Los Angeles. The California Food and Drug Branch was notified about the situation. It was not until five days later that Broker "O" admitted they had no purchase invoices for the ahi tuna trimmings which they had sold to the restaurant. They stated they bought ahi trimmings from a worker at Processor "U".

F&M filed a criminal complaint against Broker "O". Broker "O" plead guilty to one count of failing to provide food from an approved source. EHS recovered \$3000 in investigative costs. Broker "O" paid a fine to the court and was placed on probation for a year to ensure it does not violate health laws again. In the meantime, EHS was able to assist Broker "O" in obtaining the proper permits to conduct business lawfully.

CONCLUSIONS

This was an outbreak of five clinical cases of scombroid fish poisoning that affected diners who ate tuna burgers at a restaurant in LAC. The investigation found that the broker supplying the restaurant's tuna was operating fraudulently without a public health license and without proper documentation to detail their purchases and sales transactions. Environmental Health Services did not find any faults with the restaurant's operations since the restaurant had purchased the tuna in good faith had received the product one day prior to serving and all refrigeration units were functional and at temperature. The restaurant severed business ties with the seafood broker and removed tuna items from their menu.

The scombroid fish poisoning cases all recovered from their symptoms within a matter of hours. Only one case, a 68 year old man with a history of hyperlipidemia and hypertension, required medical attention; therefore, he was the only case diagnosed with scombroid fish poisoning by a physician.

Seafood Processor "U" amended its company policy of allowing workers to take unsold product for personal use. Seafood Processor "C," which was brought in for an administrative office hearing, is no longer sharing their facility with another business. EHS followed through with legal actions against Broker "O" for operating unlawfully and for being unable to show that the ahi trimmings came from an approved source. As a result, Broker "O" has obtained the appropriate permits and found an approved facility for their business. Broker "O" now obtains seafood from approved licensed seafood purveyors.

LIMITATIONS

A significant limitation in this investigation was the lack of food samples available for testing. Because scombroid fish poisoning is a clinical diagnosis, testing the food for the presence of excess histamine is necessary to confirm a link between illness and food. Secondly, ACDC did not interview dining partners who did not eat tuna, and did not conduct a case-control study which could have demonstrated a statistically association of illness with consuming the ahi tuna burger.





IMPLEMENTING THE CIFOR *GUIDELINES FOR FOODBORNE DISEASE* *OUTBREAK RESPONSE:* SOUTHERN CALIFORNIA REGIONAL WORKSHOP

Y. Silvia Shin, RN, MSN/MPH, Elaine Waldman, Alan Wu, MPH

BACKGROUND

To aid government agencies responsible for preventing and managing foodborne disease, Council to Improve Foodborne Outbreak and Response (CIFOR) and Centers for Disease Control Prevention (CDC) developed the *Guidelines for Foodborne Disease Outbreak Response* and CIFOR Toolkit. The *Guideline* was issued by the Council of State and Territorial Epidemiologists (CSTE) in 2009. Acute Communicable Disease Control Program (ACDC) at Los Angeles County Department of Public Health received a grant funding from CSTE to provide a training workshop to local public health departments using the *Guidelines* and Toolkit with the aim of integrating recommendations from the guidelines into the activities of their departments. The target audiences for this project were multidisciplinary state, county and city-based teams involved in outbreak response, including epidemiologists, public health laboratorians, environmental health specialists, and public health nurses.

OBJECTIVES

Objectives of the workshop included the following:

1. To bring together a multidisciplinary team to work together for a highly interactive day of learning and sharing.
2. To conduct a plenary session to introduce the workshop, provide an overview of the agenda, and to present case studies on topics such as multijurisdictional outbreaks, "doing more with less", and an example of a challenging outbreak with a successful response.
3. To familiarize workshop participants with the Guidelines for Foodborne Disease Outbreak Response including a participant prerequisite to have a base familiarity with the Guidelines and to bring local or existing algorithms and procedures to the workshop.
4. To familiarize workshop participants with the Guidelines Toolkit and its components.
5. To conduct small discussions about current protocols, what needs to be included in future protocols, and challenges and successes.
6. To brainstorm shared problems and barriers as well as to identify potential solutions.
7. To complete at least two to three Focus Areas of the Toolkit, pre-selected through an assessment conducted before the workshop takes place.
8. To identify improvements for foodborne disease outbreak response.
9. To identify and prioritize recommendations from the Guidelines that address needed improvements.
10. To create an action plan to implement the selected recommendations including a lead point person and timeframe.
11. To evaluate the team's experience with the Toolkit and submit an evaluation form to CSTE.
12. To create a summary report for CSTE.



METHODS

ACDC formed a workshop Planning Committee. The Planning Committee consisted of multidisciplinary staff from ACDC Food Safety Unit, Planning & Evaluation Unit, Health Education Unit, and Training Unit; LAC DPH Community Health Services, Environmental Health Program, Public Health Laboratory, Organizational Development & Training Program; California Department of Public Health (CDPH) Division of Communicable Disease Control; and Solano County Health Officer.

A project plan was developed to include tasks with timeline and responsible team member(s) in order to guide the workshop planning. The Planning Committee held bi-weekly meetings to determine the format of the workshop and agenda, to distribute workload, to review planning progress and to determine next steps in order to accomplish the workshop objectives.

The Planning Committee sought bids from area hotels and meeting venues per Los Angeles County policies and selected the workshop venue in Pomona, California for May 18, 2011.

In order to develop a relevant, effective workshop, the Planning Committee decided to conduct a pre-workshop assessment. The goal of the assessment was to prioritize topics and Focus Areas to incorporate in the workshop agenda based on the prospective workshop participants' perspectives. The assessment was modeled after the CIFOR *Guidelines* Toolkit Document E-Selecting Focus Area Worksheet. An online survey was developed and launched via SurveyMonkey™. The survey link was emailed to prospective workshop participants as well as to those who may not be able to attend the workshop but may be interested in contributing to identifying improvement needs and priorities.

Invitations to the workshop were sent out via electronic mail to local public health jurisdictions in Southern California—counties of Los Angeles, Santa Barbara, Riverside, Orange, Imperial, San Diego, Ventura, and San Bernardino; cities of Pasadena, Long Beach, and Vernon; and state of California Department of Public Health. Target audience members were health officers/program directors, epidemiologists, public health laboratorians, environmental health specialists, and public health nurses. The workshop online registration was set up on SurveyMonkey™.

The workshop agenda was formulated through a collaborative effort of the Planning Committee. The workshop agenda items consisted of the following:

- Welcome: to greet participants, introduce the workshop, provide an overview of the agenda, and convey the importance of the workshop to support “doing more with less” in the current economic climate.
- Plenary Presentation: to familiarize workshop participants with the CIFOR *Guidelines* and the Toolkit.
- Case Study Presentation and Tabletop Exercise: to promote discussions about current foodborne outbreak response protocols; identify needs for future protocols; discuss challenges and successes; and identify current practices in various aspects of foodborne disease outbreak response.
- Peer Exchange: to bring together individuals in the same public health discipline to provide networking opportunity; brainstorm shared problems and barriers as well as to identify potential solutions.
- Action Planning: to identify improvement needs for foodborne disease outbreak response; identify and prioritize recommendations from the *Guidelines* that address needed improvements; create an action plan to implement the selected recommendations including a lead point person and timeframe for at least two to three Focus Area of the Toolkit.



- Plenary Discussion: to share and evaluate the team's experience with the case study activities, peer exchange session, and action planning.

RESULTS

There were 26 Los Angeles County and CDPH staff members who served on the Planning Committee, 18 (70%) of whom attended the May 18th workshop. The Planning Committee convened for seven biweekly meetings, along with a post-workshop debriefing meeting on May 24th. These meetings involved a range of 13 to 22 participants, with an average of 17 attending in person or via teleconference. Agendas and minutes for each planning meeting were prepared and distributed to committee members to document workshop planning discussions and decisions.

The pre-workshop assessment survey was completed by 48 individuals. The assessment results showed that Focus Area 1-Relationships with Relevant Agencies and Organizations, Focus Area 2-Necessary Resources, Focus Area 3-Communications were greater gaps and needs for improvement.

The workshop was attended by 57 individuals from the following counties: Los Angeles, Santa Barbara, Riverside, Orange, Imperial, and San Diego; from the cities of Pasadena, Long Beach, and Vernon; and State of California Department of Public Health. Participants represented various public health disciplines including public health policy (i.e., health officers), epidemiology, public health laboratory, and environmental health.

The welcome session was conducted by Dr. Laurene Mascola, Chief of Acute Communicable Disease Control Program (ACDC) of Los Angeles County. She highlighted the importance of gathering to discuss current practices of foodborne outbreak response and identifying efficiencies during times of economic hardship, i.e., "do more with less". As a plenary session speaker, Dr. Bela Matyas, Solano County Health Office introduced the CIFOR *Guidelines*. He discussed CIFOR *Guidelines* history, purpose and intent, target audiences, and contents. He also presented the CIFOR Toolkit's purpose, target audiences, approach, components including the Focus Areas, and the worksheets. Finally, the plenary session also included the pre-workshop assessment results.

The case study presentation was conducted by Dr. Roshan Reporter, Food Safety Unit Head at ACDC of Los Angeles County and Dr. Akiko Kimura, medical epidemiologist in the Infectious Disease Branch of California Department of Public Health. The case study presented a foodborne outbreak scenario that addressed both local and multi-jurisdiction/national level responses. The first break-out session, tabletop exercises, was facilitated by Noel Barakat, Director at Organizational Development and Training of Los Angeles County Department Public Health. The exercises were incorporated into the case study presentation which consisted of several questions for each exercise session. Questions were related to all Focus Areas with emphasis on Focus Areas 1, 2, 3, 5, and 8. After each jurisdictional group discussed the exercise questions they were encouraged to share their answers with rest of the participants.

The second break-out session was a Peer Exchange session where each disciplinary group from across jurisdictions convened in separate rooms. There were four disciplinary groups—program directors (e.g., health officers, infectious disease program directors), epidemiologists, public health laboratorians, and environmental health specialists. Each group had a facilitator and a recorder, who documented session proceedings on flipchart paper. Facilitators were provided with a set of guide questions to motivate interactive discussions on common issues, challenges as well as successes unique in their disciplinary setting. They were also encouraged to discuss potential solutions. Facilitators presented highlights of their group discussion with all of the participants after the Peer Exchange session.



The last break-out session was Action Planning in which each jurisdictional group was asked to draft an action plan with a lead point person and timeframe utilizing the CIFOR *Guidelines* and the Toolkit. All groups were encouraged to incorporate what they have learned throughout the day from the break-out sessions.

As the last item of the workshop, representatives from each group shared what they planned to implement for improvement and what they learned from the day's experience. Dr. David Dassey, Deputy Director of ACDC, shared concluding remarks with the theme of "we're all in this together... today is just the beginning." All participants were asked to complete an evaluation form and were given a certificate of completion.

Following the workshop, each participant received an email with all jurisdictions' action plans, a summary of the evaluation, roster of participant contact information, and photos of their jurisdiction's participants in action at the workshop.

EVALUATION

Out of 60 registered workshop attendees, 57 attended the workshop from 11 jurisdictions—18 epidemiologists, 18 environmental health specialists, eight public health laboratorians, 11 health officers/program directors, and two workshop coordinators.

Each participant was asked to complete an evaluation form at the end of the workshop. A total of 36 (63%) participants completed an evaluation form. Out of the 36 participants, 24 (67%) strongly agreed and 12 (33%) agreed that the Plenary Presentation was relevant. The vast majority of the participants stated either "strongly agree" (n=20, 56%) or "agree" (n=13, 36%) that the Case Study Presentation/Tabletop Exercise was effective. All participants who completed the evaluation form strongly agreed or agreed that the Peer Exchange session was useful. The Action Planning session was rated as helpful by all participants who completed the evaluation. Participants appreciated the opportunity to network with colleagues in neighboring health jurisdictions and to address common concerns regarding foodborne outbreaks. Post-workshop feedback included:

- "It gave us a great road map to improve our job."
- "It was a very worthwhile day; it was great to get together, clarify, and put on paper our goals, dates, and responsible people, to solidify our plan."
- "We need another workshop to practice the steps of a multi-jurisdictional outbreak."

Overall, all participants stated that they "strongly agree" or "agree" that the workshop met their expectations.

DISCUSSION

As local and state public health departments are responsible for preventing and managing foodborne diseases, it is crucial for these departments to have competent workforce and resources in order to effectively and efficiently respond to disease outbreaks. The CIFOR *Guidelines for Foodborne Disease Outbreak Response* and CIFOR Toolkit was designed to provide a foundation for epidemiologists, laboratorians, environmental health specialists, and others involved in food safety programs. The *Guidelines* can influence standardization of foodborne disease investigation as well as other communicable disease investigations. Moreover, continuous utilization of the *Guidelines* and diligent



follow-through of the action planning will be essential in contributing to foodborne disease prevention and management.





EVALUATING THE LOS ANGELES COUNTY PUBLIC HEALTH URGENT DISEASE REPORTING SYSTEM

Amber Zelenay, MPH

Strengthening the ability of Local Public Health Agencies (LPHAs) to detect and respond to bioterrorism as well as natural disease outbreaks has become a national priority. In response to this priority, Centers for Disease Control and Prevention (CDC) issued guidance that clarified LPHA responsibilities for receiving and responding to urgent disease case reports and outbreaks [1]. This guidance detailed four primary recommendations: 1) a single, well-publicized telephone number to receive urgent case reports; 2) a phone triage system to process urgent case reports; 3) being capable of receiving urgent case reports 24 hours a day, 7 days a week and 4) a trained public health (PH) professional to respond within 30 minutes of receiving the report. Lacking from this guidance was the provision of tools or methods that LPHAs could use to evaluate and test their disease reporting system to identify areas that were working well and areas that needed improvement.

RAND Corporation developed a set of methods that could be used by LPHAs to evaluate their ability to respond to urgent case reports and assess their compliance with CDC recommendations. A pilot study using these methods was conducted by RAND in 2004 using several LPHAs across the country as test subjects. The study methods and results were published in 2005 [2]. Accompanying the report was a technical manual that LPHAs could use to perform similar evaluations of their own disease reporting systems. Using this manual as a guide, evaluations of the Los Angeles County (LAC) Disease Reporting System have been performed in 2006 [3], 2008, and 2010 [4]. In August 2011 another test of the system was performed using the same methods.

BACKGROUND

Los Angeles County maintains a disease reporting system capable of receiving reports 24 hours a day, 7 days a week via an 888 toll-free disease reporting hotline. In addition to the hotline, urgent disease reports can also be called in directly to Acute Communicable Disease Control Program (ACDC).

Calls received through the hotline during normal business hours—Monday-Friday, 8am-5pm—go directly to the LAC Department of Public Health Morbidity Unit. If a caller is requesting information or assistance related to infectious disease the call is transferred to ACDC. Calls are then triaged by ACDC clerical staff based on whether the caller is a healthcare provider and the exact nature of the call.

All calls received after-hours—Monday-Friday, 5pm-8am, weekends, and holidays—are forwarded directly to the County Operator [CO] (serves as the answering service for *all* county departments). Healthcare providers with questions related to infectious disease are transferred to the Public Health physician on call (aka Administrator On Duty [AOD]). Public callers, however, are provided with requested information, but not typically transferred to the AOD.

METHODS

The RAND technical manual provides a template for evaluating the competency of disease reporting systems. The manual was used to test how quickly a connection can be made between a caller and the action officer¹ (AO). A test of the system was planned for June 2010. Selected ACDC staff persons with jobs unrelated to the immediate receipt and processing of urgent disease situations were used to perform test calls. For callers without previous experience with the project, a brief training session was given. Callers signed up to perform several test calls during the test month.

The call process consisted of three phases: 1) initiating a call, 2) reaching an AO and 3) debriefing. A call was initiated when a test caller phoned the disease reporting system, used a lead-in (a short message

¹ For purposes of this test, an Action Officer (AO) is defined as a Public Health professional responsible for responding to public health emergencies at the time of the test call.



designed to move the call to an AO) and asked to speak to an AO. The caller would either be transferred directly to the AO (a warm transfer) or be asked to leave a message for the AO (callback). Once the caller reached an AO and confirmed that the person was responsible for handling urgent disease case reports, the AO was “debriefed”—informed that the call was only a test and that no further action was required.

Test callers received a script to follow for each call initiation that had them pose as a healthcare worker trying to get information regarding a potential case or cluster of infectious disease. This disguise prevented the person receiving the call from knowing immediately that the call was a test. During the call, each caller would complete a worksheet to keep track of specific call details such as the exact time the call was initiated, how long the caller was on hold, if the caller reached an AO, whether they had a warm transfer or a call back and how long the entire call took from start to finish. Callers were also encouraged to make notes on anything else of interest that happened during the call.

Information collected during the test calls was used to measure several outcomes—if contact with an AO was made within 30 minutes of call initiation (where contact was treated as a yes/no variable); the time from call initiation to contact with an AO; and the percent of calls with warm transfers as opposed to callbacks.

The test of the urgent disease reporting system was announced to physician staff, but the exact schedule of test calls was kept undisclosed. Dates and times of test calls were varied throughout the month.

RESULTS

During the month of August 2011, a total of ten test calls were made to the disease reporting system. Contact with an AO was made within 30 minutes for nine calls (Table 1). Response times for successful calls ranged from 3 to 12 minutes with a mean of 5.8 minutes from initiating the phone call to reaching an AO. All nine calls were warm transfers.

Table 1. Successful Call Line List

| Call # | Type of Call | Time of Call | Out- come | Time on hold | | | Total Time to reach AO |
|--------|--------------|--------------|--------------|--------------------|-------------------|---------|---------------------------|
| | | | | County Operator | Morbidity Unit | ACDC/IP | |
| 1 | Business Hrs | Morning | WT | ---- | 10 sec | 15 sec | 5 min |
| 2 | Business Hrs | Afternoon | WT | ---- | 20 sec | 3 min | 6 min |
| 3 | Business Hrs | Afternoon | WT | ---- | 8 sec | 3 min | 5 min |
| 4 | Business Hrs | Morning | WT | ---- | 5 sec | 1 min | 6 min |
| 5 | After Hrs | Afternoon | WT | 6 min | ---- | ---- | 12 min |
| 6 | Business Hrs | Afternoon | WT | ---- | 20 sec | 45 sec | 6 min |
| 7 | After Hrs | Evening | WT | 2 min | ---- | ---- | 6 min |
| 8 | Business Hrs | Afternoon | WT | ---- | 15 sec | 30 sec | 3 min |
| 9 | After Hrs | Evening | WT | 1 min | ---- | ---- | 4 min |

WT=Warm Transfer

Successful Calls:

Two calls stood out for being handled smoothly and professionally from start to finish. Both calls were conducted after-hours. Each CO was professional, took the appropriate information from the caller, informed the caller when the AO was connected and then left the line. The AO was able to be contacted very quickly and they were pleasant and helpful on the phone.

While all of the successful calls reached an AO in a short amount of time, issues with customer service were noted, examples of which could be found in the CO office, Morbidity Unit and ACDC.



Unsuccessful calls:

One call was not able to connect with an AO within the 30 minutes recommended by CDC (Table 2). This call was placed shortly before the time the CO switched calls back to the ACDC main office. The CO informed the caller that their call might not be returned until the main office opened, but that she would let ACDC know that there was a physician waiting for a return call. While the CO handled the call appropriately, a callback was not received for almost an hour after the initial call was made.

Table 2. Unsuccessful Call Line List

| Call # | Type of Call | Time of Call | Out-come | Time on hold | | | Total Time to reach AO |
|--------|--------------|--------------|----------|-----------------|----------------|---------|------------------------|
| | | | | County Operator | Morbidity Unit | ACDC/IP | |
| 1 | After Hrs | Morning | CB | 10 sec | ---- | ---- | 53 min |

CB=Callback

Suggested Improvements:

1. Regularly review call-transfer procedures with ACDC front office and professional staff. External healthcare professionals calling about an urgent potential infectious disease case, whether they suspect a specific disease or not, should be connected to the AOD or an appropriate back-up. As a last option, a message should be taken and a return call made as soon as possible.
2. Infectious disease calls that may regularly be handled by an alternate program (e.g., Immunization Program) should still be forwarded to an appropriate internal AOD if the external healthcare professional insists on speaking with someone immediately.
3. Remind Morbidity Unit staff that when external healthcare professionals call looking for a physician consult, they should immediately be transferred to ACDC, not to the Morbidity Unit supervisor.

DISCUSSION

All test calls except for one reached an AO within 12 minutes; well under the 30 minute standard recommended by the CDC. The telephone hardware systems functioned appropriately, but the need for improvements with the human element of the system were noted.

The evaluation of the LAC disease reporting system was successful in that the vast majority of test calls reached an AO very quickly, although customer service problems were identified that need to be addressed. The latest test shows that the current system is functional. The county maintains a system to receive reports 24 hours a day, 7 days a week and a toll-free hotline specific for receiving urgent disease case reports. The findings of this report have been shared with ACDC administration and areas of improvement have been discussed with appropriate staff affected by this response protocol.

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RESPONSE TO THE 9/11 TENTH YEAR ANNIVERSARY AND RICIN BIOTERRORISM THREAT REPORTS

Moon Kim, MD, MPH and Clara Tyson, RN, PHN, MSN

BACKGROUND

The tenth anniversary of the 9/11 attacks followed the death in May 2011 of Al-Qaeda leader Osama bin Laden. The confluence of these events led to heightened concern for acts of terrorism. In August 2011, the New York Times wrote a news article on a ricin terror threat which was subsequently also distributed via ProMed-Mail as an international ricin terror alert (1,2) expressing concerns of American counter-terrorism officials that Al Qaeda was producing ricin toxin for attacks in the United States. Ricin is a poison found naturally in castor beans. If castor beans are chewed and swallowed, the released ricin can cause injury. Ricin can be made from the waste material left over from processing castor beans. It can be in the form of a powder, a mist, or a pellet, or it can be dissolved in water or weak acid. The Centers for Disease Control and Prevention (CDC) has classified ricin toxin as a Category B threat agent. Category B agents are the second highest priority agents because they can be disseminated with moderate ease, they cause moderate morbidity and low mortality, and they require specific enhancements of CDC's diagnostic capacity and enhanced disease surveillance. We describe our efforts to prepare for the 9/11 tenth year anniversary.

METHODS

In order to prepare the Los Angeles County Department of Public Health and its partners, the following objectives were planned by the Acute Communicable Disease Control Program (ACDC): a) notification of hospitals and emergency room physicians of the need to remain vigilant for signs of illness due to possible bioterrorist events, b) notification of key internal and external partners regarding need for increased vigilance, c) calibration of syndromic surveillance and non-traditional surveillance systems (e.g., coroner database, poison control center database) look for specific illness patterns associated with ricin poisoning. Based on enhanced surveillance, if ricin is ingested, initial symptoms typically occur in less than six to 12 hours. These initial symptoms are most likely to affect the gastrointestinal system and include nausea, vomiting and abdominal pain. The symptoms of ricin poisoning are then likely to rapidly progress (generally over 12-24 hours) to include problems such as severe dehydration, and kidney and liver problems. This rapid progression of symptoms and illness is noticeably different than what typically occurs with most (but not all) commonly encountered infectious foodborne illnesses, which generally resolve within a day or two. If ricin is inhaled, initial symptoms may occur as early as 4-6 hours after exposure, but serious symptoms could also occur as late as 24 hours after exposure. The initial symptoms are likely to affect the respiratory system and can include difficulty breathing, shortness of breath, chest tightness, and cough. The symptoms of ricin poisoning are then likely to rapidly progress (generally over 12-24 hours) to include problems such as worsening respiratory symptoms, pulmonary edema (fluid within the lungs), and eventually, respiratory failure. This rapid progression of symptoms and illness is noticeably different than what typically occurs with most common colds and cough-type illnesses. (3), d) ensuring protocols and procedures related to bioterrorism agent testing are readily available to pertinent partners both internal and external, and e) maintaining heightened awareness with the Joint Regional Intelligence Center (JRIC) through our public health nurse detailed at this regional fusion center that facilitates the exchange of information both classified and unclassified among Federal agencies (e.g., FBI, Department of Health Services) and local agencies (law enforcement, fire, sheriff, public health).

RESULTS

We accomplished our objectives by performing the following:

- a) A health alert containing epidemiologic clues to a potential terrorist incident was distributed to local area hospital including Emergency Department Directors, Infectious Disease Chiefs, Infection Control Directors) and Emergency Medical Services reminding them to remain vigilant



considering the 9/11 anniversary. Healthcare Providers were also reminded to report any suspected cases of terrorism (biological, chemical/toxin, or nuclear/radiological) immediately to public health as concerns regarding infection control, management of those exposed, diagnostic testing, and specimen collection/packaging need to be addressed. A weblink to our Terrorism Agent Information and Treatment Guidelines for Clinicians and Hospitals was also provided in the health alert (<http://www.bt.cdc.gov/agent/ricin/qa.asp>).

- b) Via the Department of Public Health's Technical Advisory Group (TAG), key partners including our Public Health Laboratory, Toxics Epidemiology, Environmental Health, Veterinary Public Health, and Radiation Management were reminded to remain vigilant in identifying isolated or unusual cases of illnesses or illness clusters.
- c) An expanded bioterrorism profile was initiated for our syndromic surveillance systems which included key signs and symptoms of ricin via exposure through ingestion or inhalation.
- d) The Poison Control Center database was reviewed specifically for toxins and ricin.
- e) ACDC Food Safety Team was notified to look for unusual outbreaks or clusters of illnesses.
- f) ACDC Coroner Liaison was notified to remain vigilant in their daily corner database review to look for unusual death related to signs and symptoms of ricin exposure.
- g) The Los Angeles County Coroner was also notified and made aware of our efforts to remain vigilant in the detection of unusual deaths and protocols were shared.
- h) Continued to maintain connection at the JRIC via ACDC medical intel-analyst and TAG for review of relevant intel.

DISCUSSION

Since 9/11 and the anthrax attacks in October 2001, we must remain vigilant in the detection of another bioterrorist attack. In efforts to help ensure that the department and its partners do not become complacent in performing duties to detect potential bioterrorist events, we emphasized the importance of surveillance and monitoring to our partners during the tenth anniversary year of 9/11.

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USING SYNDROMIC SURVEILLANCE TO ASSIST IN AN INVASIVE MENINGOCOCCAL DISEASE OUTBREAK

Monica Luarca, MPH; Cheryl Faustino, MPH; Emily Kajita, MS, MPH; Megan Jones, MPH; and
Bessie Hwang, MD, MPH

BACKGROUND

Neisseria meningitidis is a gram negative diplococcus responsible for causing meningococcal disease, which may include meningitis, inflammation of the protective membranes covering the brain and spinal cord, and meningococemia, a form of sepsis¹. Beginning on March 13, 2011, the Acute Communicable Disease Control Program (ACDC) experienced an unusual increase in reported cases with culture positive *Neisseria meningitidis* in Los Angeles County (LAC). By April 30, 2011 there were 13 confirmed cases with invasive meningococcal disease (IMD), including two fatalities; a total of 20 cases were identified between March 13, 2011 and July 31, 2012. Early in the investigation there were few epidemiological links between the 20 cases: three cases were homeless, two of which resided at the same Skid Row shelter in downtown LA, and thus syndromic surveillance was used to assist in the investigation.

ACDC queried its syndromic surveillance databases to help gauge the scope of the outbreak and detect potentially missed cases. A focus was placed on homelessness as a risk factor because increased rates of IMD are often among persons with a common organizational affiliation or who live in the same community².

OBJECTIVE

The purpose of this report is to describe the complementary usage of electronic emergency department (ED) data, coroner death data, and 911 dispatch call center data for case ascertainment in an invasive meningococcal disease outbreak.

METHODS

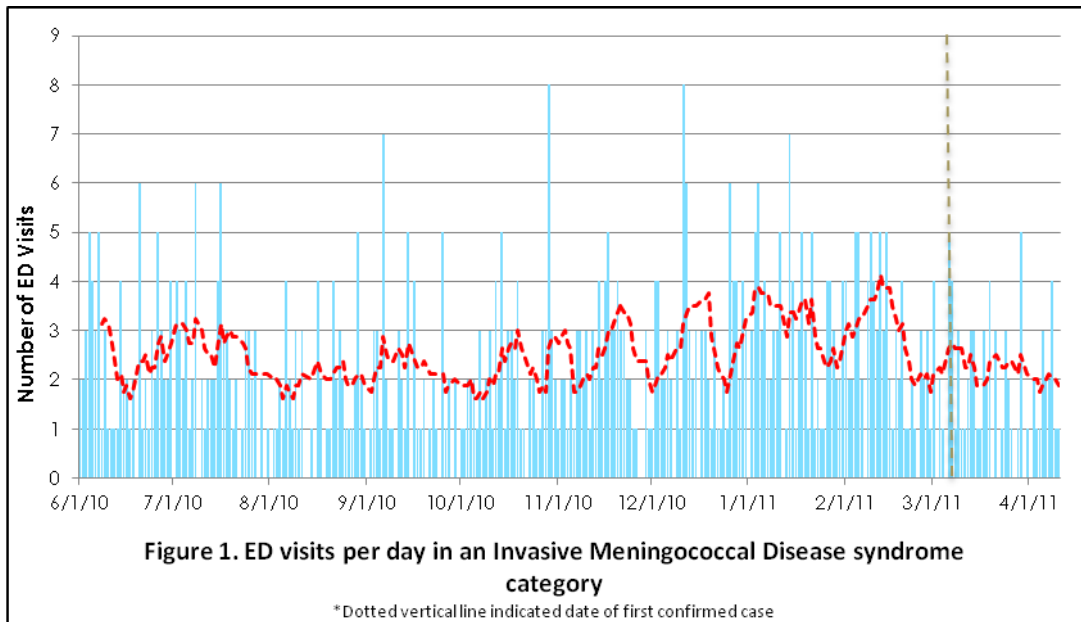
We queried electronic ED chief complaints (CC) from January 1, 2011 to April 10, 2011 from eight EDs within an 11-mile radius of Skid Row, Los Angeles (LA). A SaTScan™ cluster analysis was performed to locate clusters near Skid Row. All visits were reviewed if the CC included key words based on common IMD symptoms; all ED visits of confirmed IMD cases were also reviewed.

Coroner deaths from the same time period were reviewed for location of death and homeless status. Key words for the query were consistent with symptoms of meningitis. Deaths were excluded if the report included the words "suicide", "accident", or "homicide".

Real-time LA City emergency dispatch (911) calls were also reviewed if the calls originated from the same homeless shelter in which the two confirmed cases resided. All statistical analyses were conducted with SAS® version 9.2.1 (Cary, N.C.).

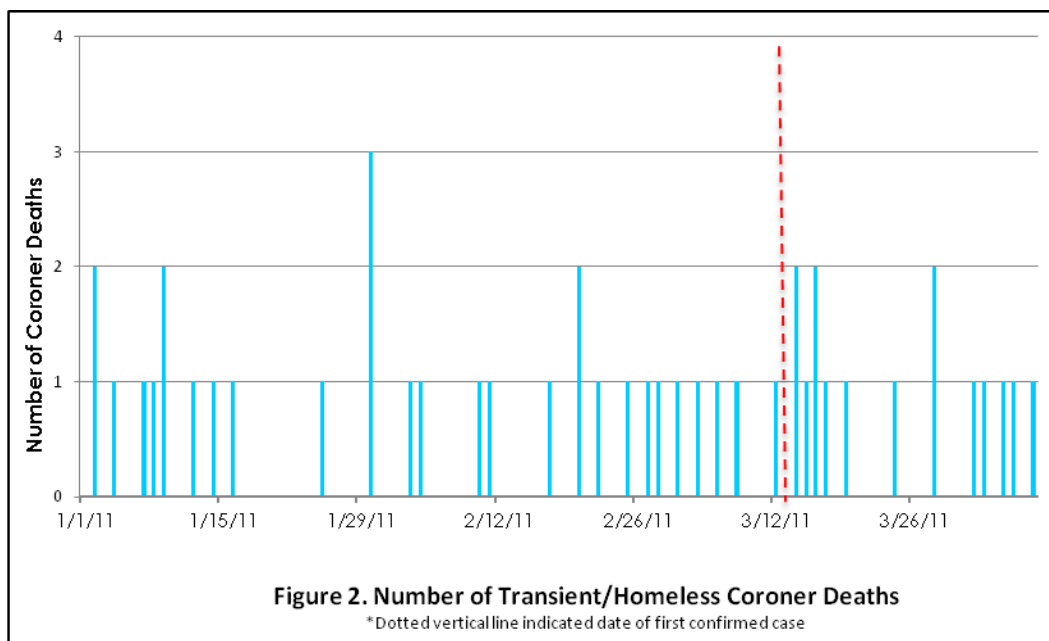
RESULTS

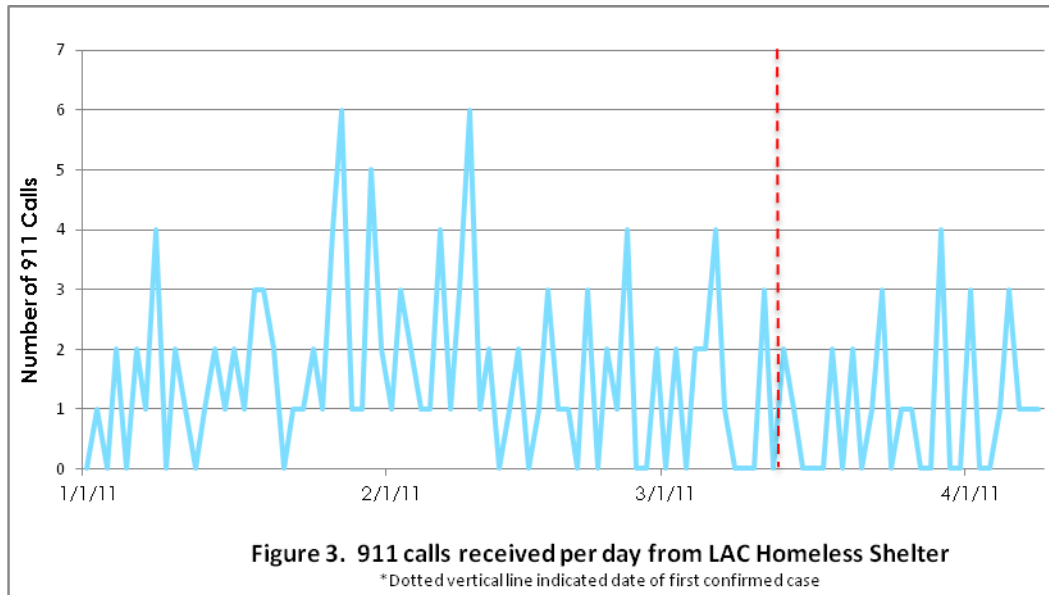
A total of 238 ED visits met the IMD syndrome definition; however, there was no substantial increase compared to the previous nine months (Figure 1). After review, there were no ED visits with mention of homelessness or shelter residence within the same zip code catchment area.



There was no overall increase in the total number of homeless coroner deaths (Figure 2). Two of 45 unrelated deaths (4.4%) took place in shelters—one death in January from “cardiomyopathy” that occurred at the homeless shelter of interest, and another non-specific shelter death in March from “strep pneumonia.”

Forty-one 911 ambulance calls were made from the homeless shelter associated with the two confirmed IMD cases. While there was no overall increase in call volume (Figure 3), one call matched a confirmed case fatality.





DISCUSSION

An IMD outbreak and two individual clusters were detected in LAC early in 2011. To aid in case ascertainment as well as help establish tighter epidemiological links, three databases within the county's syndromic surveillance system were queried. Both coroner and 911 call databases were more effective than ED data in terms of content, containing free-text fields facilitating focused queries on the key epidemiological links of homelessness and shelter residence. Coroner data are, however, limited in that there is a two-day reporting lag. Also, while many homeless deaths were found, few had precisely reported death locations which limits investigations. It is recommended that LAC coroner data switch to an automated feed, with multiple feeds per day, to facilitate investigative efforts and eliminate the time delay; automation would also allow for data analysis on weekends, when necessary.

Many 911 calls were reported from the shelter of interest. While medical information was vague, additional details enabled ACDC to match one call to a confirmed case. Follow-up for diagnosis information is possible when ED transportation information is present. When available, precise caller locations make 911 calls particularly useful for investigations with a strong emphasis on location such as point source outbreaks. In the future, electronic medical service records will be useful in quickly obtaining necessary data elements for analysis, as well as for attaining more detailed event descriptions that were not known or available at the time of dispatch.

Syndromic surveillance is an important complement to traditional surveillance, providing baselines for health conditions that are otherwise very difficult to obtain. Complementary databases such as coroner deaths and 911 calls may be useful in outbreak investigations that occur in unusual settings or among unique populations.

While no additional cases were found, the absence of an increase provides validation that a large, countywide IMD outbreak had not occurred.

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THE UTILITY OF AN EXTERNAL MEDICAL RESOURCE TO PROVIDE SCHOOL-BASED VACCINATION CLINICS

Sadina Reynaldo, PhD

BACKGROUND

When pandemic influenza H1N1 (pH1N1) first emerged in March 2009, it took about seven months for the medical and scientific communities to isolate the virus then develop and test a corresponding vaccine to be used as an effective protective response. In the US, by late-October 2009 the federal government began distributing pH1N1 vaccine to Public Health departments across the nation to then manage and oversee the local distribution to their residents; however, the strategy for disseminating the vaccine to the appropriate communities was left to the discretion of each jurisdiction. Because pH1N1 predominantly affects younger populations,¹ many jurisdictions chose to enact school-based vaccination clinics.² The Los Angeles County Department of Public Health (LACDPH), instead, chose to primarily implement community-based points of dispensing (PODs) and distribute vaccine to primary care physicians and major medical groups. As such, LACDPH's ability to enact school-based vaccine clinics was identified in retrospective assessments as an area for improvement.

Any outreach to schools in Los Angeles County (LAC) is very challenging because LAC's school system is exceptionally large and complex. In addition to countless private, parochial and home-school entities, LAC is also home to over 80 public school districts, including the Los Angeles Unified School District (LAUSD) which is the second largest in the nation; LAUSD alone serves nearly 700,000 students. Implementing campus vaccine clinics to such a vast entity as LAC's schools would require a large cadre of trained medical staff; but during a pandemic, LACDPH's staff would be hampered by the need to attend to other medical emergencies. Plus, a pandemic would likely deplete *all* staff throughout the area due to their own illnesses and the need to care for sick family members. As such, it is very likely that if LACDPH should choose to implement school-based vaccine clinics during a future medical emergency, like a another pandemic, LACDPH would require employing an outside medical agency to either assist with or take the primary role in enacting those clinics. The purpose of this project was to assess the utility of employing an outside (non-LACDPH) medical agency to implement school-based vaccine clinics in a variety of public school settings across LAC. This project would serve to identify the advantages of this strategy, as well as its gaps and challenges—and then to determine potential solutions to those disadvantages.

Shift in type of vaccine to assist with pertussis booster vaccination compliance (Assembly Bill 354):

Because the impetus for this project was LACDPH's pH1N1 response, and because funding was provided through federal pandemic planning, the initial proposal for this project was to assess the implementation of influenza vaccine via school-based clinics. However, the funding for this project was significantly delayed and unable to commence until late-February 2011, at the end of influenza season. At this point in time, the need for influenza vaccination, as well as the motivation to receive this vaccination, was extremely low. Also at this time, the California Department of Public Health sponsored a statewide vaccination mandate (Assembly Bill 354) in response to the pertussis epidemic that was currently affecting California residents.^{3,4} This new ordinance required all students entering 7th through 12th grades to provide documentation of receipt of a pertussis booster vaccination, via the tetanus/diphtheria/pertussis

¹ CDC (2009) Surveillance for pediatric deaths associated with 2009 pandemic influenza A (H1N1) virus infection - United States, April–August 2009. *MMWR Morb Mortal Wkly Rep* 58: 941–947. <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5834a1.htm>

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⁴ California Department of Public Health. Early alert to schools: Assembly Bill 354 becomes law. 2011 Pertussis (Whooping Cough) immunization requirements for students; September 30, 2010. <http://www.cdph.ca.gov/programs/immunize/Documents/EarlyAlertToSchools-AB354.pdf>



(Tdap), vaccine by July 1, 2011. Students without either documentation verifying receipt of Tdap vaccination, or a vaccination exemption waiver, would be barred from admission to school. This new law created a large cohort of students that required vaccination. In addition, because public schools had the potential of losing funding if student attendance suffered as a result of this new law, school administrators would likely be especially motivated to receive services that could assist with compliance to the AB 354 mandate. Because the core objective of this project was to assess the *process* of providing vaccine, not the *type* of vaccine, it was decided to change the vaccine administered via this project from influenza to Tdap.

METHODS

Multiple steps were enacted to implement this project. The first task was to solicit potential participating school districts, which was done with the assistance of the Los Angeles County Office of Education (LACOE), the umbrella organization that unites the over 80 public school districts across LAC. LACOE serves as a conduit for providing information and resources to LAC's public schools. This agency also provides updates in health issues and healthcare-related policy including holding quarterly meetings for key district health administrators. An announcement describing LACDPH's plans to test the utility of an outside agency to implement school-based vaccine clinics was made during their spring 2011 meeting.

Attendees at the meeting were informed that if they wanted their district to participate, they would receive a Tdap vaccination clinic. At no charge to the school, the medical agency implementing the clinic would provide the medical staff to administer the vaccine, as well as the vaccine and all necessary ancillary medical supplies. However, participating school districts would need to handle the majority of the other responsibilities to ensure the success of the project such as: disseminating consent forms and vaccine information sheets to the students, collecting and verifying the information on the consent forms, and arranging for the transportation of students to and from the clinic if held during school hours (see Table 1. Division of School-Based Clinic Roles and Responsibilities). Attendees that wished to have their school district considered for participation in the project completed a short questionnaire to provide their contact information, a description of their school district (i.e., the number of schools, approximate number of students, issues of special need, etc.). A total of 33 separate school districts completed the form requesting to be considered for participation in the project. However, because of continued delays initiating the project, the vaccination clinics could not be held until June 2011. At this point many school districts could no longer participate because they would be attending to end of the school year activities. Ultimately, ten separate school districts including LAUSD participated in the project. In addition, nine smaller clinics were held specifically for LACOE special needs students. Prior to implementing the vaccination clinics, meetings were held with school representatives at each separate school district to plan for their clinic. The breakdown of responsibilities were discussed (Table 1) and the necessary forms were reviewed. Also during these meetings, potential sites for the clinics were considered.

Table 1. Summary of Distribution of Responsibilities for School-Based Vaccination Clinics Held by an External Medical Agency

To ensure the success of the school-based vaccination clinics, all participating agencies must complete several tasks and assume a range of responsibilities as follows:

Los Angeles County Department of Public Health (LACDPH) Duties

- Arrange and provide the funding to employ the external medical agency that will provide the vaccine clinics.
- Provide and duplicate all necessary forms including: sample cover letter, consent forms (from the external medical agency), vaccine information sheet (from the CDC), and California Immunization Registry (CAIR) information sheet and declination statement.

School Duties

- Establish necessary administrative approval (i.e., approval with principals, site supervisors, board members, etc.).
- Arrange and conduct clinic promotion as necessary (including posters, flyers, and letters and/or phone calls to parents, etc.).
- At least two days prior to the clinic, collect signed consent forms and reviewed the forms for: 1) completeness, 2) contraindications, 3) whether the student has already met the vaccine requirement, and 4) to obtain an estimate of how many doses will be needed for the clinic.
- Prior to the clinic, make a copy of all of the returned consent forms. The set of original consent forms will be given to medical



agency providing the clinic, the copy will be provided to the student as a record of their vaccination. If the school would like another set of copies for their records, they can make a second copy; however, medical agency will provide the school with a participant log of students receiving vaccination after the event. The log will contain: 1) the student names, 2) their birthdates, and 3) mother's first name. This log can be used for entry into a vaccine registry like CAIR.

- Designate an appropriate room and provide for all necessary furniture (tables, chairs, trash cans).
- If the clinic is held during class hours, arrange for the transport of the students to and from the clinic. It is important to stagger the participation of students to avoid overcrowding.
- Following the clinic, enter all necessary data from the vaccine clinic into CAIR or other vaccine database. The school does not have to use CAIR to participate, but a vaccine summary database can help to demonstrate compliance with the law for future years.
- Following the clinic, complete the post-event satisfaction survey provided by LACDPH.

External Medical Agency Duties

- Connect with the school district representatives to: 1) review and confirm the division of responsibilities, 2) determine a location on the school site to hold the clinic and confirm that this selection is adequate, 3) review and confirm that the school can provide all necessary furniture as needed (i.e., the number of tables, chairs, trash cans, etc.).
- Provide consent forms in English and Spanish.
- Provide vaccine and all necessary ancillary clinic supplies.
- Provide all necessary staff to conduct the clinic.
- Following the clinic, provide the school a copy of the participant log.
- Handle all vaccine clinic complaints and ensure responsibility for any adverse events.

RESULTS

From June to July 2011, this project conducted a total of 13 clinics for ten separate school districts; three districts held a second clinic in the summer because of surplus vaccine (Table 2). In addition, nine smaller clinics were held specifically for LACOE special needs students. Total 4,160 doses of Tdap vaccine were provided, an average of 297 doses per site (median 265 doses; range 118 to 562 doses).

| | Clinic Dates | Vaccination Totals |
|----------------------------------------------------------------------------------------------------------------------|----------------------|--------------------|
| 1 | June 8 | 397 |
| 2 | June 8 | 562 |
| 3 | June 9 | 156 |
| 4 | June 14 | 423 |
| 5 | June 15 | 269 |
| 6 | June 17 | 261 |
| 7 | June ¹ | 167 |
| 8 | July 6 | 244 |
| 9 | July 12 | 425 |
| 10 | July 14 | 289 |
| 11 | July 15 | 118 |
| 12 | July 19 ² | 250 |
| 13 | July 19 ² | 227 |
| 14 | July 28 ² | 372 |
| TOTAL | | 4,160 |
| ¹ A total of nine separate and smaller clinics were held for LACOE special needs classes throughout June. | | |
| ² Because of surplus vaccine, second summer clinics were held for three districts. | | |

DISCUSSION

Overall, the vaccine clinics were extremely successful: the participating school nurses and administrators were very appreciative of LACDPH's outreach which provided vaccinations to thousands of students and greatly assisted the schools' compliance to the AB 354 mandate. The representatives from the



participating schools rated the clinics very highly, had no complaints, and felt the events ran very well with no issues or problems. However, even though the schools were grateful to receive the clinics, the clinics could not have been accomplished without the tremendous effort of the school nurses who were responsible for much of the preparation required for these events—particularly the promotion and registration of students. Uniformly, the most challenging aspects they reported were clinic promotion as well as motivating students to participate. All of the sites complained that there was a lack of understanding of the law requiring Tdap vaccination, and that it would have substantially helped their efforts if there was corresponding media support getting the word out (public service announcements, news reports, etc.). As a consequence, the school nurses became very creative instituting a range of materials to announce and promote the events and also invested a tremendous amount of time sending out letters, making phone calls and urging students to get vaccinated. Nonetheless, all of the sites had a lower turn-out for their clinics than planned; none exhausted the amount of vaccine LACDPH had allocated for their site, which is why this project was able to hold an additional three summer clinics.

Among the 13 clinics, the site that achieved the greatest student turn-out, 562 students vaccinated in one day, instituted several unique and innovative methods to achieve their successful participation. First and foremost, in retrospect, administrative support proved vital to the success the clinics. The locations that had better student turn-out were the locations where the school principal championed the project: assisted with promotion, campus awareness and school announcements—and this was certainly the case for the location that had the project's largest turn-out. At this location, the school principal made getting all of his students vaccinated his top priority. Instead going by AB 354 deadline of July 1 (which would mean his students could wait until school resumed in September to get vaccinated), he wanted his students to meet the mandate before they left school in June. He went out of his way to make this goal known to his students, parents and staff and instituted creative incentives. For instance, a few days following the LACDPH sponsored vaccination clinic, he arranged for a "DJ Party" where students that had submitted proof of vaccination could leave class for lunch 30 minutes early to enjoy a DJ dance. The students were highly motivated by this event, and the teachers were also motivated to have all of their students involved so they too could enjoy 30 extra minutes away from class. Other creative methods that the schools employed included: withholding fall registration packets until students showed proof of registration, having student leaders promote the event in classrooms, and posting signs throughout the campus and also at off-site locations that were common places where parents would likely see them (like a nearby market and laundromat).

Overall, this project demonstrated that using an external medical agency to implement school-based vaccination clinics can be a viable strategy during a pandemic or other public health crisis. However, even though the clinics were successful (ran well without issue or complaint) they still required considerable effort from LACDPH and school staff. Because of budget cuts, schools do not have the resources and funding available to develop the corresponding materials (registration forms, vaccination information sheets, etc.) essential for a vaccination clinic. The development and duplication of these items must still be provided for the schools. In addition, the schools requested that more simple (easy-to-read, lower literacy) forms be used in the future. This project required using the consent forms developed by the external medical resource because they assumed the liability for the events. Future vaccination events would likely have better participation if they used more simplified forms that improved parent and student understanding and motivation for the clinics. Similarly, LAC is very culturally and ethnically diverse; many districts require translation of forms into languages beyond just Spanish. A few sites could not participate because we were unable to provide Chinese or Vietnamese translation. Again, this is a factor that should be accounted for during future clinics.

Conducting vaccination clinics at school sites is a method that Public Health would be wise to employ more often in the future. In particular, providing influenza vaccine at school-sites could yield substantial community and school benefits. The epidemiology of influenza shows that vaccinating children is the single best method of reducing the impact of this disease in our communities. Children, especially young children, have the highest age-specific rate of influenza infection; they are less likely to practice infection control habits (washing hands, covering sneezes and coughs); they tend to play and socialize in close proximity to one another; and when sick with flu, they tend to shed the virus longer than adults. Not surprisingly then, preschool and school-age children are known to be the major disseminators of influenza



and but also respond best immunologically to influenza vaccine. Targeting influenza vaccination to this critical group has shown to provide exponential benefits to the entire population. Schools can also benefit from offering influenza vaccination since this can reduce illness and improve attendance. The convenience of providing vaccination at school sites would likely increase willingness to receive vaccination and further strengthen Public Health's partnership with our valued community partners.





TESTING BIOLOGICAL TEAM RESPONSE DURING A FULL-SCALE MULTI-AGENCY BIOTERRORISM EXERCISE ON BOARD A CARGO SHIP

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BACKGROUND

In June 2011, the Los Angeles County (LAC) Department of Public Health (DPH) participated in a full-scale multi-agency bioterrorism response exercise. The exercise was sponsored by the California National Guard 9th Civil Support Team and took place on board a military cargo vessel docked at a LAC Port. A core group was involved in the discussion and planning of the scenario leading to the event to simulate a response of a potential bioterrorism threat in LAC. The exercise scenario implicated a release of weaponized smallpox virus. Smallpox has been declared eradicated by the World Health Organization since 1980 and the immunity of the population to the virus has declined. A potential release and exposure to the smallpox virus would certainly create a public health emergency response. The scenario of the exercise implicated terrorists taking over a cargo civilian ship in the Middle East, posing as crew members, accidentally releasing the virus on the ship during their travels across the ocean, and infecting themselves and crew members. The agencies that participated in the exercise included public health, law enforcement, port authorities, coroner, fire departments, and HazMat agencies. These agencies worked together to assess and mitigate the threat.

The exercise offered the opportunity for the LAC DPH biological response team to conduct the following: test their operational capabilities to respond to a biological agent release with affected ill victims; collect clinical samples while in personal protective equipment (PPE) and respirators; and coordinate response with other responding agencies onsite. Participation in this type of exercise provided staff an opportunity to practice their response skills in a heightened threat environment and prepare the workforce to respond to potential public health related emergency incidents. In addition, participation in this type of bioterrorism exercise definitely incorporated elements of the ten essential public health services and aligned with the strategic planning goals set forth by LAC DPH.

METHODS

In preparation, Acute Communicable Disease Control Program (ACDC) Training and Response Unit provided an online competency-based training on suspected smallpox case investigation, specimen collection procedure, and process for donning and doffing of PPE. The training reviewed transmission of smallpox, the diagnostic criteria, infection control precautions and practices, and the role of the team member in the initial evaluation of a suspected smallpox case. Successful completion of the course was measured by a minimum passing score of 80% on the post-course 20-question multiple choice exam.

To supplement the online course, the bio-response team members completed a practicum session to review and perform a return demonstration of various methods of specimen sample collection for suspected smallpox, packaging of specimens, and completion of laboratory requisition forms for laboratory analysis. A demonstration of the appropriate techniques for donning and doffing of PPE and the use of a new type of Powered Air Purifying Respirators (PAPR) were offered. This training provided the opportunity for the members to perform return demonstration, test the equipment, and familiarize themselves with the components and assembly process of the PAPR.

RESULTS

On the day of the exercise, DPH staff were pre-staged and met in a designated area near the exercise incident. The team was briefed and informed of the situation (a potential act of bioterrorism) and given instructions for response. The bio-response team waited for clearance to enter the vessel once law enforcement and the fire department deemed the vessel safe and clear for entry. The initial notification to DPH described the scenario as a ship arriving from Yemen with many people, both passengers and crew



members, seriously ill with fever, generalized lesions on bodies, and an unknown number of deceased individuals upon arrival to the LAC port.

Once cleared safe for entry, a DPH specialized response team deployed on board the ship first along with the Fire HazMat unit to conduct an initial health threat assessment, perform field sampling testing and determine the extent of the situation from a public health standpoint. Members of the ACDC training and response unit briefed a second bio-response team of the health risk situation on board, reviewed the necessary steps for donning PPE, use of the partner system for safety measures, procedures for collection of clinical specimens of victims, and packaging of specimens for delivery to the public health laboratory.

The bio-response team prepared and gathered their necessary equipment at the staging area for entry on board the vessel once deemed safe to enter. Equipment consisted of supplies such as particulate resistant coveralls, chemical resistant gloves and boot covers, duck tape for sealing seams on coveralls, PAPR, specimen collection laboratory supplies, and radio. Use of the partner-system concept was crucial to ensure proper fitting and positioning of their partner's PPE/PAPR and early recognition of potential emergencies on board the ship.

The team members donned their PPE with the assistance of their partner and consultation from an environmental hygienist on site as needed. They were deployed to respond on-board the vessel, along with some of the DPH specialized team members and external partners such as law enforcement, coroner, and fire HazMat agencies. The goal was to rapidly assess, interview and collect samples of skin lesions on affected victims (both ill and deceased) on board the ship. In a real incident, the specimens would be transported under chain of custody for immediate analysis by the DPH Laboratory Response Network.

The ten bio-response team members consisted primarily of public health nurses and one public health investigator. They worked extremely well together considering all members came together from different programs within DPH and the majority of them were participating in their first bioterrorism response exercise. They quickly established methods for communication with their assigned partner while wearing a PAPR. The scenario and turn of events during the exercise changed unexpectedly throughout the drill, however, the team was flexible and able to adjust to the situations as they presented without problems. The most challenging task for the team was responding in an unfamiliar environment such as a cargo ship, while climbing steep and narrow ladders between decks, assessing victims on the floor in tight quarters while in PPE and kneeling or bending over for prolonged periods, establishing clean and dirty work boundaries and maintaining aseptic technique during the specimen collection process.

Upon successful mission of assessing victims and completing tasks on board the vessel, the bio-response team departed the ship and was directed to a decontamination area and instructed by Fire HazMat on methods to appropriately decontaminate and remove their PPE.

EVALUATION

Five DPH members were assigned to evaluate and closely observe the bio-response team member's actions during the entire response process. Evaluators were instructed to rate the quality of the following areas: overall exercise, PPE donning and doffing process, specimen collection process, team work, and communication between team members. Table 1 summarizes the ratings of assessment areas ranging: poor, fair, good, very good and excellent.



Table 1: Evaluator's Rating Table (n=5)

| Evaluator's Ratings | N/A | Poor | Fair | Good | Very Good | Excellent |
|------------------------------------|-----|------|------|------|-----------|-----------|
| Overall exercise (team response) | 1 | | | | 1 | 3 |
| PPE donning and doffing process | | | | 1 | | 4 |
| Specimen collection process | 1 | | | 1 | 1 | 2 |
| Team work | | | | | 1 | 4 |
| Communication between team members | | | | 1 | | 4 |

The bio-response team members were given an opportunity to provide feedback on their participation after the exercise. Table 2 illustrates the bio-response team responses related to their participation.

Table 2: Bio-response Team Evaluation (n=12)

| | Yes | No | N/A |
|----------------------------------------------------------------------------------------------------------------|-----|----|-----|
| 1. The orientation given onsite prepared me to effectively complete my duties. | 12 | | |
| 2. My Job Action Resource Guide (JARG) was helpful in preparing me for my role at the exercise. | 11 | | 1 |
| 3. Equipment and materials were available for me to do my job effectively. | 11 | 1 | |
| 4. My team partner and I were able to communicate and work together well without problems during the exercise. | 10 | 2 | |
| 5. The PAPR used during the exercise was comfortable to wear for a prolonged period. | 9 | 3 | |
| 6. I feel better prepared to respond to a suspected smallpox case investigation call after this exercise. | 10 | 2 | |
| 7. After today's exercise, I could benefit from more smallpox collection exercises and refresher trainings. | 12 | | |

Overall, six bio-response team members rated their overall exercise experience as "excellent," four rated their experience as "good," one rated it as "fair," and one did not respond.

DISCUSSION AND LESSONS LEARNED

Recommendations from team members for improvement for future exercise included:

- developing a cheat sheet for collection kits,
- including a small flashlight in kits,
- better organization of supplies prior to specimen collection,
- more practice in drills of this nature,
- improve communications with agencies such as Fire HazMat, and
- improving radio communication.

Recommendations from the team also included continuous on-going skills competency and refresher training sessions. Increasing opportunities to practice responding to biological incidents through multi-agency full-scale exercises is crucial and necessary to ensure a well-prepared and confident workforce capable of responding to potential public health emergency incidents. The ability to measure performance and identify areas of improvement after each exercise is important to ensuring a well-prepared health department (Gebbie, Valas, Merrill and Morse, 2006). According to Gebbie (2006), public health agencies must be able to measure performance and identify areas for improvement. This can be done through ongoing training and emergency response exercising, and through the use of response exercises that include plans for evaluation.



CONCLUSION

Each year, LAC DPH participates in table-top exercises, full-scale exercises and functional exercises. The 2008 National Profile of Local Health Departments reported that 86% of local health departments participated in a tabletop exercise, 72% participated in a functional exercise, and 49% in a full-scale exercise (Biddinger, Savoia, Massin-Short, Preston & Stoto, 2010). Preparedness exercises are effective in familiarizing personnel with emergency plans, allowing different agencies to practice working together, and identifying gaps and shortcomings in emergency planning (Biddinger et al., 2010). Participation in this full-time bioterrorism exercise reinforced the departments need to continue participating in exercises such as these. The Harvard School of Public Health Center for Public Health Preparedness evaluated 38 public health emergency preparedness exercises employing realistic scenarios, and reported usefulness of the exercises in clarifying public health workers' role and responsibilities, facilitating knowledge transfer among these individuals and organizations, and identifying specific public health systems-level challenges (Biddinger et al., 2010).

Participating in full-scale multi-agency bioterrorism exercises provides a realistic simulation of the highly stressful and threatened environment that a possible bioterrorism threat causes. Coordination and communication with multiple external agencies can be challenging in the field, as experienced during this exercise. Despite the challenges, it's extremely important for LAC DPH to continue participation in full-scale bioterrorism exercises and continue testing their skills capabilities, and improve workforce competence and confidence in their response to potential public health emergency events and incidents.

REFERENCES

- Biddinger, P.D., Savoia, E., Massin-Short, S.B., Preston, J. & Stoto, M.A. (2010). Public Health Emergency Preparedness Exercises: Lessons Learned. 2010 Supplement 5, volume 125. Public Health Reports. Boston, MA. Association of Schools of Public Health.
- Gebbie, K.M., Valas, J., Merril, J. & Morse, S. (May-June 2006). Role of exercises and drills in the evaluation of public health in emergency response. *Prehospital and Disaster Medicine*. New York, NY. Center for Health Policy, Columbia University School of Nursing and National Center for Disaster Preparedness. <http://pdm.medicine.wisc.edu>

RESOURCES

National Association of County and City Health Officials at <http://www.naccho.org/>

National Center for Disaster Preparedness at <http://www.ncdp.mailman.columbia.edu/>

Harvard School of Public Health Center for Public Health Preparedness at <http://www.hsph.harvard.edu/hperlc/>