Acute Communicable Disease Control Program

Special Studies Report

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Los Angeles County
Department of Public Health

Public Health
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ACDC SPECIAL STUDIES REPORT 2012

TABLE OF CONTENTS

Disease Surveillance, Trends, & Summaries:

Infectious Disease Incidents/Clusters/Outbreaks:

BOTULISM CASE REPORT SUMMARY
LOS ANGELES COUNTY, 2012

David Dassey, MD, MPH

Four cases of botulism were confirmed and reported in 2012; all cases survived. One additional report of suspected botulism was not confirmed.

Two of the cases comprised a foodborne botulism outbreak. A cohabiting couple ingested soup that had not been refrigerated for over a week. One case was hospitalized for several days and received botulinum antitoxin. The other case was stable and was hospitalized for only one day for observation. Tests of several clinical specimens were negative for botulinum toxin and organisms for both cases; however the occurrence of clinically compatible botulism in two persons who had consumed a risky food item was sufficient to meet the case definition of a foodborne botulism outbreak. The investigation identified conflicting label instructions for food storage; this was brought to the attention of the federal Food and Drug Administration and the soup manufacturer, which took immediate steps to correct the labeling problem on its products nationwide. See the special report for details.

One case was classified as wound botulism. The case patient was an injection drug user with cellulitis; both serum and wound culture demonstrated botulinum toxin type A. The patient received antitoxin and recovered.

The fourth case also occurred in an injection drug user but was classified as a case of “other” botulism. Botulinum toxin type A was detected in the patient’s serum obtained prior to treatment with antitoxin. No wound culture was obtained, but a stool sample also showed evidence of toxin type A, which would not happen in wound botulism. Before the patient could be questioned further about his recent food consumption, he left the hospital against medical advice. Lacking a history of exposure to a botulism-prone food item, the case could not be classified definitively as foodborne botulism.

The unconfirmed botulism suspect was an injection drug user who presented with a clinical picture similar to botulism, but additional tests confirmed myasthenia gravis. He did not receive antitoxin and no further botulism tests were conducted.

There were 14 cases of infant botulism confirmed by the California Department of Public Health, Infant Botulism Treatment and Prevention Program[1]; ten were due to type A and four were due to type B toxin. Seven cases were Hispanic, six were white, non-Hispanic, and one was Asian. There were four female cases and ten male cases, with ages ranging from 48 to 240 days (mean, 136 days) at time of onset. All survived.

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

FACILITY-LEVEL PREDICTORS OF *CLOSTRIDIUM DIFFICILE* INFECTION RATES IN LOS ANGELES COUNTY HOSPITALS, 2010-2012

Kelsey OYong, MPH, Patricia Marquez, MPH, Dawn Terashita, MD, MPH

BACKGROUND

Clostridium difficile is an anaerobic, spore-forming bacterium that lives naturally in the intestine of 3% of healthy adults.[1] However, with disruption of the natural gut flora, through use of antimicrobials or illness, *C. difficile* is able to infect the host. During infection, *C. difficile* produces toxins which cause watery diarrhea, fever, abdominal pain, cramping, and dehydration, leading to higher costs and length of hospital stay.[2,3,4] The incidence and mortality of *C. difficile* infection (CDI) have increased in recent years nationally. An emergent resistant strain of *C. difficile*, NAP1/ BI/027, has been associated with many outbreaks and cases of severe illness, and may account for this surge in CDI rates.[5]

In 2008, California mandated hospital reporting of CDI to the Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN). NHSN is a free internet-based surveillance system that collects data from healthcare facilities on infections and other adverse events. California hospitals began reporting CDI data to NHSN on April 1, 2010 using the Lab ID module, a component of NHSN used by facilities to monitor and analyze CDI and multi-drug resistant organism infections. In Los Angeles County (LAC), 100 (100%) hospitals report to NHSN; all of these hospitals have voluntarily conferred rights to Los Angeles County Department of Public Health (LAC DPH) to access their NHSN data.

Population-based CDI rates in LAC have not been previously determined. Additionally, few studies have examined facility-level predictors of CDI rates. High levels of CDI have been associated with hospitals that are non-teaching and without emergency departments or trauma services.[6,7] CDI testing method is another factor that affects a facility's CDI rates and is not well understood. Several different testing methods are available with varying degrees of sensitivity and specificity, which may impact CDI rates.[8] The objective of this report is to describe the first two years of facility-level CDI data collected in NHSN, from April 2010 to March 2012, by time period, hospital-level attributes, and testing method.

METHODS

CDI counts and total CDI patient-days were collected using NHSN. Patient-days are defined as the sum of the daily count of the number of patients per location. Hospitals reporting less than ten months per reporting year of CDI summary data were excluded. Hospital attributes were determined using surveys conducted by the LAC DPH Hospital Outreach Unit (HOU). The analyzed attributes were: status as a long-term acute care (LTAC) facility, presence of a residency program, presence of an emergency department, and status as a trauma center. Rate calculations for the latter three attributes excluded LTACs. The Centers for Medicare and Medicaid Services certifies a hospital as LTAC if its average length of stay among patients is greater than or equal to 25 days.[9] *C. difficile* sample testing methods were determined using the NHSN user survey, which was self-reported by hospitals. The testing methods were not mutually exclusive; some hospital laboratories employed more than one method. The CDI annual rates were calculated with SAS 9.3.

Cases were defined based on the NHSN LabID component criteria for onset type. Hospital-associated (HA) CDIs include both hospital-onset cases (HO CDI) and community-onset-healthcare-facility-associated cases (COHCFA CDI). HO CDIs are defined as events occurring more than three days after admission to the facility. COHCFA CDIs are defined as events occurring in patients who were discharged from the facility four weeks or less prior to the date of stool specimen collection. Community-onset (CO) CDIs were defined as events occurring as an outpatient or an inpatient equal or less than three days after admission to the facility. CDI rates were calculated as cases per 10,000 patient-days, as defined and collected in NHSN. Duplicate CDI specimens were excluded following the NHSN definition for duplicate *C. difficile*-positive test: any *C. difficile* toxin-positive laboratory result from the same patient and NHSN-

mapped location within the hospital, following a previous *C. difficile* toxin-positive laboratory result within the past two weeks.

RESULTS

In the first year of reporting, from April 2010 to March 2011, complete NHSN CDI data were available for all 100 hospitals. In the second year of reporting, April 2011 to March 2012, complete NHSN CDI data were available for 99 hospitals. The breakdown of reporting hospitals by attribute is shown in Table 1. For the reporting year 2010-2011, 8516 CDIs were reported to NHSN by LAC hospitals. The second year of reporting, 2011-2012, yielded 9474 CDIs (Figure 2). The numbers of CDIs by onset type for the two reporting years are shown in Table 2. Figure 1 displays the median CDI rates by type for the two reporting years. For the 2010-2011 time period, LAC hospitals reported an HA CDI rate of 9.8 events per 10,000 patient-days and an HO CDI rate of 7.6 events per 10,000 patient-days. During the 2011-2012 time period, LAC hospitals reported an HA CDI rate of 10.9 events per 10,000 patient-days and an HO CDI rate of 8.4 events per 10,000 patient-days. The HA CDI rates by status as a LTAC, presence of a residency program or an emergency department, and status as a trauma center are displayed in figures 2-5. Of note, the HA CDI rate in LTACs was 23.8 and 22.2 events per 10,000 patient-days for 2010-2011 and 2011-2012, respectively; for non-LTACs, the HA CDI rate was 9.6 and 10.5 events per 10,000 patient-days for the same time periods. Table 3 displays the HA CDI rates for 2010-2012 by *C. difficile* sample testing method. For both reporting years, the HA CDI rate was highest in those LAC hospitals using nucleic acid amplification, including PCR, testing.

Table 1. Number of LAC hospitals, by attributes, 2010-2012.

	2010-2011	2011-2012
LTAC	8	9
Non-LTAC	92	90
Residency program	19	20
No residency program	81	79
ED	77	77
No ED	23	22
Trauma center	15	15
No trauma center	85	84

Table 2. Number of *Clostridium difficile* infections reported to NHSN, by onset type, Los Angeles County, 2010-2012

CDI Type	No. infections, 2010-2011	No. infections, 2011-2012
HA	5574	6058
HO	4332	4684
COHCFA	1242	1374
CO	2942	3416

HA – hospital associated HO – hospital onset CO – community onset
COHCFA – community onset, healthcare facility associated (see text for details)

Figure 1. Median *Clostridium difficile* rates reported to NHSN, by disease onset type, Los Angeles County, 2010-2012

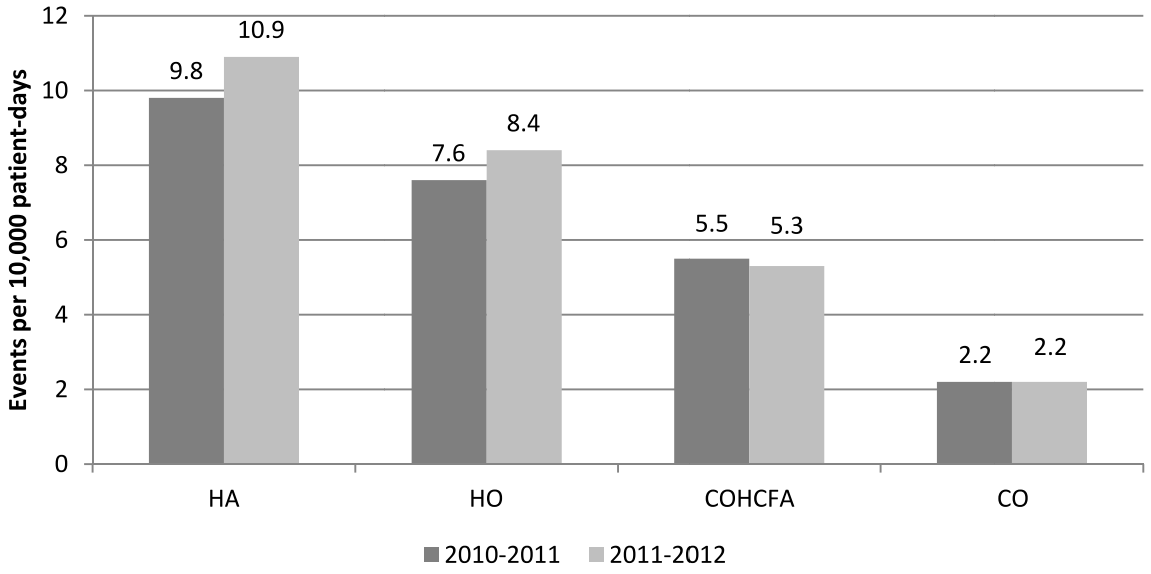


Figure 2. Median hospital-associated *Clostridium difficile* rates by LTAC status, Los Angeles County, 2010-2012

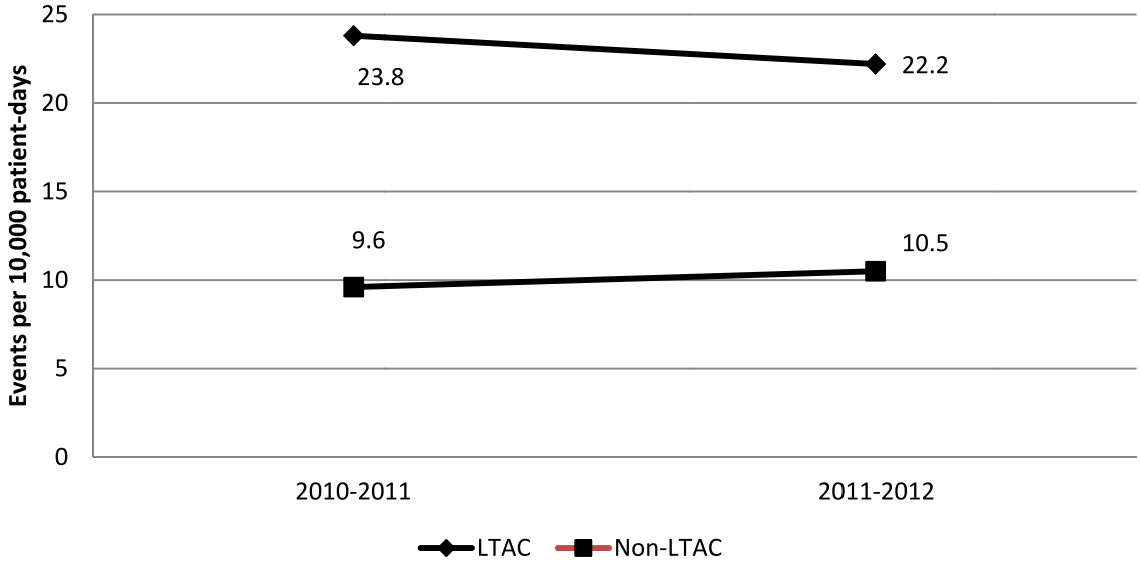


Figure 3. Median hospital-associated *Clostridium difficile* rates by ED status, Los Angeles County, 2010-2012

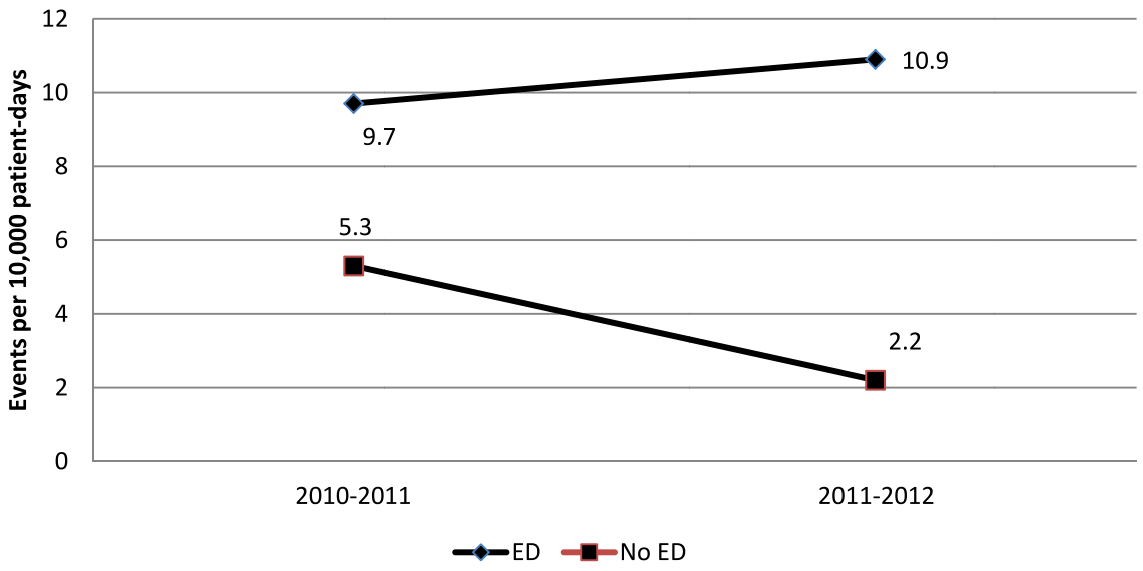
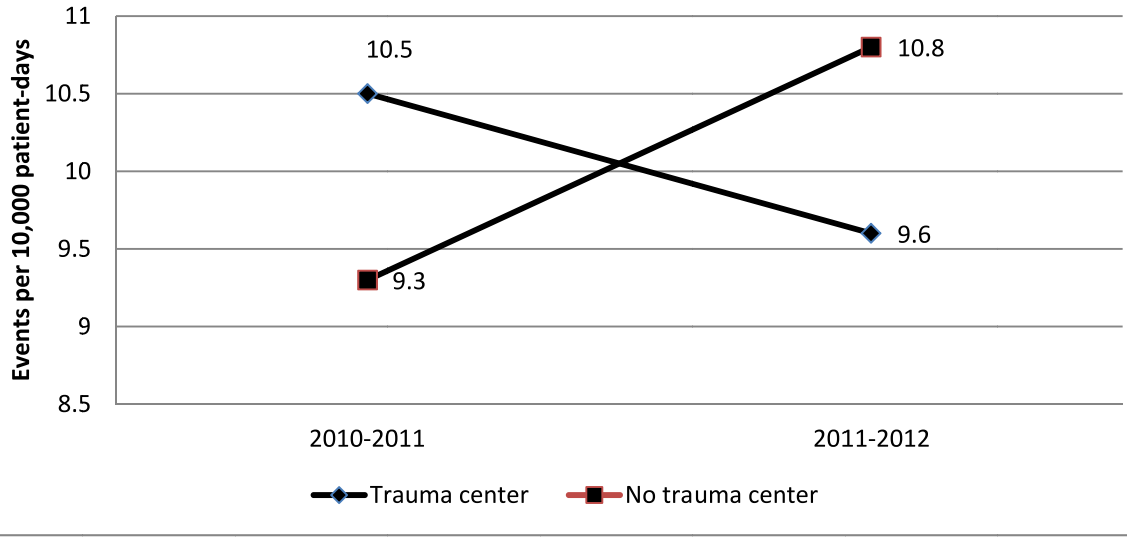


Figure 4. Median hospital-associated *Clostridium difficile* rates by status as a trauma center, Los Angeles County, 2010-2012



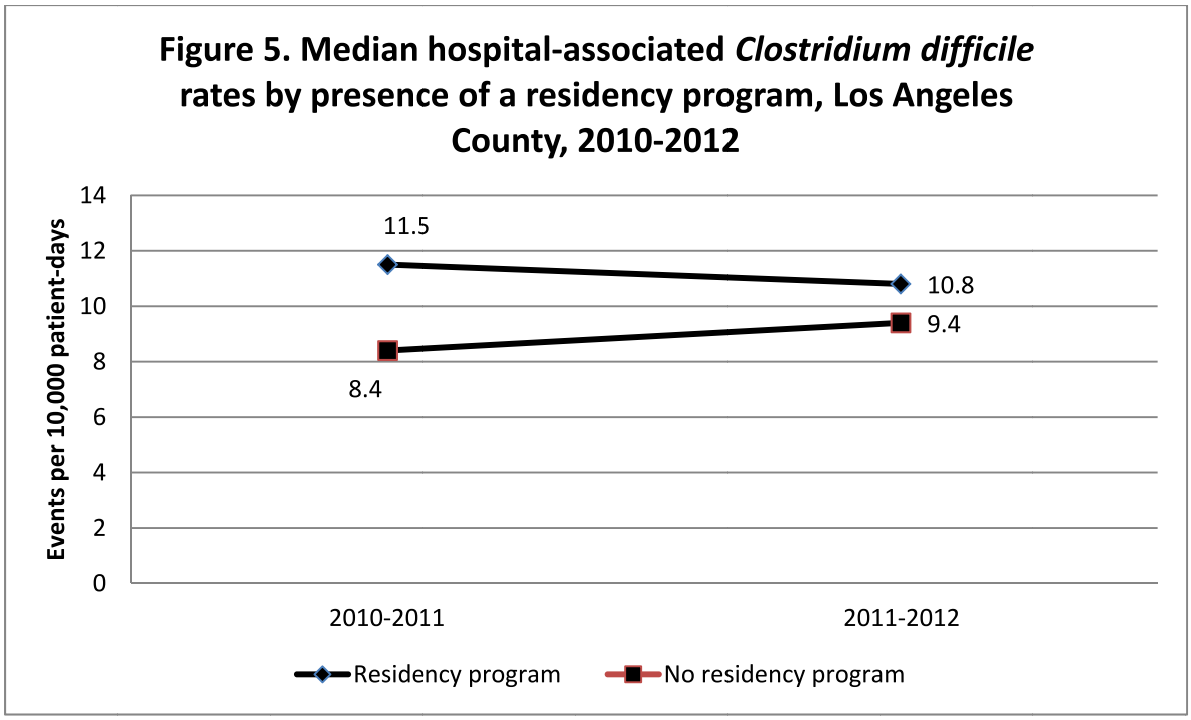


Table 3. Median hospital-associated *Clostridium difficile* rates by sample testing method (per 10,000 patient-days), Los Angeles County, 2010-2012

Year	Testing method					
	Stool Culture	Cytotoxin assay	Enzyme immunoassay for toxin	Nucleic acid amplification	Stool antigen	Other
2010	8.0	6.5	8.9	10.9	8.7	10.5
2011	7.1	8.0	6.6	14.9	7.3	10.9

DISCUSSION

This is the first report of CDI rates in LAC using NHSN data and hospital attributes. The CDI rates in LAC are similar to, yet higher than state and national trends. Compared to the California 2010-2011 state HA rate of 9.4 events per 10,000 patient-days, LAC hospitals reported higher rates in 2010-2011 and 2011-2012 (9.8 and 10.9 events per 10,000 patient-days, respectively). Similarly, the 2010-2011 and 2011-2012 LAC HO rates (7.6 and 8.4 events per 10,000 patient-days, respectively) were higher than both the 2010-2011 state HO rate, 7.0 events per 10,000 patient-days, and the 2010 national HO rate of 7.4 events per 10,000 patient-days.[10,11]

Notably, HA CDI rates were higher in hospitals that had residency programs and in hospitals with an emergency department for both time periods. These findings are in contrast to prior studies on hospital attributes associated with high CDI rates; however, our analyses were specific to NHSN-defined hospital-associated infections, rather than overall rates.[6,7] We removed LTACs from the rate comparison of facilities by presence of a residency program, presence of an emergency department, and status as a trauma center because the rates of HA CDI among LTACs was much higher than general acute care facilities. LTACs had an HA CDI rate of over two fold that of non-LTAC hospitals in LAC. LTACs represent a specific role on the continuum of care, as many patients are transferred to LTACs following stays in critical or intensive care units of general acute care hospitals, before being sent home. CDI rates between LTACs and non-LTACs vary greatly for a number of reasons, including longer average length of stays in

LTACs. In California, the average length of stay for patients in LTACs was over six times longer than non-LTACs.[10] Further, the patient populations are quite different for LTACs and non-LTACs. LTAC patients are generally medically complex, with a higher numbers and severity of comorbidities. LTAC patients are on average, older in age, a risk factor in CDI.[12,13] Targeted interventions for LTAC patient population is needed, as these facilities access services in all aspects of patient care.

Differences in CDI rates by various testing methods have been reported.[14] In some cases, the CDI rate doubled after implementation of polymerase chain reaction (PCR) testing replaced immunoassay methods.[14] Several hospitals reported using more than one testing method, rendering comparisons between the methods difficult. A limitation of this study was that it was not possible to determine if the testing methods changed within a study year or how often multiple tests were employed and used in conjunction with each other.

Collaboration across the continuum of care is imperative in decreasing CDI rates. A regional approach to CDI reduction, including continued surveillance using NHSN and further strengthening LAC DPH relationships with acute care and outpatient facilities, may assist in decreasing rates of this costly and preventable infection.

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SHIGA TOXIN-PRODUCING *ESCHERICHIA COLI* (STEC) IN LOS ANGELES COUNTY, 2006-2011: A COMPARISON OF NON-O157:H7 SEROTYPES WITH SEROTYPE O157:H7

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Roshan Reporter, MD MPH

BACKGROUND

Shiga toxin-producing *Escherichia coli* (STEC) are a group of bacterial pathogens that cause severe illness worldwide. The Centers of Disease Control and Prevention estimates that STEC infections cause more than 265,000 illnesses each year in the United States (US), with more than 3,600 hospitalizations and 30 deaths [Scallan 2011]. Persons with STEC infection often have diarrhea, sometimes bloody, along with abdominal cramps and vomiting. Approximately 5%-10% of cases develop hemolytic-uremic syndrome (HUS), which is associated with high case mortality (3%-7%) [Griffin 2003].

STEC infection can be acquired through contaminated food or water, and through direct contact with infected animals or humans. In 1995, Karch et al. demonstrated that STEC (serotype O157) is shed in the feces of persons with STEC infection long after their symptoms have abated, which indicates the potential for person-to-person transmission of this organism [Karch 1995]. In response to such findings, California mandated reporting of all suspect serotype O157:H7 STEC cases as well as all HUS cases from health care providers and laboratories to their local health department in 1995 [State Report 2009]. To prevent person-to-person spread of STEC in Los Angeles County (LAC), public health follow-up of all confirmed cases is carried out. Follow-up involves source investigation, education, and identification of any case or household contact from a sensitive occupation or situation (SOS) and their removal until cleared of infection.

In 2006, Johnson et al. demonstrated that other STEC serotypes (non-O157:H7) also have the potential to cause considerable morbidity and mortality [Johnson 2006]. Findings like this prompted California to broaden the STEC reporting requirements in 2006 to include serotypes other than O157:H7 (non-O157:H7). Additional studies of non-O157:H7 serotypes by Hedican et al. demonstrated that this group generally causes less severe illness than serotype O157:H7 [Hedican 2009]. However, Nitschke et al. in 2012 [Nitschke 2012] demonstrated that serotype O104:H4 is capable of causing severe illness, comparable to that for O157, with cases excreting STEC organism for a considerable amount of time after symptoms subsided.

Our current study examines trends in STEC cases reported to the Los Angeles County (LAC) Department of Public Health (DPH) over a six year study period. We compared demographics, duration of illness and shedding times of STEC cases by serotype (non-O157:H7 serotypes vs serotype O157:H7).

METHODS

A study period from 2006 to 2011 was selected for this review. A study data set containing epidemiological and laboratory information on all culture confirmed LAC STEC cases was constructed. Cases that were shiga toxin positive but culture negative and culture negative HUS cases were excluded even though these meet the current surveillance definition for a case of STEC. The epidemiological information consisted of case demographics, symptoms and illness duration, SOS status, hospitalization status, and outcome. Information was obtained by public health nurses (PHNs), who interview all reported cases using a standardized case interview form.

The laboratory information included STEC culture and serotype results and date the results were finalized. This information was obtained from the LAC Public Health Laboratory (PHL) data system which contains information on all STEC isolates or broths submitted to PHL for testing. Common STEC serotypes can be identified by the LAC PHL; less common serotypes are sent to the California DPH

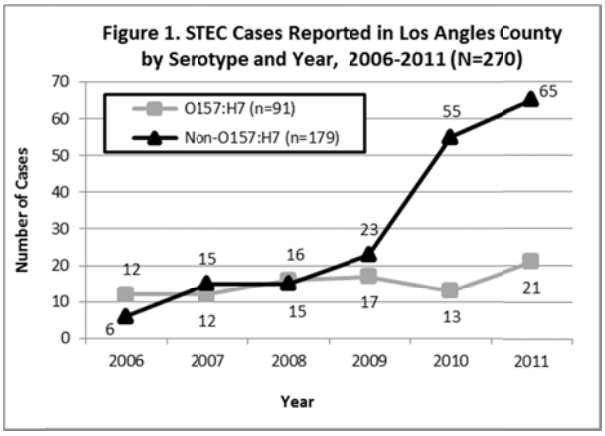
Microbial Diseases Laboratory or to the Centers for Disease Control National Laboratory for identification. Final results are reported back to LAC PHL and recorded into the laboratory data system.

The study data set was used to assess trends in STEC cases, demographics, illness severity and duration of shedding by serotype (non-O157:H7 serotypes vs serotype O157:H7). STEC 0157:NM was included as a non-O157:H7 serotype. Communicability by serotype was assessed by reviewing the following: 1) the number of stool specimens collected from SOS cases until clearance of infection; 2) the median and average time for clearance of SOS cases, defined as the time from date of collection of the first positive test to date of collection on the first of two negative tests. Clearance of infection for SOS cases was defined as having two consecutive negative stool cultures collected at least 24 hours apart.
Statistical analyses were conducted using Statistical Analysis Software (SAS®) version 9.2. Categorical variables were analyzed using Fisher's exact test. Continuous variables were analyzed using a Student's t-test (data distribution that was normal) and Kruskal-Wallis test (data distribution that was not normal). Only two-sided p-values ≥0.05 were considered to be statistically significant.

RESULTS

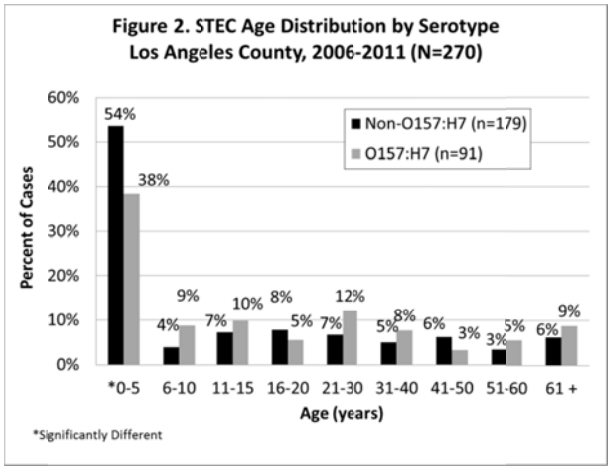
Trend in STEC Cases

From 2006 to 2011 there were a total of 270 laboratory confirmed STEC cases reported to the LAC DPH. Reported cases followed an upward trend over the study period; cases increased an average of 13.5 cases per year, from 18 cases in 2006 to 86 cases in 2011. The crude STEC incident rate per million population over the study period was 4.8, increasing from 1.9 in 2006 to 9.3 in 2011 (data not shown). Non-O157:H7 cases comprised 66% of reported STEC cases over the study period (n=179). Non-O157:H7 cases increased every year of the study period, from six cases in 2006 to 65 cases in 2011, with the increase more pronounced after 2009 (Figure 1). Reports of O157:H7 cases remained fairly consistent over the study period, ranging from 12 to 21 cases per year (median 14.5) with no apparent temporal trend.



Demographics

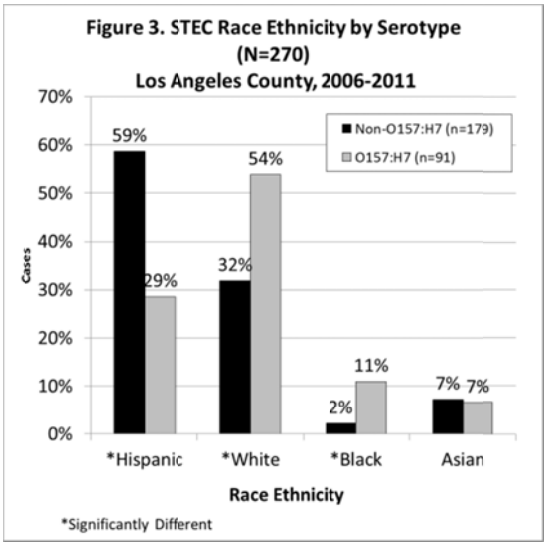
The median age of reported STEC cases was 6.5 years (range 6 months to 95 years). The median age of non-O157:H7 cases was younger than that identified among O157:H7 cases (3 vs 14 years, p<0.05). In addition, a larger proportion of non-O157:H7 cases were under the age of five years as compared to O157:H7 cases (54% vs 38%, p<0.05) (Figure 2). There were some differences in proportion by serotype for other age groups as well, but the numbers of cases involved were much smaller.



STEC cases reported over the study period in LAC were primarly Hispanic (49%), followed by white (39%), Asian (7%) and black (5%). Whites had the highest crude incidence rate over the study period (6.3), followed by Hispanics (4.8), blacks (2.8) and Asians (2.5) per million population. However, whites and Hispanics had equivalent incident rates in the last year surveyed (both at 10.9 per million popuation in 2011).

Non-O157:H7 cases were more likely to be Hispanic (59% vs 29%, p<0.05) and less likely to be white (32% vs 54%, p<0.05) or black (2% vs 11%, p<0.05) as compared to O157:H7 cases (Figure 3). The

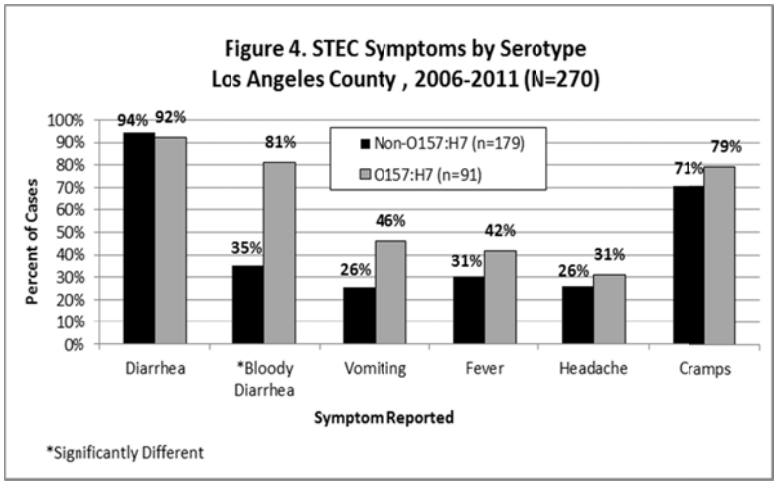
crude incident rate for non-O157:H7 over the study period was similar for Hispanics (3.9) and whites (3.4) per million population, but the rate for Hispanics surpassed whites in the last year surveyed (9.3 vs 6.4, 2011).



STEC cases occurring after 2009 (n=154) were more likely to be Hispanic than cases reported from 2006 to 2009 (58% vs 35%, p<0.05). Cases occurring in the under five year age group were more likely to be Hispanic than those age five years and older (73% vs 26%, p< 0.05).

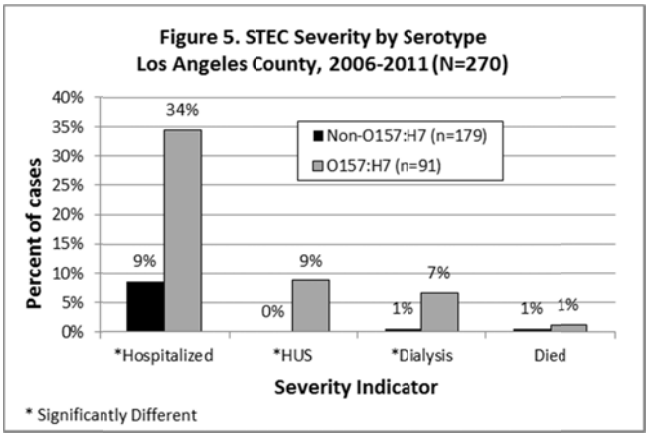
Symptoms and Duration

Symptoms reported by STEC cases in LAC over the study period included diarrhea (91%), bloody diarrhea (50%), cramps (69%), vomiting (32%), fever (33%) and headache (23%). Non-O157:H7 cases were less likely to report bloody diarrhea than O157:H7 cases (35% vs 81%, p<0.05) (Figure 4). Other symptoms such as vomiting, fever, headache and cramps were reported by O157:H7 cases; however, these differences were not statistically significant. The average duration of illness reported by non-O157:H7 cases was comparable to that reported by O157:H7 cases (10 vs 9 days, p= 0.22).



Illness Severity

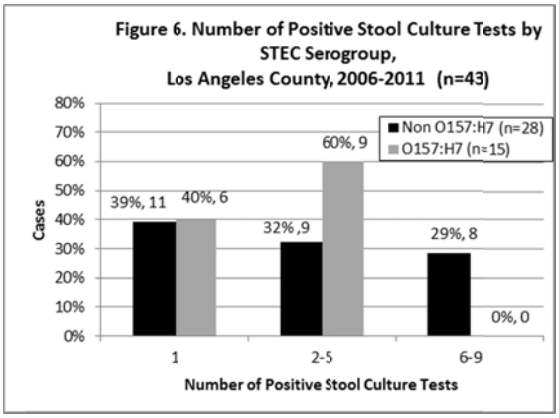
Seventeen-percent of reported STEC cases were hospitalized, with 3% of STEC cases resulting in HUS and 3% requiring dialysis. Two deaths were reported (1%). Non-O157:H7 cases were less likely to be hospitalized (9% vs 34%, p<0.05), less likely to result in HUS (0% vs 9%, p<0.05) and less likely to require a dialysis procedure (1% vs 7%, p<0.05) (Figure 5). The case mortality rate appeared comparable, with one death in each group. The non-O157:H7 case that died was a 66-year-old Hispanic, with other underlying health conditions, infected with serotype O118:H16. The O157:H7 case that died was a 57 year old White male with history of hypertension who developed HUS during the course of his infection.



Shedding Time

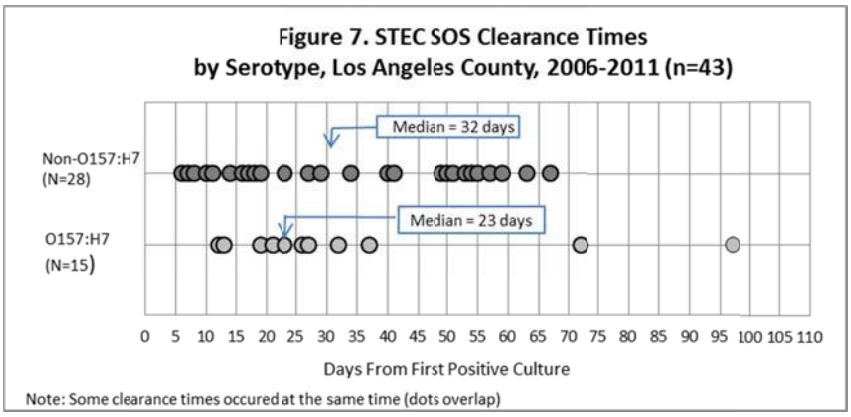
Public health follow-up and clearance testing was performed on 43 STEC cases in LAC over the study period (16%). The mean age for cases requiring clearance (7.9 years) was younger than those that did not require clearance (19.7 years). Forty-percent of STEC cases that required clearance (n=17) tested

negative on the first set of clearance specimens collected. However, 19% of cases (n=8) required more than six specimens to be collected before clearance of infection was validated (range 6-9 specimens).
Of the 43 STEC cases requiring clearance, 28 were a non-O157:H7 serotype and 15 were serotype O157:H7. The percent of STEC cases that tested negative on the first set of clearance specimens collected did not differ by serotype (40% for non-O157:H7 and 39% of O157:H7) (Figure 6). However, non-O157:H7 cases made up the entirety of the cases requiring more than six specimens to be collected before clearance of infection was validated (29% of non-O157:H7 vs 0% for O157:H7). On average, more specimens were required to be collected for clearance of a non-O157:H7 case (average 5.8 specimens) than for clearance of an O157:H7 case (average 4.8 specimens); however, the results were not statistically significant (p=0.15).



The median number of days to clear a STEC case was 26 days (range 6 to 97 days, average 32 days). Non-O157:H7 cases have a median clearance time of 32 days, with the distribution of times appearing very bimodal; a cluster of times around 15 days and another around 53 days (Figure 7). The median clearance time for O157:H7 cases was 23 days (range 11 to 95 days, average 26), with the distribution of times skewed toward a shorter clearance time.

STEC cases under the age of ten years had a longer median clearance time (33 days, n=34) than cases ten years of age and older (27 days, n=9). Non-O157:H7 cases under the age of ten years had an even longer clearance time (37 days, n=24).



Risk Factors

PHNs interviewed all STEC cases to obtain risk factors such as travel history and food history for the seven days prior to illness. Risk factors where at least 5% of cases responded "yes" (Table 1). Of interest, non-O157:H7 cases were more likely to have traveled outside of the US during their incubation period than O157:H7 cases (13% vs 1%, p<0.05). Travel destinations for the non-O157:H7 cases (n=23) included: Mexico (n=12), Latin America (n=7), and Europe or Asia (n=4). Other risk factors, such as recent farm exposure, were only reported by 5% of STEC cases, with little difference by serotype.

There was no significant difference observed in selected food histories by serotype (Table 1). Forty-three percent of cases report consuming ground beef: 38% for non-O157:H7 serotypes and 43% for serotype O157:H7 (p=0.12). Forty-one percent of cases reported eating lettuce with little difference by serotype. STEC cases also reported consuming steak (25%) and dried meats (7%), with little difference by serotype. Other food items reported by fewer than 5%

Table 1. Risk Factors for STEC Cases by Serotype

		Total		Non-O157:H7		O157:H7		Comparison
	N	n	%	n	%	n	%	p-value
All	270	270	100%	179	100%	91	100%	-
Travel History								
Travel outside of U.S.	254	14	6%	23	**13%**	1	**1%**	**<0.05**
Visit a Farm	261	12	5%	6	4%	6	7%	0.41
Food History								
Ground Beef	251	109	43%	65	38%	44	49%	0.12
Undercooked	241	17	7%	8	5%	9	10%	0.26
Lettuce	257	106	41%	66	39%	40	45%	0.38
Steak	248	61	25%	40	24%	21	24%	0.84
Dried Meats	229	17	7%	8	5%	9	10%	0.18

of cases included raw steak, raw milk, berries, and alfalfa sprouts.

Non-O157:H7 Serotypes

The non-O157:H7 organisms identified over the study period are comprised of 36 different serotypes. The more commonly isolated serotypes include O103:H2 (18%, n=32), O111:NM (18%, n=32) and O26:H11 (16%, n=29) (Table 2). One non-O157:H7 case was identified with two different STEC serotypes. This case was exposed while traveling in Mexico and was confirmed with O4:H11 and O186 (flagellar antigen undetermined). There was one case with serotype O1O4:H4 (a serotype associated with high morbidity) identified during the study period with exposure occurring while traveling in Russia. This case was not considered part of the large outbreak of O1O4:H4 in Germany in 2011.

Table 2. Frequency of Non-O157:H7 STEC Serotypes (N=179) Los Angeles County, 2006-2011

	n	%
O103:H2	32	18%
O111:NM	32	18%
O26:H11	29	16%
O157:NM	12	7%
O118:H16	9	5%
O26:NM	7	4%
O69:H11	3	2%
O103:NM	3	2%
Other Non-O157:H7 serotype	34	13%
Other Non-O157:H7 incomplete serotype	18	7%

DISCUSSION

The recent increase in non-O157:H7 reports in LAC is believed to be due to several factors, which include: 1) increased testing by reference laboratories with the enzyme immunoassay (EIA) used for the detection of shiga toxin; 2) improved compliance with reporting by both providers and laboratories, especially in light of increased electronic laboratory reporting in LAC during the study period; and 3) possibly higher incidence of non-O157:H7 cases.

The overall incidence rate for reported STEC cases in LAC identified in this study (4.8 per million population) is slightly lower than that identified in a recent STEC report for California cases occurring from 2001 through 2008 (7 per million population) [State Report 2009]. Whites had the highest incidence rate in LAC, followed by Hispanics, but rates were equivalent for both whites and Hispanics in the last year surveyed.

The demographics of LAC STEC cases differ by serotype, with a higher prevalence of younger Hispanics identified among non-O157:H7 serotypes as compared to serotype O157:H7. The incidence rates for non-O157:H7 appear comparable between whites and Hispanics over the study period; however, the crude incidence rate for Hispanics surpassed whites in the last year surveyed. Possible explanations for this demographic difference by serotype include consumption of a contaminated food item imported from Latin America or other exposure for this group that travels more frequently to Central and South America. Our study also indicates that non-O157:H7 serotypes in LAC cause less severe illness than serotype O157:H7, involving less severe symptoms and fewer hospitalizations. This finding appears consistent with other studies comparing STEC serotypes [Hedican 2009]. There was one death reported among non-O157:H7 serotypes and one among serotype O157:H7, but these small numbers make it difficult to generalize this finding. Our study did not find any significant difference in the duration of symptoms by serotypes.

A majority of the non-O157:H7 serotypes (53%) identified in this LAC study were serotypes O103, 0111, and O26. These serotypes are among the nine most common serotypes identified in the US [Johnson 2009]. One LAC serotype not seen on this national list is serotype 0118:H16, which was identified in 5% of non-O157:H7 cases in LAC and associated with one death. This serotype is more commonly identified in Spain, Germany and Belgium.

Our review of STEC cases requiring public health clearance indicates that the shedding time for persons infected with non-O157:H7 serotypes are comparable to that for persons infected with serotype O157:H7. Non-O157:H7 cases requiring clearance actually required more stool specimens to be collected, on average, before clearance of infection was verified, and they were identified with slightly longer clearance times than O157:H7 cases. The average clearance time for STEC cases identified in our study of 32 days

is comparable to the average shedding time of 34 days identified for serotype O104:H4 (not treated with antibiotics) [Nitschke 2012].
However, Karch et al. [Karch 1996] identified a median shedding duration of 13 days for children under the age of ten years, with O157:FAU (flagellar antigen unspecified) infection having diarrhea or hemorrhagic colitis and 21 days in cases that developed HUS. In comparison, our study identified a longer median shedding time for all STEC cases (26 days), as well as those age under ten years of age (33 days); 37 days for non-O157:H7 cases. Karch also found that 68% of O157:FAU cases had cleared infection (three consecutive negative stools) after the first positive culture, which is a much higher proportion than that identified among our study population (40%, two consecutive negative stools). The reason for this difference is unclear, but it may reflect improved testing capabilities of laboratories to detect fewer organisms. STEC cases under the age of ten years in our study had a longer median shedding time than those older than 10 years, which is consistent with other studies.

In comparing STEC shedding times to other potentially foodborne pathogens that require public health follow-up, Bushwald et al. found that the median duration for non-typhi salmonella excretion was approximately five weeks, which is slightly longer than the median clearance time of 26 days identified in our study of STEC cases [Bushwald 1984].

LIMITATIONS

The STEC cases reported to LAC DPH and utilized for this analysis may not be representative of all STEC infections that actually occurred in LAC. For example, shiga toxin positive cases that were not culture confirmed were not analyzed here. Some STEC cases may not be reported, such as milder cases that do not seek medical attention. Scallan et al. estimate that only one in 26 cases of serotype O157 are reported to the public health department and only one in 107 cases of non-O157 are reported [Scallan 2011]. Thus, the results of our study may underestimate the burden of STEC in LAC and may overestimate the severity of illness. Also, the findings of this review may not be generalized to other regions of California, other states in the US or regions of the world where the distribution of non-O157:H7 serotypes may differ from that identified in LAC.

STEC cases requiring public health clearance are likely to be associated with retail food preparation or daycare and may be of lower economic status. This must be kept in mind when interpreting the shedding time results and generalizing to all STEC cases reported, as well as all STEC cases occurring in the county.

The non-O157:H7 serotypes grouped for this analysis are quite varied, and some may argue that it is not proper to place all non-O157:H7 serotypes into one category for analysis. There may be a few non-O157:H7 serotypes that cause severe illness, such as O104:H4, but are lost in the vast majority of non-O157:H7 serotypes that appear to be less severe than serotype 0157:H7.

STEC 0157:NM was included as a non-O157:H7 serotype. This serotype accounted for 12 of the 179 non-O157:H7 cases (7%). Some might argue that the serotype stratification should be between O157 and non-O157; however, this would probably not change the results of this study significantly.

Using clearance times as a proxy for shedding times may lead to biased estimates. Cases may have been shedding the bacteria days before they first tested positive, which would make our clearance time calculations shorter than the actual shedding time by perhaps a few days. In addition, cases may cease shedding the bacteria days before they are actually tested and cleared of infection, which may make our clearance time calculations longer than the actual shedding time.

The use of antibiotics by STEC cases may have influenced the shedding times reported in this study. Two of the non-O157:H7 cases that required public health follow-up (7%) reported taking antibiotics. None of the O157:H7 cases reported receiving antibiotic treatment.

The epidemiological form used during the study period did not specifically ask for travel history. However, this information was usually obtained during the course of reviewing any exposures within the seven day

prior to onset of illness. But it is possible that some responses to travel questions were not recorded, which would underestimate the number of cases that actually did travel. The updated STEC epidemiological form specifically asks about travel history.

CONCLUSION

The results of this study suggest that non-O157:H7 serotypes in LAC are more likely to occur among young Hispanics than serotype O157:H7. Non-O157:H7 serotypes appear to cause less severe illness than O157:H7; however, the morbidity of these serotypes was still found to be appreciable. Non-O157:H7 serotypes also appear to be just as communicable as O157:H7, with similar clearance times and number of stools needed for clearance. These results indicate that public health control measures, including clearance of SOS cases, are necessary for all for STEC cases, regardless of STEC serotype.

ACKNOWLEDGEMENTS

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VARICELLA SURVEILLANCE IN THE ANTELOPE VALLEY, 2006-2011

Karen Kuguru, MPA and Rachel Civen, MD, MPH

BACKGROUND

In September 1994, the Los Angeles County Department of Public Health (DPH) entered into a cooperative agreement with the Centers for Disease Control and Prevention (CDC) to establish active surveillance for varicella in Antelope Valley (AV), California. The active surveillance project became known as Varicella Active Surveillance Project (VASP). Information on disease incidence, clinical presentation and varicella vaccine coverage levels by age group and the impact of increasing vaccine coverage has been collected since 1995.

From 1995 to 2000, VASP demonstrated that varicella incidence declined by 71% with the successful implementation of the childhood varicella vaccination program recommending routine varicella vaccination between 12-18 months of age (1). Starting in 2001, VASP data showed that varicella cases and outbreaks involving previously vaccinated varicella cases or "breakthrough" varicella were increasing (2,3). By comparing contact registries of vaccinated and unvaccinated varicella cases and secondary cases within households, VASP data demonstrated that varicella zoster virus (VZV) could be transmitted by varicella cases with a previous vaccination. However, breakthrough varicella cases were less transmissible than unvaccinated cases by approximately 50% (4). In 2006, the Advisory Committee on Immunization Practices (ACIP) and American Academy of Pediatrics updated the 1996 and 1999 recommendations to implement a routine 2-dose varicella vaccination program for children, with the first dose administered at 12-15 months and the second dose at 4-6 years or a second dose catch-up varicella vaccination for children, adolescents, and adults who previously had received one dose (5). In the fall of 2012, the AV VASP ended. The 2011 surveillance report represents the 16th and final year of varicella active surveillance in AV. This report summarizes five years of varicella surveillance data since the second dose recommendation in 2006.

SURVEILLANCE METHODS

Nearly 100% of all identified reporting sites participated in the surveillance project, including public and private schools and day care centers with enrollments of 12 or more children; public health clinics, hospitals, emergency rooms, private practice physicians and health maintenance organizations offices; correctional facilities; and miscellaneous others likely to identify and report cases of varicella. All sites submitted varicella surveillance logs to VASP on a biweekly basis. Electronic reporting was completed by two health maintenance organizations (HMO) on a weekly basis and one acute care facility on a monthly basis using diagnostic codes for varicella. Forty-five vaccine providers submitted varicella vaccine doses administered and age of recipient on a monthly basis. Additionally, Merck, the manufacturer of varicella vaccines Varivax® and ProQuad®, reported the total doses of varicella vaccines sold to healthcare providers in the AV.

Case Definitions:

A case of varicella was defined as illness with acute onset of a diffuse papulovesicular rash without other known cause that was diagnosed or reported by a licensed healthcare provider, school nurse, or parent. VASP project staff completed case reports by interviewing the parent or guardian of varicella cases <18 years old or interviewed the case himself if ≥18 years old; if interview was not obtained, a medical chart review was completed. A *verified varicella case* met the above case definition, had a completed case report, and resided in the AV. A *probable varicella case* did not have a completed case report either because there was no medical record or an interview could not be completed. Probable cases were excluded from the analysis.

A *breakthrough varicella case* was defined as a verified varicella case with a documented varicella vaccine at least six months prior to disease onset. A *varicella outbreak* was defined as five or more verified varicella cases within one incubation period (21 days) linked to a common setting, such as a school.

Receipt of varicella vaccine was confirmed in one of three ways: 1) VASP staff obtained immunization records during the telephone interview, 2) medical office staff provided vaccine records for suspect varicella cases, or 3) the school the child attended provided vaccination documentation. If varicella vaccination could not be documented as stated, parental recall was utilized. Susceptible household contacts of varicella cases were re-interviewed four weeks after the initial contact to identify additional cases.

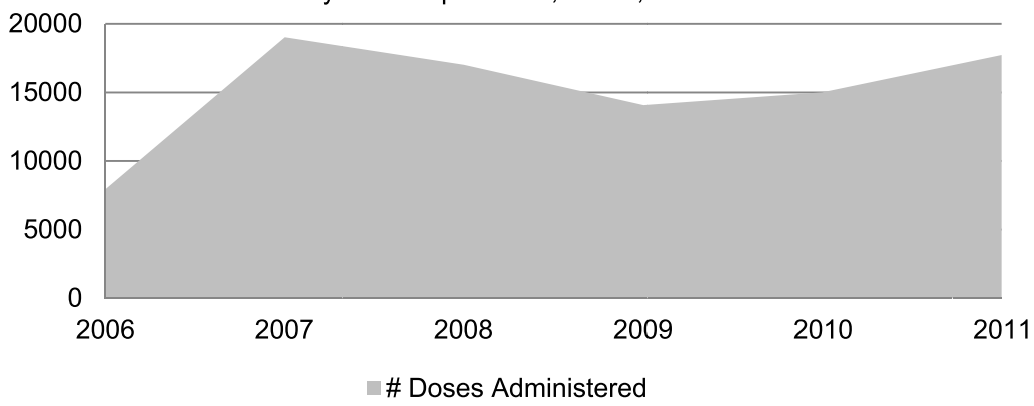
Skin scrapings for laboratory confirmation were obtained by VASP staff or medical providers on a portion of suspected varicella cases. Polymerase chain reaction (PCR)-based testing was completed at the National Varicella Zoster Virus Laboratory in Atlanta, Georgia (6).

From 1995 to 2002, varicella data were entered into a Turbo Pascal® based database designed by project staff; beginning in 2003, all data were entered into Microsoft Access® and data analysis was performed using SAS®. To calculate incidence rates, verified varicella cases were used in the numerator and census estimates for AV stratified by age and race/ethnicity were used as denominators. For each surveillance year, completeness of varicella reporting was estimated using a two-source capture-recapture method. Aggressive manual and computer verification of data was used to ensure data quality.

RESULTS

Varicella vaccine doses administered (*Varivax*® and *ProQuad*®) were obtained from 45 vaccine providers in AV. In 2011, the total number of varicella vaccine doses administered by surveillance sites increased 18% with 17,729 and 15,004 doses reported in 2011 and 2010, respectively. The total doses in 2011 represent an increase of 123% from the 7,937 doses reported in 2006 (Figure 1).

Figure 1. Total number of varicella vaccine doses administered by Antelope Valley vaccine providers, VASP, 2006-2011

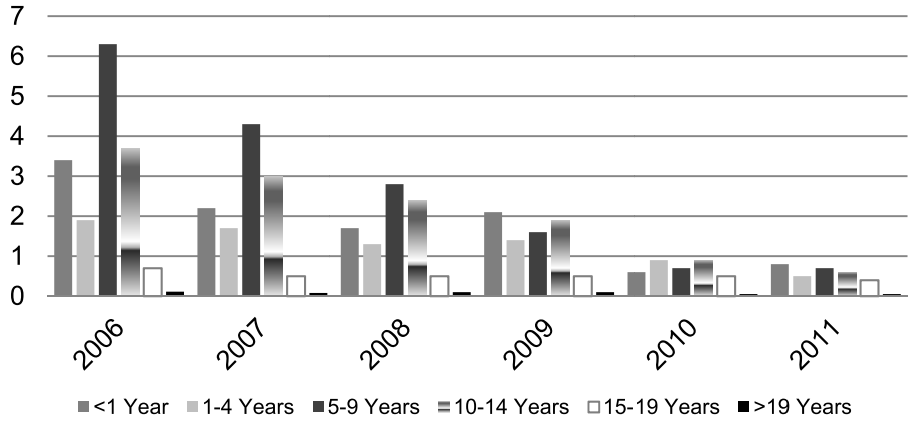


From 2006 to 2011, vaccine doses administered in the AV increased across most age-groups. Vaccine doses administered increased in the following age groups: 12 to 24 months of age, from 4165 to 4193, 3-4 years of age from 643 to 4194, 5-9 years of age from 387 to 1063, 10-12 year olds from 760 to 3782, and in adolescents 13-19 years of age from 471 to 3309 doses. Varicella vaccine doses administered decreased from 515 to 447 doses among two year olds and also in persons >19 years old from 275 to 41 doses during the respective years (data not shown).

Since the introduction of the two dose varicella vaccine regimen, the overall varicella incidence rate for the AV continued to decline from 1.1 to 0.2 cases per 1,000 population in 2006 and 2011, respectively. In 2011, the highest varicella incidence was among infants <1 year old (who are ineligible for vaccination) with 0.8 cases per 1,000, followed by those 5-9 years old, 0.7 cases per 1,000. Most age-groups of children showed declines in incidence from 2006-2011, including infants <1 year of age with rates declining from 3.2 to 0.8 cases per 1,000, in respective years. The most significant declines was in the 5-9 year old age group with incidence declining from 6.2 to 0.8 cases per 1000 in 2006 and 2011, respectively (Figure 2).

From 2006 through 2010, outbreaks decreased from 11 to 1 in the respective years. There were no outbreaks reported in 2011. In 2010, only one outbreak was identified compared to two and four in 2009 and 2008, respectively. In 2010, the proportion of outbreak related cases (ORC) that were classified as breakthrough was 100% compared to 50% of cases in 2009 and 67% of cases in 2008 (data not shown).

Figure 2. Varicella cases by incidence rates and age-groups, Antelope Valley, CA, 2006 to 2011



The total number of varicella cases during the study period was 1,260 ranging from 395 in 2006 to 79 in 2011. The proportion of these that were breakthrough (BT) varicella cases steadily increased since 2000, from 16.8% of cases in 2000 to a high of 66.4% of cases in 2008; in 2011, the proportion of BT cases was 61%. Since 2006, 106 BT cases who received two doses of varicella vaccine were documented (Table 1). Laboratory testing was completed on 15 (17%) 2-dose BT cases; five cases were PCR-positive with wild type VZV. The annual proportion of breakthrough cases with two doses of vaccine rose from just 1% in 2006 to 56% in 2011.

Table 1. Varicella Breakthrough Cases and vaccination status Antelope Valley, VASP, 2006-2011

Age at Breakthrough (years)	2006 N=235	2007 N=175	2008 N=144	2009 N=108	2010 N=57	2011 N=48
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
1-4	26 (11.1)	25 (14.3)	19 (13.2)	28 (25.9)	12 (21.1)	9 (18.8)
5-9	139 (59.1)	94 (53.7)	65 (45.1)	36 (33.3)	18 (31.6)	19 (39.6)
10-14	66 (28.1)	55 (31.4)	58 (40.3)	42 (38.9)	22 (38.6)	13 (27.1)
15-19	3 (1.3)	1 (0.6)	2 (1.4)	2 (1.9)	5 (8.8)	6 (12.5)
>20	1 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.0)
1st Dose Vaccine Only	233 (99.0)	165 (94.3)	126 (87.5)	78 (72.0)	38 (66.7)	21 (43.8)
Both 1st and 2nd Dose	2 (1.0)	10 (5.7)	18 (12.5)	30 (28.0)	19 (33.3)	27 (56.3)

The clinical presentation of varicella continued to be mild between 2006 and 2011. In 2006 and 2011, 60% and 50% of varicella cases reported < 50 lesions during respective years. In 2006, only 3% of cases reported >500 lesions, whereas no cases were documented with this many lesions in 2011. Since 2008, there have been no reports of hospitalized varicella cases. In addition to decreasing clinical severity, work and school absenteeism have declined by over 90% from 2220 days to only 238 days in 2006 and 2011, respectively.

Information on the likely exposure source for varicella cases has been tracked since 1996. An increasing proportion of varicella cases could not identify a source of infection, increasing from 9% in 1996 to16% in 2006 and 77% in 2011 (Table 2). Reports of school exposure declined from 25% of verified cases in 2006 to no reports of school exposures in 2011. The proportion of cases reporting household exposure to varicella zoster virus (VZV) (either another varicella case or a herpes zoster [HZ] case) has decreased from 42% in

1996 to 29% and 18% in 2006 and 2011, respectively. History of recent exposure to a HZ case within the varicella case's household ranged from 3% to 5% of all exposures since 2003. HZ will most likely continue to be an important source of exposure for VZV, which could possibly prevent the elimination of varicella despite increases in childhood varicella vaccination coverage.

Table 2. Suspected Source of Varicella Infection by Year, Antelope Valley, VASP, 2006-2011

Suspected Source of Infection	2006 N (%)	2007 N (%)	2008 N (%)	2009 N (%)	2010 N (%)	2011 N (%)
Exposure to a varicella case						
Household	64(16.2)	31(10.5)	23(10.6)	19(10.9)	12(12.0)	10(12.7)
School	98(24.8)	91(30.8)	32(14.8)	6(3.4)	11(11.0)	0(0.0)
Church/ Neighborhood	15(3.8)	5(1.8)	3(1.3)	1(0.6)	0(0.0)	0(0.0)
Childcare	2(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Other	14(3.5)	6(2.0)	17(7.9)	1(0.6)	2(2.0)	4(5.1)
Exposure to a herpes zoster case						
Household	16(4.0)	6(2.0)	4(1.9)	9(5.1)	3(3.0)	4(5.1)
School	0(0.0)	0(0.0)	0(0.0	0(0.0)	0(0.0)	0(0.0)
Church/ Neighborhood	2(0.5)	0(0.0)	0(0.0	0(0.0	0(0.0)	0(0.0)
Childcare	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Other	0(0.0)	6(2.0)	1(0.5)	2(1.0)	0(0.0)	0(0.0)
Unknown Exposure	184(46.5)	150(50.9)	136(63.0)	137(78.4)	72(72.0)	61(77.1)
Total	395(100)	295(100)	216(100)	175(100)	100(100)	79(100)

CONCLUSIONS

Declines in varicella incidence, clinical severity, and outbreaks have continued since the adoption of a routine two-dose varicella vaccine program. Incidence declines were notable in all age groups, even in those who were not eligible or recommended for varicella vaccination. Success of the two-dose program is also supported by the doubling of the number of varicella vaccine doses provided by AV healthcare providers from 2006 to 2011. The trend of increasing proportion of documented BT varicella cases should continue with high rates of one and two dose vaccination coverage and declining community transmission of varicella. In 2011, over 60 % of varicella cases had a history of previous vaccination and more than half of these cases had two verified varicella vaccines. It is unclear the role that varicella cases with a history of two dose vaccine will have in sustaining community transmission of varicella. It is clear that efforts to promote catch-up vaccination among older susceptible individuals should continue. Although the AV VASP closed in September 2012, national two-dose varicella vaccine coverage and case based state surveillance data are needed to more fully understand the impact of routine two-dose varicella vaccine.

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CHARACTERISTICS BETWEEN PEAK AND OFF-PEAK WEST NILE VIRUS SURVEILLANCE LOS ANGELES COUNTY, 2004-2012

Van Ngo, MPH and Rachel Civen, MD, MPH

BACKGROUND

Since West Nile virus (WNV) was first detected in North America in New York City in 1999, the infection has spread throughout the continental United States (US), and is now the leading cause of arboviral encephalitis in the US. WNV is a flavivirus closely related to the viruses that cause Japanese encephalitis and Saint Louis encephalitis. Usually transmitted by mosquitoes between bird reservoir hosts, humans are incidentally infected with the virus when bitten by an infected mosquito. Additional, but less frequent, documented routes of transmission include transplantation of WNV-infected organs, blood transfusions, transplacental (mother-to-child) transmission, occupational exposure, and breast milk (1,2).

Most infected persons are asymptomatic but about 20% will develop WN fever with symptoms that include fever, headache, rash, muscle weakness, fatigue, nausea and vomiting, and occasionally lymph node swelling. WN fever symptoms can last from a few days to months. Less than 1% will develop more severe illness, manifesting as WNV neuro-invasive disease (NID), including meningitis, encephalitis, and acute flaccid paralysis. WNV-associated meningitis usually involves fever, headache, and stiff neck, and has a good prognosis. WNV-associated encephalitis is commonly associated with fever, altered mental status, headache, and seizures, and can be fatal. It usually necessitates a high level of specialized medical care and is associated with prolonged, even permanent, disability (1,2).

Los Angeles County (LAC) first detected WNV-infection in dead birds, mosquitoes, and sentinel chicken flocks in 2003 and documented its first human case later that year. In 2004, LAC reported 309 human cases and California (CA) reported the greatest number of any state, 779 cases; 2539 confirmed human WNV cases were reported nationally to the Centers for Disease Control and Prevention (CDC). Since then, LAC has documented WNV infection every year in mosquitoes, birds, humans, and other mammals (i.e. horses, squirrels). Surveillance of human WNV infections documented three peaks of activity occurring every four years, once in 2004, then in 2008 (n=170), and most recently in 2012 (n=174). In other non-peak years, human cases have ranged from four in 2010 to 63 in 2011 and included the two years with the lowest case counts, 2006 and 2010, with four cases each. The objective of this report is to compare the demographic and clinical characteristics as well as the climatic variations between peak human WNV activity (2004, 2008, and 2012) with those in years of low WNV activity.

METHODS

All suspect human cases of WNV disease and asymptomatic blood donors are reportable to the LAC Department of Public Health (DPH) within one working day. Cases included in this analysis comprised of both symptomatic infections and asymptomatic blood donors who were residents of LAC, and had onset of illness or a date of blood donation between January 1, 2004 and December 31, 2012. Symptomatic human cases were defined as those who had diagnosed febrile illness or NID in addition to supportive laboratory evidence of WNV infection. Patients with febrile symptoms alone were classified with WN fever. Patients with a clinical diagnosis of meningitis, encephalitis, or acute flaccid paralysis were classified with NID. Supportive laboratory evidence of WNV infection included a single acute cerebrospinal fluid (CSF) or serum serology that was positive for WNV IgM by capture enzyme-linked immunosorbent assay (ELISA) or immuno-fluorescent antibody (IFA) slide test kit. Asymptomatic donors had a single reactive nucleic acid-amplification test (NAT) with a signal-to-cutoff score of equal or greater than 17 (3).

Peak years were defined as the three surveillance years in which LAC documented the highest number of confirmed cases— 2004, 2008, and 2012. Off-peak years were defined as the remaining six surveillance years 2005-2007 and 2009-2011. Public health staff completed a standardized WNV case report form by

reviewing medical records and by conducting a telephone interview with the case or family member. The reporting form included variables for age, gender, residence, race/ethnicity, hospitalization, outcome, and major diagnoses. Climactic data (maximum monthly temperature and total monthly precipitation) were obtained from measurements documented at a weather station located in Pomona, CA, a city in the San Gabriel Valley area (4). Means and frequencies were calculated using SAS version 9.3. Mean climactic values were evaluated by the student t-test.

RESULTS

Eight hundred forty six human cases of WNV were documented between 2004 and 2012 in LAC. Six hundred fifty two (77%) of WNV cases occurred during the peak years of 2004, 2008, and 2012 compared to 194 cases in off-peak years. WNV seasons were longer in peak versus off-peak years. In peak years, cases occurred from June through November with a mean duration of 21.7 weeks compared to a mean of 12.8 weeks in off-peak years. Off- peak seasons lasted from June through October, with the exception of 2009, which began in May and ended in September. The latest documented WNV case in LAC had an onset of November 25 (MMWR Week 48), occurring in 2012. The weekly number of cases occurring during the most active periods of peak years was as high as 40 per week. In off-peak years, the weekly number of cases did not reach over 10 per week, with the exception of 2011 when 12 and 13 cases occurred during MMWR Weeks 36 and 37, respectively.

The demographic characteristics of cases did not vary considerably between peak and off-peak years. The median ages were 56 and 57 years old for peak and off-peak years, respectively. There were approximately twice as many male cases in both peak and off-peak years. And the large majority of cases were white or Latino (49% and 36%, respectively, in peak years vs. 59% and 32% in off-peak years). There were not more than 5% each of cases that were Asian, black, or other in both peak and off-peak years.

Across the entire surveillance period, 279 cases classified with WN fever, 480 with NID and 87were asymptomatic blood donors. The mean annual proportions of asymptomatic blood donors and cases with NID presentation were slightly higher in off-peak years than in peak years, separated by a difference of 2 and 3%, respectively (Table 1). Over all years, the mean proportion of asymptomatic donors was 14% per year and of NID cases was 58% per year. In contrast, the mean proportion of those with WN fever was higher in peak years, 32% per year compared to 27% per year in off-peak years. The mean percentage of hospitalizations among symptomatic cases was also slightly higher in peak compared to off- peak years, 77% versus 73%, respectively. Fatality rates among symptomatic cases were similar in peak and off-peak years, 4.3% overall.

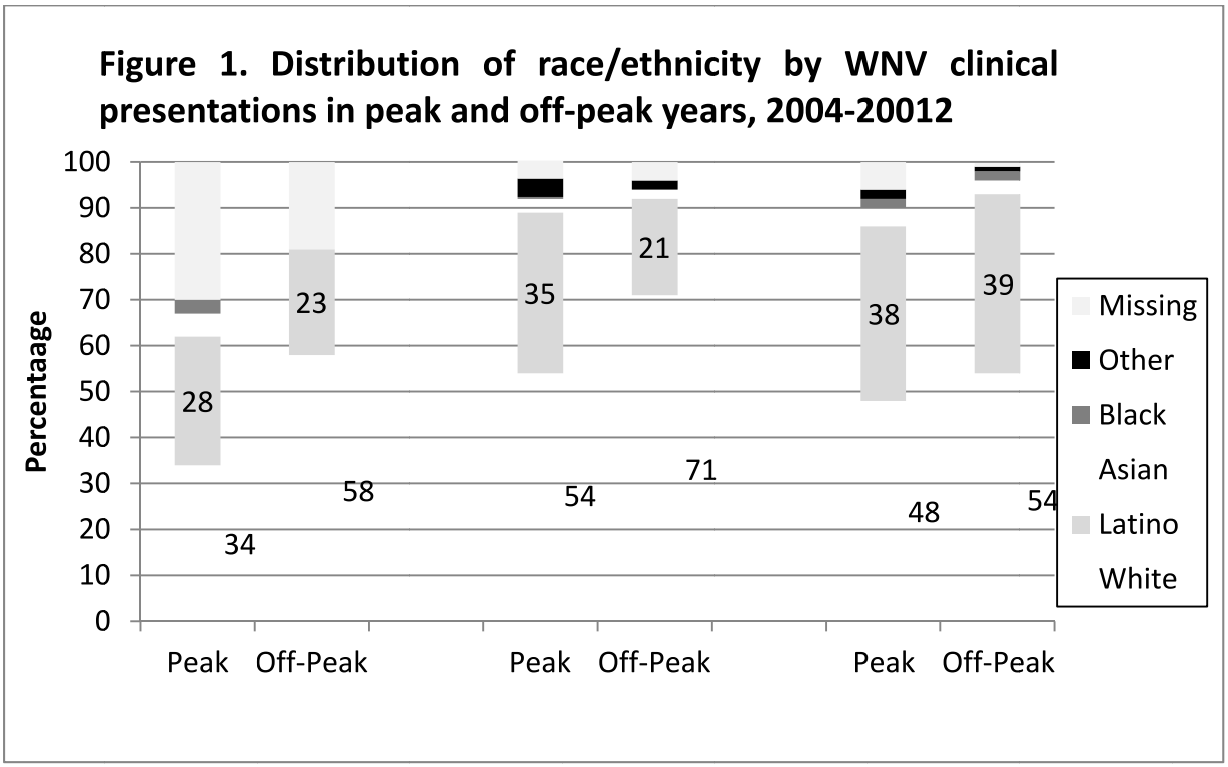
Table 1. Clinical Presentation and Severity of WNV Cases in Peak and Off-Peak Years, 2004-2012

Years	Hospitalizations* Mean Annual %, Annual Range %	Fatalities* Mean Annual %, Annual Range %	Neuroinvasive Disease Mean Annual %, Annual Range %	WN Fever Mean Annual %, Annual Range %	Asympt. Donor Mean Annual %, Annual Range %
Peak	77, 63-85	4.3, 4-5	58, 44-68	32, 23-48	10, 7-13
Off-Peak	73, 38-86	4.3, 0-14	60, 31-75	27, 19-50	13, 0-20
All	75, 38-86	4.3, 0-14	58, 31-75	29, 19-50	14, 7-19

*Excludes asymptomatic blood donors

Gender, age, and race/ethnicity demographics were analyzed by the various presentations of WNV (NID, WN fever, and asymptomatic donor). With the exception of WN fever cases during off-peak years, the male to female ratio for all diagnoses of WNV, including asymptomatic donors, remained nearly 2:1 throughout peak and off-peak years. For WN Fever, the male to female ratio was 1.7:1 in peak years versus 1.4:1 in off-peak years. Median age of cases were similar between peak and off-peak years, but increased from 49 to 52 to 61 years old (for all years) as severity of presentation increased from asymptomatic to WN fever to NID, respectively. Whites accounted for higher proportions of WN fever and positive asymptomatic donations during off-peak years than peak years (71% vs. 54% for WN fever and 58% vs. 34% for asymptomatic donors). However, the opposite occurred among Latinos (Figure 1). Twenty-three percent of asymptomatic donors and 21% of WN fever cases was Latino in off-peak years compared to 28% and 35% in peak years, respectively. The proportion of whites and Latinos were distributed similarly between peak and off-peak years for NID cases. The proportions of Asians, blacks, and other were too small for evaluation.

Figure 1. Distribution of race/ethnicity by WNV clinical presentations in peak and off-peak years, 2004-20012



Nearly all NID patients were hospitalized, during both peak (96%) and off-peak years (99%), 97% overall. Those presenting with WN fever were hospitalized at a higher proportion during peak years compared to off-peak years, 40% vs. 29%, respectively. Fatalities occurred mainly among those with NID diagnosis and the proportion was similar across peak and off-peak years, 7% overall. A few fatalities occurred among those with WN fever diagnosis, 1% overall (data not shown).

Cases have been documented in all health districts during the three peak years of WNV, with the highest number of cases occurring in health districts in the San Fernando (SF) Valley and San Gabriel Valley regions (Figure 2), particularly in the West Valley Health District (n=68). In off-peak years, West Valley remained active, with the highest total case count (n=48). And no cases occurred during the six years in the South, Southeast, and East LA Health Districts. The mean maximum monthly temperatures documented in Pomona during peak and off-peak years were nearly identical. However, during the main months of WNV activity (June through October), temperatures were cooler in peak years than off-peak years (100° Fahrenheit (F) vs. 101°F) (Table 2). On the contrary, mean maximum temperatures in the preceding 5 months of January through May were warmer in peak years than off-peak years (89.5°F vs. 87.6°F). Mean monthly precipitation was higher in peak years than off-peak years, for both the total year

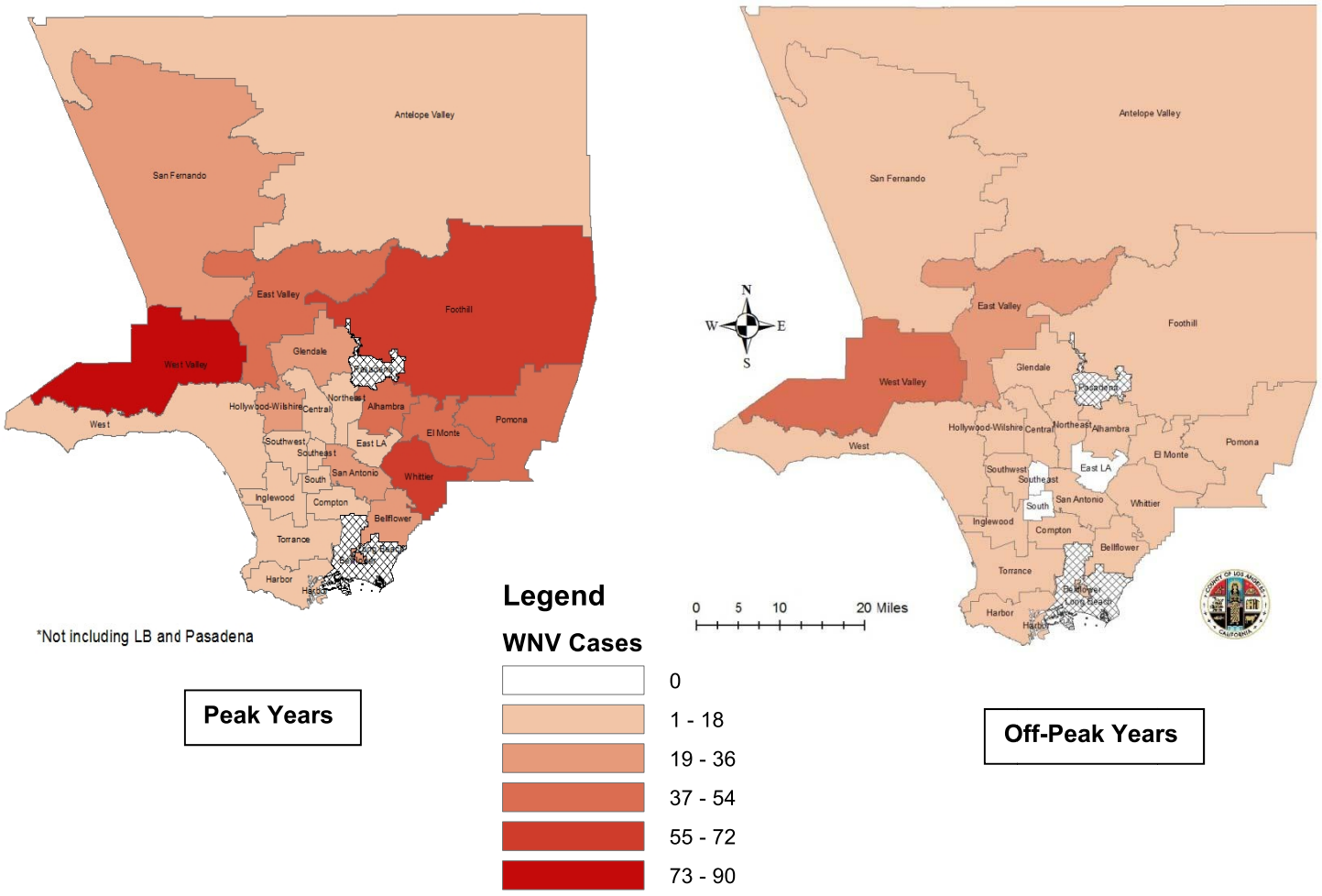


Figure 2. Total Number of Human WNV Cases by Health District, LAC*, Peak vs. Off-Peak Years, 2004-2012

(1.61" vs. 1.17") as well as during June through October (0.65" vs. 0.17"). However, there was less precipitation in peak years during January through May (1.17" vs. 1.97"). None of these temperature and precipitation differences were statistically significant.

Table 2. Temperature and Precipitation, Pomona, California, 2004-2012

	Total Year		Jun-Oct		Jan-May	
	Peak	Off-peak	Peak	Off-peak	Peak	Off-peak
Mean Maximum Monthly Temperature (°F)	92.5	92.3	100	101	89.5	87.6
Mean Total Monthly Precipitation (inches)	1.61	1.17	0.65	0.17	1.17	1.97

DISCUSSION

Since its arrival in 2003 to LAC, surveillance has documented a cyclic pattern of WNV activity with peaks of human infection occurring every four years – in 2004, 2008, and 2012 – and the fewest cases being documented two years after - in 2006 and 2010. Peak years were characterized by differences in demographic and environmental trends. In LAC, cases occurred each year from June through October, with the season extending into November in some peak years. However, peak years had much longer seasons, with cases reported over an average of 21.7 weeks compared to 12.8 weeks in off-peak years. In comparison, in Dallas County, Texas, during the 2012 outbreak season when 393 human infections were reported, cases occurred over only 13 weeks (5). During peak years in LAC the number of cases occurring per week were much higher than off-peak years, which numbered less than 10 cases per week compared to up to 40 per week in peak years.

The high number of cases in peak years appears to be driven by increased reports of severe WN fever, cases severe enough to require hospitalization. In these years, a higher proportion of males and Latinos were represented among WN fever cases, indicating that in off-peak years, WN fever may be mild enough that issues in accessing healthcare may be a barrier in diagnosing the infection. NID, on the other hand, is consistently represented among gender and race/ethnicity groups between peak and off-peak years, likely a result of NID infection necessitating nearly universal hospitalization.

The monitoring of asymptomatic blood donors has been utilized as a method of detecting the underlying rate of WNV infection in a population (6,7). However, our surveillance documented slightly more asymptomatic infections in off-peak years as with NID, likely representing a more stable source of diagnosis in comparison to WN fever infections. Interestingly, our asymptomatic donors were mostly white, which is consistent with the demographics of blood donor populations; even in regions with higher proportions of minorities in the population, whites tend to over-represent the blood donor population (8). However, asymptomatic donors were overwhelmingly male in both peak and off-peak years, whereas, white blood donors in the general donor population are equally male and female (8). Although the development of NID occurs more frequently among males, the risk for initial infection with WNV has not been found to be significantly higher among males (9).

Our data corroborates what is known about the presentation of NID. The surveillance of NID is a robust method of following WNV as its rate remains relatively stable across gender and race/ethnicity subgroups as well as through peak and off –peak years. That the average age of the LAC WNV case population increases with the severity of WNV infection supports the fact that those over the age of 50 years are at increased risk for NID disease (9).

Human WNV activity in LAC remained high in the SF Valley area between peak and off-peak years. Several studies on WNV geographic distribution have shown that incidence rates are substantially affected by variables that are relatively static over long periods of time such as land use, population density, and even climate normals as opposed to yearly weather fluctuations (10,11). These stable factors are likely a major contributor to the maintenance of WNV activity in the SF Valley. In addition, there are likely local breeding habitats unique to the region that continually maintain vector and/or host populations 10,11,12). Indeed, our analysis of temperature and precipitation data from Pomona, located in an area with high WNV activity, showed no significant differences between peak and off-peak years.

This analysis is limited by possible underreporting of cases when diagnostic tests for WNV are not ordered for a patient and also when suspected or known WN infections were not reported to the public health department. This is particularly true for patients with mild WN infections, such as WN fever, who may not even seek or have access to medical care. In addition, awareness of WNV among both patients and healthcare providers may vary from year to year due to media interest or fatigue, driving the WNV testing rate up or down. A major limitation in the climactic analysis was that maximum monthly temperature and precipitation data from a single weather station in Pomona was used to represent climate for all regions of LAC. Climate data obtained from the geographic location of each WNV case would describe the variation between peak and off-peak years more accurately. We also assumed that the reported residence of each case was the likely site of acquisition of WNV infection. Patterns in WNV

incidence are difficult to generalize from one geographic area to another due to the environmental and behavioral factors of vectors and hosts that occur on smaller scales and even by individual human behavior (10,11,12). Thus, more complicated modeling of weather, geographic, mosquito population, susceptible bird population, and human behavior data would provide better descriptions of the activity occurring in LAC.

The distinct cyclical pattern of human WNV activity in LAC from 2004-2012 allows us an opportunity to neatly assess characteristics between peak years and off-peak years. Though major limitations prevent concrete conclusions, patterns have emerged in the demographics of human WNV cases and environmental characteristics of peak years in comparison to off-peak years. Because WNV activity can be highly specific to geographic areas, it is important to review data specific to Los Angeles County as it may begin to elucidate ways that LAC DPH can target mosquito abatement services and health education.

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SUMMARY AND HIGHLIGHTS OF THE 2012-2013 INFLUENZA SEASON IN LOS ANGELES COUNTY

Wendy Manuel, MPH

OVERVIEW

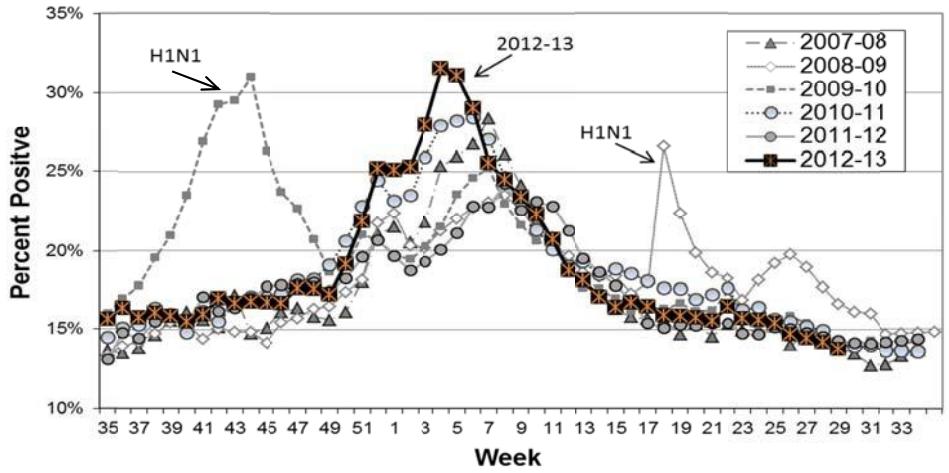
The 2012-2013 influenza season in Los Angeles County (LAC) was moderately severe with an increased number of confirmed fatal cases. LAC experienced the highest number of deaths since the 2009-2010 H1N1 pandemic, primarily in the older population. The highest percent positive cases of influenza tests from our sentinel laboratories in LAC occurred during the same week that influenza-like illness (ILI) visits in emergency departments peaked (Figure 1). Overall activity reached a highpoint during the last week of January/beginning of February with 13 respiratory community outbreaks confirmed and 13 influenza attributed fatalities, including one pediatric death (Table 1). Locally and nationally type A dominated, specifically the H3N2 strain (1,2).

Table 1. Surveillance Summary for LA County (2012-2013)
Peak Activity MMWR Week 5

LA County Surveillance Summary	Influenza Peak Week 5 1/27/13-2/2/13	2012-13 Season Summary 9/30/12-7/20/13
Positive Flu Tests/Total Tests (Percent Positive Flu Tests)	552/1,904 (29.0%)	3163/28,642 (11.0%)
Percent Flu A/B	79%/21%	68%/32%
Community Respiratory Outbreaks (Influenza, Confirmed†)	13 (2)	62 (9)
Flu Deaths, Confirmed†† (Pediatric Deaths, Confirmed††)	13 (1)	69 (7)

†Confirmed influenza outbreak is defined by 2 or more positive lab tests for Influenza
††Confirmed influenza death is defined by a positive lab test, compatible symptoms, and clear progression from illness to death

Figure 1. Percent Positive Emergency Department Visits for Influenza-Like Illness, LA County (2007-2013)

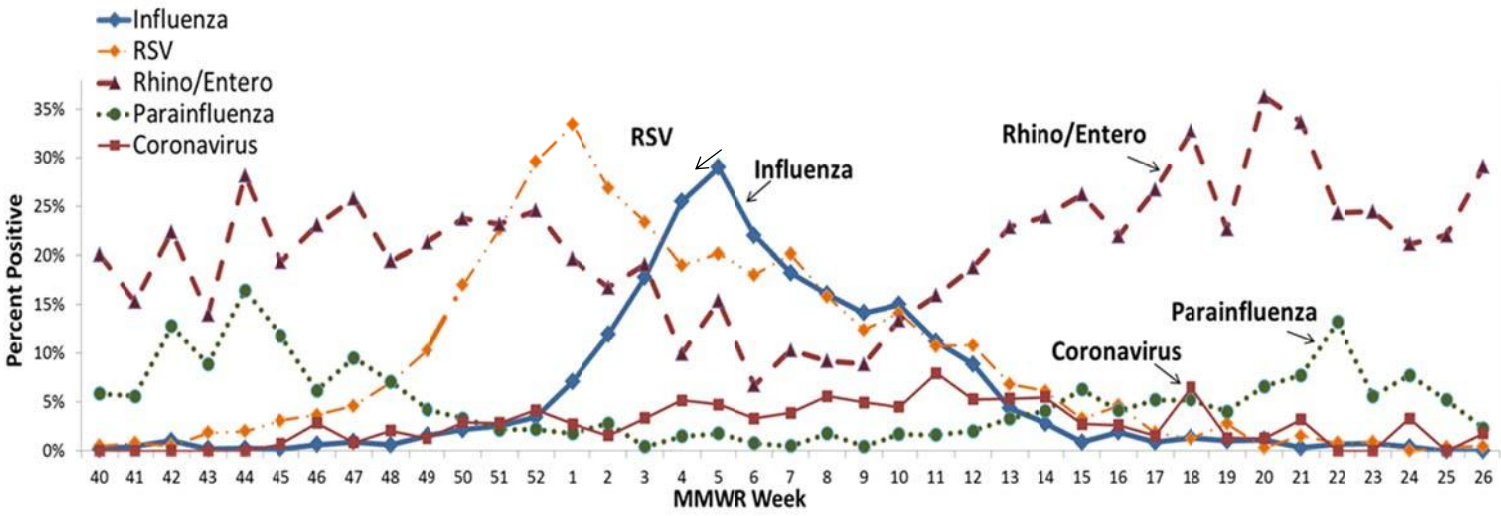


SURVEILLANCE IN LAC

Respiratory illness and responsible pathogens are tracked in LAC from nine sentinel laboratory sites geographically spread across the county that report weekly data on influenza test rates at their facilities. In addition some sites return reports on the following respiratory viruses: respiratory syncytial virus (RSV), rhino/enterovirus, parainfluenza, human metapneumovirus, and coronavirus. Figure 2 shows the percent positive lab results for the various respiratory viruses by MMWR week. Los Angeles County Department of Public Health (LAC DPH) also monitors syndromic surveillance of ILI from participating emergency departments (ED) throughout the county. ILI symptoms include: fever, sore throat or cough, runny nose, sneezing, and congestion. The percent positive of ILI visits over total ED visits is monitored as an additional measure of regional influenza activity. Figure 1 compares percent positive ILI visits to participating EDs over the past 6 influenza seasons.

LAC DPH requires that all influenza related deaths be reported; therefore, data collection differs in fatal cases from routine surveillance. Data collection of fatal influenza cases has changed over the past decade. In 2003, the California Department of Public Health (CDPH) began requiring reports of fatal pediatric cases attributed to influenza. A few years later in 2009 with the emergence of the type A pH1N1 pandemic strain, LAC DPH required that all intensive care and fatal cases of influenza be reported in order to monitor the rapidly changing status of the pandemic. Once the emergency situation was over, data collection was revised and as of October 2010 intensive care cases were no longer reportable however all influenza related fatalities remained reportable to LAC DPH within seven days of identification. Currently CDPH only collects influenza fatality data for those 0-64 years old, however LAC tracks fatalities of all age groups in order to monitor a more comprehensive scope of the impact of influenza in our region. These longitudinal findings allow us to track changes in severity from season to season and help identify high risk groups that would benefit from future prevention methods aimed at decreasing morbidity. Additional information about surveillance methods can be found at the LAC DPH website (3).

**Figure 2. Respiratory Viruses LA County 2012-2013,
Percent Positive Cases by MMWR Week**



INCREASED FATALITIES: 4 YEAR COMPARISON

During the 2012-13 influenza season LAC experienced a substantial increase in fatalities attributed to influenza compared with the previous two seasons. The past three influenza seasons have been predominated by type A influenza (H3N2) however for the 2012-13 season a different strain emerged antigenically characterized as A/Victoria/361/2011, whereas the previous two seasons were primarily of the Perth lineage, A/Perth/16/2009. Despite the Victoria strain being included in the 2012-13 seasonal

influenza vaccine, LAC identified the highest number of influenza deaths since the H1N1 pandemic (pH1N1) season reflecting a moderately severe season. Consistent with last season, those 65 years of age and older comprised the majority (52%) of deaths (Table 2). The CDC found a low vaccination efficacy rate for those over 65 years old which suggests a failure to mount a sufficient immune response (4). In contrast, table 2 shows the atypically high percentage of deaths in those under 65 years old (77%) that were most affected during the 2009 pandemic year relative to those 65 and up. During pandemic influenza seasons mortality rates skew disproportionately towards the young (5). Pandemic mortality burden is contrary to normal seasonal influenza years, where 90% of deaths nationally occur in those over 65 years old (6). Comparing the past four influenza seasons, with each consecutive season since pH1N1 the majority of fatal cases shifts back to the typical seasonal influenza trend that disparately affects the elderly. This measure of morbidity burden shift to an older age group progressively increases each year as we move farther away from the pandemic. Comorbid factors related to influenza fatalities remain similar to previous years, with high blood pressure, overweight/obesity, and heart disease continuing to be the top 3 risk factors. Overweight/obesity is a relatively new risk factor for influenza mortality first identified during the 2009 pH1N1 season, however in LAC it was the second most common comorbidity found in 42% of adult influenza deaths (Table 3).

Table 2. Demographic Characteristics of Influenza Fatalities by Flu Season 2009-2013

		2012-13 N (%)	2011-12 N (%)	2010-11 N (%)	2009-10† N (%)
Age (years)	Median	**68**	64	45	48
	Range	**0-100**	0-104	0-92	0-94
	0-5	**5 (7)**	2 (8)	4 (9)	3 (2)
	6-17	**2 (3)**	2 (8)	2 (5)	10 (8)
	18-40	**4 (6)**	2 (8)	14 (33)	37 (29)
	41-64	**22 (32)**	6 (25)	19 (44)	60 (47)
	65+	**36 (52)**	12 (50)	4 (9)	17 (13)
Gender	Female	**35 (51)**	14 (58)	23 (53)	70 (55)
	Male	**34 (49)**	10 (42)	20 (47)	57 (45)
Race	Hispanic	**28 (42)**	12 (50)	26 (60)	56 (49)
	White Non-Hispanic	**25 (37)**	5 (21)	9 (21)	39 (34)
	Black	**8 (12)**	4 (17)	4 (9)	11 (9)
	Asian/Pacifc Islander	**6 (9)**	3 (12)	4 (9)	9 (8)
SPA‡	1: Antelope Valley	**3 (4)**	0 (0)	1 (2)	6 (5)
	2: San Fernando	**18 (26)**	4 (17)	16 (37)	25 (21)
	3: San Gabriel	**8 (12)**	2 (8)	4 (9)	32 (26)
	4: Metro	**12 (17)**	5 (21)	3 (7)	14 (12)
	5: West	**8 (12)**	2 (8)	1 (2)	8 (7)
	6: South	**7 (10)**	3 (13)	6 (14)	6 (5)
	7: East	**6 (9)**	4 (17)	8 (19)	24 (20)
	8: South Bay	**7 (10)**	4 (17)	4 (9)	8 (7)
Total Fatalities		**69**	**24**	**43**	**127**

†2009-10 season is missing race data for n=12 and SPA data for n=4

‡ Service Planning Areas in LA County, http://publichealth.lacounty.gov/chs/SPAMain/ServicePlanningAreas.htm

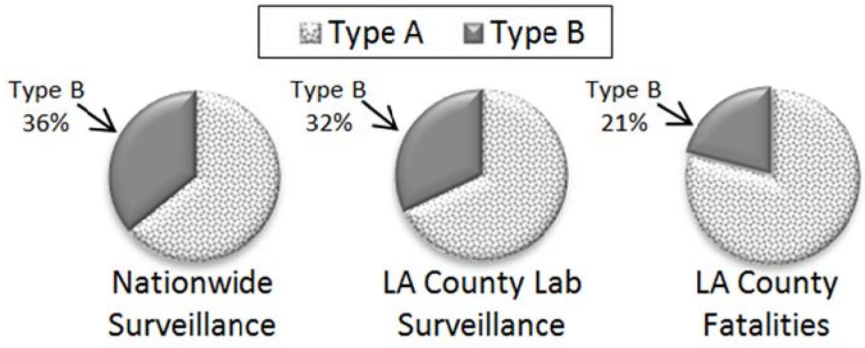
Table 3. Top 10 Underlying Medical Conditions, Confirmed Adult Influenza Fatalities LA County 2009-201				
Sorted by % for 2012-13 Season	2012-13 N (%)	2011-12 N (%)	2010-11 N (%)	2009-10 N (%)
Hypertension	**32 (52)**	13 (65)	17 (47)	34 (27)
Overweight or obese	**26 (42)**	9 (45)	31 (86)	69 (54)
Heart Disease	**23 (38)**	12 (60)	6 (17)	40 (31)
Diabetes	**19 (31)**	7 (35)	10 (28)	44 (35)
Lung Disease	**11 (18)**	3 (15)	6 (17)	42 (33)
Immunosuppression	**9 (15)**	7 (35)	5 (14)	30 (24)
History of tobacco use	**8 (13)**	8 (40)	9 (25)	12 (9)
History of drug or alcohol abuse	**5 (8)**	4 (20)	3 (8)	7 (5)
Asthma	**5 (8)**	3 (15)	3(8)	9 (7)
Pregnancy	**0**	0	1 (3)	4 (3)
Total Adult Fatalities	**62**	**20**	**37**	**114**

Notes: Overlapping conditions and complications may total over 100%, data not available for all categories, data taken from self-reported medical records

H3N2 TYPE A DOMINATED THIS SEASON

Nationally and locally type A, H3N2 subtype dominated this influenza season. 68% of positive influenza lab tests from sentinel sites returned type A results. Type A was the major strain responsible for influenza mortality in LAC found in 79% of fatal cases (Figure 3). Out of 69 fatal cases, 52 were type A and of those, 23 (32%) were further subtyped H3N2. The pandemic H1N1 strain that emerged during the 2009-10 pandemic season was still circulating during the 2012-2013 season but in low numbers (7% of fatalities). Figure 4 provides an overview of percent positive reports by our sentinel sites by MMWR week (weeks are counted starting at the beginning of the calendar year where week 1 is the first week of January). Consistent with ILI activity from reporting EDs in LAC (Figure 1), LAC sentinel laboratories also reported peak positive influenza tests at the end of January (week 5). The majority of positive influenza during the 2012-2013 season was type A, however type B was simultaneously circulating and showed increased activity over type A later in the season starting in March through the beginning of May until overall influenza activity in LAC dropped. Table 4 shows the waning effect of pH1N1 mortality over time as the rate of fatal pH1N1 cases continue to decrease by about half each consecutive year from 2009-2010.

Figure 3. Percent Positive Influenza Type Nationwide and LA County 2012-2013



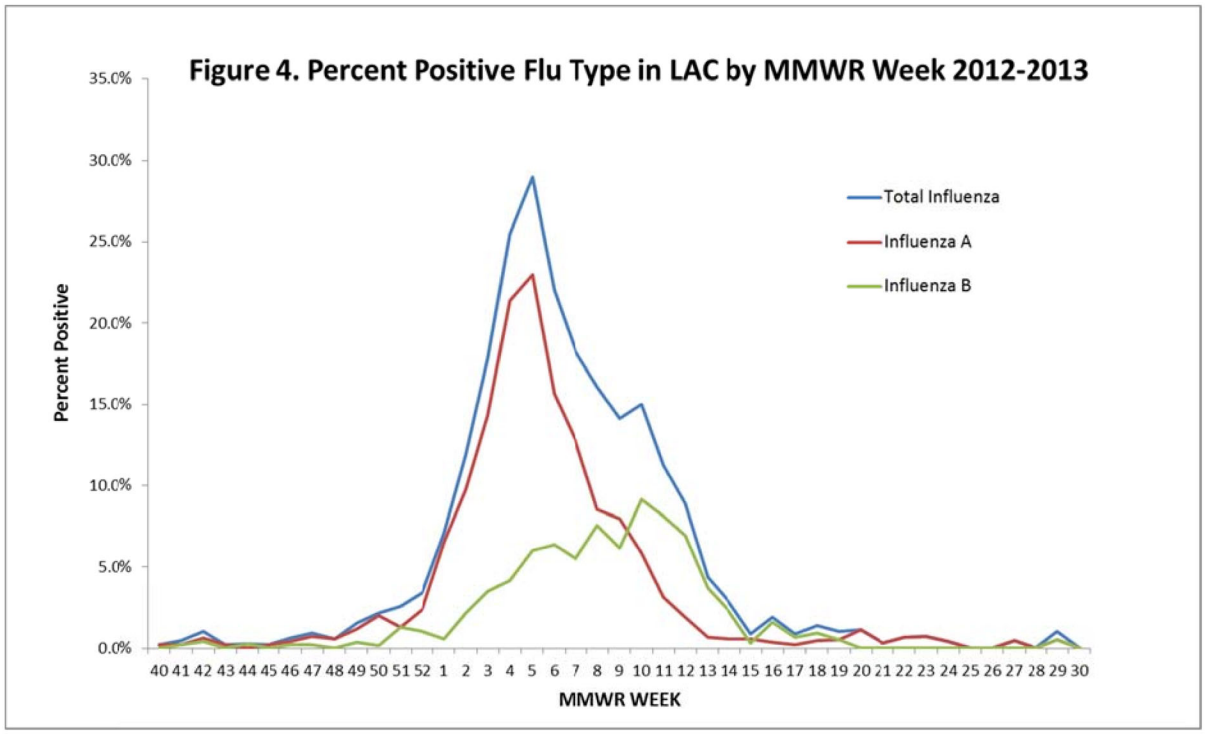


Table 4. Viruses Associated with Confirmed Influenza Fatalities 2009-2013

	2012-13† N (%)	2011-12 N (%)	2010-11‡ N (%)	2009-10 N (%)
A no type	29 (42)	14 (58)	15 (35)	19 (16)
A H1N1p	5 (6)	5 (21)	18 (42)	104 (82)
A H3N2	23 (32)	1 (4)	3 (7)	0
B no type	14 (20)	4 (17)	7 (16)	3 (2)
Total	**69**	**24**	**43**	**127**

†One case tested positive for H1N1p & H3N2, and one tested positive for Flu A&B, both counted twice
‡Two cases tested positive Flu A&B counted twice

RESPIRATORY COMMUNITY OUTBREAKS

A total of 50 respiratory outbreaks were confirmed, of those nine were attributed to influenza having at least two positive lab tests (3 A, 4 B, and 2 A& B mixed). Consistent with previous influenza seasons, the majority (over 80%) of 2012-13 outbreaks in LAC were school based (Table 4). This steady trend emphasizes the continued need to monitor influenza activity in school settings and encourage parents to vaccinate their children. Outbreak locations were mapped across service planning areas with most occurring in the San Fernando, Metropolitan, and San Gabriel areas.

Table 5. Characteristics of Confirmed Community Respiratory Outbreaks in LA County 2009-2013				
Characteristic	2012-13 N (%)	2011-12 N (%)	2010-11 N (%)	2009-10 N (%)
Total†	**50**	**27**	**53**	**432**
Location				
School or Pre-School	**41 (82)**	22 (81)	46 (87)	376 (87)
Assisted Living	**6 (12)**	2 (7)	3 (6)	20 (5)
Daycare/child care	**3 (6)**	3 (11)	3 (6)	6 (1)
Juvenile Detention/Jail	**0**	0	0	13 (3)
Hospital	**0**	0	0	8 (2)
Other	**0**	0	1 (1)	9 (2)
Etiology				
Influenza††	**9 (18)**	3 (11)	14 (26)	82 (19)
Streptococcal	**1 (2)**	5 (19)	3 (6)	0
Other respiratory	**40 (80)**	19 (70)	36 (68)	350 (81)

†Totals from previous seasons have been updated

††Confirmed influenza outbreaks must include at least 2 positive lab tests

CONCLUSION

Influenza disease causes significant morbidity and mortality every year. Estimating overall influenza burden is difficult since only a small portion of those who are sick seek treatment and of those not all are tested. Therefore only a small percentage of the population who actually suffer from the disease are counted towards morbidity values. With those limitations in mind, LAC DPH tracks specific measures of influenza in the county from year to year to compare between seasons. The level of activity in LAC during the 2012-2013 influenza season was more severe compared with the previous two seasons as the county suffered the highest number of fatalities since the H1N1 pandemic in 2009-2010. The elderly were disproportionately affected as well as those with underlying medical conditions. Type A H3N2 was the dominant strain both nationally and locally, however type B and A pH1N1 were also present and contributed to morbidity and mortality. As the remarkable effects of the H1N1 pandemic diminish over time, regular seasonal influenza patterns return to normal where activity peaks from December to February and the elderly are most susceptible. The 2009-2010 influenza season is used as a marker to compare other seasons since it was a unique event with lasting effects on our population. Four influenza pandemics have occurred in the past century and because influenza viruses can mutate and adapt to new hosts, public health officials need to diligently monitor for new strains in the event that another pandemic situation emerges.

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HEALTHCARE ASSOCIATED INFECTION OUTBREAK INVESTIGATIONS IN AMBULATORY CARE SETTINGS, LOS ANGELES COUNTY, 2000 – 2012

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BACKGROUND

Healthcare services are increasingly delivered in outpatient, ambulatory care settings (ACSs) rather than inpatient, acute care settings. Nationwide, there are nearly 1.2 billion outpatient visits per year.[1] ACSs encompass a broad array of facilities, such as primary care clinics, ambulatory surgery centers, pain clinics, oncology clinics, imaging facilities, dialysis centers, urgent care centers, and other specialized facilities. The types of procedures performed in ACSs are also diverse, including podiatry (e.g., nail clipping, wound care, podiatric surgery), surgery, endoscopy (e.g., gastrointestinal, urological, arthroscopic), pain injections, and more.

Ambulatory surgery centers, a subset of ACSs, have seen an astounding growth. In 1985, the number of ambulatory surgery centers participating in Medicare was 336; the number boomed to approximately 5368 in 2011.[2,3] Sixty-three percent of all surgeries in 2005 were outpatient, compared with 51 percent in 1990 and only 16 percent in 1980.[4] Explanations for this shift in delivery of healthcare services include lower costs, increased patient satisfaction, and convenient scheduling[5]; however, there are also a number of concerns.

Often, the procedures performed in ACSs are invasive, putting patients at high risk of infection. Further, many procedures currently performed in ACSs were previously performed in hospitals where infection control oversight is regulated. Despite the surge in ambulatory care, there has not been a corresponding increase in infection control oversight in ACSs, and there are insufficient data on the rates of infections resulting from procedures performed in ACSs. In fact, only 20 ambulatory surgery centers reported data to the National Healthcare Safety Network (NHSN) for 2006 through 2008, compared to 1545 hospitals that reported data during the same period.[6]

At the same time, the amount of literature demonstrating a need for infection control oversight in ACSs is growing. For example, from 2001 through 2011, at least 18 outbreaks of viral hepatitis were associated with unsafe injection practices in ACSs, such as physician offices or ambulatory surgery centers.[7] Additionally, an infection control audit performed by the Centers for Medicare and Medicaid Services (CMS) in 2008 found that 46 of 68 ambulatory surgery centers surveyed had at least one lapse in infection control; 12 had lapses identified in three or more of five infection control categories.[8] As such, CMS now requires adherence to its Infection Control Surveyor Worksheet for participation in CMS.[9] However, many ACSs do not fall into the category of licensed surgery or dialysis center or do not participate in CMS, and are thus not held to the same infection controls standards.

Recognizing the infection control concerns associated with ACSs, the Los Angeles County (LAC) Department of Public Health (DPH) Acute Communicable Disease Control Program (ACDC) conducted an analysis to characterize healthcare associated infection (HAI) outbreaks in LAC in ACSs.

METHODS

Adapting the CMS definition for ambulatory surgery centers, ACDC defined an ACS as a distinct healthcare entity, either hospital-based or non-hospital-based, that operates exclusively on an outpatient basis for patients who do not require hospitalization and who are expected to stay less than 24 hours.[10] ACSs affiliated with a hospital are under the common ownership, licensure, or control of a hospital.[11] Ophthalmology offices, hospital clinics, urology offices, radiology offices, pain clinics, orthopedist offices, oncology offices, OB/GYN clinics, and medical spas were grouped together into offices/clinics.

LAC DPH relies on passive surveillance, the receipt of reports of infections from hospitals, laboratories, clinics, and other healthcare facilities and professionals required to submit such reports as defined by

regulation. In California, all outbreaks, confirmed or suspected, are mandated under Title 17 of the California Code of Regulations § 2500 to be reported to the local health department. At LAC DPH, reported outbreaks are documented in the LAC DPH Disease Control Outbreak Log. For this analysis, ACDC reviewed the LAC DPH Disease Control Outbreak Log database, LAC DPH Special Studies Reports where many outbreak investigations are described for ACDC's annual report, and personal correspondence with LAC DPH employees involved in investigations of reported suspected and confirmed HAI outbreaks in ACSs that occurred from January 2000 through November 2012.

These suspected and confirmed HAI outbreaks in ACSs were classified by public health activities undertaken by ACDC, infection control breaches, duration of investigation, and number and outcome of cases. Data were analyzed using SAS 9.3.

Public health activities were separated into 15 categories, including site visit(s), medical record review, epidemiologic studies, patient notification, active surveillance, recommendations to facility, sample collection, laboratory analysis, and environmental investigation. Epidemiologic analyses included case control, retrospective cohort, prospective cohort, and comparison studies. Patient notification refers to the process of informing patients about potential exposures through mailed notification letters or postage of a letter in the facility. Active surveillance, as opposed to passive surveillance, is surveillance in which ACDC proactively solicited infection reporting (e.g., analyzed current patient medical records from facilities for case finding or surveying patients to identify additional cases). Sample collection involved the ascertainment of biological specimens from patients (e.g., from blood, wound, urine), environmental samples (e.g., water, air), medication samples, and samples from equipment (swabs from inside or outside of equipment). Laboratory analyses included genetic typing, pulsed-field gel electrophoresis for DNA fingerprinting, and genomic sequencing. Laboratory analysis was conducted by either LAC DPH Public Health Laboratory or sent to the Centers for Disease Control and Prevention (CDC) laboratory or California Department of Public Health (CDPH) laboratory for testing. Environmental investigations were conducted in conjunction with LAC DPH Environmental Health Division and involved evaluating facility layouts, monitoring staff compliance with environmental infection control standards, and collecting and laboratory testing air, water, or equipment samples.

Infection control characteristics were classified into ten categories, including breaches in hand hygiene, use of personal protective equipment (PPE), injection safety, medication documentation, equipment processing and sterilization, written infection control policies and procedures, and staff credentials.

RESULTS

Characterization of Outbreak Investigations

Twenty-eight investigations of suspected or confirmed HAI outbreaks in ACSs in LAC met the inclusion criteria. The majority of identified outbreak investigations were in facilities not affiliated with a hospital (71.4%). The most common settings for outbreak investigations were ambulatory surgery centers (21.4%) and dialysis centers (21.4%). The distribution of settings by outbreak investigations is shown in Table 1.

Table 1: Distribution of outbreaks by hospital affiliation and setting type

Setting type	Number of outbreak investigations (% of total)	Total number of cases (% of total)
Hospital Affiliation		
Yes	8 (28.6)	42 (25.0)
No	20 (71.4)	126 (75.0)
Setting type		
Office/ clinic	11 (39.3)	53 (31.5)
Ambulatory surgery center	6 (21.4)	26 (15.5)
Dialysis center	6 (21.4)	70 (41.7)
Contracted home health agency	5 (17.9)	19 (11.3)

Outbreaks were reported 0 to 1160 days after exposure of the first case (median: 69 days). The total case count was 168 (mean: 6; range: 0–36); 59 cases were hospitalized and five cases died. The types of implicated agents included bacterial, viral, fungal, ectoparasitic, toxin, and chemical. Bacterial agents were implicated in 50% of identified outbreak investigations. One investigation found no cases and did not implicate an agent. The distribution of agent types by outbreak investigations is shown in Table 2.

Table 2: Types of implicated agents

Agent type	Number of outbreak investigations (% of total)	Examples
Bacterial	14 (50)	*Enterobacter*, *Klebsiella*, *Pseudomonas*, *Stenotrophomonas*, *Staphylococcus*, *Mycobacterium*
Viral	6 (21.4)	Hepatitis B, Hepatitis C
Fungal	3 (10.7)	*Fusarium*
Ectoparasitic	1 (3.6)	Scabies
Toxin	1 (3.6)	
Multiple	1 (3.6)	Adenovirus and *Streptococcus*
Unknown	1 (3.6)	
Not applicable	1 (3.6)	

Public Health Activities

Investigations lasted a median of 36 days (range: 7–94 days). The mean number of control activities undertaken by ACDC during the investigations was 6.8. The most common actions taken by ACDC were: conducting one or more site visits (78.6% of investigations); providing written recommendations to the facility (78.6%); medical record reviews of cases and other patients (75%); formal interviews of facility staff (64.3%); and laboratory analysis (60.7%). ACDC also often consulted CDC (50.0%) and CDPH (35.7%) during investigations. Other partners consulted included the Food and Drug Administration, the Medical Board of California, the California Board of Pharmacy, and internally, LAC Public Health Laboratory (PHL) and LAC Environmental Health Division. Non-case patients were notified of possible risk in 7.1% of investigations. In one investigation, nearly 2,300 patients were notified of possible exposure. Public health activities performed by LAC DPH are summarized in Table 3.

Table 3: Public health activities conducted during outbreak investigations

Public health activity	Number of outbreak investigations (% of total)
Site visit	22 (78.6)
Medical record review	21 (75.0)
Formal staff interviews	18 (64.3)
Epidemiologic study[‡]	9 (32.1)
Sample collection	13 (46.4)
Environmental sample[¥]	9 (32.1)
Biological specimen	6 (21.4)
Medication sample	4 (14.3)
Laboratory analysis	17 (60.7)
LAC PHL	14 (50.0)
CDC	9 (32.1)
Environmental health investigation	7 (25.0)
Patient interviews	6 (21.4)
Patient notification	2 (7.1)
Active surveillance	8 (28.6)
Sought outside consultation	17 (60.7)
CDC	14 (50.0)
CDPH	10 (35.7)

Review of facility policies and procedures	15 (53.6)
Written recommendations to facility	22 (78.6)
Special report published by ACDC	10 (35.7)
Other publications×	5 (17.9)

±Epidemiologic study includes case control (5), retrospective cohort (2), prospective cohort (1), and comparison (1)
¥Environmental samples include air, water, and equipment isolates
×Other publications include CDC's Morbidity and Mortality Weekly Reports, the American Journal of Infection Control, Emerging Infectious Diseases, and an abstract for the Society for Healthcare Epidemiology of America (SHEA) conference

Infection Control Breaches

Of the 28 outbreak investigations included, 22 (78.6%) cited at least one infection control breach. The mean number of infection control breaches identified by LAC DPH during the outbreak investigations was 2.4 (range: 0 – 8). The most common breaches recorded were associated with injection safety (35.7%), equipment processing and sterilization (35.7%), medication documentation (25.0%), and environmental cleaning (21.4%). Injection safety violations included reuse of single-dose medication and not using aseptic technique to enter multi-dose vials. Breaches in equipment processing and sterilization included incomplete disinfection of reusable dialyzers following dialysis and use of incorrect cleanser and disinfection method for endoscopes. Infection control breaches are summarized in Table 4.

Table 4: Infection control breaches noted in outbreak investigations

Infection control breach	Number of outbreak investigations (% of total)
Hand hygiene	5 (17.9)
Personal protective equipment (PPE)	3 (10.7)
Proper glove use	2 (7.1)
Injection safety	10 (35.7)
Injection preparation technique and environment	7 (25.0)
Single-use medication policies	2 (7.1)
Logging exposure events	2 (7.1)
Single-use equipment (e.g., blood glucose meters)	4 (14.3)
Medication documentation	7 (25.0)
Dosage or lot number	3 (10.7)
Open date or expiration date	5 (17.9)
Equipment processing and sterilization	10 (35.7)
Log of equipment maintenance	2 (7.1)
Documentation or manuals for equipment	2 (7.1)
Documentation of infection control policies and procedures	5 (17.9)
Knowledge and adherence to policies and procedures	4 (14.3)
Credentials of staff	5 (17.9)
Environmental cleaning	6 (21.4)

Outbreak investigations in which infection control breaches were identified required significantly more public health activities than those that did not find infection control breaches (7.5 actions versus 3.7 actions; $p<0.05$). When a site visit was part of the outbreak investigation, significantly more infection control breaches were identified than when there was no site visit conducted (3.0 breaches versus 0.2 breaches; $p <0.0001$).

Suspected Sources of Outbreaks

Lapses in infection control were suspected as the source for 16 (57.1%) of the outbreak investigations reviewed. Suspected causes included single-use medication used on multiple patients, reuse of finger stick blood glucose meters on multiple patients, deficiencies in dialyzer reprocessing, and improper equipment cleaning and disinfection. Two outbreak investigations identified externally contaminated medication as the suspected source (7.1%). Nine investigations did not identify a source of the outbreak (32.1%). One investigation found no cases and thus identified no source.

DISCUSSION

ACDC documented considerable morbidity and mortality associated with the 28 suspected and confirmed HAI outbreak investigations in ACSs included in this review. Cumulatively, over one-third of cases associated with these investigations were hospitalized; there was a 3% mortality rate among the cases. The analysis revealed diversity in types of ACSs and outbreak settings in LAC. A dozen different types of outbreak settings were identified, ranging from complex surgery centers with multiple operating rooms to small medical spas and pain clinics, all performing a variety of services. Additionally, the review demonstrates that outbreak investigations require substantial public health resources. The 28 investigations required many public health activities including site visits, laboratory analysis, and patient notification; our investigations lasted, on average, over one month. Interestingly, outbreak investigations that uncovered infection control breaches were associated with a greater number of public health activities than those without infection control breaches.

The most common infection control lapses identified in this analysis are consistent with those found by a national audit of ambulatory surgery centers nationwide.[8] Notably, injection safety violations and equipment cleaning issues were most frequent, both of which are preventable through taking Standard Precautions and practicing basic infection control. These findings highlight a need for better reporting from ACSs as well as more infection control oversight of ACSs.

There were some limitations to this analysis. This retrospective review relied on the availability and completeness of investigation documents. It is possible that some investigations were not documented in the LAC DPH Disease Control Outbreak Log or recalled by ACDC personnel and were not included in this review. Another limitation is delayed reporting to LAC DPH. Surveillance of HAIs in ACSs is passive in LAC, relying on facilities to recognize and report outbreaks and reportable conditions to LAC DPH. Among the 28 investigations included in this review, the median time between exposure of first case and report to LAC DPH was 69 days, with some situations reported years following the first exposure. Delayed reporting may be due in part to difficulty in tracking infections in outpatient populations; ACSs may have minimal patient follow-up. The difficulty in tracking infections also reduces the ability of public health officials to attribute infections to ACSs, especially if the infection is identified in an acute care setting after exposure at an ACS. In many cases, ACSs were unaware of the reporting requirements for outbreaks and other notifiable conditions. As a result of reporting issues, the findings of this review may be an underestimation of the true morbidity and mortality associated with HAIs in ACSs in LAC.

The difficulty in tracking infections in ACSs is concerning, especially in the case of acute communicable diseases, because delayed reporting can have serious consequences for public health intervention and patient safety. To improve reporting, ACSs should be encouraged to utilize NHSN reporting tools when applicable. NHSN is a useful system for both active and passive surveillance of HAIs and can be applied to ambulatory settings. NHSN recently launched a module for dialysis facilities to track infections; ambulatory surgery centers can already report infections to NHSN in the same way as hospitals.[6]

In addition to enhanced reporting, there are several potential opportunities to improve infection control practices and guidelines in ACSs through more oversight. While more research is needed to identify common infection control errors in ACSs and how to prevent them, state policies for oversight through licensure, incorporating training requirements, infection control standards, and regular inspection may be an approach for reducing HAIs in ACSs. As an example, the New York State Department of Health requires all office-based surgery practices to be accredited, mandates infection control training for every licensed healthcare provider, and requires providers in these facilities to report adverse events within one day.[12] Furthermore, much like following the CMS Infection Control Surveyor Worksheet is mandatory for CMS participation, requiring site visits, infection prevention programs and adherence to nationally recognized infection control guidelines for licensure may be appropriate for ACSs.[9] In our analysis, we found that site visits made by ACDC were helpful in identifying infection control breaches during the investigation process, as opposed to when no site visits are made. With regular inspection, infection control violations can be detected and addressed. The CDC and Healthcare Infection Control Practices Advisory Committee (HICPAC) created the *Guide to infection prevention in outpatient settings: Minimum*

expectations for safe care, which is intended to provide infection control and prevention recommendations to ACSs. Included in the recommendations are the development of an infection prevention program in the facility, specific infection prevention education and training of healthcare personnel, surveillance of HAIs, and adherence to Standard Precautions.[13] This document should serve as a guide to ACSs in LAC for infection prevention practices.

CONCLUSION

HAI outbreaks in ACSs occur frequently, in diverse settings, and require substantial public health resources. The reviewed outbreak investigations were associated with considerable morbidity and mortality, as more than one-third of affected patients were hospitalized. Infection control standards and appropriate event reporting should be promoted, enhanced, and enforced in ACSs to ensure patient safety.

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OUTBREAK OF FUNGAL ENDOPHTHALMITIS ASSOCIATED WITH AN OUT-OF-STATE COMPOUNDING PHARMACY

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BACKGROUND

On March 6, 2012, the Acute Communicable Disease Control Program (ACDC) of the Los Angeles County (LAC) Department of Public Health (DPH) received a report from the California Department of Public Health (CDPH) about a cluster of clinically diagnosed fungal endophthalmitis cases in nine patients. All nine case-patients had undergone vitrectomy with retinal membrane peeling by any one of five retinal surgeons at a single ambulatory surgery center, Facility A. Case-patients underwent surgeries from October 31, 2011 through December 27, 2011. All nine case-patients were exposed to Brilliant Blue-G (BBG), a dye used during the retinal surgery. The BBG used during the surgeries was purchased from Franck's Compounding Lab (FCL) in Ocala, Florida. Signs of post-operative infection were noted starting in mid-November 2011.

Cases of fungal endophthalmitis associated with BBG were subsequently identified in other multiple states. The multistate investigation, including national case findings, specialized laboratory tests and collaboration with the United State (US) Food and Drug Administration (FDA) to develop recommendations to prevent infections, was led and coordinated by the Centers for Disease Control and Prevention (CDC).

During the course of investigating the initial infections associated with BBG, CDC identified clusters of fungal endophthalmitis in patients who had been administered intraocular injections of triamcinolone acetonide ("triamcinolone"), which was also compounded at FCL. On March 31, 2012, FCL issued a press release stating that they had recalled triamcinolone.

On April 2, 2012, ACDC was notified by the CDC of a cluster of three cases of fungal endophthalmitis after intraocular injections with triamcinolone at an outpatient ophthalmology clinic, Office B. Office B had purchased the triamcinolone from FCL.

ACDC investigated both of these facilities to confirm the presence of the outbreak, by interviewing staff, reviewing medical records, conduct case findings, and in conjunction with the CDC, determine source of infection and recommend measures to control the outbreak. ACDC was regularly in consultation with the CDPH and the CDC throughout this multistate outbreak investigation.

Investigation of FCL was conducted by the US FDA and the State of Florida Department of Health Services.

METHODS

Case Finding

A probable case was defined as ophthalmologist-diagnosed fungal endophthalmitis occurring in a patient who underwent an invasive ophthalmic procedure, including but not limited to vitrectomy, corneal surgery, or intravitreal injections on or after August 23, 2011, the production date of the BBG stock used on the Facility A patients. Confirmed cases met criteria for probable infection and also had fungi identified from the affected eye by culture, genetic sequencing, or histopathology. Each infected eye was counted separately as a case.

To identify cases, we first reviewed medical records from Facility A patients who received BBG from FCL and received a clinical diagnosis of fungal endophthalmitis. ACDC worked with Facility A to identify all patients who received BBG since Facility A first began purchasing BBG from FCL to determine if there were any other cases of fungal endophthalmitis. Billing codes were reviewed by Office B to identify

patients who had received triamcinolone intraocular injections. All patients who had received injections of triamcinolone subsequently recalled by FCL were identified and their medical records were reviewed.

Active Surveillance:

To identify other cases of fungal endophthalmitis related to BBG, ACDC contacted large retinal surgery practices in LAC to inquire about the use of sterile products from FCL.

Notifications and Recalls:

Local alerts and national notifications to ophthalmologists, retinal specialists, and clinicians were distributed by LAC DPH, CDC and CDPH. The FDA also posted recalls, safety alerts, and MedWatch (The FDA Safety Information and Adverse Events Reporting Program) alerts. National ophthalmology and retinal surgery organizations sent notices to their members. FCL sent recall notices to physicians. The California State Board of Pharmacy was also notified by LAC DPH.

Site Visits

1. Facility A: On March 7 and 8, 2012, site visits were conducted at Facility A by an ACDC team of medical, nursing, and epidemiology staff to meet with the Director of Nursing, President, and Medical Director; for a tour of the facility, to review pharmacy invoices, medication storage, infection control policies, and medical records. Subsequent site visits occurred to complete medical record review.

2. Office B: On April 4, 2012, an initial site visit was conducted by an ACDC physician and nurse to meet with the owner and ophthalmologist, to review pharmacy invoices, and review medical records. Medical records of patients who had received recalled triamcinolone from FCL were reviewed. Subsequent site visits occurred to complete medical record review.

Case-Control Studies

1. Facility A: On March 14 and 15, 2012, ACDC returned to Facility A to conduct a case-control study to determine risk factors associated with illness. Cases were defined as patients that underwent vitrectomy during the investigated time period at the Facility A from October 13, 2011 through January 12, 2012 (the dates BBG from FCL were used at Facility A) and who were subsequently clinically diagnosed with fungal endophthalmitis. Controls were patients who underwent vitrectomies during the same time period and were well at the time of the study. Two matched controls per case were selected from among other patients who also underwent vitrectomies in the same operating room on the date of each case's procedure; thirteen other controls that underwent vitrectomies from October 13, 2011 through January 12, 2012 were selected randomly. Using a standardized questionnaire, clinical and laboratory data were abstracted from medical records; SAS® version 9.2 was used for statistical analysis. A national case-control study is also being conducted by the CDC.

2. Office B: On May 18, 2013, ACDC abstracted data from medical records using a standardized questionnaire for a national case-control study being conducted by the CDC.

Laboratory Testing

Available case specimens (e.g., vitreous fluid, intraocular lens) that showed fungal hyphae by histopathology or fungal growth on culture were sent to the LAC DPH Laboratory for further fungal identification and then forwarded to the Antifungal and Fungal Reference Unit of CDC's Mycotic Diseases Branch for additional molecular testing. Polymerase Chain Reaction (PCR) was performed by CDC on available case specimens (e.g., vitreous fluid, intraocular lenses, and natural lens) that had no evidence of fungal hyphae on histopathology and no fungal growth on culture. ACDC worked with local hospitals and the LAC DPH Laboratory to coordinate specimen collection and transport.

All testing of BBG and triamcinolone products from FCL was conducted by the FDA.

RESULTS

Facility A reported first ordering BBG from FCL on September 12, 2011. On December 8, 2011, Facility A noticed that the expiration dates printed on the BBG vials received from FCL had differed from dates printed on the box they came in. They reported this inconsistency to FCL and they were advised to return any used vials to FCL. In December 2011, Facility A noticed a few patients who had retinal surgery during November/December 2011 had developed extended post-operative inflammation and severe vitritis. Facility A stopped using BBG from FCL on January 12, 2012 and returned remaining vials of BBG to FCL. Lot numbers of the BBG were not recorded on patient's medical records; however, Facility A's central supply department kept records of shipments. On February 21, 2012, Facility A received a laboratory results sent by FCL showing that a 5mL BBG sample (labeled as Sample #W-1-1316 and received by the laboratory on January 16, 2012) was positive for *Fusarium* species (report date February 14, 2012). Facility A then notified the CDC, CDPH, FDA, and the Florida State Board of Pharmacy.

Case Finding

1. Facility A: A total of nine cases (in nine patients) were identified (two confirmed and seven probable) with no bilateral infections. A total of 28 patients had exposure to BBG from October 13, 2011 through January 12, 2012 out of a total of 122 vitrectomies performed during this time period. Cases underwent their initial surgeries from October 31, 2011 through December 27, 2011. Two cases had hyphae by histopathology on ocular specimens. Fungal cultures had not been obtained. Six cases had ocular specimens sent to the CDC for PCR; no fungal DNA was amplified by PCR from these specimens. The onset of symptoms in the first case was November 14, 2011. Mean incubation period from procedure date to endophthalmitis onset was 13.3 days (range from 3-36 days).

2. Office B: A total of 14 cases (in 12 patients) were identified (eight confirmed and six probable). Case patients received intravitreal injections of triamcinolone from December 21, 2011 through February 29, 2012. A total of 15 patients received recalled triamcinolone during this time period, three with bilateral injections and three receiving multiple injections in the same eye. Two patients who received bilateral injections with recalled triamcinolone subsequently developed infections in each of those eyes. Three cases had evidence of fungal hyphae on histopathology without culture confirmation. One case had growth of *Bipolaris* species on culture but no hyphae observed on histopathology. Four had both fungal hyphae on histopathology and growth of *Bipolaris* species in culture. Seven specimens were sent to the CDC for PCR; no fungal DNA was amplified by PCR from these specimens. Incubation period (date of triamcinolone injection to date of vision changes or clinical diagnosis of endophthalmitis) ranged from seven days to ten months. To date, three patients of the 15 total patients exposed to recalled triamcinolone have not shown evidence of infection.

All nine cases exposed to BBG required repeat surgery or surgeries. Seven received antifungal treatment.

All 12 case-patients exposed to triamcinolone required repeat surgery or surgeries. All cases received antifungal treatment.

Active surveillance:

No additional cases associated with products from FCL were identified after calling 15 retinal surgery centers in LAC.

Notifications and Recalls:

- On March 7, 2012 the LAC DPH posted a report regarding the BBG-associated fungal endophthalmitis cases to the CDC's Epidemic Information Exchange (*Epi-X*).

- Both the American Society of Retinal Surgeons and the American Academy of Ophthalmologists issued multiple warnings to its members about BBG.

- FCL sent a letter recalling its BBG on March 9, 2012 to ordering physicians.[1] The FDA publicly issued this letter as a press release on March 16, 2012, then issued a follow-up notice on its MedWatch site on March 19, 2012.[2, 3]

- On March 31, 2012, a single lot of triamcinolone was recalled by FCL.[4] An additional lot of triamcinolone was recalled on May 2, 2012.[5]

- On April 13, 2012 the LAC DPH notified the California State Board of Pharmacy regarding the second ophthalmic product, triamcinolone, associated with a cluster of fungal endophthalmitis cases in LAC.

- FDA issued a second warning to physicians regarding drugs from FCL on April 20, 2012 and May 4, 2012.[6, 7]

- On April 16, 2012, the LAC DPH issued an alert to healthcare providers, hospital laboratories, clinical laboratories, and pharmacies.[8] The alert described the outbreak of fungal endophthalmitis associated with the use of two separate products purchased from FCL and advised healthcare workers to immediately discontinue use of those products and report, to LAC DPH, any cases of endophthalmitis or clusters of any other bacterial or fungal infections following use of sterile compounded products from FCL.

- On April 19, 2012, the California State Board of Pharmacy served FCL with an Order to Cease and Desist, prohibiting it from shipping any sterile injectable compounded products into California.

- On May 4, 2012, the CDC and multiple state/local health departments published a brief report of the outbreak and recommended that clinicians and patients avoid use of compounded products labeled as sterile from FCL.[9]

- On May 25, 2012, FDA announced an expanded recall of all sterile compounded drugs from Franck's distributed from November 21, 2011 through May 21, 2012.[10,11]

- On July 9, 2012, the FDA issued a warning letter to FCL describing its inspection and charges.[12]

- Through disciplinary action of the California Board of Pharmacy, both of Franck's compounding pharmacy licenses issued by the state of California were voluntarily surrendered.[13]

Case-Control Study

Nine BBG-exposed cases and 33 controls were included in the LAC case-control study. The mean age of cases was 72.3 years and the mean age of controls was 61.8 years. Cases and controls did not differ significantly by gender, past history of diabetes, hypertension or recent past history of eye surgery; preoperative or intraoperative medicines including eye drops; or operating staff. However, cases had significantly higher odds of being exposed to BBG than controls (odds ratio: ∞; $P < 0.001$).

National case data is under review by the CDC; at the time of this report, those results were not available.

Laboratory Testing

All available fungal isolates from confirmed nationwide cases associated with BBG exposure were identified by culture or genetic sequencing as the mold *Fusarium incarnatum-equiseti* species complex. Culture of unopened bottles and intact (unused, pharmacy-prepared) syringes of BBG dye collected by FDA yielded multiple bacterial and fungal species, including *Fusarium incarnatum-equiseti* species complex.[9] *Fusarium incarnatum-equiseti* species complex isolates from BBG tested were shown by multilocus DNA sequencing at CDC to be indistinguishable from cases in the national outbreak.

All available fungal isolates from confirmed cases nationwide occurring after intravitreal injection of triamcinolone-containing products were identified as *Bipolaris hawaiiensis*.[9] Bipolaris *hawaiiensis* was identified by DNA sequencing of multiple isolates from triamcinolone-exposed case isolates across multiple states.

CONCLUSIONS

In LAC, a total of 23 cases of fungal endophthalmitis associated with products compounded by FCL were identified (ten confirmed and 13 probable) in 21 patients. Nine cases were associated with BBG exposure (two confirmed, seven probable) and 14 cases (in 12 patients, two of which had bilateral eye infections) were associated with triamcinolone exposure (eight confirmed, six probable). Both the BBG and triamcinolone administered to these cases were compounded at FCL.

Confirmed national cases associated with BBG exposure were identified by culture or genetic sequencing as the mold *Fusarium incarnatum-equiseti* species complex. BBG from FCL was also found to have *Fusarium incarnatum-equiseti species complex* that was indistinguishable from cases in the national outbreak by DNA sequencing.

Bipolaris hawaiiensis was identified by DNA sequencing of multiple isolates from triamcinolone-exposed cases across multiple states, suggesting a common source.

Alerts and recalls of products from FCL were distributed locally and nationally by LAC DPH, CDC, and FDA. Investigation of FCL was performed by the FDA[12] and Florida Department of Health.

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OUTBREAK OF *MYCOBACTERIUM FORTUITUM* SURGICAL SITE INFECTIONS AT A PLASTIC SURGERY AMBULATORY CENTER

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BACKGROUND

Mycobacterium fortuitum is a rapidly-growing mycobacterium (RGM) that is commonly found in water and soil. RGM as a group (consisting of *M. fortuitum*, *Mycobacterium abscessus*, and *Mycobacterium chelonae*, including their subspecies) are increasingly linked to localized infections of skin and soft tissue following a variety of procedures (1), including but not limited to cardiothoracic surgery, mesotherapy, liposuction, abdominoplasty, and Mohs micrographic surgery. In particular, RGM, especially *M. fortuitum*, have been increasingly associated with plastic/reconstructive procedures such as breast augmentation, in some cases leading to outbreaks (2-4). While a specific route of transmission was postulated in some RGM outbreaks, such as a contaminated skin-marking medication shared among multiple patients (5), contaminated solutions or instrumentation (6,7), or body colonization of a staff member (8), no source of RGM is identified in most outbreaks. However, due to their ubiquitous nature, tap water and the surgical or hospital environment (9) are likely sources.

On October 20, 2011, the Los Angeles County Department of Public Health (LAC DPH) Acute Communicable Disease Control Program (ACDC) was notified by an ambulatory plastic surgery center (Facility A) of an ongoing cluster of five *M. fortuitum* surgical site infections among patients who underwent breast augmentation and/or abdominoplasty procedures at their facility; the first two cases underwent surgery during December 2010, and the subsequent three cases had surgery in January 2011, June 2011, and August 2011, respectively. All patients had uneventful surgeries but returned for follow-up within two months with infected wounds that grew *Mycobacterium fortuitum* by culture.

ACDC conducted an initial investigation in October 2011 and consulted with the California Department of Public Health and the Centers for Disease Control and Prevention (CDC) throughout the investigation to discuss methods, findings, and recommendations.

After the initial three cases were identified by the surgeon, Facility A hired a private infection control firm in May 2011, and implemented several infection control measures including installation of filters on scrub and utility sinks, changes in patient cleansing procedures both preoperatively and intraoperatively, changes in surgeon and operating room (OR) staff preoperative scrub technique, collection of multiple cultures of staff, and other measures. However, two additional cases of *M. fortuitum* infection occurred after initiating these infection control actions, prompting the surgeon to contact ACDC in October 2011.

Subsequently, in August and October 2012, two additional case-patients were diagnosed with *M. fortuitum* wound infections following breast surgery in June 2012 and July 2012, approximately one year after the first cluster of five case-patients were identified and reported. Both of the latest case-patients underwent uneventful surgeries and presented for follow-up at two and three months post-surgery with initial onset of wound infection.

METHODS

CASE FINDING

A case was defined as a patient who developed an *M. fortuitum* surgical site infection more than 30 days following breast or abdominoplasty surgery at Facility A from December 2010 to present.

At the onset of the investigation in October 2011, ACDC asked Facility A staff to identify all primary/secondary breast augmentation and abdominoplasty patients who underwent surgery between December 1, 2010, and September 1, 2011 who did not return for follow-up within three months of their

procedures. Facility A contacted patients by email and telephone to discuss each patient's post-operative course and to schedule follow-up visits whenever possible. ACDC also consulted with the LAC DPH Tuberculosis Control Program and reviewed their surveillance data of nontuberculous mycobacteria isolated from non-pulmonary sites dating back to January 1, 2010. ACDC also reviewed medical records of four additional patients listed in a recovery room infection log as having developed post-operative infections between September 2010 and October 2011.

CASE-CONTROL STUDY

A case-control study was conducted to identify exposures epidemiologically associated with *M. fortuitum* infection during the investigation of the initial cluster of five cases. For this study, cases were defined as described earlier; control subjects were breast augmentation and abdominoplasty patients selected randomly from noncase months between December 2010 and August 2011. Using a standardized chart abstraction form, data from all case and control subjects was collected regarding surgical patient order in a given day, surgery day of week, length of surgery, medications used pre- and intraoperatively, placement of drains for post-operative management, post-operative destination, county of residence, anatomic surgical site location, and stay at a nearby independent post-operative recovery center (Facility X).

SITE VISITS

An initial site visit to Facility A was made on October 21, 2011, by ACDC medical, nursing, and epidemiology staff. Infection-control deficiencies and corrective actions were verbally discussed with the surgeon involved in the five initial cases and his staff, and environmental samples were collected for mycobacterial testing.

On October 26, 2011, ACDC staff observed a secondary breast augmentation surgery, collected additional environmental samples, and reviewed medical records. Cleaning, disinfection, and sterilization procedures/policies were also reviewed. Recommendations to correct infection-control deficiencies were provided to Facility A both verbally and in writing following the first two site visits.

An environmental health inspection was conducted on November 4, 2011, to evaluate air flow, collect environmental samples, and further medical record review was completed by ACDC.

On November 9, 2012, ACDC returned to Facility A for a site visit due to the identification of two additional cases. Medical records of the case-patients were reviewed and a tour of the clinic area and building of the facility area were conducted. On November 13, 2012, ACDC observed a secondary breast surgery, and collected additional environmental samples in addition to personnel samples for mycobacterial testing.

LABORATORY TESTING

Environmental samples collected on October 21 and 26, 2011, by LACDPH from Facility A included:

- filters from the scrub sink and utility room sink
- faucet aerator from recovery room sink
- water (both with and without filter) from the scrub sink and utility room sink
- irrigation solutions and swabs of irrigation solution bottles used during an observed secondary augmentation surgery
- Marcaine™ solution and swab of the medication vial opened with bottle opener and used during observed surgery
- bottle opener used in the OR
- autoclave water, including prepackaged distilled water, autoclave reservoir water, autoclave wastewater, and swabs of reservoir and wastewater ports
- surgical marking pens
- disinfectant solution from instrument soaking trays in multiple exam rooms
- swabs of OR microwave
- sealed, microwaved 500 ml container of sterile saline solution

- open vial of single-dose lidocaine from OR
- open, expired bottle of tricholoracetic acid (TCA) 35% in OR
- Gentian Violet and Methylene Blue solutions from OR
- open bottles of single-use sterile saline from exam rooms
- building HVAC (heating, ventilation, and air conditioning) system pre-filter and swab of condensation drainage line, and
- air samples collected from the OR, utility room, and OR suite hallway via an Andersen sampler.

On November 13, 2012, a total of 36 environmental samples and 15 personnel samples were collected. Environmental samples included:

- water from sinks in exam rooms (1, 2, 3, and 4), fish aquarium in the medical office above Facility A, and cooling tower located on the roof of the building
- water (both with and without filter, where applicable) from kitchen sink, utility room, scrub sink, and OR recovery room
- office kitchen refrigerator water and ice
- staff bathroom sink and toilet tank water, and
- swabs of utility sink faucet, recovery room sink faucet, inner surfaces of utility room freezers, inner walls of the fish aquarium, inner surface of the cooling tower, and spigots from bathroom sink and exam rooms 1, 2, 3 and 4.

Personnel samples included:

- sponge wipes of nares, eyebrows, and hands/nails of the OR circulating nurse #1 and #2, scrub technician, anesthesiologist, and surgeon.

The LAC DPH's Public Health Lab (PHL) performed acid-fast bacilli (AFB) testing on environmental samples collected during the site visits, including culture and high pressure liquid chromatography (HPLC). AFB testing on environmental samples collected on November 4, 2011, was performed by CDC; methods included culture, HPLC, and genetic sequencing.

CDC also performed pulsed field gel electrophoresis (PFGE) of the four available patient isolates, those from four patients that underwent surgery in June and August 2011, and June and July 2012, respectively.

ACDC also reviewed the final environmental testing results performed by a private laboratory prior to the initiation of our investigation of this outbreak.

RESULTS

CASE FINDING

Between December 1, 2010, and September 1, 2011, a total of 20 abdominoplasties, 86 primary breast augmentations, and 45 secondary breast augmentations were performed.

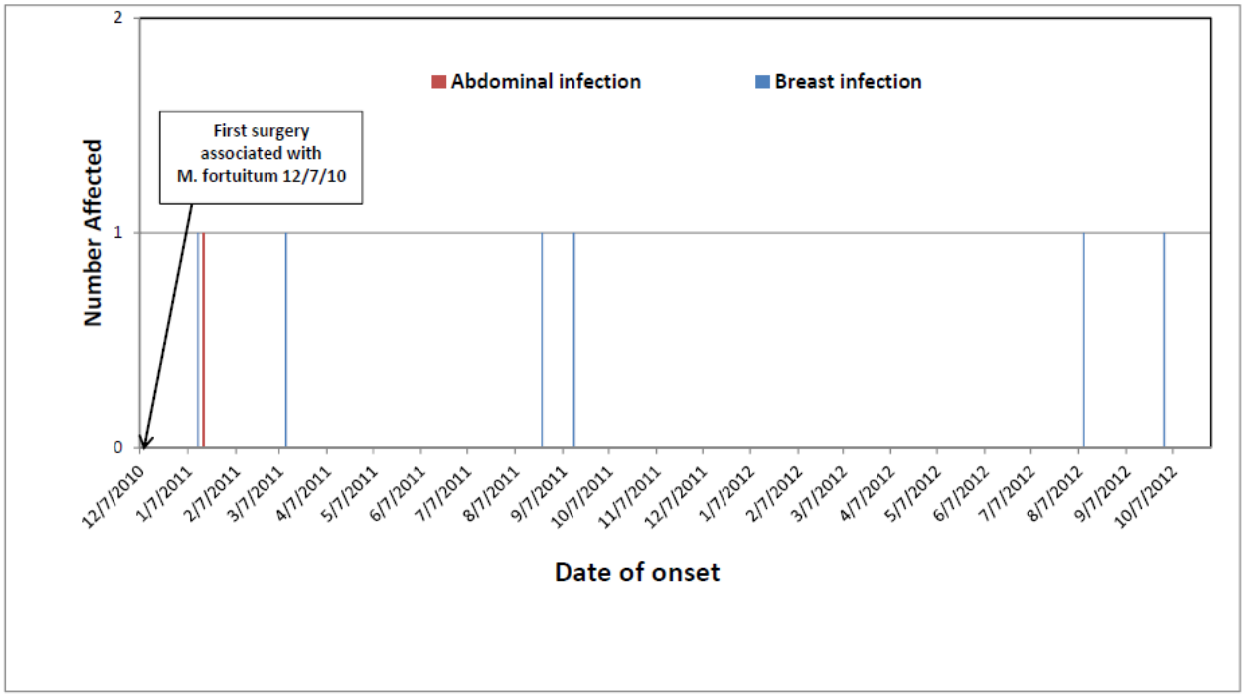
A total of seven cases meeting the case definition were identified: Six of the seven cases were infections following a breast procedure and one case was an infection following an abdominoplasty procedure. All had surgical site specimens that were AFB smear-negative but had growth of *M. fortuitum* on culture. The abdominoplasty case also underwent a concurrent secondary breast augmentation procedure, but only the abdominoplasty wound was infected with *M. fortuitum*. Six of seven case-patients were female, with a mean age of 37 years (range 23-49 years). The mean incubation period from date of the initial surgery to date of symptom (wound swelling without fever) onset was 53 days (range 27-82 days).

All case-patients required treatment with antibiotics; four breast augmentation case-patients also required surgical implant removal to manage their infections. None were hospitalized. Figure A is an epidemic curve depicting the dates of diagnosis of all seven case-patients associated with this outbreak.

Thirty-eight abdominoplasty and primary/secondary breast augmentation patients were identified as not having returned for follow-up within three months of surgery from December 1, 2010 to September 1, 2011. Facility A was able to reach 18 of these patients for clinic follow-up; none had experienced any signs of infection post-operatively.

No other cases were identified via review of the LAC DPH Tuberculosis Control surveillance data for AFB wound site or medical record review of patients named on an internal infection control log.

FIGURE A. Epidemic curve depicting symptom onset dates of post-surgical *M. fortuitum* infections at Facility A from Jan 2011 to October 2012



CASE-CONTROL STUDY

The initial cluster of five case-patients and 29 identified control subjects were included in the case-control study. There were no statistically significant differences between case-patients and control subjects with regards to surgical patient order in a given day, surgery day of week, length of surgery, medications used pre- and intraoperatively, placement of drains for post-operative management, county of residence, and anatomic surgical site location (Figure B). A significant difference between case-patients and control subjects was observed regarding post-operative stay at Facility X, but this likely represents a statistical anomaly due to the small number of case-patients in the analysis; additionally, this facility is used by multiple surgeons from multiple facilities who have not experienced known clusters of mycobacterial post-operative infections, making Facility X a less plausible source of *M. fortuitum* transmission for this outbreak.

FIGURE B. Case-control study results – Initial Cluster of Five Case-Patients

	Cases (N=5)			Controls (N=29)				
	%	n	N	%	n	N	Attack Rate	p-value
Post op stay at Facility X	80%	4	5	10%	3	29	**57%**	**0.003**
Out-of-county resident	60%	3	5	48%	14	29	18%	0.64
Drains placed	80%	4	5	24%	7	29	36%	0.05
Pain pump used	20%	1	5	7%	2	29	33%	0.92
Bilateral procedure	100%	5	5	90%	26	29	16%	1.00
Marcaine™ used locally	100%	5	5	97%	28	29	15%	1.00
Irrigation solution used	100%	5	5	90%	26	29	16%	1.00
R&R with caps	60%	3	5	28%	8	29	27%	0.36
Day of Week								
Monday	0%	0	5	10%	3	29	0%	1.00
Tuesday	0%	0	5	38%	11	29	0%	0.71
Wednesday	40%	2	5	21%	6	29	25%	0.46
Thursday	60%	3	5	31%	9	29	25%	0.25
Surgery Length								
1 hour	20%	1	5	66%	19	29	5%	0.16
2 hours	60%	3	5	28%	8	29	27%	0.36
2.5 hours	20%	1	5	7%	2	29	33%	0.92
Case Order								
First	40%	2	5	48%	14	29	13%	1.00
Second	20%	1	5	31%	9	29	10%	1.00
Third	20%	1	5	17%	5	29	17%	1.00
Fourth	20%	1	5	3%	1	29	50%	0.67

SITE VISITS

On October 21, 2011, ACDC personnel conducted a site visit to review medical records of the five known cases. A walk-through of the facility was also performed. Facility A is an ambulatory surgery center housed within a medical office building. Patient care areas consist of four exam rooms, with a separate operating suite containing a single OR with adjacent recovery room and a utility room with a sink and two autoclaves. These areas are shared by three physicians: the plastic surgeon who operated on all seven case patients (Surgeon A), a dermatologist who uses the exam rooms and occasionally also does procedures in the OR, and a second plastic surgeon who performs only a few surgeries per month at this facility. All three physicians hold active medical licenses in the state of California. The surgical team for each of the seven cases consisted of Surgeon A, an anesthesiologist, scrub tech, and circulating nurse; the recovery room was staffed by a different nurse than that in the OR. The four office Registered Nurses (RN) each held a current RN License issued by the California Board of Registered Nurses. The scrub tech also held a current surgical technologist certificate issued by the National Board of Surgical Technology and Surgical Assisting.

ACDC reviewed the office's infection control policies and procedures manual, employee training log, nursing staff meeting minutes, quality improvement studies, and infection control log maintained by the supervising RN.

The facility was overall clean and orderly, but several infection control deficiencies were observed in the patient examination rooms, including:

- opened single-use medication vials

- undated, opened sterile water and sterile saline bottles
- expired multi-use medication vials
- multi-use medication vials without a written open-date, and
- drawers containing syringes pre-filled with medication with no labeling of the syringe contents, expiration dates, or medication dosages.

In the operating room, the following infection control deficiencies were observed:

- opened, single-use vial of lidocaine
- expired, unopened multi-use Marcaine™ vials
- can/bottle opener used to remove medication vial cap and rubber stopper prior to pouring contents into sterile bowl, and
- microwave used to warm sterile saline and irrigation solutions used during surgery.

On October 26, 2011, ACDC staff returned for additional medical record review. A secondary augmentation surgery was also observed during this visit. The following infection control deficiencies were observed.

- During surgery the circulating nurse opened a sterile Marcaine™ vial by completely removing the vial top (including both the rubber stopper and glass vial neck) with a common household bottle opener, then poured the vial contents into a sterile bowl. The OR staff stated this was their standard procedure for Marcaine™ preparation.
- Sterile saline bags for infusion and sterile saline bottles for irrigation were heated in a microwave located just outside the OR that was dedicated to heating OR solutions only. A review of staff meeting documents found that prior to January 2011, the kitchen microwave used for heating of food was also used to heat the OR solutions.
- Movement of personnel in OR was not kept to a minimum (circulator nurse walked in and out of OR on a cell phone).

In addition, irrigation solution was mixed in bulk at the start of surgery, but exact volumes used during surgery and location of irrigation administration (e.g., left breast or right breast) were not recorded in the medical record. Exact dose of Marcaine™ administered and location administered was also not documented in the medical record.

Fourteen environmental specimens, including the bottle opener used to open medication vials, were collected during the October 26, 2011 visit and submitted to LAC PHL for culture. Recommendations for rectifying infection control breaches were discussed verbally that day and also in writing in a follow-up email.

ACDC visited Facility A on November 4, 2011, with an LAC DPH Environmental Health (EH) Industrial Hygienist for air flow testing, medical record review, and case finding. Seventeen environmental samples were collected and submitted to CDC for testing. Autoclave records including biologic monitoring were reviewed dating back to December 2010; no system deficiencies were noted during this time period.

ACDC returned to Facility A on November 9, 2012, in response to the report of the two additional cases. Medical records of the case patients were reviewed, in addition to inspection of the exam rooms, OR, and utility room where the autoclave and sterilizer are located. On November 13, 2012, ACDC observed a secondary breast augmentation surgery. Overall, the clinic was very clean and had implemented the recommendations provided during the site visits approximately one year prior, except for the observation of opened single-dose vials in patient exam rooms.

Steam exhausted from the autoclave during a cycle was observed accumulating in the utility room which is located directly across from the OR door. The exhaust fan is not always turned on in the utility room. Condensation of steam was also noted on the lower shelf items when the autoclave water was being drained into a basin placed on a step stool and on the upper shelf items during the autoclave cycle, when steam is continually exhausted directly above the autoclave.

In the OR, the staff were observed to use correct aseptic technique in the transferring of medication from a vial to a sterile field in the preparation of irrigation solution. The use of a cabinet with temperature controls specifically designed for warming irrigation and intravenous fluids was observed in the OR and the microwave used for heating up solutions during the site visits in October and November 2011 was removed.

ENVIRONMENTAL HEALTH INSPECTION

Air flow testing conducted by an LAC DPH EH Industrial Hygienist during the November 4, 2011, visit suggested that there was suboptimal air circulation in the OR. Specific findings included:

- placement of supply and return air registers in the OR were too close in proximity to each other, resulting in stagnant air over the operating table; this was confirmed via smoke tubes, which demonstrated that air in the OR tended to remain suspended over the operating table
- low air flow at both the supply and return air registers in the OR, based on smoke tube testing, and
- no positive- or negative-pressure air flow in the OR, as demonstrated by smoke tube testing, also suggesting stagnant air in the OR.

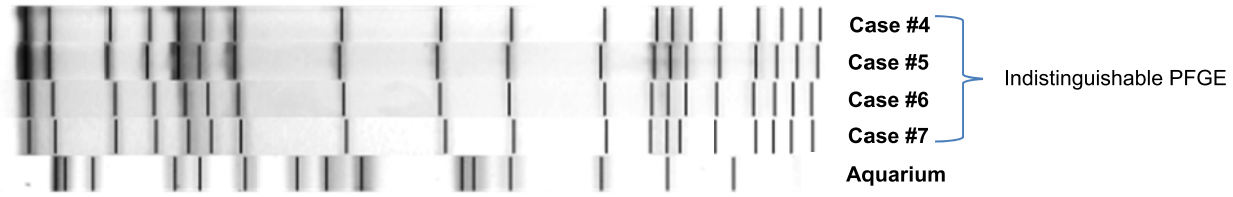
The Industrial Hygienist returned to Facility A on November 28, 2011, to conduct microbiologic air sampling of the OR, utility room, and OR suite hallway with a standard Andersen sampler. During this visit the air flow in the OR had improved and the room was now under positive pressure. The Industrial Hygienist felt that under ideal conditions, an OR should have high-efficiency particulate air (HEPA)-filtered air supplied at the ceiling and exhausted near the floor, which was not observed in the OR at Facility A. However, in light of the negative microbiologic results suggesting contaminated air was not likely to be the source of patient infections, Industrial Hygiene did not ultimately feel that an improved air supply within the OR was absolutely necessary.

LABORATORY TESTING

PFGE of *M. fortuitum* isolates from the two case-patients who underwent surgery in June and August 2011, respectively, was indistinguishable suggesting that their *M. fortuitum* isolates may have originated from a common source. The *M. fortuitum* isolates from the two case-patients who underwent surgery in June and July 2012 were also submitted to the CDC for PFGE testing. Their patterns are indistinguishable from each other and also from the two 2011 (June and August) cases previously tested by PFGE.

All environmental and office personnel samples collected throughout the investigation were *M. fortuitum* culture-negative, except for a swab taken on November 13, 2012, from inside the aquarium in the medical office located directly above the surgery suite. Growth from this swab was identified as *M. fortuitum*; an isolate was subsequently sent to the CDC for PFGE to compare its relatedness to the four case-patient isolates. The final result of the aquarium isolate indicated no relation to the four case-patients based on standard PFGE interpretation criteria (Figure C).

FIGURE C. CDC PFGE testing of four case-patient and aquarium *M. fortuitum* isolates.



Additionally, ACDC learned that a specimen from the building HVAC system that was submitted to an outside laboratory independent of our investigation was AFB positive by culture. The specimen was forwarded to the LAC DPH PHL for further testing; *M. chelonae* was identified by HPLC.

Environmental samples collected by Facility A staff and tested at an outside laboratory prior to ACDC's investigation included water from the autoclave and OR sink, an air vent in the OR, swabs from the utility and OR sinks, a plastic basin believed to have been used for instrument cleaning, skin swabs of several staff members, and water collected from a staff member's home swimming pool. ACDC reviewed all microbiologic results: with the exception of *M. chelonae* isolated from water from the OR (scrub) sink, all testing from the surgery suite and office in Facility A was negative for RGM species.

RECOMMENDATIONS

1. Continue to immediately notify LAC DPH of any new cases of post-operative infections with acid-fast bacilli (AFB) or culture-confirmed mycobacteria.
2. Discontinue use of the can/bottle opener. Ensure strict use of aseptic technique in the transferring of medication from a vial to the sterile field in the operating room. The medication vial cap and rubber stopper should not be removed from vials for the purpose of pouring medication as the edge of the vial can become contaminated. Sterile transfer devices should be used to dispense medications to the sterile field; alternatively, the medication should be drawn from the vial into a sterile syringe with the use of a sterile needle.
3. Infusions and irrigation solutions should not be heated in microwave ovens. Temperatures cannot be controlled in a finite way in microwave ovens and therefore medical products are subjected to uncontrolled conditions. Not only is product degradation a concern but so is degradation of the container. An appropriate temperature controlled fluid warming cabinet should be used, which Facility A has now obtained. Follow the manufacturer's recommendations for the appropriate temperature for solution warming.
4. Single dose (single-use) medication vials or bottles of solution should be used for only one patient then discarded. The safest practice is to enter a single-dose or single-use vial only once so as to prevent inadvertent contamination of the vial and infection transmission. Single-dose or single-use vials should be used for a single patient for a single case/procedure/injection.
5. Label all pre-filled medication syringes with the name of the medication, date filled, concentration and dosage of the medication, and expiration date.
6. Date multi-dose vials when they are first opened and then discard within 28 days unless the manufacturer specifies a different (shorter or longer) date for that opened vial. *Note: This is different from the expiration date printed on the vial.*
7. Discard expired medication vials.
8. Keep accurate documentation in the peri-operative notes regarding amount of medications and irrigation solutions administered to the patient and the location site given.
9. Ensure training of staff in infection control practices and routinely review staff's use of proper aseptic technique.
10. Work with the building management to prevent further leaks from the aquarium located above Facility A and fix any pipes that have leaked into any office space.
11. Keep the exhaust fan in the utility room turned on at all times. Minimize traffic in the hallway between the utility room and the OR, and minimize opening the OR door when surgery is in progress. Minimize traffic in and out of the OR during surgery
12. Change patient surgical skin preparation in the operating room to iodine-based formulations, such as providone-iodine (unless contraindicated), rather than a chlorhexidine-based product, such as Chloraprep®. Iodine-and alcohol-based compounds are more reliably mycobactericidal than chlorhexadine.
13. Discontinue home laundering of OR attire. Use a facility-approved and monitored commercial healthcare laundry company, which abides by Occupational Safety and Health Administration and CDC guidelines to ensure OR attire are free from microbial contaminants. Follow the standards developed by the Association of Surgical Technologists regarding OR attire and laundering (10).
14. Discontinue practice of wearing OR attire (e.g., scrubs) outside the surgical area, When leaving the OR area, remove and dispose of shoe/hair covering.
15. Hair coverings in the OR should cover facial hair, sideburns, and the nape for the neck.
16. Remove the items stored in storage bins on the shelves located directly underneath the autoclave and on the shelf above the autoclave.

CONCLUSIONS

In summary, a total of seven case-patients were identified at Facility A with *M. fortuitum* surgical site infections following breast or abdominoplasty surgery performed between December 2010 and July 2012. Of the seven cases, isolates were available for four patients, surgery in June 2011, August 2011, August 2012, and October 2012, respectively. These isolates were submitted to the CDC for PFGE, which indicated that these four case-patient isolates were indistinguishable from each other, despite nearly one year between the two clusters, suggesting that these infections originated from a common exposure.

RGM are ubiquitous environmental organisms that can be readily isolated from soil and water, and the recovery of *M. chelonae* and *M. mucogenicum* from several water-associated specimens collected during this investigation underscores this. However, RGM are not typical skin flora; soft tissue infections by these organisms are typically associated with trauma and/or a foreign material breaching the integrity of the skin. The common source was most likely an environmental source at Facility A, as the likelihood of infection with the same genetically-indistinguishable organism by exposure to water/soil at home or in another setting not held in common by four cases is extremely low. The ubiquitous nature of RGM highlights the importance of strict adherence to appropriate sterilization procedures and aseptic technique at all stages of an invasive procedure.

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OUTBREAK INVESTIGATION OF VENTRICULOPERITONEAL SHUNT INFECTIONS AMONG NEUROSURGERY PATIENTS, LOS ANGELES 2012

Patricia Marquez, MPH; L'Tanya, RN, MPH; and Dawn Terashita, MD, MPH

BACKGROUND

Ventriculoperitoneal (VP) shunts are one of the main methods to treat hydrocephalus, either excess production or reduced drainage of cerebrospinal fluid (CSF), which can cause increased pressure against the brain and subsequent neurological issues. VP shunts drain the excess fluid from the brain through a catheter into the abdominal cavity where it is reabsorbed by the body. Infections related to VP shunt insertions and revisions occur in 5-27% of patients, and most often are caused by *Staphylococcus epidermidis (S. epidermidis)* and *S. aureus*.[1,2] Risk factors for infection include premature birth, prolonged hospital stay, previous shunt infection and the conversion of an external ventricular drain to a VP shunt.[3] Many of these infections are hypothesized to be caused by the patient's own skin flora, as organisms such as staphylococci produce a biofilm that adheres to the inside of the shunt tubing.[3]

In March 2012, the infection preventionist (IP) of Hospital A notified the Los Angeles County Department of Public Health (LAC DPH) Acute Communicable Disease Control (ACDC) of four patients with *S. aureus* infections related to their recent VP shunt surgery; three were CSF infections and one a wound infection. All patients had a VP shunt placement (1) or revision (3) prior to positive culture, and all surgical procedures were performed by Surgeon A. An investigation was initiated to identify additional patients, determine the source of infection, and prevent additional cases.

METHODS

A case was defined as a patient post VP shunt surgery (insertion or revision) who was CSF or surgical wound culture positive with any staphylococcal species between January 1, 2012 and May 30, 2012. Infection control staff was instructed to notify ACDC of any new patient meeting the case definition throughout the investigation.

ACDC conducted a comprehensive review of case medical records, including clinical, surgical and microbiologic records. The monthly neurosurgery unit's *S. aureus* background rate, as well as the monthly count of neurosurgeon-specific *S. aureus* infections from January-December 2011 were reviewed. In addition ACDC requested a monthly log of total procedures and VP shunt procedures performed in operating room (OR) 7, the main room for VP shunt surgeries, from October 2011-March 2012.

ACDC staff made multiple site visits to examine the hospital environment and obtain additional information. All available case isolates were sent to the LAC Public Health Laboratory (PHL) for pulsed field gel electrophoresis (PFGE) testing.

RESULTS

A total of seven patients met the case definition. Four cases were culture positive for *S. aureus*, two cases had *S. epidermidis*, and one case was *S. hominis* positive. Two cases were female. Ages ranged from two months to 18 years, with a median age of three years. All cases had complex underlying medical problems. Three cases had multiple shunt revisions since birth and four cases had first-time shunt insertions. There were no deaths.

Background Surveillance

From January 2011 to December 2011 the monthly rate of patients in the neurosurgical unit positive with *S. aureus* at any site ranged from 4.42 to 22.1 per 1000 patient days; the CSF *S. aureus* infection rate in this same unit ranged from 0 to 1.12 per 1000 patient days during the same time period. Only two surgeons, Surgeon A and Surgeon B, perform VP shunt procedures in Facility A. Surgeon A performed

57% (n=100) of all VP shunt procedures during the background period; two CSF infections occurred in these patients, with a mean monthly infection rate of 2.0 infections per 100 procedures (range 0.0 - 12.5 infections per 100 procedures). Surgeon B performed 43% (n=74) of VP shunt procedures; none of Surgeon B's patients experienced any CSF infections during the same time period.

Epidemiologic Analysis

The main OR nursing note, brief operative note, the OR floor plan, staffing roster and related documents were reviewed for all cases. All cases received single dose pre-operative, weight-dependent antibiotic prophylaxis with vancomycin whether the procedure was elective or emergent. Six cases had their VP shunt surgery performed in OR 7; this OR is also used for other neurosurgical procedures. The seventh case had surgery performed in OR 1.

The OR 7 procedure count from October 2011 to March 2012 was reviewed; VP shunt surgeries account for nearly a quarter of total procedures performed (range 17-28%). Per communications with facility IPs, increases in infections from other procedures performed in this OR were not noted.

The operative record for each case was reviewed to identify common OR surgical staff, including the attending neurosurgeon, neurosurgery fellows and residents, anesthesiologist, nurses and scrub technicians. All cases had VP shunt surgery performed by the same neurosurgeon; however, the neurosurgery fellow, neurosurgery resident, anesthesiologist and other surgical staff varied in each procedure. The pooled mean VP shunt procedure infection rate for Surgeon A during the outbreak period January - May 2012 was 16.9 per 100 procedures (monthly range 7.7 – 30 per 100 procedures).

Molecular Epidemiology

PFGE was performed by the LAC PHL on three available *S. aureus* isolates and two *S. epidermidis* isolates. The three outbreak isolates of *S. aureus* had greater than seven band differences and were considered unrelated. The two *S. epidermidis* outbreak isolates also differed by greater than seven bands and were considered unrelated. PFGE was not performed on the single *S. hominis* isolate.

Surgical Procedure Review

A surgical practice shared by both neurosurgeons, and performed for over 15 years in the facility, is the use of a dilute iodine tincture solution to flush the shunt valve and ventricular and peritoneal catheters prior to insertion; gloved hands are also submerged into the iodine tincture solution. The solution is also used to irrigate the cranial incision prior to suture at the end of the procedure. No other neurosurgeons follow this practice at Facility A.

Site Investigation

ACDC conducted multiple site investigations during the outbreak. On April 30, 2012, we observed a VP shunt surgery performed by Surgeon A. The surgical team was double-gloved throughout the procedure and no lapses in infection control practice were identified. Hair clipping was performed by the neurosurgery resident in the prep room prior to surgery and surgical skin preparation was performed by the neurosurgery resident or fellow and supervised by the attending neurosurgeon. Interviews with Surgeon A, the neurosurgery fellow, the neurosurgery resident and the OR charge nurse were also conducted. No deficiencies were noted.

Control Measures

Upon identification of the cluster the facility notified DPH, the neurosurgical team, and the chief infectious disease physician. Facility neurosurgery staff described their infection control measures, which exceeded standards of practice in similar facilities. Most infection control measures were implemented prior to the outbreak. Ongoing measures included administration of prophylactic vancomycin to all surgical patients, the use of DuraPrep™ for skin preparation prior to surgical incision, hair clipping performed in the OR

immediately prior to surgery, double gloving of all surgical team members, double hat (bouffant and hood) for surgeons and limiting OR traffic during surgery.

DISCUSSION

Review of the literature denotes VP shunt infection rates of 5%-27%; the background rate of VP shunt infection among Surgeon A's patients prior to the outbreak period was lower, with a mean rate of infection of 2.0 per 100 procedures (monthly range 0 to 12.5 infections per 100 procedures).[1,4] ACDC analysis of the VP shunt infections in Facility A from January 2011 to April 2012 indicates that all CSF infections that occurred in this time period were in Surgeon A's patients. Surgeon A's mean infection rate during the five month outbreak period was 16.9 per 100 procedures, slightly higher than the national rates reported in the literature.

Relevant infection control policies/procedures were reviewed and determined to be within community standards of practice. The facility is compliant with the 1999 Centers for Disease Control and Prevention and the Hospital Infection Control Practices Advisory Committee's Guideline for Prevention of Surgical Site Infection (e.g., hair clipping, antibiotic prophylaxis, antimicrobial sutures and double-gloving). We were told that two cases had large volumes of CSF which could affect the patient's response to the antibiotic prophylaxis at the time of surgery.

There was no apparent point-source for the outbreak, as *S. epidermidis* and *S. aureus* are frequently identified in shunt infections and usually originate from the patient's own skin flora. DNA fingerprinting of available isolates by PFGE indicated that all were unrelated.

All infections during and prior to this outbreak occurred in Surgeon A's patients; none occurred in Surgeon B's patients. We were unable to conclusively determine the route of infection in these seven cases. However, the epidemiologic investigation identified Surgeon A as the only link between the seven cases. During the investigation it was revealed that a dilute iodine tincture solution was regularly used to flush sterile implantable medical devices and catheters prior to insertion, a practice conducted by both surgeons over 15 years and implemented purportedly to decrease the patient's risk of infection after surgery. This practice is an off-label and an unapproved use of the product. Although it is unlikely that the use of iodine tincture during surgery was the cause of the outbreak, DPH recommended all neurosurgeons in Facility A discontinue the practice and to strictly adhere to the manufacturer's recommendations and guidelines for shunt preparation before insertion.

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OUTBREAK OF INFECTIONS CAUSED BY *SHIGELLA SONNEI* WITH DECREASED SUSCEPTIBILITY TO AZITHROMYCIN

Roshan Reporter, MD, MPH and Marifi Pulido, PhD

SUMMARY

In May 2012, the Los Angeles County Department of Public Health's (LAC DPH) Acute Communicable Disease Control Unit (ACDC) and Environmental Health Services (EHS), Food and Milk Program (F&M), investigated an outbreak of shigellosis associated with a private bridge club. This investigation documented the first known outbreak-transmitted *Shigella sonnei* with decreased susceptibility to azithromycin in the United States (US).

BACKGROUND

On Tuesday, May 29, 2012, LAC DPH received a web-based foodborne illness report (FBIR) stating that all eight people who ate a lunch buffet at a bridge club where they attend daily bridge classes and/or tournaments became ill with diarrhea, vomiting, nausea, stomach cramps, fever, and headache. The initial exposure was believed to have occurred on May 22nd; the food was prepared by club staff. ACDC initiated an epidemiological investigation to determine the extent of the outbreak, risk factors for the disease, and steps needed to prevent further infections.

METHODS

ACDC requested line lists of club attendees and staff then developed two separate questionnaires. Questionnaires were administered to attendees and staff who were present during the classes and/or tournaments from May 21-26, 2012. Attendees were interviewed by telephone. Some club staff members were interviewed by telephone while others self-administered the questionnaire.

F&M contacted the complainant to obtain additional information on food and drinks eaten at the bridge club. F&M conducted a facility inspection of the bridge club in question on Tuesday, May 29, 2012. On June 5, 2012, a second visit was made by both F&M and ACDC staff to ensure compliance with recommendations.

An outbreak-associated case was defined as a person eating or drinking anything at the bridge club during the week of May 22 - 26, 2012 and were: 1) a laboratory confirmed case of *Shigella sonnei*, 2) had diarrhea (three or more loose stools in a 24 hour period) with fever, or 3) had diarrhea with at least two of the following symptoms: bloody diarrhea, fever, abdominal cramps, body aches, fatigue, dizziness, nausea, headache, and chills. An outbreak-associated control was defined as a person eating or drinking anything during the same time period who did not become ill.

Stool samples were collected by ACDC and LAC DPH Community Health Services (CHS) from employees and members with clinical symptoms for testing in the LAC DPH Public Health Laboratory (PHL).

ACDC calculated frequency and distribution of symptoms among cases. An analysis of foods eaten by cases and controls was also performed. All analyses were conducted using SAS 9.2 statistical analysis software.

RESULTS

Setting

The bridge club in question convenes in a facility that has three rooms and separate bathrooms for men and women. The room that functioned as the “kitchen” contained a sink and a refrigerator. The space is only for bridge club members, except for the occasional chess club meeting on Sundays. Food is not

supplied for the chess club. The club employs a total of 15 staff (2 co-owners, 11 teachers, 2 food handlers). There are about 100 to 130 bridge club members who attend either bridge classes and/or open play that were held Monday through Saturday (May 22-26, 2012). Members play bridge in two separate rooms. The larger of the two rooms is for more seasoned players and can accommodate up to 100 members per day. Daily classes are offered in the smaller of the two rooms and accommodate up to 30 members.

A small luncheon buffet is included as part of the club fees and is provided daily to attendees and as well as employees. The food is prepared in the "kitchen" at the facility. The daily menu for the week in question included egg salad, tuna salad, cut fresh vegetables (celery, cucumbers, carrots, and tomatoes), bagels, sliced bread, coffee, and hot tea. No cold beverages were served.

ACDC Investigation

ACDC attempted to contact all staff present during the week in question for interviews (n=13); two teachers who were not present were not interviewed. Of the 13, only one employee (teacher) did not return calls from ACDC for interview. The teachers that ACDC interviewed are part-time bridge instructors who teach at least one or two sessions a week. Of the two food handlers interviewed, one is employed full time and the other works on Fridays only. The two co-owners interviewed are present at the facility a majority of the time. Employees reported no illness prior to, or during the classes and/or tournaments. All staff were interviewed by EHS and initially denied any recent GI illness. Neither of the two food handlers present during the week in question reported illness. One of the co-owners reported symptoms after a second interview was conducted by a CHS public health nurse. CHS collected stool specimens on a total of nine staff members for testing by PHL.

ACDC called all club members in attendance May 21-26, 2013. Two line lists were obtained: one by F&M (members participating in events taking place in the larger room) and one by ACDC (participants of the small room events). The list obtained by ACDC required a personal trip to the bridge club as they were initially unwilling to provide the information. According to the lists, 108 members were in attendance; ACDC was able to interview 103 of them (95%).

Cases

There were a total of 43 cases (one case was reported after the investigation was completed and therefore not included in the analysis). Of these 43 cases, 14 had positive *Shigella* lab cultures. Four of the confirmed cases were reported to ACDC by a healthcare provider and found to be associated with the bridge club by CHS. The remainder of the cases (10 confirmed and 29 presumptive cases) were identified through the interviews.

Slightly more than half the cases were female (55%) and had an average age of 75.3 years (range 54-98 years) (Table 1). Symptoms reported by cases included diarrhea (95%), abdominal cramps (71%), and fever (57%) (Table 2). The average duration of illness was 5.9 days (range 1-14 days). The average incubation period from the lunch (Tuesday, May 22, 12 pm) was 49.6 hours (range 9-101 hours). Illness onsets occurred from Thursday, May 24, 2012 to Saturday, May 26, 2012 (Figure 1).

Table 1. Case Demographics (N=42)

	n	Percent
Gender		
Male	19	45%
Female	23	55%
Age Group		
1-4	0	0%
5-19	0	0%
20-49	0	0%
50-59	1	2%

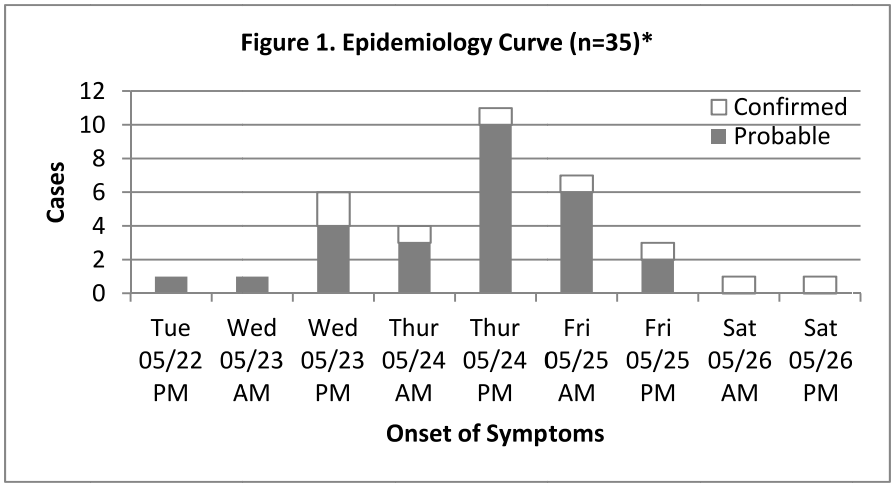
60-69	8	19%
70-79	19	45%
80-89	11	26%
90-99	3	7%
Mean Age	**Median Age**	**Range**
75.3 years	75 years	54-98 years

Table 2. Reported Symptoms (N=42)

Symptom	n	Percent
Diarrhea	40	95%
Bloody Diarrhea	4	10%
Abdominal cramps	30	71%
Fatigue	29	69%
Nausea	26	62%
Chills	24	57%
Fever	24	57%
Fever > 102˚F	5	12%
Body Aches	18	43%
Dizziness	17	40%
Headache	16	38%
Vomiting	14	33%
Tingling	0	0%
Rash	0	0%
Medical Care	23	55%
Duration (days)*		
Mean = 5.9	Median = 6	Range (1-14)
Incubation (hrs)**		
Mean = 49.6	Median = 48	Range (9-101)

* Based on 35 cases

** Based on 36 cases



*Onset dates and/or times for seven cases were not provided; three cases only provided onset date, four cases did not provide either onset date or onset time.

Food Analysis

All food served at the event was prepared by a bridge club employee. The results of the cohort analysis of food items eaten at the bridge club are shown in Table 3. Consuming any cut vegetables (tomatoes, celery, carrots, and cucumbers) was associated with illness (relative risk [RR] = 3.07, confidence interval [CI]: 1.53 to 3.60), with a food specific attack rate of 67%. All cases ate at least one of these vegetable items. These cut vegetables were also individually associated with illness. Vegetables that were not cut, such as pickles and olives, were not associated with illness. Consuming the egg salad at this event was also associated with illness (RR=1.94, CI: 1.15 to 3.21) with a food specific attack rate of 66%, as was the tuna salad (RR = 1.65, CI: 1.01 to 2.28) with a food specific attack rate of 57%.

Table 3. Food-Specific Attack Rate

	Ate/drank				Did not eat /drink						
	Ill	Not Ill	Total	Attack Rate (%)	Ill	Not Ill	Total	Attack Rate (%)	Difference in rates	Relative Risk	95% Confidence
Food Item	(a)	(b)	(a+b)	(a/a+b x 100)	(c)	(d)	(c+d)	(c/c+d x 100)	(a/a+b)-(c/c+d)	(a/a+b)/(c/c+d)	Interval
Bagels	9	4	13	69%	33	48	81	41%	28	1.70	0.9298 -11.5196
Cream Cheese	1	4	5	20%	41	48	89	46%	-26	0.43	0.4178 - 1.0878
Potato Chips	10	7	17	59%	32	45	77	42%	17	1.42	0.7800 - 2.5824
Crackers	15	16	31	48%	27	36	63	43%	6	1.13	0.7404 - 1.6556
Cookies	12	7	19	63%	30	45	75	40%	23	1.58	0.6876 - 2.1669
Peanut Butter	13	8	21	62%	29	44	73	40%	22	1.56	0.8893 - 2.8150
Jelly	2	1	3	67%	40	51	91	44%	23	1.52	0.3359 - 8.4165
Onion Dip	1	5	6	17%	41	47	88	47%	-30	0.36	0.4264 - 0.9634
Salsa	1	1	2	50%	41	51	92	45%	5	1.12	0.2740 - 4.4868
Egg Salad	21	11	32	66%	21	41	62	34%	32	1.94	1.1543 - 3.2062
Tuna Salad	24	18	42	57%	18	34	52	35%	23	1.65	1.0213 - 2.2790
Bread	7	2	9	78%	35	50	85	41%	37	1.89	0.7698 - 9.1027
Canned Fruit	8	7	15	53%	34	45	79	43%	10	1.24	0.6876 - 2.1669
Cut Vegetables (Tomato, Celery, Cucumber, Carrots)	32	16	48	67%	10	36	46	22%	45	3.07	1.5302 - 3.6023
Tomatoes	18	9	27	67%	24	43	67	36%	31	1.86	1.0969 - 3.3796
Celery	14	9	23	61%	28	43	71	39%	21	1.54	0.8991 - 2.6644
Cucumber	18	9	27	67%	24	43	67	36%	31	1.86	1.0969 - 3.3796
Carrots	19	12	31	61%	23	40	63	37%	25	1.68	1.0140 - 2.6531
Pickles	9	7	16	56%	33	45	78	42%	14	1.33	0.7330 - 2.3722
Olives	8	5	13	62%	34	47	81	42%	20	1.47	0.7402 - 3.0751
Milk	1	0	1	100%	41	52	93	44%	56	2.27	-
Water	12	9	21	57%	30	43	73	41%	16	1.39	0.8092 - 2.3344
Iced Tea	5	8	13	38%	37		44	84%	-46	0.46	0.5496 - 1.4176
Coffee	10	12	22	45%	32	40	72	44%	1	1.02	0.6600 - 1.5717

Bridge Club Inspection

On Tuesday, May 29, F&M conducted an inspection of the bridge club and kitchen facility. This facility had no public health permit for preparing food and the health inspector ordered that all food preparation cease. All non-packaged food that was available to patrons at the time of inspection was discarded. The health inspector identified numerous health code violations, finding several food items held at unsafe temperatures (i.e., egg salad, tuna salad, tomatoes, onion dip, and cream cheese). The health inspector recommended that any food served to attendees be limited to pre-packaged food items. Also identified were building and safety violations pertaining to an employee (food handler) living and sleeping in

quarters within the facility without partitioning. An administrative office hearing was held on May 31, 2012, to discuss health code violations, legal consequences, and results of findings. A second joint visit was made on June 5, 2012, by F&M and ACDC staff to ensure compliance with all recommendations for food storage and preparation. During this second inspection the preparation of coffee and tea by club staff was observed and stopped. The co-owners were instructed to serve only pre-packaged items and to purchase pre-brewed coffee.

Laboratory Results

Among the 43 cases, 14 were culture-confirmed as *Shigella sonnei*. Four of eight employees tested were positive for *S. sonnei* (one co-owner, two teachers, and one food handler). Ten isolates underwent pulsed-field gel electrophoresis (PFGE), all yielding an indistinguishable pattern. CDC's PulseNet national surveillance network identified two additional isolates indistinguishable from the outbreak PFGE pattern. One was from a 23-year-old man in Pennsylvania who had visited Los Angeles in April. The other isolate was from a 53-year-old man in Hawaii who visited Los Angeles during April and May. Both men were hospitalized with diarrhea. Neither case was epidemiologically linked to the bridge club or to each other.

Four isolates submitted to CDC's National Antimicrobial Resistance Monitoring System (NARMS) displayed resistance to streptomycin, sulfisoxazole, tetracycline, and trimethoprim-sulfamethoxazole. Unlike most *Shigella* isolates tested by NARMS, these isolates also showed elevated azithromycin minimum inhibitory concentrations (MIC) of >16 μg/mL[1] and harbored a plasmid-encoded macrolide resistance gene, *mphA*.[2]

DISCUSSION

A common source outbreak of *Shigella sonnei* occurred among persons eating, playing bridge, and utilizing the bathroom facilities at the bridge club over a period of one week (May 22-26, 2012). Laboratory testing of bridge club members and staff confirmed the etiology of this outbreak as *Shigella* and symptoms and duration of reported cases are consistent with shigellosis.[3] The median incubation time of 48 hours is consistent with a common source exposure occurring at the bridge club on May 22. The incubation period for shigellosis in humans is usually between 24 and 72 hours.[3]

ACDC's investigation identified a food handler at the bridge club who tested positive for *Shigella sonnei* with the outbreak PFGE pattern. This food handler was involved in the preparation of the egg salad and cut vegetables which were food items statistically significantly associated with illness in the cohort food analysis. These food items require considerable hand manipulation and are food items that were the apparent source of this outbreak.

Shigella has a human reservoir and can be found in the stool of infected individuals. Transmission occurs from ingestion of the bacteria, either by direct person-to-person contact or via food or drink contamination. Food may become contaminated by an infected food handler when there is a lack of good hygiene, such as practicing proper hand washing technique or having long, dirty fingernails.[4]

Although sporadic cases of shigellosis caused by *Shigella* strains with increased azithromycin MICs have been reported in the US, this is the first such outbreak documented in the US and might indicate increasing circulation of such strains.[1] Illnesses in this outbreak tended to be severe; however, the affected population was much older than the general US population. Clinical management of such illnesses in children is likely to be complex; although azithromycin currently is recommended for treatment of infections caused by multidrug-resistant *Shigella,* options for alternative treatment for children with such infections primarily include parenteral antimicrobial medications.[5,6]

Guidelines for azithromycin susceptibility testing and criteria for interpretation of MICs for *Shigella* species have not been published. Clinicians are urged to report azithromycin treatment failure among shigellosis patients to public health authorities and to retain *Shigella* isolates from such cases for further analysis.

PREVENTION

F&M and CHS distributed information about the control of shigellosis to the co-owner of the bridge club establishment along with specific recommendations, including frequent and vigorous hand-washing, and the exclusion of infected persons from handling food and being on the premises until they were demonstrated to be free of *Shigella* by LAC DPH. During the investigation, members and staff of the bridge club were interviewed via telephone and were educated regarding the practice of good hand washing technique. A Public Health Investigator was involved in the removal of the employee in a sensitive occupation (food handler) who was confirmed with *Shigella sonnei*. CHS provided educational material about the control of *Shigella* to this employee and initiated the clearance process.

LIMITATIONS

The possibility of recall bias of persons interviewed limited the usefulness of the results. There was also a lack of cooperation from some club staff regarding the submission of stool collection to identify additional cases.

CONCLUSIONS

An outbreak of *Shigella sonnei* occurred among members and staff of a bridge club in May 2012. The symptoms and duration reported by cases were consistent with *Shigella* infection and the PHL confirmed this etiology. The outbreak was likely due to an employee who reported asymptomatic *Shigella* infection and worked as a food handler at the bridge club. This employee most likely contaminated multiple food items, including the egg salad and vegetables. There were no other reports of illness from persons attending this facility and it appeared that public health control efforts limited the outbreak to a one week period.

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Staphylococcus epidermidis Outbreak Associated With a Cardio-Thoracic Surgeon With Dermatitis on The Hands

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BACKGROUND

Hospital associated infections have been documented in the literature as being associated with increased morbidity and mortality. Patients hospitalized in the intensive care unit (ICU) and those undergoing cardiac surgery are among those at greatest risk of such infections[1], this is especially true in prosthetic valve replacement surgeries where infections occur postoperatively in 5% to 34% of cases. *Staphylococcus (S) epidermidis*, a common skin colonizer, is a predominant organism isolated in post cardiac valve related surgeries.[2]

On October 1, 2012, the infectious disease (ID) physician and infection preventionist (IP) from Hospital A notified the Los Angeles County (LAC) Department of Public Health (DPH), Acute Communicable Disease Control Program (ACDC) of five cases of *S. epidermidis* infections post-cardiac valve surgery; four with endocarditis and one pacemaker lead infection. All cases had aortic valve replacement surgery between January and May 2012. Three cases were identified in June 2012, and two cases were identified in September 2012. All cases were discharged home after surgery and required readmission. Four of the five patients required a second surgery as a result of the endocarditis. All cases had the same cardio-thoracic (CT) surgeons, Surgeon A, who was training at the facility during the outbreak period and had contact dermatitis on the hands and Surgeon B who was primary surgeon for each case. Surgeon A performed approximately 100 valve replacement surgeries from September 2011 through June 2012. On completion of the training in June 2012, Surgeon A started a job at another hospital in LAC (Hospital B).
This report describes an outbreak investigation of *S. epidermidis* infections among patients who underwent cardiac valve replacement surgery at Hospital A, measures taken to enhance patient safety, and collaborations between DPH and Hospitals A and B.

METHODS

Case Definition
A case was defined as a patient who was *S. epidermidis* culture positive between February 1, 2012 and August 31, 2012 post cardiac surgery.

Case Characterization

ACDC staff conducted a comprehensive review of case medical records, including surgical and microbiological records.

Surgeon Evaluations

The primary surgeon (Surgeon B) and surgeon in training (Surgeon A) for each case were interviewed by the facility. Cultures were obtained by the facility of Surgeon A's axilla, nares, and hands. Cultures of the hands and nares of Surgeon B were also obtained by the facility.

Microbiological Analysis

We reviewed culture reports and sensitivity patterns for the five patient cases and Surgeon A.

Molecular strain testing by polymerase chain reaction (PCR) was performed by the facility on four available S. *epidermidis* positive blood isolates, surgeon A's isolate, and one S. *epidermidis* positive control (background) isolate. One case had a S. *epidermidis* positive aortic root culture. This isolate had been discarded and was not available for genetic testing.

Background Surveillance

On June 15, 2012, the facility initiated a retrospective review of all surgical site infection (SSI) surveillance in valve surgeries from September 2011 to June 2012. On September 23, 2012 upon identification of two additional cases, this review was then expanded to include any SSI post coronary artery bypass graft with both chest and donor site incisions (CBGB) and all other cardiac surgeries from January 2011 to July 2012.

Control Measures
The facility implemented control measures upon identification of the outbreak.

Hospital B

On October 3, 2012, ACDC contacted Hospital B to discuss the concerns/issues surrounding Surgeon A.

RESULTS

Case Definition
Five patients met the case definition.

Case Characterization

All cases were male between the ages of 55 to 88 years, with a mean age of 69 years. All cases had multiple complex medical problems with significant comorbidities, including diabetes, hypertension, renal insufficiency and chronic obstructive pulmonary disease. Four cases had a second surgery subsequent to their *S. epidermidis* infection.

Surgeon Evaluations
Surgeon A reported having a rash to his hands since November 2011 that was being treated with topical ointments. Surgeon A was S. *epidermidis* culture positive from the axilla, nares and hands. Surgeon A also reported a change in the type of gloves used in surgery since January 2012 and noted a change in gloving procedure during surgery, switching from double-gloves use to single-glove use. Surgeon B reported no skin impairments. Surgeon B's cultures were negative for *S. epidermidis*.

Microbiological Analysis

All cases were S. *epidermidis* culture positive. Sensitivity patterns of two cases matched those of Surgeon A. Sensitivity patterns differed among the rest of the cases. All four patient cases and Surgeon A isolates were indistinguishable by polymerase chain reaction (PCR), indicating a common source.

Background Surveillance

Upon look-back from January 2011, 62 patients were identified as having Surgeon A as one of their surgeons. No additional cases were identified.

Control Measures

Hospital A performed a review of operating room protocols as it relates to infection control, reinforced staff hand hygiene principles, and revised the facility's policy/guidelines for glove use during implant surgery. Double gloving protocol was reinstated in late April 2012. Antibiotic prophylaxis was changed from cefazolin to vancomycin as this strain was resistant to cefazolin.

Surgeon A was advised not to perform any additional operations until hands were healed completely. Infection control operating room policies were reviewed. In October 2012, notification of the 62 identified exposed patients was initiated by CT surgeons. A call center staffed by registered nurse practitioners was established to handle follow-up calls. The facility also conducted cardiology assessments of all exposed

cases for signs and symptoms of endocarditis, echocardiogram for baseline assessments of all exposed, and follow-up surveillance for 12 months post-surgery. Hospital A contacted Hospital B, where Surgeon A was now employed, and notified the hospital epidemiologist of the outbreak.

Hospital B

Upon evaluation of Surgeon A's hands, Hospital B determined it was safe for Surgeon A to perform surgical procedures with the following restrictions: 1) report any recurrence of dermatitis immediately and cease surgical procedures, 2) double-glove for all procedures, and 3) change to new double-gloves during specified periods of the surgical procedures. Additionally, Hospital B will conduct enhanced surveillance of all surgeries performed by Surgeon A for one year.

DISCUSSION

This report describes an investigation of a cluster of *S. epidermidis* infections post cardiac valve replacement surgery. S. *epidermidis* is a gram positive bacterium that is a common skin commensal; primarily colonized from the axillae, head, and nares. Bacterial contamination of the surgical site by skin flora occurs in a high proportion of open heart surgeries. S. *epidermidis* is the predominant organism isolated in post cardiac valve related surgeries and has a high probability of device contamination.[3,4] Other sources of coagulase negative Staphylococcus (CNS) surgical site infections have been attributed to the hands of healthcare workers.

The epidemiologic data supports the hypothesis that transmission likely occurred during surgery with Surgeon A as the source. Prior to their infection, all five cases had exposure during surgery to Surgeon A while he had infection on his hands. Additionally, there was the change in protocol, from double gloving to single gloving. Genetic testing done on Surgeon A's isolate substantiated this hypothesis; all four patient isolates genetically matched Surgeon A's isolate and the sensitivity patterns of two patient cases identically matching the sensitivity patterns of Surgeon A. Hospital A suggested contamination may have occurred due to nicks and tears of the surgical gloves that may have occurred due to the types of suturing and knots that are used in cardiac surgery. Hospital A conducted their own informal glove study and found nicks and tears in surgical gloves. The literature suggests that perforated gloves may play a role in contamination of the surgical site. Microscopic tears in gloves occur in 6%-20% of operative procedures; however, this greatly increases in cardiac surgery due to irregularity of the sternal edges and the frequency in which wire sutures are used. [5,6] One study measured the rate of glove breakage immediately after open heart surgery and found that holes were identified in 39% of gloves post-operatively. The rate was increased when gloves that were changed during the surgical procedure were tested, increasing the glove breakage rate to 48%.[6]

Dermatitis among healthcare workers is well documented in the literature. However, there are very few reports that directly link outbreaks of *S. epidermidis* to individual carriers. One report described a cluster of four positive cases of CNS post cardiac surgery, where the surgeon was found to be the source of contamination, presumably contaminating the surgical site via accidental puncture of gloves.[7] Another report indicated the surgical resident in a cluster of patients who developed CNS SSIs post cardiac surgery, during which the surgical resident had dermatitis to his hands and was a carrier of the epidemic strain that caused the majority of infections during the outbreak.[4]

In summary, ACDC investigated an outbreak of *S. epidermidis* infections post cardiac valve replacement surgery at a local hospital. After control measures were implemented, no further cases were identified at either hospital A or B.

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POSSIBLE ASPERGILLOSIS OUTBREAK IN A BONE MARROW TRANSPLANT UNIT: HIGHLIGHTING THE DIFFICULTY OF INTERPRETING NON-CULTURE LABORATORY TECHNIQUES

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BACKGROUND

Invasive aspergillosis (IA) causes significant morbidity and mortality in post-bone marrow transplant (BMT) and other immunocompromised people. According to Weber and Peppercorn, et al., "Invasive *Aspergillus* infections have been reported in 2-26% of hematopoietic stem cell transplant (HSCT) recipients and in 1-15% of solid organ transplant recipients…mortality rate has ranged from 74-92%."[1]
A non-invasive assay to detect circulating galactomannan (GM) in serum or bronchoalveolar lavage (BAL) fluid became available in the United States in May 2003. GM is a cell wall polysaccharide released by *Aspergillus* species (spp.) during fungal growth in tissue. Circulating GM may be detected at a median of five to eight days before clinical manifestation of aspergillosis.[2, 3]

In September 2012, Hospital A notified Los Angeles County (LAC) Department of Public Health (DPH) Acute Communicable Disease Control Program (ACDC) of nine patients with blood specimens positive for GM *Aspergillus* antigen. All patients were hospitalized in the bone marrow transplant (BMT) unit, had a BMT during their current or a recent admission, and were GM positive between September 3, 2012 and September 11, 2012.

Prior to this cluster, three patients were GM positive in June 2012 (two blood specimens, one BAL). The hospital infection preventionist initiated enhanced surveillance and GM testing on all patients in the unit increased by 160%, going from an average of 19 GM tests per month from January 2010–May 2012 to an average of 48 GM tests per month from June–September 2012. On September 3, 2012, six patients, including one patient who was GM BAL positive in June 2012, converted from a negative GM value to markedly high positive GM values. Four additional newly positive patients were identified between September 7, 2012 and September 11, 2012, resulting in a total of 10 newly positive patients (83% GM positive) in September 2012.

This report describes the investigation of a GM antigen positive cluster among patients on a BMT unit, the process used to identify *Aspergillus* infection in this medically complex population and efforts made to categorize the cluster as an outbreak or pseudo-outbreak.

METHODS

A case was defined as a patient in the BMT unit who had a BMT procedure in the current or previous admission and who had a newly positive blood or BAL GM test, with or without symptoms, from June 1, 2012 to September 30, 2012. Criteria developed by the European Organization for Research and Treatment of Cancer/Invasive Fungal Infections Cooperative Group and the National Institute of Allergy and Infectious Diseases Mycoses Study Group (EORTC/MSG) Consensus Group[4] were used to categorize and define invasive fungal disease (IFD) in immunocompromised patients with cancer and hematopoietic stem cell transplant patients. A comprehensive review of case clinical, laboratory, pharmacy, nutrition and related data was conducted. Case medical history questionnaires prepared by a BMT clinician were also reviewed.

An analysis of all patients who were tested for GM hospital-wide from August 15, 2012 - September 11, 2012 was conducted to identify medications or other administered items that might cross-react with the Bio-Rad Platelia™ *Aspergillus* Ag EIA test (Platelia). Case BMT schedules were reviewed for conditioning agents (chemotherapy medications and/or radiation treatments) that are used to eliminate the patient's existing bone marrow to prepare for transplantation that may cross-react with the GM test and may interfere with test.

Hospital A conducted routine water sampling in BMT patient rooms for random surveillance. The sampling schedule varied and two rooms were sampled every few weeks on a rotating basis. Tap water was collected from March through August 2012 and the samples were tested for fungus. Public health staff collected 25 water and swab samples from three case rooms. The samples were cultured by the LAC public health laboratory for fungus only. Details of construction were reviewed.

Multiple control measures were implemented and included an environmental investigation and enhanced environmental cleaning. Initial environmental sampling was conducted in June, July and August 2012 by outside environmental consultants. Air and surface samples from the BMT unit work areas, nurses' stations and the air handling system were tested. In October 2012, comprehensive air and surface sampling of all BMT patient rooms, staff work areas, public areas (e.g., family lounge, restrooms) and other targeted locations throughout the facility was conducted to obtain baseline air quality data. The investigation included multiple site investigations and phone consultations to discuss the status and provide interim management recommendations. ACDC consulted with the manufacturer of the Platelia *Aspergillus* Antigen kit, Bio-Rad, regarding any changes in the kit or similar complaints.

RESULTS

Twelve patients met the case definition. There were eight males. All cases were immunocompromised with an underlying hematological and/or genetic disorder (e.g., leukemia, severe combined immunodeficiency). Ten cases had a BMT procedure during their current admission and two cases had a BMT procedure during their previous hospitalization. Case age ranged from 6 months to 17 years, with a mean age of 7 years. There were no obvious commonalities among the cases. The number of days from admission to first positive GM test ranged from 3 to 164 days, with a mean of 58 days.

Ten cases were GM positive ≥7 days after admission and considered healthcare-associated possible aspergillosis infections (HAI). Two cases were not considered HAI; one case was symptomatic on admission with a history of chronic cough for seven months and was GM BAL positive seven days after admission. This case subsequently had three negative GM values prior to becoming GM seropositive in September. The second case had a BMT in March 2012, was discharged and re-admitted in September 2012 for a second procedure and was GM positive three days after admission.

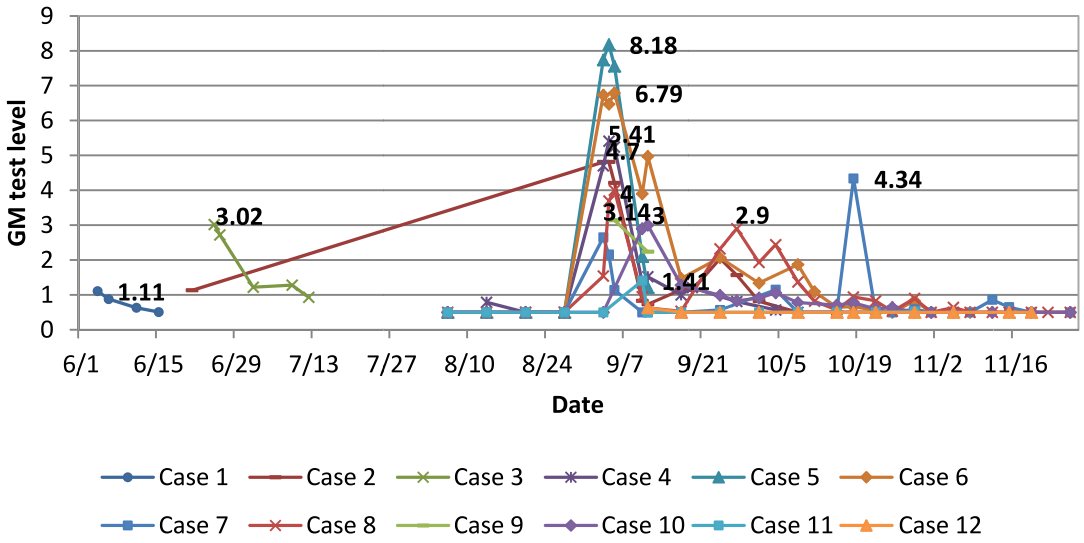
Five cases (42%) experienced respiratory symptoms during their hospitalization. Six cases (50%) had radiographic changes consistent with fungal infection. Four cases (33%) had neither clinical symptoms nor radiographic changes and were considered by the BMT clinician to have *Aspergillus* infection that was treated early.

ACDC used criteria developed by the EORTC/MSG to categorize and define invasive fungal disease (IFD) in immunocompromised patients with cancer and hematopoietic stem cell transplant patients. The categories are "proven", "probable" and "possible" IFD, and each category has specific requirements. Proven requires tissue culture and identification. Probable IFD requires a host factor, clinical features and mycological evidence. Possible IFD requires host factors with clinical evidence consistent with IFD but for which there was no mycological support. Based on these classifications, ACDC designated four cases as probable aspergillosis and eight cases as possible aspergillosis. There were no proven aspergillosis cases.

The facility used the Bio-Rad Platelia™ *Aspergillus* Ag EIA test kit (Platelia) to test all case specimens for GM. The assay is a non-invasive test for early detection of aspergillosis before clinical signs and symptoms begin and used in conjunction with other diagnostic techniques, such as computed tomography (CT) scan.

All cases were *Aspergillus* antigen GM blood and/or BAL positive at least once during their hospitalization, and ten cases were GM blood positive multiple times throughout the surveillance period, from June 1 through November 30, 2012 (Figure 1).

Figure 1. Galactomannan Case Results, June-November 2012



Weekly GM testing was conducted on most BMT patients beginning in July or August 2012. During a two week period in September 2012, case GM levels ranged from 0.63 to 8.15. Six cases had three consecutive high GM positive levels; among all the cases identified after September 3, 2012 there was an average of seven positive GM tests per case (range 1-14). Blood specimens collected on September 5, 2012, for the six patients who were GM high positive on September 3rd were sent to an outside laboratory for confirmation. The outside laboratory used the same GM test as the hospital laboratory, and all were confirmed. Nine cases had a fluctuating high/low pattern, as tested by the Hospital A laboratory, after their highest GM value which is not uncommon.

During the outbreak period, 47 patients, including the BMT patients, were tested using the GM assay hospital-wide, of which 13 were GM positive. GM positive patients were more likely to be BMT cases (10 of 15 patients, 67%) than GM negative patients (6 of 32 patients, 9%). In addition, the positive GM test values of the non-BMT patients were not as high as the BMT unit positive patients, with the highest value at 3.18, compared to a high value of 8.15 among the BMT patients. Case antifungal prophylactic medication dosages were increased to treatment doses and a second or third antifungal was ordered for many cases upon identification of the positive GM assay. Review of medications showed that all BMT unit patients during this review period were on either prophylactic or treatment doses of mold-active antifungals and at least one antimicrobial, compared to only seven (22%) of the non-BMT unit GM positive patients. None of the conditioning agents were found to cross-react. The Platelia test kit was current, and there were no changes in hospital laboratory procedure that may have indicated these were false positive tests.

Major construction was ongoing at Hospital A for several years prior to the cluster. Construction on a new building was completed in 2010 and patients, including those on the BMT unit, were moved into the new structure in July 2011. Construction of a pedestrian bridge crossing to the other side of the street near the main hospital entrance, visible from the windows of the west side of the BMT unit, began in January 2011 and was ongoing at the time of the outbreak. Patients, staff and visitors passed by the construction area to access the main entrance. Shoe covers were mandatory for anyone entering the unit. Environmental cleaning was enhanced in all patient rooms and the cleaning frequency of the BMT common areas increased from once a day to three times a day during the outbreak period.

Initial environmental sampling on the BMT unit was conducted in June, July and August 2012 and showed a few fungal colonies, e.g., *Cladosporium cladosporioides*, *Phyllosticta maydis* and *Penicillium oxalicum*. No *Aspergillus* was found. Comprehensive air and surface sampling was conducted over six

consecutive days to obtain baseline air quality data. *Aspergillus* species were recovered in ten BMT rooms, mostly in small amounts; *A. fumigatus* was recovered on a surface sample on the window blinds of one room. A variety of other common environmental fungal organisms were found in the rooms, such as penicillium species, *Paecilomyces lilacinus* and *Cladosporium* species.

Random sampling of tap water in BMT patient rooms was conducted from March through August 2012. None of the samples were positive for *Aspergillus*. DPH EH staff collected 24 water and swab samples. All were negative for fungal growth with the exception of a showerhead swab which was positive for *Paecilomyces lilacinus*.

Six cases expired, five cases while hospitalized and one case after discharge home. The death certificate and/or death summary or final progress note was reviewed. Invasive aspergillosis (IA) was listed among the causes of death on the death certificates for two cases. IA infection was documented on the final progress report for one case. IA was also listed as contributing to the cause of death for a third case. Two of the six cases who expired were among the cases with the highest GM levels. An autopsy was not performed on any of the cases due to parental declination secondary to religious or personal reasons.

DISCUSSION

This was a complex investigation that involved a GM antigen positive cluster with all cases testing positive by blood or BAL assay and none confirmed by specimen culture or histology. There were two distinct GM positive clusters, the first cluster occurred in June 2012 and the second cluster occurred in September 2012. *Aspergillus* species are fungi commonly found in the environment. Certain species, especially *A. fumigatus* and *A. flavus,* frequently cause disease in immunocompromised individuals. In the acute care hospital setting, aspergillosis clusters are frequently discovered after construction, demolition or renovation activities. Transmission is not person-to-person but by direct inhalation of spores or direct contact with wound or skin. According to Pfeiffer and Fine, et al., "IA occurs in 8%-15% of patients undergoing allogeneic stem cell transplantation…despite advances, IA is associated with considerable morbidity and mortality, ranging from 30% to 70% in transplant recipients." [5]

Aspergillus infection in immunocompromised patients is difficult to identify due to subtle symptom changes in patients. Review of the literature shows that the definition of *Aspergillus* infection has been inconsistent among clinicians and researchers alike and is dependent on many factors, such as the patient's clinical condition and x-ray changes. As stated by DePauw, et al., "These revised definitions…are intended to advance clinical and epidemiological research and, as such, may serve as a useful model for defining other infections in high-risk patients. The definitions are not meant to be used to guide clinical practice."[4]

The Platelia assay is a non-invasive test used for the early detection of aspergillosis before clinical signs and symptoms begin. Early detection is significant in this patient population, as invasive procedures such as tissue culture or biopsy are not tolerated well due to their immunocompromised status. A GM test result of <0.5 is interpreted as negative and a GM test result of >0.5 is interpreted as positive. Test specificity varies depending on multiple factors, including patient population, antibiotic treatment and food products consumed. A negative test does not rule out an aspergillosis diagnosis, and, conversely, a positive result may not indicate aspergillosis infection.[6] The literature notes that many common food items (cereals, cow's milk, pepper, peanut butter, popcorn), antibiotics (piperacillin/tazobactam, ampicillin-sulbactam and amoxicillin-clavulanic acid) and fungal organisms (*Penicillium* species, *Paecilomyces lilacinus* [*P. lilacinus*]) may cross-react with GM, creating a false-positive result. [3, 7, 8]

ACDC analyzed available case GM levels from June through November 2012. Weekly, or more frequent, GM testing began in July and August for all BMT patients. On September 3, 2012, GM levels spiked for six cases then decreased sharply within a few days. After September 3, 2012 case GM levels fluctuated. All cases were placed on antifungal prophylaxis upon admission per protocol; after the positive GM result all cases were started on aspergillosis treatment with the addition of a second or third antifungal and/or initiation of a treatment dose, which may be an indication of partially-treated disease as they were continuously on prophylaxis or therapeutic doses of antifungals.[7]

Air sampling conducted on the unit in October 2012 was to provide a baseline sample. Testing did not reveal an obvious mold reservoir and there was no obvious evidence of environmental contamination. *Penicillium* species and *P. lilacinus* were found in small amounts, and both cross-react with the Platelia test. *Aspergillus* species such as *A. fumigatus, A. brasiliensis* and *A. flavus* were found in ten BMT rooms in small amounts. These organisms do not typically cause illness in immunocompetent people but may be the cause of significant morbidity and/or mortality in immunocompromised persons. As noted by Vonberg and Gastmeier "...any *Aspergillus* species in air samples from special care areas should raise concern of invasive infection…even concentrations of airborne *Aspergillus* spores below 1 CFU/m^3 have been shown to be sufficient to cause outbreaks in immunocompromised patients."[9]

Several Hospital A physicians believed that this cluster was a pseudo-outbreak based on a number of factors, including 1) six GM tests were positive on the same day, 2) there was a rapid decline of GM positive to GM negative in the blood levels, 3) many of the blood levels were very high and the patient's clinical condition did not match the GM level and 4) there was no evidence of an environmental source based on routine and enhanced environmental testing. These concerns are valid and the possibility of a pseudo-outbreak cannot be excluded, since there was no culture or biopsy from a sterile site to confirm the diagnosis.

Conversely, there were significant reasons to suggest that an outbreak occurred. Specimens from the six cases who were GM positive on September 3, 2012, were sent to an outside laboratory and confirmed positive. Additionally, five cases had respiratory symptoms, six cases had x-ray changes and four cases had documentation of *Aspergillus* infection in the medical record. IA was listed among the causes of death on the death certificate for two cases and as a contributing factor for another case. Lastly, four cases were considered to possibly have had an *Aspergillus* infection that was treated early by the BMT physicians.

Non-culture based diagnostic methods for mycotic infections have evolved to include PCR and GM antigen detection in patient serology.[10] The lack of confirmatory identification of the suspected disease-causing organism places the burden of diagnosis on documentation of corresponding symptomatology in tested patients. In this investigation the highly positive GM tests did not decisively diagnose aspergillosis due to the difficulty determining if case symptoms were due to fungal infection or a by-product of their underlying illnesses.

We were unable to conclusively determine that this was a true aspergillosis outbreak. Review of the literature shows that pseudo-outbreaks of aspergillosis have been reported, frequently due to specimen contamination; however, the Platelia test kit was within the expiration date and there were no changes in the laboratory test procedure or problems reported. After comprehensive analysis of all the evidence, the most likely hypothesis is that the cases in this GM cluster were exposed to a source in the environment that caused the cluster of positive GM tests, and the probable source was *Aspergillus.* No additional GM clusters were identified after September 2012.

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KNOWLEDGE OF PUBLIC HEALTH CONTACTS FOR EMERGENT OR URGENT COMMUNICABLE DISEASE SITUATIONS IN LOCAL EMERGENCY DEPARTMENTS

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BACKGROUND

Timely disease reporting to local Public Health Departments is essential to prevent and control outbreaks and ensure rapid responses to public health emergencies and urgent communicable disease situations. The emergency department (ED) is often the first health care contact for a patient exposed to an emerging pathogen or agent of bioterrorism. In fact, a survey of 11 hospital EDs in the District of Columbia suggested that "reporting is most complete if it is controlled by emergency department administration and integrated into the department's routine quality assurance activities."[1]

Recently, physicians on call from the Los Angeles County (LAC) Department of Public Health's (DPH) Acute Communicable Disease Control Program (ACDC) noticed a considerable number of misdirected calls received from local EDs, particularly after normal business hours. For example, EDs called the Centers for Disease Control and Prevention (CDC) or the California Department of Public Health (CDPH) to report or request consultation on infectious disease situations, instead of LAC DPH. This concerned ACDC because these calls had to be directed back to LAC DPH and potentially delayed the response to public health emergencies or urgent communicable disease situations.

To increase EDs' awareness of local public health contacts, ACDC's Hospital Outreach Unit (HOU) created and distributed the *Frequently Called Directory for Communicable Diseases,* a single-page document listing important local public health references and telephone numbers. Between August and November 2012, all hospital infection preventionists (IPs) were sent the document through email and in-person communications with instructions to provide it to ED staff. The HOU worked with ACDC's Planning and Evaluation Unit (PEU) to develop a method to evaluate whether local EDs know to call LAC DPH in public health emergencies or urgent communicable disease situations after the distribution of the *Frequently Called Directory for Communicable Diseases*. In November 2012, the Units implemented a test call strategy for the evaluation and then conducted follow-up interviews with selected EDs between February and May 2013.

METHODS

To assess whether local EDs know to call LAC DPH in public health emergencies or urgent communicable disease situations, the HOU and PEU conducted test calls to all 72 EDs in LAC during the month of November 2012. The EDs in the cities of Long Beach and Pasadena were excluded as they function within their own independent local Public Health Departments. The test call strategy was to interview two different ED staff members by telephone, ideally a member of the ED's clerical staff and a member of the ED's clinical staff. Each ED staff member interviewed was asked the following questions in a standardized telephone survey:

- What is your role in the Emergency Department?
- If a patient with a public health emergency or urgent situation presents to your Emergency Department during or after normal business hours, for example with suspect botulism or meningococcal infection, do you know who to call outside your hospital/externally to report the disease or to seek consultation?
    - If yes, who would you call? Please provide name and telephone number of person and organization.

At the end of each call, the final interviewee was offered an additional copy of the *Frequently Called Directory for Communicable Diseases*. Both ED staff members interviewed were reminded to contact LAC DPH for disease reporting and consultation, particularly for public health emergencies or urgent communicable disease situations, both during and after normal business hours. Length of interviews ranged from two to three minutes.

After analyzing results from the test calls, the HOU and PEU developed a follow-up questionnaire and conducted fifteen minute interviews with ED management at ten EDs in LAC to learn more about ED staff knowledge of LAC DPH, internal processes for reporting, and methods for information distribution among ED staff. EDs where interviews were conducted were chosen based on test call results and availability of ED management.

RESULTS

ED Test Calls

Response Rate

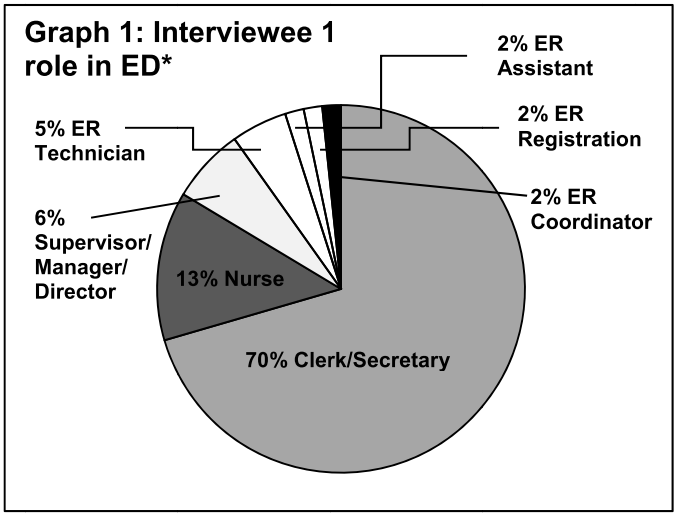
The test call response rate was 100% with all 72 EDs in LAC participating with at least one member of the ED staff. Response rates are summarized in Table 1. The response rate was 85% with a total of 61 responses from the first ED staff member interviewed, designated as "Interviewee 1" in the tables, and 97% with a total of 70 responses from the second ED staff member interviewed, designated as "Interviewee 2" in the tables.

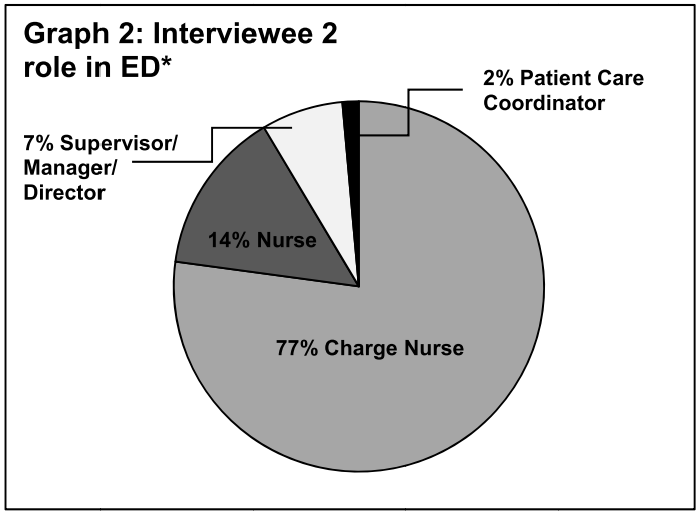
Table 1: Hospital ED Response Rates (N=72)*

	Interviewee 1		Interviewee 2		Interviewee 1 or 2	
	n	%	n	%	n	%
Responded	61	85%	70	97%	72	100%
Unavailable	9	13%	2	3%		
Refused	2	3%				

Respondent Characteristics

Respondent roles are summarized in Graph 1 and Graph 2. Interviewee 1 respondents were categorized as clerk/secretary (70%), nurse (13%), supervisor/manager/director (6%), ER technician (5%), ER assistant (2%), ER registration (2%), and ER coordinator (2%). Interviewee 2 respondents were categorized as charge nurse (77%), nurse (14%), supervisor/manager/director (7%), and Patient Care Coordinator (PCC) (2%).





*Percentages in tables and graphs may add up to greater than 100% due to rounding.

Table 2: Characteristics of hospitals where ED staff were interviewed (N=72)			
Characteristics	**Mean**	**Median**	**Range**
Bed Capacity	293	262	12-958
Average Daily Census	179	150	10-775
Number of beds in ED	22	19	2-63
Number of hospital IPs	2	2	1-10
Teaching (Count)	16		

Descriptive characteristics about the hospitals obtained by the HOU from hospital IPs are summarized in Table 2. Interviewed hospitals had a median bed capacity of 262 (mean: 179; range: 10-775), median average daily census of 150 (mean: 179; range: 10-775), median number of beds in the ED of 19 (mean: 22; range 2-63), and between one to ten IPs (mean: 2; median: 2). Sixteen hospitals were teaching institutions.

Findings

Among the 131 ED staff members interviewed, 57% (n=75) responded "yes" to knowing who to call to report a disease or to seek consultation (Table 3). Parsing out by interviewee groups, 48% of interviewee 1 respondents and 66% of interviewee 2 respondents indicated knowing who to call.

Table 3: ED staff responses to question: ***Do you know who to call outside your hospital/externally to report the disease or to seek consultation?***						
Response	**All Respondents (N=131)**		**Interviewee 1 (N=61)**		**Interviewee 2 (N=70)**	
	n	**%**	**n**	**%**	**n**	**%**
Yes	75	57%	29	48%	46	66%
No	56	43%	32	52%	24	34%

Among the 75 ED staff members who indicated they knew who to call to report a disease or seek consultation (Table 3), 43% (n=32) specifically indicated the local Public Health Department (Table 4). Looking by interviewee groups, 38% of interviewee 1 respondents and 46% of interviewee 2 respondents specifically indicated the local Public Health Department. Thirty-six percent (n=26) of all EDs had at least one interviewee indicate the local Public Health Department. Three interviewee 1 respondents and three interviewee 2 respondents, together representing five different EDs, provided specific, accurate LAC DPH telephone numbers as well.

Table 4: Responses of who to call in public health emergencies or urgent situations*				
	Interviewee 1 (N=29)		**Interviewee 2 (N=46)**	
Responses	**n**	**%**	**n**	**%**
Local Public Health Department[±]	11	38%	21	46%
Hospital infectious disease doctor, IP, or unit	8	28%	7	15%
Reference hospital binder, list, poster or form	5	17%	6	13%
Consultation with another member of the ED staff	3	10%	2	4%
Centers for Disease Control & Prevention (CDC)	2	7%	3	7%
Other[×]			3	7%
Unable to specify			4	9%

[±]Local Public Health Department includes the following responses: LAC DPH, DPH, Department of Health Services (DHS), Department of Health, Local Public Health, Public Health, and County

[×]Other includes Medical Alert Center (MAC), Department of Mental Health (DMH), and Poison Control

[*]Percentages may add up to greater than 100% due to rounding

In Table 4, other responses of who to call in the case of a public health emergency or urgent situation included the hospital's infectious disease doctor, preventionist, or unit (Interviewee 1: 28%; Interviewee 2:

15%); reference to an internal binder, list, poster, or form (Interviewee 1: 17%; Interviewee 2: 13%); and consultation with another member of the ED staff (Interviewee 1: 10%; Interviewee 2: 4%). Seven percent of respondents from each interviewee group specified contacting the CDC and 7% of interviewee 2 respondents specified other external organizations, such as the Medical Alert Center (MAC), Department of Mental Health (DMH), and Poison Control. Another 9% of interviewee 2 respondents were unable to specify a person or organization to call in the case of a public health emergency or urgent situation after indicating "yes" to know who to call.

Eighty-eight percent (n=63) of all EDs requested an additional copy of the *Frequently Called Directory for Communicable Diseases* at the end of the interview.

There are no considerable differences in descriptive characteristics between hospitals with EDs where at least one interviewee indicated to call the local Public Health Department and hospitals with EDs that did not (Table 5).

Table 5: Characteristics of hospitals by EDs who knew to call the local Public Health Department in the case of a public health emergency or urgent situation

	Indicated local Public Health Department (N=26)			**NOT indicate local Public Health Department (N=46)**		
	Mean	**Median**	**Range**	**Mean**	**Median**	**Range**
Bed Capacity	269	234	12-603	307	264	76-958
Average Daily Census	160	148	10-472	189	160	25-775
Number of beds in ED	23	21	2-57	21	18	3-63
Number of hospital IPs	2	2	1-4	2	2	1-10
Teaching (%)	5 (19%)			11 (24%)		

ED Interviews

Respondent Characteristics

Ten EDs were asked to participate in follow-up interviews; however, only nine EDs agreed based on availability of hospital personnel. ACDC interviewed ED management at seven (78%) participating EDs. Management roles included ED Directors, ED Assistant Directors, ED Managers, and ED Nurse Managers. One interview was conducted with an ED Charge Nurse and one was conducted with the hospital IP alone. In seven (78%) of the nine interviews, the hospital IP was present.

Of participating EDs, five (56%) had at least one respondent indicate the local Public Health Department as who to call to report a disease or seek consultation during the test calls; three (33%) had respondents who indicated not knowing who to call outside the hospital/externally to report a disease or seek consultation; and one (11%) had at least one respondent indicate the hospital's infectious disease doctor, preventionist, or unit as who to call to report a disease or seek consultation during the test calls.

Findings

Among the nine interviewees, six (67%) indicated that ED staff contact LAC DPH, primarily to report diseases and seek consultation. Respondents specified reporting and seeking consultation for influenza, meningitis, tuberculosis, sexually transmitted diseases, smallpox, measles, and suspected outbreaks.
Five (56%) interviewees were familiar with ACDC and three of the five indicated they knew their HOU Liaison Public Health Nurse (LPHN) prior to their interview. All interviewees noted that ED staff and the hospital IP knew one another. Contact between ED staff and the hospital IP ranged from multiple times per day to an "as needed" basis. Four (44%) interviewees indicated contact between the ED and hospital

IP occurring once to multiple times per day, three (33%) indicated once to multiple times per month, one (11%) indicated multiple times per week, and one (11%) indicated as needed.

All nine EDs had a policy and/or procedure for reporting urgent communicable diseases after normal business hours. Six (67%) EDs kept written policies and/or procedures and three (33%) kept unwritten policies and/or procedures. All nine EDs' policies and/or procedures required contacting the hospital IP first, who may then advise ED staff to call LAC DPH. When asked who would be contacted if the hospital IP is unavailable, five (56%) interviewees indicated LAC DPH, one (11%) indicated CDC, and three (33%) provided no answer, stating that the hospital IP is always available. Among those who indicated contacting LAC DPH or CDC should the hospital IP be unavailable, interviewees specified that such contact would be initiated by a physician, charge nurse, or any registered or licensed vocational nurse.

When asked about methods for information dissemination, interviewees were presented with six methods and an "Other" option and asked to identify which methods were commonly used to reach all ED staff on all shifts. Two methods that multiple respondents indicated when choosing the other option were distributing or posting memos and shift huddles. Shift huddles occur at the beginning of each ED shift and involve all ED staff coming together to share announcements. Once methods were identified, interviewees were asked to rank each selected method on a scale from 1 to 5, with 1 being not effective and 5 being extremely effective. Results are summarized in Table 6.

Table 6: Methods and rankings for information dissemination to all ED staff on all shifts

Method	Number of EDs	Average Ranking
In-person in-service	8	4.5
Regular staff meetings	7	3.5
Email	7	3.6
Brochures	6	3.7
Training-of-Trainer Session(s)	5	3.8
Online video or webinar	3	3.7
Originated from Other Option		
Shift huddles	4	4.3
Distributing or posting memos	2	4.5

In-person in-service was the method of information dissemination most commonly used at participating EDs and also received the highest average ranking for effectiveness.

At the end of each interview, interviewees were asked to share how ACDC could help clarify the distinctions between CDC, CDPH, and LAC DPH for hospitals and EDs. Three interviewees suggested that a chart, defining each organization and their roles, which could be emailed or posted in EDs may be helpful; however, two interviewees said that additional information may be overwhelming. Instead, the latter two interviewees emphasized that establishing and fostering personal relationships with hospital IPs will be more helpful to clarify the distinctions between CDC, CDPH, and LAC DPH.

LIMITATIONS

While the test calls provide a snapshot of EDs' knowledge to call LAC DPH in the case of public health emergencies or urgent communicable disease situations, there are important limitations to note. ACDC spoke to a limited number of ED staff members from each hospital; therefore, the responses are not generalizable to all ED staff members or shifts within a single hospital or, more broadly, to EDs throughout LAC. Furthermore, due to the chaotic and demanding nature of EDs, test calls had to be very brief, which prohibited ACDC from asking meaningful follow-up questions when ED staff members specified contacting the hospital's infectious disease doctor, IP, or unit; referenced a hospital binder, list, poster, or form; or said that they would consult with another member of the ED staff. In each of these

scenarios, ACDC was unable to determine if these processes would eventually result in timely contact to LAC DPH. As such, ED staff stating an alternative process to calling the local Public Health Department does not clearly indicate whether or not EDs know to call LAC DPH in the case of a public health emergency or urgent communicable disease situation. Considering the HOU's close relationships with hospital IPs and previous outreach to EDs, it is likely the case that if given sufficient time during the test call, ED staff would know to call LAC DPH. Additionally, given that all test calls were conducted during normal business hours to accommodate ACDC staff work schedules, ED staff responses may have been influenced by the fact that during normal business hours internal personnel, such as hospital IPs, are more readily available. It may be the case that ED staff working after normal business hours knows to call LAC DPH more readily, as fewer internal personnel are available to consult. However, it may also be true that ED staff working after normal business hours would be less likely to know to LAC DPH possibly due to less experience with LAC DPH.

Similarly, an important limitation of the follow-up interviews is that only nine EDs were included. Therefore, responses, though informative, are not representative of all EDs throughout LAC.

DISCUSSION

Only a small percentage of respondents specified an inaccurate external Public Health agency, such as the CDC, to call in the case of a public health emergency or urgent communicable disease situation during the test calls. Although ACDC physicians on call observed a number of misdirected calls from local EDs, the information obtained from the test calls indicates that the likelihood for misdirected calls is low, but can be improved.

Considerable percentages of respondents from both interviewee groups from the test calls indicated an alternative process to contacting LAC DPH when asked to specify who to call external to their hospital to report a disease or seek consultation. These alternative processes included contacting the hospital's infectious disease doctor, IP, or unit; referencing a hospital binder, list, poster, or form; and consulting with another member of the ED staff. As noted in the Limitations Section, this does not necessarily mean that LAC DPH would not eventually be contacted, nor does it clearly indicate a lack of knowledge to call LAC DPH. In fact, the follow-up interviews suggest that alternative processes would likely result in contact to LAC DPH if needed. For example, contacting the hospital IP first, who then may advise ED staff to contact LAC DPH, was standard policy and/or procedure for urgent communicable disease situations at all EDs who received a follow-up interview.

The vast majority of interviewee 1 respondents were ED clerks and secretaries and the vast majority of interviewee 2 respondents were ED charge nurses in the test calls. A higher percentage of interviewee 2 respondents specified to call the local Public Health Department than interviewee 1 respondents and a higher percentage of interviewee 1 respondents specified an alternative process to contacting LAC DPH than interviewee 2 respondents. As such, it appears that charge nurses tend to know to call the local Public Health Department in the case of a public health emergency or urgent communicable disease situation more so than clerical staff. As made evident in the follow-up interviews, it may be the case that it is the responsibility of ED charge nurses to report diseases or seek consultation with Public Health, which could explain the differences between interviewee 1 and interviewee 2 specifications of who to call. Respondents to the follow-up interviews indicated that should LAC DPH be contacted, such contact would be initiated by a physician, charge nurse, or any registered or licensed vocational nurse, not clerical staff.

A high percentage of EDs requested an additional copy of the *Frequently Called Directory for Communicable Diseases* during the test calls. Potential explanations for this request may include: (1) The ED did not receive the directory from the hospital IP; (2) The ED received the directory, but the staff member interviewed was not aware of it; (3) The ED received it and the staff member asked was aware, but wanted an additional copy for the ED or themself. Based on the chaotic and demanding nature of EDs, it is likely the case that the first two explanations are applicable for many EDs. As such, it is imperative that ACDC identify appropriate and effective channels to disseminate information to hospitals to continue to outreach to ED staff. From the follow-up interviews it appears that establishing and

fostering personal relationships with hospital IPs and communicating with ED staff in-person can facilitate effective outreach and communication going forward.

CONCLUSION

The test calls and follow-up interviews garnered important information for internal program improvement at ACDC despite limitations. While ACDC found that a low percentage of EDs who indicated LAC DPH as the external Public Health organization to call in the case of a public health emergency or urgent communicable disease situation during the test calls, an even lower percentage of EDs indicated an inaccurate external Public Health organization. This demonstrates room for improvement in ED knowledge of LAC DPH, but at the same time reveals that the problem of misdirected calls by local EDs to LAC DPH is likely small. ACDC also learned that a deeper understanding of internal hospital contacts and processes for reporting diseases and seeking consultation as well as the appropriate channels of information dissemination are needed to prevent misdirected calls by local EDs in the future. The follow-up interviews helped ACDC to learn more about EDs' internal reporting processes and methods for information dissemination. Moving forward, ACDC will continue to build close personal relationships with hospital IPs through HOU LPHNs to facilitate effective outreach and communication to EDs.

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MONITORING THE IMPACT OF HEAT WAVES WITH EMERGENCY SERVICE UTILIZATION DATA IN LOS ANGELES COUNTY, JANUARY 1, 2010 TO OCTOBER 15, 2012

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OBJECTIVE

To assess current indicators for situational awareness during heat waves derived from electronic emergency department (ED) and 911 emergency dispatch call (EDC) center data.

INTRODUCTION

Los Angeles County's (LAC) early event detection system captures over 60% of total emergency department (ED) visits, as well as 800 to 1,000 emergency dispatch center (EDC) calls from Los Angeles City Fire (LACF) daily. Both ED visits and EDC calls are classified into syndrome categories, and then analyzed for aberrations in count and spatial distribution. We describe how syndromic surveillance serves as an important near real-time, population-based instrument for measuring the impact of heat waves on emergency service utilization (ESU) in LAC.

METHODS

Daily electronic ED registration data, EDC calls, and maximum daily temperatures from Palmdale, California were queried from January 1, 2010 to October 15, 2012. A custom "heat exposure" category was created by searching ED chief complaints and diagnoses for key terms such as "heat stroke," "hyperthermia," "overheat," "heat rash" and relevant International Classification of Diseases (ICD) 9 diagnosis codes. Similarly, EDC calls were classified as related to heat exposure.

Pearson correlation tests were used to determine correlation between total ED visits, heat-related ED visits, heat-related EDC calls, and averaged maximum temperatures per Centers for Disease Control and Prevention (CDC) week. Counts were mapped for weeks in 2012 with the highest heat-related ESU. Daily counts were used for calculating rates and rate ratios per temperature range and age group.

RESULTS

From January 1, 2010 through October 15, 2012 counts have exceeded cumulative to October 15th for the past two years in the number of heat-related ED visits, heat-related EDC calls, and hot days (Table 1). There were 937 heat-related ED visits and 509 heat-related EDC calls during the study period; 78.3% and 82.6% (respectively) occurred on days that were ≥80ºF (N=478).

Table 1. Number of heat-related ED visits, EDC calls, and days exceeding temperatures to October 15th and to the year's end.

	2010 to 10/15 (year end total)	2011 to 10/15 (year end total)	2012 to 10/15	Study period total
Heat-related ED visits	294(323)	266(297)	317	937
Heat-related 911 calls	158(169)	116(128)	212	509
Days 90˚-99˚F	79(80)	76(77)	92	249
Days >=100˚F	29(29)	23(23)	35	87

Heat-related ESU increases seasonally with increased temperatures (Figure 1). Weekly heat-related ED visits and EDC calls were moderately correlated with weekly averaged maximum daily temperatures (r=0.60 p<0.0001 and r=0.57 p<0.0001, respectively), and more strongly correlated with each other (r=0.83 p<0.0001). Total ED visits did not increase during summer months and were therefore not found

to be correlated to temperature ((*p*=0.73), heat-related ED visits or EDC calls (*p*=0.18 and *p*=0.17, respectively).

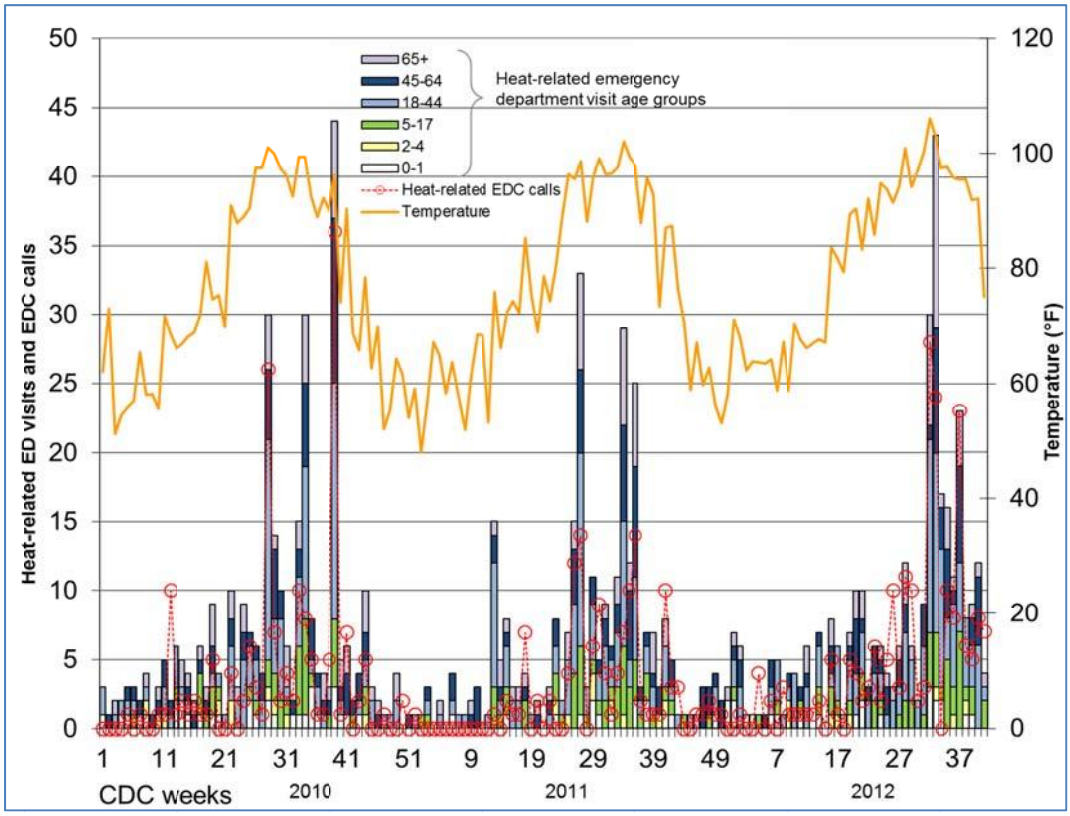

Figure 1. Weekly heat-related ED visits and heat-related EDC calls (left axis); and 7-day averaged maximum daily temperatures in Palmdale, California (right axis). Heat-related ED visits are stratified by age group.

Maps depict weekly counts of heat-related ED visits and EDC calls leading to and during the peak weeks of heat-related ESU activity and temperature in 2012 (Figure 2). Note that while coverage of ED visits is widespread, EDC calls are only captured for the LA City region, which does not include cities such as Santa Monica, Pasadena and Long Beach.

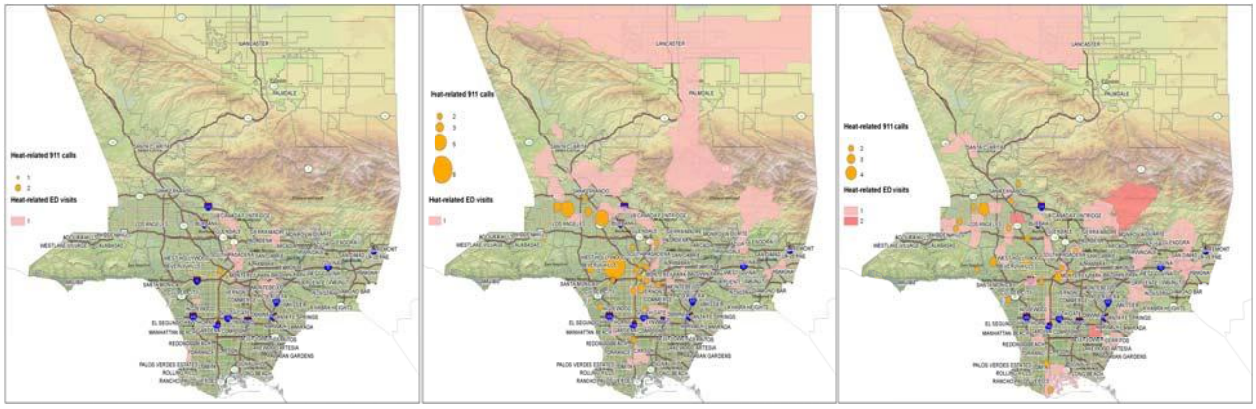

Figure 2: From left to right, heat-related ESU during CDC weeks 31 (7/29-8/4), 32 (8/5-8/11) and 33 (8/12-8/18) in 2012. The greatest single day numbers of heat-related ED visits and EDC calls in 2012 occurred on 8/8-8/10; highest temperatures occurred on 8/11-8/13. Shaded areas represent number of heat-related ED visits per resident zip code. Size of circles represent number of heat-related EDC calls by resident zip code.

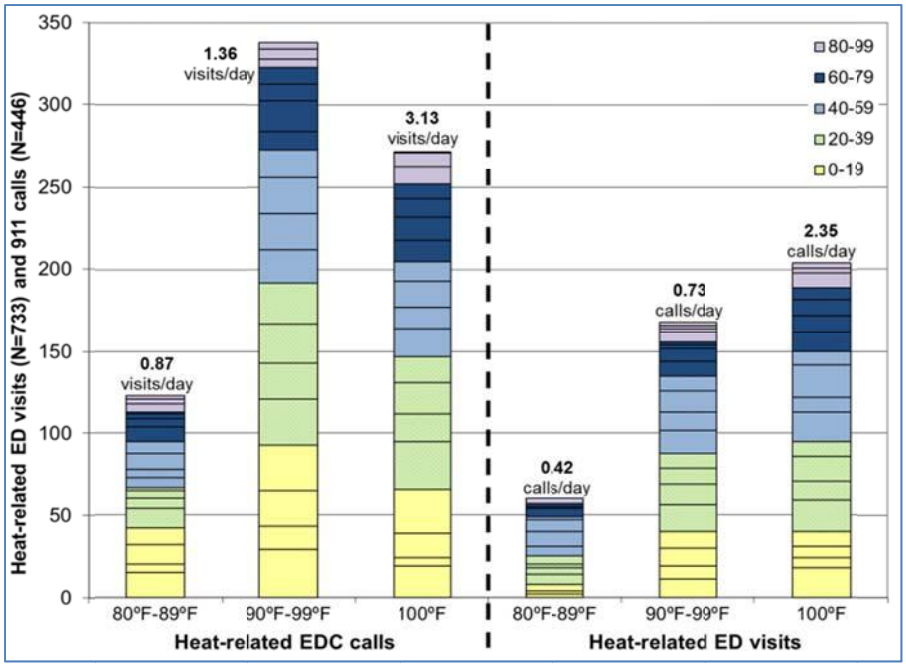

Figure 3: Total counts and daily rates of heat-related EDC calls and ED visits from 1/1/2010-10/15/2012 by age group and by temperature ranges 80ºF-89ºF (N=142), 90ºF-99ºF (N=249), and ≥100ºF (N=87). Divisions within age groups mark 5 year intervals

There were 3.6 times as many heat-related ED visits per day on days ≥100ºF compared to 80ºF-89ºF; days 90ºF-99ºF had rates 1.56 times greater (Figure 3). There were 5.6 times as many heat-related EDC calls per day on days ≥100ºF compared to 80ºF-89ºF; days 90ºF-99ºF had rates 1.74 times greater (Figure 3). Mean age of heat-related ED visitors increased with hotter temperature ranges, with values of 36.5, 37.2, and 39.8 years for 80ºF-89ºF, 90ºF-99ºF, and ≥100ºF days, respectively. Mean age of heat-related EDC calls did not increase with hotter temperatures, with values of 41.3, 38.2, and 41.1 years, respectively.

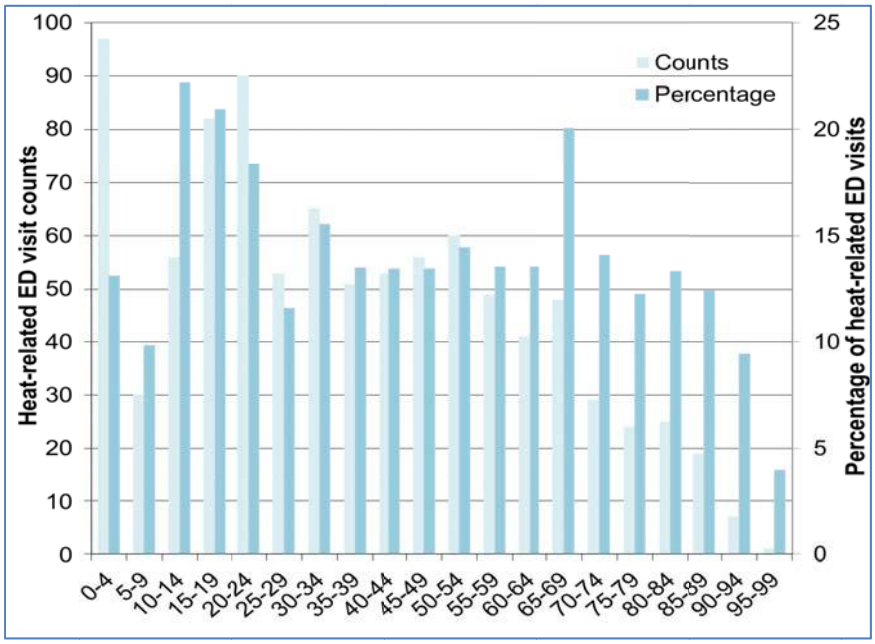

Figure 4: Count and percentage of heat-related ED visits by age group in five year intervals.

Analyzed in five year intervals, 0-4 year olds (10.4%), 20-24 year olds (9.6%) and 15-19 year olds (8.8%) experienced the most heat-related ED visits (Figure 4). As a percentage of total ED visits however, 10-14 year olds (22.2%), 15-19 year olds (21%) and 65-69 year olds (20.1%) formed the majority.

CONCLUSIONS

The average number of heat-related ED visits is very small compared to total ED visits; therefore total ED visits do not increase with hotter temperatures, have little to no correlation with heat-related ED visits and EDC calls, and thus may not serve as a good indicator of heat-related ESU in LAC. Filtering chief complaints to obtain heat-specific ED visits, however, enables patterns of increase to emerge which correlate with higher temperatures and heat-related emergency dispatch calls. About 36% of the week to week variation in heat-related ED visits, and 32% of the week to week variation in heat-related EDC calls can be explained by week to week variations in averaged maximum daily temperatures. These correlations may be exaggerated since temperatures from Palmdale, one of the hottest regions of Los Angeles County, were used; correlations will be calculated more precisely in future studies using temperature data from specific zip codes.

Heat-related ED visits are most common among 10 to 19 year olds, possibly because of more time spent outdoors. That heat-related visits were otherwise similarly distributed in age as all ED visitors suggests that heat does not disproportionately affect young children and the elderly any more than the rest of the acute health conditions that bring visitors to the ED.

The syndromic surveillance system provides an underestimate of heat-related healthcare seeking behavior since it does not capture information on visits to private providers, urgent care and other facilities. In addition,some syndrome misclassification of heat-related ED visits is inevitable due to having symptoms common to other illnesses. For instance, while even moderate heat may trigger cardiac arrest or syncope, adverse events such as these can also be prompted by other factors such as stress, extra physical exertion, or secondary illnesses. Accepting some misclassification, however, syndromic surveillance databases are useful for providing baselines and quantifiable, age-based measures of the effects of environmental exposure on ESU otherwise difficult to measure in near real-time.

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EVALUATING THE LOS ANGELES COUNTY PUBLIC HEALTH URGENT DISEASE REPORTING SYSTEM: PAST AND PRESENT

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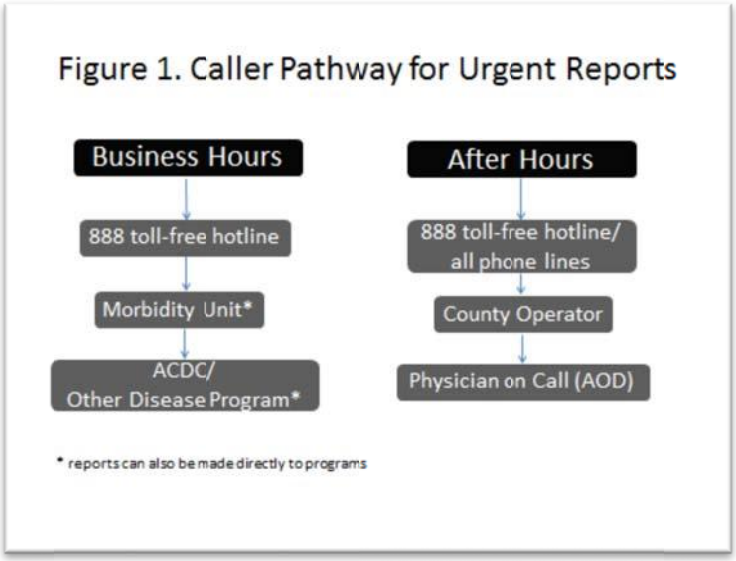
To improve Local Public Health Agencies' (LPHAs) ability to detect and respond to bioterrorism events and natural disease outbreaks, the Centers for Disease Control and Prevention (CDC) issued guidance that clarified LPHA responsibilities for receiving and responding to urgent disease case reports and outbreaks [1]. This guidance included 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) capacity to receive 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. To evaluate the LPHA disease reporting system, the RAND Corporation developed a set of methods [2]. In 2006 [3], 2010 [4], and 2011 [5], the Los Angeles County (LAC) Department of Public Health (DPH) Acute Communicable Disease Control Program (ACDC) evaluated LAC's Disease Reporting System . During the last months of 2012, another test of the system was performed. This report reviews the most recent test results and summarizes all evaluations since 2006.

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. This hotline is publicized on LAC DPH's website and in numerous publications and health education materials. In addition to the hotline, urgent disease reports can also be called in directly to ACDC.

Calls received through the hotline during normal business hours—Monday-Friday, 8am-5pm—go directly to the LAC DPH Morbidity Unit (Figure 1). If a caller is requesting information or assistance related to infectious disease, the call is transferred to ACDC. Other non-ACDC diseases such as tuberculosis, sexually transmitted diseases, and HIV are triaged to their respective programs. ACDC calls are triaged by ACDC clerical staff based on whether the caller is a healthcare provider and the exact nature of the call.



All hotline 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) (Figure 1). Healthcare providers with questions related to infectious disease are transferred to the Public Health physician on call, referred to as the Administrator On Duty (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 officer[1] (AO). The call process consisted of three phases: 1) initiating a call, 2) reaching an AO and

[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.

3) debriefing. A call was initiated when a test caller phoned the disease reporting system, used a lead-in (a short message 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.

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. 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. 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. The test of the urgent disease reporting system was not announced to physician staff and the exact schedule of test calls was kept secret. Dates and times of test calls were varied throughout the month.

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 number of calls with warm transfers as opposed to callbacks.

RESULTS

2012 Test Calls

In November and December 2012, a total of ten test calls were made to the disease reporting system. Contact with an AO was made within 30 minutes for all ten calls (Table 1). Response times for successful calls ranged from 3 to 15 minutes with a mean of 7.6 minutes from initiating the phone call to reaching an AO. Eight calls were warm transfers and two were callbacks.

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	After Hrs	Evening	WT	90 sec	----	----	4 min
2	After Hrs	Morning	CB	4 min	----	----	13 min
3	After Hrs	Morning	CB	----	----	----	7 min
4	Business Hrs	Morning	WT	----	10 sec	75 sec	9 min
5	After Hrs	Evening	WT	12 min	----	----	15 min
6	Business Hrs	Afternoon	WT	----	30 sec	1 min	3 min
7	Business Hrs	Afternoon	WT	----	10 sec	30 sec	3 min
8	Business Hrs	Morning	WT	----	1 min	2 min	10 min
9	Business Hrs	Afternoon	WT	----	45 sec	----	8 min
10	Business Hrs	Afternoon	WT	----	15 sec	10 sec	4 min

WT=Warm Transfer
CB=Call Back

Review of All Test Calls from 2006-2012:

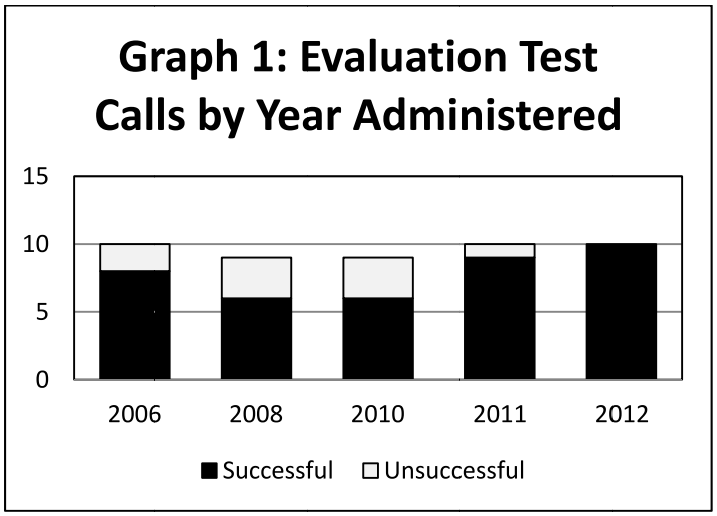
ACDC has evaluated LAC's Public Health Disease Reporting System five times since 2006. There have been a total of 48 test calls administered with nine or ten per evaluation. Table 2 summarizes these calls.

Eighty-one percent (39) of the calls successfully reached an AO within 30 minutes and nine calls were unsuccessful due to response times of 30 minutes or greater (4) or no response (5). The overall mean time for successful calls was 7.7 minutes with a range of 3 to 29 minutes, which was similar to the 2012 mean time but with a lower upper range of 15 minutes. Ninety-seven percent of the warm transfers had a successful outcome whereas 73% of call backs were successful. A higher proportion of the successful calls occurred after-hours (89%) rather than during business hours (76%). Also, evening was the most successful time to call (100%) followed by the afternoon (85%) and morning (66%). Type of call and time of call were not statistically associated with a successful call (p-value ≤ 0.05). In Graph 1, there were one to three unsuccessful test calls per evaluation in past years but 2012 was the first evaluation where all the calls were successful.

Table 2. A Retrospective Review of LAC's Disease Reporting System Evaluations, 2006-2012

Characteristic	Successful (percent)	Unsuccessful (percent)	Total number
All test calls	39(81)	9(19)	48
Mean time to reach AO (minutes)	7.7 (3 -29) median = 6	65.8 (30-144)* median = 45	
Call outcome			
Warm transfer	31(97)	1**(3)	32
Call back	8(73)	3(27)	11
No response	0(0)	5(100)	5
Type of call			
After-hours	17(89)	2(11)	19
Business hours	22(76)	7(24)	29
Time of call			
Evening	10(100)	0(0)	10
Afternoon	17(85)	3(15)	20
Morning	12(67)	6(33)	18

*Only 4 calls analyzed. No response was received for other five calls.
**Warm transferred but disconnected after being put on hold.



DISCUSSION

For the 2012 evaluation, all test calls reached an AO within 15 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.

Since its inception in 2006, ACDC has demonstrated that the LAC Public Health Disease Reporting System is functioning well within the LPHA responsibilities outlined by the CDC for receiving and responding to urgent disease case reports and outbreaks. Almost all the calls were handled in a timely manner and customer service issues were identified and addressed. The most successful calls seem to occur after-hours, in the evening hours and after a warm transfer.

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. Routine testing of the LAC's Disease Reporting System should be maintained so new issues may be identified and dealt with immediately.

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PARTNERING WITH EARLY CHILDHOOD EDUCATION PROVIDERS TO PREVENT INFECTIOUS DISEASE: A REVIEW OF A *FOTONOVELA* INTERVENTION

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BACKGROUND

The Los Angeles County (LAC) Department of Public Health (DPH) Acute Communicable Disease Control Program (ACDC) is committed to engaging in collaborative projects with diverse stakeholders to build community capacity for infectious disease prevention. This report briefly reviews ACDC's work with LAC early childhood education (ECE) providers on the topic of reptile-associated salmonellosis (RAS).

Reptile-associated Salmonellosis (RAS)

Over 1,200 cases of *Salmonella* are reported to ACDC each year in LAC.[1] Although largely considered a foodborne illness, an average of 9% of locally reported *Salmonella* cases is associated with reptile exposure, primarily turtle exposure.[1] This is higher than the national average; reptile exposure accounts for 6% of total reported *Salmonella* cases nationally.[2] According to ACDC surveillance data, low-income Spanish-speaking Latino families with young children living in apartments in LAC Service Planning Areas (SPAs) 2 and 4 who have had exposure to baby turtles as pets are disproportionately affected by RAS, accounting for the majority of RAS cases in LAC.[1, 2, 3]

Federal law, established in 1975, prohibits the sale or distribution of turtles with shells less than four inches in length and the Centers for Disease Control and Prevention (CDC) recommends that children under age five have no contact with reptiles or amphibians.[2, 4] Despite regulations and recommendations, small turtles are often sold illegally at swap meets and open air markets in LAC and have been popular pets in child care programs and preschool classrooms (i.e., ECE provider sites) throughout LAC.[2]

Building Relationships with ECE Providers

In order to target ECE providers to partner in a RAS initiative, a RAS Working Group was formed in 2007. The RAS Working Group began connecting with ECE providers by participating in monthly Los Angeles County-wide Child Care Planning Committee (CCPC) meetings with public health updates during the public comment period on a range of infectious disease prevention topics. The CCPC monthly meetings are attended by diverse ECE stakeholders, such as family-based and center-based providers, parents, advocates, and representatives of community-based organizations. Attending these meetings helped the RAS Working Group understand the important role that ECE providers play in linking families to needed health and social services.

In 2009, RAS Working Group members conducted field visits with seven ECE providers to exchange information, share LAC DPH resources and health education materials, and understand the context within which ECE providers serve local children, families, and communities.[2] The field visits strengthened the RAS Working Group's relationships with ECE providers, demonstrated that the issue of RAS was relevant at both center-based and family-based programs, and reinforced the important role that ECE providers play in reaching local children, families, and communities with relevant health messages. Recognizing the significance of partnering with local ECE providers, the RAS Working Group began planning strategies for reaching vulnerable children and parents in a standardized way about the issue of RAS through center-based and family-based programs.

RAS Fotonovela and Readers' Theater Activity

In late 2009, ACDC staff suggested that a *fotonovela* may be an effective approach to engage Spanish-speaking communities in LAC based on research showing that comics, stories, and pictures can effectively reach Spanish-speaking individuals with health messages.[5] A team of graduate public health students from a local university, in collaboration with the RAS Working Group, drafted, field tested, and

produced a 12-page glossy, bilingual *fotonovela* booklet telling a story about RAS with photographs and text based on real experiences from ECE providers and parents.[3]

ACDC developed an interactive readers' theater activity and plan to disseminate the *fotonovelas*. The readers' theater approach involved acting out the story in front of a group of peers. Three tools were developed to standardize the readers' theater process for presenting and discussing the *fotonovela*. The tools included a 1) readers' theater leaders' guide with a checklist of steps for facilitating the activity, 2) group evaluation form asking participants about their knowledge and practices related to RAS before and after the session, and 3) fax coversheet to send to ACDC after each readers' theater session summarizing the challenges, successes, and next steps.[3]

After developing the tools, the RAS Working Group began conducting hour-long training-of-trainer (TOT) sessions with nine ECE partners from 2009 to 2011.[3] ACDC staff facilitated TOT sessions with the ECE providers, who then presented the *fotonovela* and readers' theater activity to parents of enrolled children at regular parent meetings. Two large ECE partners who serve thousands of low-income Spanish-speaking families with children ages 0-5 regularly provided feedback to ACDC.[3] Results from one sample of 2010 group evaluation forms are presented in Table 1.

Table 1: Responses of *Fotonovela* and Readers' Theater Activity Participants from single ECE program to Group Evaluation Forms, 2010[4]

Group Evaluation Form Item	ECE Providers (n=78)	Parents (n=211)
Have seen baby turtles for sale	90%	84%
Before this meeting, knew that turtles could make you sick	67%	25%
Will not buy pet turtle if asked by child	97%	96%
Think this fotonovela is a good way to learn about the problem of *Salmonella*	99%	99%
Will share lessons learned with others	100%	99%

METHODS

In August 2012, ACDC staff developed a 16-question discussion guide for facilitating in-depth phone interviews with ECE providers to obtain their feedback on the *fotonovela* and readers' theater activity. Questions asked about their use of the *fotonovela*, how parents and staff were reached with the *fotonovela* and readers' theater activity, challenges and successes with implementing the readers' theater activity, progress with their next steps post learning about RAS, ideas for improving the activity, satisfaction with LAC DPH, recent changes to their organization, and interest in future trainings. The 16-question discussion guide included both quantitative and qualitative elements. While developing the 16-question discussion guide, ACDC staff reconnected with the nine ECE providers who initially implemented the *fotonovela* and readers' theater activity through email and phone communications to schedule interviews. Phone interviews were conducted from September through November 2012.

RESULTS

To date, there have been 5,590 *fotonovelas* disseminated, 143 ECE providers trained by ACDC, 4,721 families of children ages 0-5 reached, and considerable numbers of programs, providers, and parents committed to reducing the risk of RAS in their communities through 1) policy change, prohibiting reptiles from classrooms; 2) encouraging parents read the *fotonovela* to their child; 3) adding the *fotonovela* to classroom libraries; and 4) spreading RAS prevention messages by sharing the *fotonovela* with neighbors, friends, and relatives.[6]

Response Rate

Seven (78%) of the nine ECE provider sites who initially implemented the *fotonovela* and readers' theater activity were interviewed in 2012. Eight interviews within the seven sites were conducted because two

separate interviews with distinct contacts at a single ECE provider with multiple sites were needed due to the size of the organization.

Use of Fotonovela

While ACDC conducted TOT sessions with all nine ECE partners in 2009, not all providers were able to facilitate the readers' theater activity at their sites. When asked to indicate all the ways that the *fotonovela* was used, all eight interviewees used the *fotonovela* in one or more ways—six (75%) of the interviewees indicated that they facilitated the readers' theater activity, all eight (100%) distributed the *fotonovela* to parents, three (38%) gave copies of the *fotonovela* to community partners, five (63%) added the *fotonovela* to a classroom library, and one (13%) brought copies of the *fotonovela* on home visits to parents. The six interviewees who indicated that they facilitated the readers' theater activity as part of their use of the *fotonovela* facilitated the readers' theater activity primarily at parent meetings and staff trainings.

Challenges and Successes with Facilitating Reader's Theater Activity

When asked about their experience facilitating the readers' theater activity, all six of the interviewees that indicated that they used the *fotonovela* in this way reported that their experience was excellent. The six interviewees were presented with a series of statements inquiring about specific aspects of implementing the readers' theater activity and were asked to select one of the following answers in response to each statement: strongly disagree, disagree, neutral, agree, strongly agree, unsure, or not applicable. The number of ECE providers that selected strongly disagree, disagree, neutral, agree, strongly agree, unsure, or not applicable for each of the statements is presented in Table 2.

Table 2: Number of ECE providers per response option to each statement, 2012

Statement	Number of ECE providers per response option						
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Unsure	N/A
It was easy to obtain permission to facilitate the RAS *Fotonovela* and readers' theater at my organization					6		
It was easy to gather participants to conduct the RAS *Fotonovela* and readers' theater activity				2	4		
It was easy to use the RAS *Fotonovela* and readers' theater activity as a health education tool					6		
The topic of RAS was relevant to participants (i.e., many had seen baby turtles for sale)				2	4		
Attendants participated in the RAS *Fotonovela* and readers' theater activity				2	4		
Participants felt that the RAS *Fotonovela* and readers' theater activity was a good way to learn about the problem of RAS				1	5		
Participants were committed to not purchasing pet turtles after participating in the RAS *Fotonovela* and readers' theater activity				2	4		
Participants were willing to share what they learned with others				1	5		

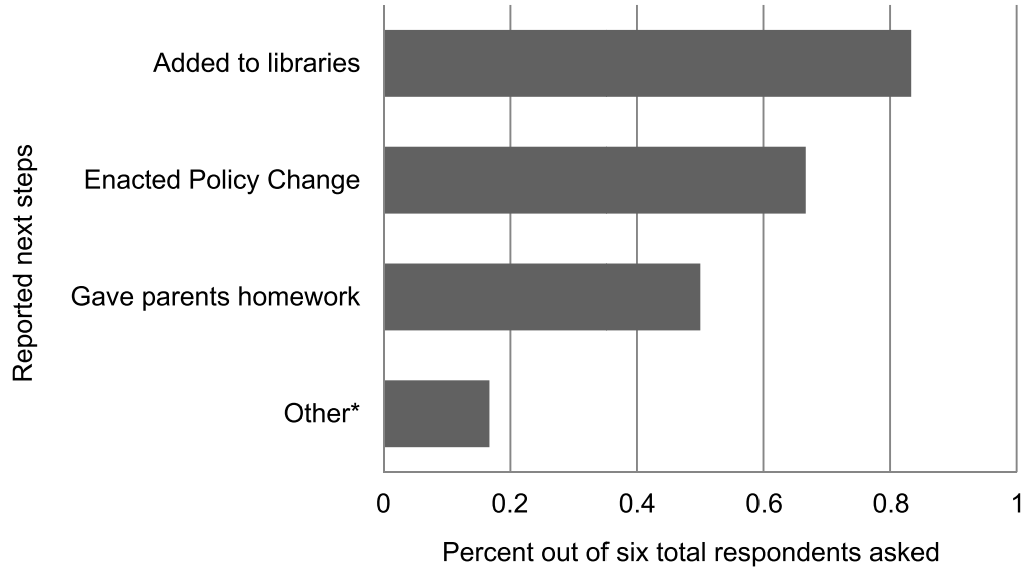
Interviewees were also given opportunities to provide qualitative feedback about their challenges and successes. When asked about reactions from parents after learning about the issue of RAS, multiple

interviewees noted that parents were surprised to learn about the dangers associated with owning baby turtles. Overall, parents were very receptive to the message and committed to not purchasing baby turtles, which was a success noted by multiple interviewees. Challenges included the competing priorities that parents face in attending parent meetings, since they struggle to balance family, work, school, and other commitments; conducting the readers' theater activity in both English and Spanish simultaneously if the audience required it; and not permitting classroom pets when children were used to having baby turtles or other reptiles at the site(s).

Progress and Next Steps

Four (50%) of the eight interviewees indicated that they had reptiles at their ECE site(s) prior to trainings from LAC DPH; however, the interviewees who had reptiles at their sites found more suitable homes for the reptiles and did not have them in the classroom at the time of the phone interview in 2012. All six interviewees who indicated that they facilitated the readers' theater activity also implemented changes to their organization in response to their knowledge about RAS. Four (67%) out of the six interviewees said that they changed policy, not allowing reptiles or other pets in the classroom; three (50%) gave parents homework of reading the *fotonovela* to their child; five (83%) added the *fotonovela* to classroom libraries; and one (17%) sent an organization-wide memo to their director and staff to inform them about RAS. Respondent next steps are summarized in Figure 1.

Figure 1:
Respondent reported next steps post learning about RAS



*Respondent who indicated other, specified sending an organization-wide memo about RAS

Ideas for Improvement

Interviewees proposed a number of suggestions when presented with the open ended question, "What could we do to improve the *Fotonovela* and readers' theater activity?" Suggestions included translating the *fotonovela* into additional languages, making the *fotonovela* easier to copy, from color to black and white for mass distribution, and more clearly labeling the dialogue bubbles as well as reducing the amount of text in the *fotonovela* to ease reading and acting it out.

Satisfaction with LAC DPH

Interviewees were asked to rank their satisfaction with LAC DPH's previous trainings, visits to their programs, and promotion materials on a scale from 1 to 5, with 5 being extremely satisfied. When asked for their overall satisfaction with LAC DPH's previous trainings and visits, seven interviewees provided answers with an average score of 4.93 (median: 5, range: 4.5 to 5). When asked how satisfied they were with the materials received from LAC DPH (i.e., *fotonovelas*, readers' theater activity handouts, educational materials on RAS and other health topics), eight interviewees provided answers with an average score of 4.81 (median: 5, range: 4.5 to 5).

Changes to ECE Provider Sites

Many ECE providers interviewed noted multiple changes to their organizations since 2009. Changes included staff turnover, budget cuts, and reductions in enrollment, making it difficult to continue implementing the readers' theater activity. In fact, one interviewee said that while the organization can continue to distribute the *fotonovela*, it may be difficult for their ECE providers to keep conducting the readers' theater activity due to scarce resources, limited time with parents, and reduced staffing.

Future Trainings and Topics of Interest

Two (25%) interviewees said that they would like additional training about the *fotonovela* and readers' theater activity, five (63%) were not interested in additional training, and one (13%) interviewee was not able to respond to the question as the interviewee no longer worked at the partner ECE organization. All of those able to respond to the question indicated that they were interested in participating in future disease prevention and health promotion activities on other topics, including food safety (6), hand washing (6), public health resources (5), emergency preparedness (7), influenza (6), and bats and rabies (2), among others.

DISCUSSION

The work of the RAS Working Group and ACDC staff from 2008 through 2012 demonstrates the relevance of RAS to local ECE providers and the parents and children they serve. The field visits in 2009, feedback from an ECE partner in 2010, and recent phone interviews in 2012 all indicate that the *fotonovela* and readers' theater activity are useful tools for local communities served by ACDC's ECE partner organizations to learn about the issue of RAS and motivate change in community norms around purchasing baby turtles as pets. The data from 2009 through 2012 show willingness by ECE providers and the parents that they serve to share what they learn about RAS with others, reaffirming ECE providers as important community partners in Public Health.

Since 2009, the RAS Working Group and ACDC have seen considerable success working with ECE providers to inform local communities about RAS with the *fotonovela* and readers' theater activity, reaching nearly 5000 families of children ages 0-5. However, limited staff resources, funds, and time are increasingly inhibiting ECE providers' abilities to focus on health education activities. Although deeply committed to promoting infectious disease prevention in their communities, ACDC's ECE partners may not be able to implement the readers' theater activity as rigorously as in previous years. Despite this shift, all partners are enthusiastic about continuing to distribute copies of the *fotonovela* to parents, making *fotonovelas* available in classroom libraries, and enforcing policies to not permit reptiles at their site(s). With this in mind, ACDC recently distributed remaining copies of the *fotonovela* to ECE providers in attendance at CCPC's first meeting of 2013 and the Los Angeles County Office of Education Head Start programs. As ECE partners interviewed in 2012 expressed satisfaction with LAC DPH health promotion materials and interest in receiving resources on multiple other infectious disease topics in the future, ACDC anticipates continued partnership with ECE providers throughout LAC to reach vulnerable communities with needed health resources.

CONCLUSION

ECE providers continue to be important partners in reaching often vulnerable and underserved, local communities with relevant health promotions materials and public health messages. ACDC's partnership with ECE providers on the *fotonovela* and readers' theater activity not only proved successful in informing parents and children about the issue of RAS locally, but also in generating lessons learned for future collaborations with the ECE provider community.

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SYNDROMIC SURVEILLANCE DETECTION OF TRADITIONALLY REPORTED TYPHOID FEVER CASES IN LOS ANGELES COUNTY

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BACKGROUND

Typhoid fever, or enteric fever, is a life-threatening disease caused by *Salmonella typhi*, a gram negative enteric bacillus. Transmission may occur person-to-person or by ingestion of food or water contaminated by the urine or feces of acute cases or carriers. The characteristic symptom of typhoid fever is a sustained fever of 103° to 104°F. Other symptoms may include stomach pain, headache, or loss of appetite[1]. Typhoid fever is a laboratory-reportable disease in Los Angeles County (LAC); all confirmed isolates must be forwarded to the LAC Department of Public Health Laboratory within one working day for confirmation and surveillance activities.

The Syndromic Surveillance (SS) system at LAC uses emergency department (ED) patient registration data, among other data sources, to help provide early detection of disease outbreaks and assist in monitoring of the population's health. The SS system places chief complaints (CC), the primary symptom that a patient states as the reason for seeking medical care, and diagnoses into categories, or syndromes, and monitors for any aberrations from established baselines and thresholds.

Between May 2011 and May 2012 a total of 16 confirmed cases of typhoid fever were reported to the LAC Department of Public Health (DPH) Acute Communicable Disease Control Program (ACDC) (average cases per year =16)[2]. ACDC queried its SS database to assess the ability of the SS system to correctly classify the cases' CCs, to locate reported cases of typhoid fever in LAC, and to detect potentially missed cases. All cases were also mapped to better gage the disease's distribution within our county.

The purpose of this report is to determine the distribution of reported typhoid fever cases in LAC, their presence within the SS data, and what CCs cases were presenting with to EDs in LAC.

METHODS

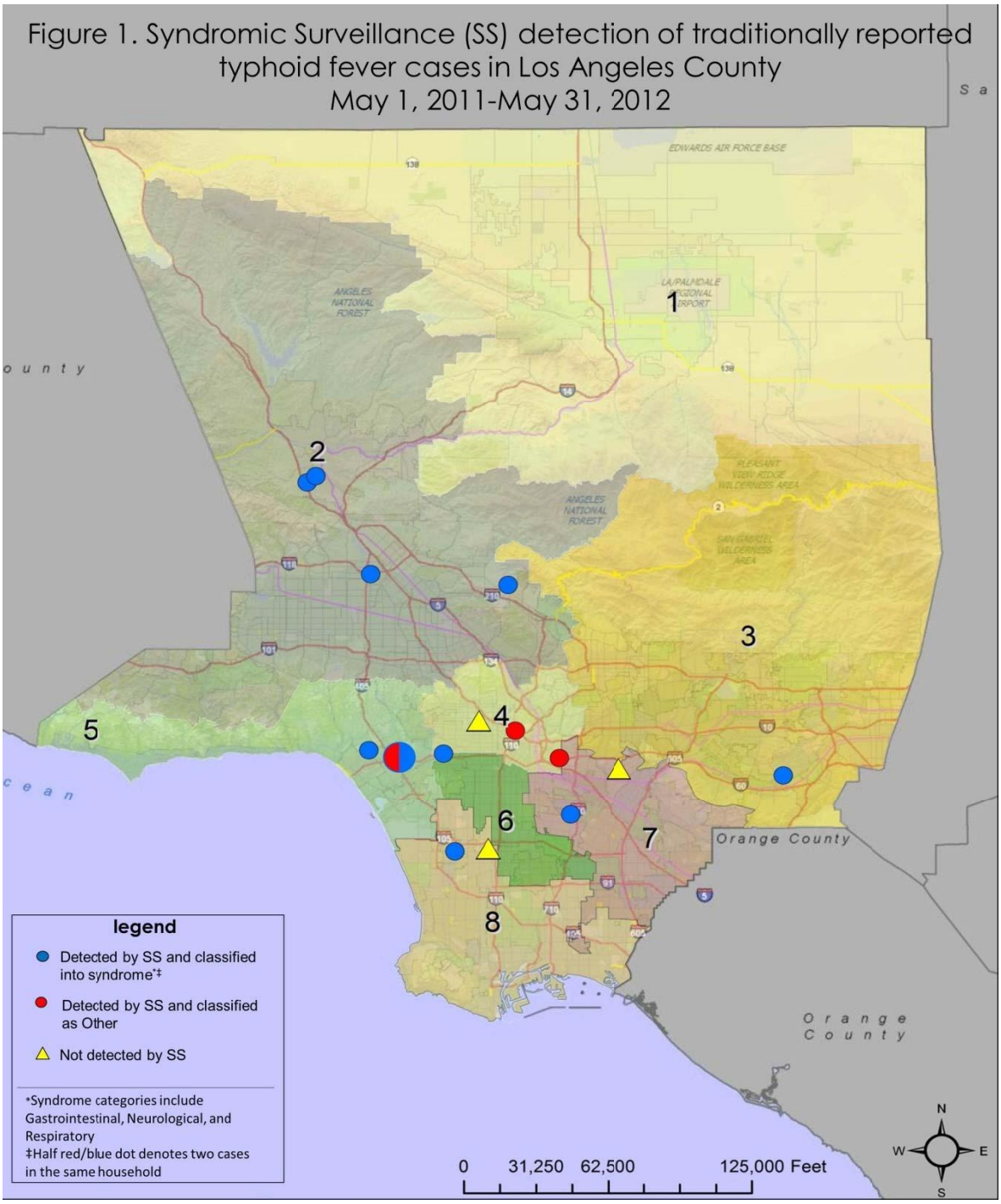
We acquired all confirmed case files between May 1, 2011 and May 31, 2012 from ACDC staff responsible for typhoid fever surveillance. A total of 16 case files were reviewed. Zip codes were obtained for each case from their respective case file and were mapped using ArcMap 10.

We attempted to locate confirmed cases among ED visitors within the SS database using two methods; first, by searching for specific CCs and diagnoses. Key words for this query included "typhoid fever", "salmonella", the International Classification of Diseases (ICD)-9 code for typhoid fever, and multiple variations in the spelling of these words to capture errors in data entry.

Secondly, we queried the SS database for matches based on known demographic information. Once a case was found, we noted the CCs cases were presenting to the ED with and whether they were classified into one of four syndrome categories: neurological, gastrointestinal, rash, and respiratory.

RESULTS

A total of 16 typhoid fever cases were identified in LAC between May 1, 2011 and May 31, 2012. Most cases resided in Service Planning Area (SPA) 2 (n=4, 25%) and SPA 5 (n=4, 25%) followed by SPA 7 (n=3, 19%) (Figure 1).



Overall we were able to locate 13 of the 16 cases (81.3%) reported to LAC in the SS database. Three of the 13 located cases reported to an ED more than once before a confirmed diagnosis was given. The first query, which searched CCs and diagnoses, resulted in only one match (6%) that explicitly stated the diagnosis as “acute typhoid fever”. The demographic information based query resulted in 12 more matches; reported CCs from this query included “cough”, “diarrhea, abd pain, vomiting”, and “fever for 5 days/headache/weak” (Table 1).

Of the 13 cases found in the SS database, ten were classified into one of four syndrome categories during at least one ED visit (six respiratory, three gastrointestinal, and one neurological). Two of the

remaining three cases were not classified into a syndrome category because the CCs did not contain any patient symptoms and were thus classified as “other” (Table 1); the last case had a CC of “chest pain” which does not fit into either of the four syndrome classification and was also classified as “other”. Seven of the 13 cases reported “fever” in their CC (the most notable symptom of typhoid fever). A typographical error in entering the CC for case #3 as “fewer” resulted in incorrectly classifying his first ED visit as other rather than respiratory.

Table 1. Emergency Department Chief Complaints Recorded from Confirmed Typhoid Fever Cases in LAC, May 2011-May 2012

Case	Number of ED Visits	Chief Complaint	Syndrome Category
1	2	ABNORMAL LAB RESULTS FEVER	Other Respiratory
2	1	DIARRHEA, ABD PAIN, VOMITING	Gastrointestinal
3	2	FEWER FEVER X 1 WEEK	Other Respiratory
4	3	FEVER, VOMITING, ABDOMINAL CRAMPS FEVER, VOMITING, WEAKNESS POSS FEVER	Gastrointestinal Gastrointestinal Respiratory
5	1	COUGH	Respiratory
6	1	FEVER FOR 5 DAYS, HEADACHE, WEAK	Neurological
7	1	VOMITING, DIARRHEA, FEVER	Gastrointestinal
8	1	QUICK REG	Other
9	1	ABNORMAL LAB RESULTS	Other
10	1	SYNCOPE AND COLLAPSE, FEVER	Respiratory
11	1	CHEST PAIN	Other
12	1	FEVER OF UNKNOWN ORIGIN	Respiratory
13	1	FEVER X 1 MONTH	Respiratory

A total of three confirmed cases were not located within our SS database (18.7%). One case was not found because he did not visit an ED and instead visited an urgent care center. A second case was not found within the SS system because he reported to one of the hospital EDs not currently participating in the SS system. One case’s chart states that he was admitted through one of the hospitals monitored by the SS system; however, it is possible that his visit was registered for inpatient care. We were not able to locate any additional cases aside from the 16 reported cases.

DISCUSSION

The 16 confirmed typhoid fever cases reported to LAC between May 2011 and May 2012 showed distribution patterns consistent with previous years[2], with the majority of cases residing in SPA 2 in 2007, 2008, and 2009.

Traditionally typhoid fever is thought to be a systemic or gastrointestinal illness, even though the characteristic symptom of typhoid fever is sustained fever. Of the 13 confirmed cases found within the SS database, eight (62%) included “fever” in their CC during at least one of their ED visits, however, the syndromic classification algorithm currently assigns the term “fever” when appearing alone to the respiratory category. As a result, of the ten cases that were classified into one of the four syndrome categories, three were classified as gastrointestinal while six fell into the respiratory syndrome category. This finding will help guide our future efforts to detect a community-wide increase in ED visits due to typhoid fever; we will be more successful in querying for “fever” visits rather than querying for visits classified under gastrointestinal and/or respiratory syndromes.

In general, using demographic information to search retrospectively for confirmed typhoid cases within SS databases is much more effective than searching for key words within the CC and diagnosis fields. As in the case with "fever" misspelled as "fewer", misspellings and typographical errors within CC and diagnosis fields limit our ability to correctly identify all disease events. Another limitation in querying the SS databases is that the ED data is de-identified; thus, we cannot be sure that the cases we match are in fact the same person. While we are fairly certain that cases matched on date of birth, zip code, visit date, and hospital are legitimate, missing variables in the ED registration data hinder our ability to easily perform case finding.

Despite these limitations, SS databases can be used to locate a high percentage of confirmed cases as long as symptoms are severe enough to warrant visits to the ED. Typhoid fever appears to be particularly suited for SS queries, as a striking 15 of 16 (94%) confirmed cases reported to an ED. Although CCs for typhoid fever are not specific and can fall into multiple syndrome categories, expanded queries for other illnesses can detect potential outbreaks or diseases not found in automated syndrome categories[3]. This near real-time surveillance can be useful during large scale outbreaks to capture disease events or clusters that have not yet been identified. Future studies evaluating the SS system's capacity to detect reportable disease clusters will be beneficial.

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