Acute Communicable Disease Control Program

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ACUTE COMMUNICABLE DISEASE CONTROL
SPECIAL STUDIES REPORT 2017

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THE FIRST YEAR OF MANDATED CARBAPENEM-RESISTANT *ENTEROBACTERIACEAE* AND ANTIBIOGRAM REPORTING IN LOS ANGELES COUNTY: 2017

BACKGROUND

Carbapenem-resistant *Enterobacteriaceae* (CRE)[1] are a family of gram-negative bacteria that can be resistant to most antibiotics including the carbapenem class of drugs which are used to treat severe infections. The majority of CRE infections are associated with patients in an acute care hospital or skilled nursing facility (SNF) who are immunocompromised or have invasive devices such as intravenous catheters or are ventilator dependent. The Centers for Disease Control and Prevention (CDC) is concerned about the rapid spread of CRE and has recommended aggressive approaches for identifying and preventing further spread [1].

Using data from 2010–2012, the Los Angeles County Department of Public Health (LAC DPH) assessed the prevalence of CRE in LAC[2] and received over 2,000 laboratory reports of carbapenem-resistant *Klebsiella pneumoniae*, one type of CRE. Prior work by the CDC suggested only sporadic cases of CRE were identified in LAC hospitals and prevalence was unknown. The large number of cases received was substantially higher than anticipated, providing justification for further surveillance.

CDC's National Healthcare Safety Network (NHSN)[3] is an electronic healthcare-associated infection (HAI) tracking system. In California, all acute care hospitals are mandated to report select HAIs to the California Department of Public Health via this system. The NHSN includes an option to report the three most common CRE infections (*Escherichia coli, Enterobacter sp., Klebsiella sp.)* as part of the system's LabID Event module. In April 2010, LAC DPH requested and received voluntary conferral of rights to the NHSN data submitted to California Department of Public Health. On January 19, 2017 a Health Officer Order (HOO)[4] was issued requiring all acute care hospitals and SNFs report CRE infections as well as a facility-specific annual antibiogram to LAC DPH. Antibiogram data provide a comprehensive summary of antimicrobial resistance organisms isolated in healthcare facilities. LAC DPH will use data submitted from healthcare facilities to compile a regional antibiogram to assess resistance and detect new trends in LAC.

METHODS

In California, general acute care hospitals (GACH) and long term acute care hospitals (LTACH) mandatorily report HAI data into NHSN. LAC DPH decided to build CRE reporting into this already established system and expand the data captured by creating a LAC CRE Group which added patient information and key variables needed to assess and describe the epidemiology of CRE in LAC. For surveillance purposes in this study, CRE infections were defined using the NHSN Safety Component Manual[5] as *Enterobacteriaceae* (*E. coli, Enterobacter sp., Klebsiella sp*.) resistant to carbapenem antibiotics or that produce carbapenemases.

[1] https://www.cdc.gov/hai/organisms/cre/definition.html
[2] http://publichealth.lacounty.gov/acd/docs/CRKP_ICHE.pdf
[3] https://www.cdc.gov/nhsn/index.html
[4] http://publichealth.lacounty.gov/acd/docs/CREorder.pdf
[5] https://www.cdc.gov/nhsn/pdfs/pscmanual/pcsmanual_current.pdf

LAC DPH sent detailed instructions for this new reporting requirement to all LAC facilities mandated to report. In addition, a webinar was created to provide step by step guidance on how to join the LAC CRE Group, as well as how to confer rights to LAC DPH and create custom variables. In contrast to GACHs and LTACHs, because most SNFs are not enrolled in the NHSN, a paper reporting form was created for these locations.

The NHSN LAC CRE group was used as the data source for analysis to calculate hospital and community onset rates as well as for descriptive epidemiology statistics. All SNF reports were submitted via paper case report forms and were entered into an Access database by ACDC staff.

For GACHs and LTACHs, CRE rates were analyzed using NHSN calculations of number of infections reported for the numerator and admissions for community-onset (CO) and patient days for healthcare-onset (HO) for the denominator. CO infections were identified within 3 days of admission and HO after 3 days of admission in both GACHs and LTACHs. Stratification of data by onset type in SNFs was not possible since most admission date information was either missing or filled out incorrectly.

According to the Centers for Medicare and Medicaid services (CMS) requirements, GACHs and LTACHs submitted final reports to NHSN by May 15, 2018. Data analysis was performed in May and June 2018. Additional analysis was done comparing CRE case counts between the two NHSN LAC groups; the general LAC group and the LAC CRE Group containing patient information and custom variables.

RESULTS

Out of 83 GACHs and 8 LTACHs in LAC, 72 (86.7%) GACHs and all LTACHs reported at least one CRE event. Pooled LTACH HO rates were higher than GACHs at 1.22 (range 0.50–2.18) infections compared to 0.66

Figure 1.
Boxplots of HO Infection Rate Distribution GACHs and LTACHs where >0 cases reported, LAC 2017

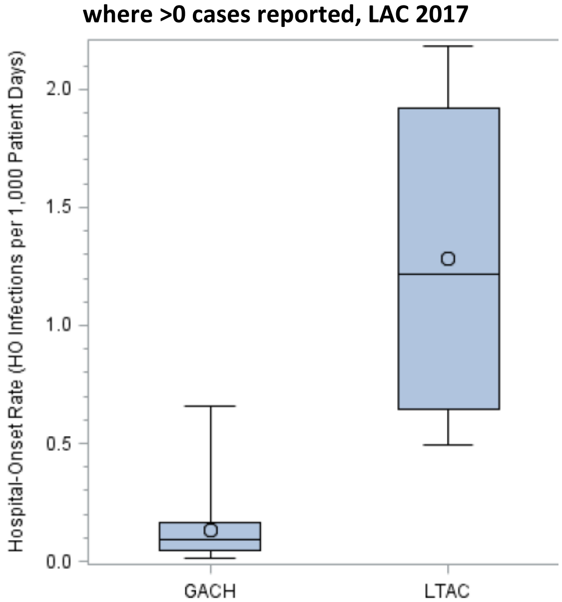
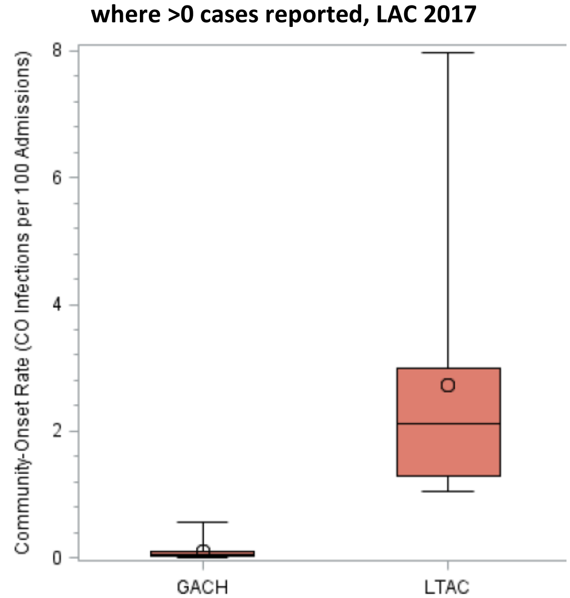


Figure 2.
Boxplots of CO Infection Rate Distribution GACHs and LTACHs where >0 cases reported, LAC 2017



(range 0.01–0.66) per 1,000 patient days respectively (**Figure 1**). The pooled CO CRE rates reported from LTACHs were also higher than GACHs, 2.11 (range 1.04–7.97) infections and 0.35 per 100 admissions, respectively (**Figure 2**).

GACH

In GACHs, the majority of healthcare-onset CRE reported was *Klebsiella* (64.9%), followed by *Enterobacter* (22.4%) and *E. coli* (12.7%) (**Table 1**). *Klebsiella* (75.6%) was also the most commonly reported community onset CRE followed by *E. coli* (13.5%) and *Enterobacter* (10.9%).

Table 1.
CRE Organism Type by Healthcare or Community Onset, GACH
LAC, 2017 (N=1280)

	HO		CO		
Organism Type	No.	%	No.	%	**TOTAL**
E. coli	63	12.7	106	13.5	169
Enterobacter	112	22.4	85	10.9	197
Klebsiella	323	64.9	591	75.6	914
TOTAL	**498**	**38.9**	**782**	**61.1**	**1280**

Across the three CRE organisms that were assessed, the most common type of CRE infections reported from GACH were CO genitourinary tract infections, followed by HO respiratory infections (**Table 2**).

Table 2.
CRE Organism by Specimen Source by Healthcare or Community Onset, GACH
LAC, 2017 (N=1280)

	E. coli				Enterobacter				Klebsiella			
	HO		CO		HO		CO		HO		CO	
Specimen Source	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Cardiovascular	7	11.1	10	9.4	6	5.4	3	3.5	38	11.8	43	7.3
Digestive System	7	11.1	1	0.9	6	5.4	3	3.5	7	2.2	25	4.2
Ear, Eye, Nose, Throat	0	0	0	0	0	0	0	0	0	0.0	2	0.3
Genitourinary	14	22.2	69	65.1	14	12.5	44	51.8	73	22.6	312	52.8
Musculoskeletal	0	0.0	0	0.0	0	0.0	2	2.4	1	0.3	0	0.0
Reproductive Male	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3	0	0.0
Respiratory	16	25.4	7	6.6	65	58.0	10	11.8	120	37.2	70	11.8
Skin/Soft tissue	11	17.5	11	10.4	14	12.5	17	20.0	67	20.7	122	20.6
Unspecified	8	12.7	8	7.6	7	6.3	6	7.1	16	5.0	17	2.9
TOTAL	**63**	**4.9**	**106**	**8.3**	**112**	**8.8**	**85**	**6.6**	**323**	**25.2**	**591**	**46.2**

The mean age of CRE HO and CO infections reported from GACH were 63.5 and 67.4 years respectively. Although data on race and ethnicity was collected, much of this data was missing (**Table 3**).

Table 3.
CRE Infections Demographic Data by Healthcare or Community Onset, GACH LAC, 2017 (N=1280)

Demographics	HO No.	HO %	CO No.	CO %
Gender				
Female	187	37.6	371	47.4
Male	311	62.4	411	52.6
Ethnicity* (N=176)				
Hispanic	19	29.2	33	29.7
Non-Hispanic	46	70.8	78	70.3
Mean Age (Median, Range)	63.5	(65, 0–97)	67.4	(70, 0–102)

* Missing 1104; not a required field.

Information on fatalities related to CRE infections was requested; however, a large proportion of these data were missing. Of the 283 CRE events where death data was completed, 38 reported a fatal outcome.

LTACH

In LTACHs, the majority of HO CRE reported was *Klebsiella* (93%), followed by *E. Coli* (4.5%) and *Enterobacter* (2.5%) (**Table 4**). *Klebsiella* (86.2%) was also the most commonly reported CO CRE followed by *Enterobacter* (7.6%) and *E. Coli* (6.3%).

Table 4.
CRE Organism Type by Healthcare or Community Onset, LATCH LAC, 2017 (N=517)

Organism Type	HO No.	HO %	CO No.	CO %	TOTAL
E. coli	16	4.5	10	6.3	26
Enterobacter	9	2.5	12	7.6	21
Klebsiella	333	93.0	137	86.2	470
TOTAL	**358**	**69.2**	**159**	**30.8**	**517**

The most common type of CO CRE infections across all three organisms and HO *E. Coli* reported from LTACHs were identified from urine specimens. HO *Enterobacter* and *Klebsiella* were most commonly reported from respiratory sources (**Table 5**).

Table 5.
CRE Specimen Source by Organism by Healthcare or Community Onset, LTACH LAC, 2017 (N=517)

	E. coli				Enterobacter				Klebsiella			
	HO		CO		HO		CO		HO		CO	
Specimen Source	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	0	0.0	0	0.0	2	22.2	1	8.3	28	8.4	1	0.7
Digestive System	0	0.0	0	0.0	0	0.0	2	16.7	5	1.5	39	28.5
Genitourinary	9	56.3	9	90.0	0	0.0	6	50.0	117	35.1	62	45.3
Respiratory	3	18.8	1	10.0	6	66.7	2	16.7	141	42.3	24	17.5
Skin/Soft tissue	4	25.0	0	0.0	1	11.1	0	0.0	38	11.4	9	6.6
Unspecified	0	0.0	0	0.0	0	0.0	1	8.3	4	1.2	2	1.5
TOTAL	**16**	**3.1**	**10**	**1.9**	**9**	**1.7**	**12**	**2.3**	**333**	**64.4**	**137**	**26.5**

The mean age of CRE HO and CO infections reported from LTACHs were 69.9 and 66.8 years respectively. Although data on race and ethnicity was collected, because this was not a required field, much of this data was missing and could not be analyzed and reported (**Table 6**).

Table 6.
CRE Infections Demographic Data by Healthcare or Community Onset, LTACH LAC, 2017 (N=517)

	HO		CO	
Demographics	No.	%	No.	%
Gender				
Female	185	51.7	78	49.0
Male	173	48.3	81	51
Mean Age (Median, Range)	69.9	(72, 0–100)	66.8	(71, 0–96)

Information on fatalities at LTACH hospitals related to CRE infections, like the GACH, was requested, however a large proportion of these data were missing. Of the 59 CRE events where death data was completed, 15 reported a fatal outcome.

SNFs

A total of 56 CRE events were reported by 33 SNFs in 2017. No deaths were reported.

Table 7. CRE Organism Type, SNF LAC, 2017 (N=56)		
	No.	%
E. coli	9	16.1
Enterobacter	7	12.5
Klebsiella	40	71.4
TOTAL	**56**	

The mean age of SNF CRE infections was 68.8 years, which was similar to both GACHs and LTACHs. CRE in females was more commonly reported from SNFs.

Table 8. CRE Infections Demographic Data, SNF LAC, 2017 (N=56)		
Demographics	No.	%
Gender (N=56)		
Female	30	53.6
Male	26	46.4
Ethnicity* (N=32)		
Hispanic	14	43.8
Non-Hispanic	18	56.2
Race* (N=50)		
African American	8	16.0
Asian	11	22.0
White	31	62.0
Mean Age (Median, Range)	68.8	(69, 24–94)
* Missing data		

The most common specimen source reported in *Klebsiella* and *E. Coli* infections was urine. Sputum was the most common specimen source for *Enterobacter* infections.

Table 9. **CRE Specimen Source by Organism, SNF** **LAC, 2017 (N=56)**						
	E. coli		**Enterobacter**		**Klebsiella**	
Specimen Source[1]	No.	%	No.	%	No.	%
Blood	0	0.0	1	14.3	1	2.5
Sputum	1	11.1	5	71.4	7	17.5
Wound	3	33.3	0	0.0	0	0
Urine	5	55.6	0	0.0	24	60
Rectal	0	0.0	0	0.0	3	7.5
Other[2]	0	0.0	0	0.0	3	7.5
No Source	0	0.0	1	14.3	3	7.5
TOTAL[3]	**9**	**16.1**	**7**	**12.5**	**40**	**71.4**

1. Multiple specimen source listed for some cases.
2. Tracheal and gastrostomy tube.
3. No organism specified for 3 cases.

The majority of CRE events reported by SNFs list the patient was admitted from a GACH (60.7%).

Table 10. **Admissions from Facility Type, SNFs** **LAC, 2017 (N=56)**		
	Admissions	
Facility Type	No.	%
Hospital	34	60.7
LTACH	5	8.9
SNF	2	3.6
Home	0	0
Missing	15	26.8
TOTAL	**56**	

Data Analysis

For GACHs and LTACHs, 19 hospitals were found to have reporting issues in the CRE Group including not joining or conferring rights, incorrect reporting plans, or a lag in data entry. Communication addressing the specific issue identified for each hospital was generated and sent via email to the hospital infection preventionist by the respective LAC DPH liaison public health nurse and an epidemiologist. If additional troubleshooting or technical assistance was required, the assigned epidemiologist would follow-up with the infection preventionist. By May 2018, all 19 with reporting issues had corrected the problems. In addition, 2018 reporting plans were checked to ensure the corrections had carried over to the new year.

Forty duplicates were identified within NHSN data. Efforts were made to reach out to NHSN to troubleshoot how this occurred and make appropriate corrections to avoid future duplicate event entry.

SNF data was merged with the GACH and LTACH data to check for duplicate reporting. Multiple errors were identified including CRE reported by a SNF that should have or had already been reported by the ordering acute care hospital, incorrect date of current admission to the SNF, reporting a history of CRE (no current lab), and reporting on different organisms (i.e. *Pseudomonas*) not covered by the HOO. Analysis of SNF reports resulted in identification of two CRE reports that should have been reported by the acute care hospital but were missed. Five cases had already been reported in NHSN by the acute care hospital. These errors were communicated to the appropriate facilities.

Antibiogram

All 92 acute care hospitals (including LTACHs) in LAC submitted antibiograms during the first year of the HOO. With this information, the first LAC regional antibiogram[6] was completed, published, and distributed in January 2018 and is posted on the ACDC website. Data entry and analysis is currently underway for 2017 data.

DISCUSSION

Overall the first year of CRE reporting in LAC generated valuable data and identified high rates of CRE in healthcare facilities, especially among LTACHs. This information will help guide targeted prevention efforts moving forward. Reporting errors were identified from GACHs, LTACHs, and SNFs and efforts have been made to correct discrepancies both retrospectively and going forward.

LIMITATIONS

All the custom variables that LAC DPH requested in NHSN reporting plans exhibited low response rates resulting in missing data. We plan to address these reporting gaps by identifying facilities that did not complete the custom variable fields and reaching out to them to notify them and provide additional assistance as needed.

There was no NHSN data validation done to ensure that hospitals are reporting CRE accurately and thoroughly. Historically, the California Department of Public Health has performed hospital data entry validation for other diseases, however this verification has not been conducted as CRE is not reportable at the state level. Currently, data validation in SNFs is not feasible as there are over 300 SNFs in LAC.

REFERENCES

1. Centers for Disease Control and Prevention (CDC). Healthcare-associated Infections: FAQs about Choosing and Implementing a CRE Definition. https://www.cdc.gov/hai/organisms/cre/definition.html Accessed August 2018.
2. Marquez P, Terashita D, Dassey D, Mascola L. Population-based incidence of carbapenem-resistant Klebsiella pneumoniae along the continuum of care, Los Angeles County. Infect Control Hosp Epidemiol. 2013;34(2):144–150. http://publichealth.lacounty.gov/acd/docs/CRKP_ICHE.pdf

[6] http://publichealth.lacounty.gov/acd/AntibiogramData.htm

ACTIVATING VITAL ADVANCES IN ANTIMICROBIAL RESISTANCE TESTING AMONG LOS ANGELES COUNTY HEALTHCARE FACILITIES

BACKGROUND

Antibiotic resistance (AR) and multi-drug resistant organisms (MDRO) are an intensifying public health threat. Carbapenem-resistant Enterobacteriaceae (CRE) are especially concerning. CRE mortality rates are often as high as 30-40% [1-5] due to limited treatment options. In addition, many CRE can spread AR to other bacteria via plasmid-encoded genetic resistance mechanisms, called carbapenemases [6]. Given this, it is not surprising that CRE has been classified as a critically important and urgent global threat by the Centers for Disease Control and Prevention (CDC) and the World Health Organization [7-8]. While CRE has been steadily increasing in the United States [9-10], Los Angeles County (LAC) has been identified as a hotspot for CRE infections because of its large number of healthcare facilities and its international patient population [11], which create a complex system within which CRE and other MDROs can readily spread.

Early administration of microbiologically active antimicrobial therapy can reduce morbidity and mortality from CRE infections [5, 12-14]. This depends on accurate determination of the minimum inhibitory concentration (MIC) of the infecting organism to antibiotics. Interpretation of the MIC results is conducted using breakpoints, which categorize whether an antibiotic is resistant or susceptible to any given antibiotic and determine the probability of treatment success. The Clinical Laboratory Standards Institute (CLSI) provides guidance on what methodologies clinical laboratories should use to detect CRE and other nosocomial pathogens.

The CLSI updated the carbapenem MIC breakpoints for Enterobacteriaceae in 2010 based on data from multiple clinical studies demonstrating that ongoing use of the previous breakpoints resulted in higher patient mortality [3, 4]. Failure to update breakpoints also impacted infection control measures, which is estimated to contribute to a 3-5% annual spread of CRE [15]. Ongoing use of outdated CLSI breakpoints will result in the failure to recognize clinically and epidemiologically concerning MDROs such as CRE.

It is thus imperative that clinical laboratories are up-to-date on their CRE detection methods. To assess CRE detection practices amongst clinical laboratories, the Acute Communicable Disease Control Healthcare Outreach Unit (HOU) partnered with California Department of Public Health and academic investigators to conduct the California Antimicrobial Resistance Laboratory Network Assessment (CARLA) survey in 2015. The CARLA survey identified that 42% of hospital laboratories in LAC used outdated carbapenem breakpoints for Enterobacteriaceae [16]. Furthermore, many laboratories did not perform carbapenemase testing, as recommended by CLSI to ensure detection of carbapenemase-producing Enterobacteriaceae with use of outdated breakpoints [16].

Clinical laboratories must take manual steps to ensure their antimicrobial susceptibility testing (AST) instruments are up-to-date. However, the HOU theorized that lack of awareness of the problems surrounding use of outdated breakpoints and/or technical knowledge of how to update breakpoints caused the delayed uptake of revised breakpoints. This prompted our initiative to better understand why laboratories failed to update breakpoints and, in turn, assist them in implementing up-to-date CRE detection methods.

OBJECTIVE

This report describes the HOU's efforts to update carbapenem breakpoints amongst targeted clinical laboratories in LAC to improve detection of CRE.

METHODS

HOU established the antimicrobial resistance/antimicrobial stewardship (AR/AS) team, composed of five HOU liaison public health nurses (LPHNs), an epidemiologist, and an infectious disease physician serving as the HOU's AR expert. Targeted hospitals were chosen based upon their responses to the question of using outdated CRE breakpoints in the CARLA survey. To be included in our target list, the labs had to respond with i or ii to the following question: What breakpoints does your laboratory use for carbapenems when testing Enterobacteriaceae?

i. Pre-2010 breakpoints only ←
ii. Pre-2010 breakpoints combined with tests for carbapenemase production ←
iii. Current CLSI M100 S25 breakpoints
iv. Other

The AR/AS team collaborated with CDC and local microbiology experts to develop a protocol that guides clinical laboratories through the process of updating CRE detection methods, which includes:

1. ordering verification panels from the Food and Drug Administration (FDA)/CDC AR Isolate Bank;
2. updating breakpoints in the AST instrument, which may involve scheduling a visit with the local service technician of their AST device manufacturer; and
3. conducting a verification study to ensure accurate results.

The team first conducted in-person visits with each hospital's laboratory director, microbiology supervisor, antimicrobial stewardship chair, and infection preventionist to discuss unique issues that were impacting their CRE detection methods and provide initial recommendations. Following the initial visit, the AR/AS team provided each hospital with the CRE breakpoint update protocol, sample verification study protocol, and template to document the results of the verification studies.

During follow-up consultations, the AR expert provided additional support, which included facilitating communication with the CDC, FDA, and local laboratory equipment representatives. The AR/AS team also checked in with each hospital regularly to encourage progress, and that their methods were thoroughly implemented.

RESULTS

Between July to August 2017, the AR/AS team conducted outreach to 41 hospitals who responded with i or ii to the question above. The survey was sent out to all hospitals in California in 2015, including 97 in Los Angeles (at the time of the survey). All 41 laboratories had in person AR/AS team visits. At the time of the initial AR/AS visit, 7 (17%) had updated to the current CLSI breakpoint following the CARLA survey, and were not targeted for further follow-up.

Of the remaining 34 laboratories, 27 (79.4%) assumed their AST instruments were using current breakpoints. Half of laboratories (17, 50%) were uncertain of how to approach changing breakpoints on their AST instrument, and 10 (29.4%) indicated they lacked the resources to perform a verification study. Only 7 (20.5%) facilities were familiar with the FDA/CDC AR Isolate Bank as a resource for verification studies. All 34 laboratories using historical breakpoints were accredited, most were accredited by the College of American Pathologists (29, 85%), the others by the Joint Commission (5, 15%). Laboratory staffing included dedicated microbiology staff in 28 (82%) laboratories, a laboratory director with a specialization in microbiology (MD or PhD) in 5 (15%), and a clinical laboratory scientist in 29 (85%).

All 34 hospital laboratories agreed to work toward updating carbapenem breakpoints following the AR/AS team visit. After one year of follow-up, 15 laboratories (47%) successfully updated breakpoints; 12 (35%) received isolates but did not update; and 6 (18%) are planning to complete the update in 2018. Common barriers for the 19 laboratories failing to update the breakpoint included: too much clinical work and/or not enough staffing (12, 63%) and inability to update the laboratory information systems or electronic medical record (5, 26%). Other less common reasons included waiting on new testing platforms (n=2) and changes in laboratory staff (n=3).

DISCUSSION

Ongoing use of outdated carbapenem breakpoints by clinical laboratories is a public health problem. Failure to update breakpoints hampers infection control initiatives, hinders CRE treatment success, and helps fuel spread of CRE [2-5, 15]. Prior to the AR/AS visit, most microbiology laboratory personnel did not feel empowered to make changes, even when they were aware of the problem. However, with the cooperation of antimicrobial stewardship and infection control leadership—in conjunction with ongoing follow-up by the AR/AS team—the laboratories gained vital support for the breakpoint update initiative.

The AR/AS team visits allowed HOU to use existing resources for targeted outreach to engage hospital laboratories in updating carbapenem breakpoints. The key to success of the project was developing a strong system of collaborations with our CDC partners, local experts, representatives of AST device manufacturers, and individual hospital staff—especially the clinical laboratory scientist who typically leads the laboratory methodology validation efforts. The process of verifying new MIC breakpoints is outside the scope of typical laboratory work-flow, so many facilities needed encouragement and administrative support to complete the process. Thanks to the AR/AS team visits, all (100%) of targeted hospitals began the process of updating breakpoints and nearly half of the hospital laboratories completed the update within one year.

Physicians and other healthcare staff depend on the assurance that the results provided by their laboratory are accurate, significant, and clinically relevant. By improving laboratory detection methods, CRE will now be correctly classified in LAC hospital laboratories. This will decrease inappropriate antibiotic therapy and in turn decrease the risk of death from CRE infection. Now that CRE can be accurately detected and reported, HOU can also improve our efforts to contain the spread of CRE within LAC. In addition, because LAC has a large international patient population, this project likely will also decrease the spread of CRE globally.

There are several limitations to this intervention. While the AR/AS team was successful with improving updated carbapenem MIC breakpoint usage in LAC, the HOU experience may not be generalizable to other public health jurisdictions. The AR/AS team includes academic investigators in infectious disease and microbiology. However, we hope that making our resources available to other jurisdictions will make our initiative more widely adoptable. To date, the FDA—which dictates which breakpoints AST instruments must use—has officially recognized many but not all CLSI breakpoints, which complicates the process of updating AST systems in a timely manner. Additionally, HOU did not collect information on how the breakpoint initiative impacted patient outcomes, infection prevention practices, antimicrobial prescribing, or the incidence rate of CRE in LAC.

Despite the large number of hospital laboratories in LAC using outdated CRE detection methods and limited staff resources, this project was a success. The AR/AS team's findings informed a need to do further broad education to improve AR detection practices across LAC. This project also greatly improved HOU's rapport with hospital laboratories, which is critical to detect and contain CRE and other AR bacteria of epidemiological concern. Now that these partnerships have been established, HOU will be able to continue to improve laboratory capabilities in our jurisdiction in the global fight against AR.

REFERENCES

1. Centers for Disease Control and Prevention (CDC). Vital signs: Carbapenem-resistant Enterobacteriaceae. MMWR. Mar 8, 2013;62:165–170. https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6209a3.htm
2. Falagas, M. E., Tansarli, G. S., Karageorgopoulos, D. E., & Vardakas, K. Z. (2014). Deaths Attributable to Carbapenem-Resistant Enterobacteriaceae Infections. *Emerging Infectious Diseases*. 20(7), 1170-1175. https://dx.doi.org/10.3201/eid2007.121004
3. Patel TS, Nagel JL. Clinical outcomes of Enterobacteriaceae infections stratified by carbapenem MICs. *Journal of Clinical Microbiology*. Jan 2015;53(1):201-205. http://jcm.asm.org/content/53/1/201.short
4. Esterly JS, Wagner J, McLaughlin MM, Postelnick MJ, Qi C, Scheetz MH. Evaluation of clinical outcomes in patients with bloodstream infections due to Gram-negative bacteria according to carbapenem MIC stratification. *Antimicrobial Agents and Chemotherapy*. Sep 2012;56(9):4885-4890. http://aac.asm.org/content/56/9/4885.full
5. Lodise T, Berger A, Altincatal A, et al. Carbapenem-resistant Enterobacteriaceae (CRE) or Delayed Appropriate Therapy (DAT)—Does One Affect Outcomes More Than the Other Among Patients with Serious Infections Due to Enterobacteriaceae? *Open Forum Infectious Disease*. Oct 2017:S14. Abstract https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5632073/

6. Potter RF, D'Souza AW, and Dantas G. The rapid spread of carbapenem-resistant Enterobacteriaceae. *Drug Resistance Updates*. Nov 2016; 29:30–46. Abstract https://www.ncbi.nlm.nih.gov/pubmed/27912842
7. Centers for Disease Control and Prevention (CDC). Biggest Threats: Antimicrobial/Antibiotic Resistance https://www.cdc.gov/drugresistance/biggest_threats.html Accessed July 2018.
8. World Health Organization (WHO). Essential Medicines and Health Products Information Portal: A World Health Organization resource. Global priority list of antibiotic-resistant bacteria to guide research, discovery, and development of new antibiotics. http://apps.who.int/medicinedocs/en/d/Js23171en/ Accessed July 2018.
9. Rhomberg PR, Jones RN. Summary trends for the Meropenem Yearly Susceptibility Test Information Collection Program: a 10-year experience in the United States (1999-2008). *Diagnostic Microbiology and Infectious Disease*. Dec 2009;65(4):414-426. https://www.sciencedirect.com/science/article/pii/S0732889309003629
10. Sievert DM, Ricks P, Edwards JR, et al. Antimicrobial-resistant pathogens associated with healthcare-associated infections: summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2009-2010. *Infection Control and Hospital Epidemiology*. Jan 2013;34(1):1-14. https://www.jstor.org/stable/10.1086/668770
11. Marquez P, Terashita D, Dassey D, and Mascola L. Population-Based Incidence of Carbapenem-Resistant *Klebsiella pneumoniae* along the Continuum of Care, Los Angeles County. *Infection Control and Hospital Epidemiology*. Feb 2013;34(2):144-150. Abstract https://www.ncbi.nlm.nih.gov/pubmed/23295560
12. Kollef MH, Sherman G, Ward S, Fraser VJ. Inadequate antimicrobial treatment of infections: a risk factor for hospital mortality among critically ill patients. *Chest.* Feb 1999;115(2):462-474. Abstract https://www.ncbi.nlm.nih.gov/pubmed/10027448
13. Kang CI, Kim SH, Park WB, et al. Bloodstream infections caused by antibiotic-resistant gram-negative bacilli: risk factors for mortality and impact of inappropriate initial antimicrobial therapy on outcome. *Antimicrobial Agents and Chemotherapy.* Feb 2005;49(2):760-766. Abstract https://www.ncbi.nlm.nih.gov/pubmed/15673761
14. van Duin D, Lok JJ, Earley M, et al. Colistin Versus Ceftazidime-Avibactam in the Treatment of Infections Due to Carbapenem-Resistant Enterobacteriaceae. *Clinical Infectious Diseases.* Jan 6 2018;66(2):163-171. Abstract https://www.ncbi.nlm.nih.gov/pubmed/29020404
15. Bartsch SM, Huang SS, Wong KF, et al. Impact of Delays between Clinical and Laboratory Standards Institute and Food and Drug Administration Revisions of Interpretive Criteria for Carbapenem-Resistant Enterobacteriaceae. *Journal of Clinical Microbiology.* Nov 2016;54(11):2757-2762. http://jcm.asm.org/content/54/11/2757.full
16. Humphries RM, Hindler JA, Epson E, et al. Carbapenem-Resistant Enterobacteriaceae Detection Practices in California: What Are We Missing? *Clinical Infectious Diseases.* Mar 19, 2018;66(7):1061-1067. Abstract https://www.ncbi.nlm.nih.gov/pubmed/29099915

USING CDC'S CORE ELEMENTS OF OUTPATIENT STEWARDSHIP TO IMPROVE ANTIBIOTIC PRESCRIBING PRACTICES IN LOS ANGELES COUNTY

BACKGROUND

Inappropriate antibiotic use is the primary contributor to the spread of antibiotic resistance. To date, most efforts by the Los Angeles County Department of Public Health (LAC DPH) to build antimicrobial stewardship capacity has focused on inpatient settings. However, estimates are that more than 30 percent of antibiotics prescribed in outpatient settings are unnecessary [1]. Primary care clinics and clinicians prescribe approximately half of all outpatient antibiotics in the United States [2]. Outpatient antibiotic prescribing, in particular, has been demonstrated to be directly associated with antimicrobial resistance [3].

Antimicrobial stewardship efforts have been demonstrated to influence antimicrobial prescribing, microbial resistance, and costs. Antimicrobial stewardship has become a current standard of care in medical practice and interventions to improve antibiotic prescribing are supported by the California Medical Foundation, the Infectious Disease Society of America (IDSA), and the Centers for Disease Control and Prevention (CDC) [4]. Unfortunately, outpatient antimicrobial stewardship is neither uniform nor widely adopted across LAC.

The CDC Core Elements of Outpatient Antibiotic Stewardship note four key areas of stewardship: commitment, action for policy and practice, tracking and reporting, and education and expertise [5]. A review of the literature demonstrated that individual interventions targeting these four areas had varying degrees of effectiveness; however, no outpatient antimicrobial stewardship program meeting all Core Elements has been assessed for effectiveness nor implementation characteristics studied [6].

The objective of Targeting Appropriate Prescribing in Outpatient settings (TAP OUT) is to assist outpatient clinics to implement an antimicrobial stewardship program. The outcome of interest is inappropriate antibiotic prescribing for acute upper respiratory infections (URI).

METHODS

LAC DPH recruited 20 primary care and 3 urgent care clinics, representing 208 providers, to participate in the TAP OUT project. The clinics are all part of the same medical network. LAC DPH staff partnered with the clinics' stewardship team, which included the medical director, infection preventionist, and two physician stewardship champions, to develop an antimicrobial stewardship program that met all the CDC Core Elements of Outpatient Stewardship. The stewardship program implemented includes public commitment, communication skills training, clinical treatment education, and prescribing audits. LAC DPH and the clinic stewardship team adapted evidence-based strategies to meet the needs and preferences of the clinic providers and patients. To measure the effectiveness of the program, patient encounter data were analyzed for changes in inappropriate antibiotic prescribing for URI between the 2016–17 and 2017–18 influenza seasons. Inappropriate antibiotic prescribing was defined using California Medical

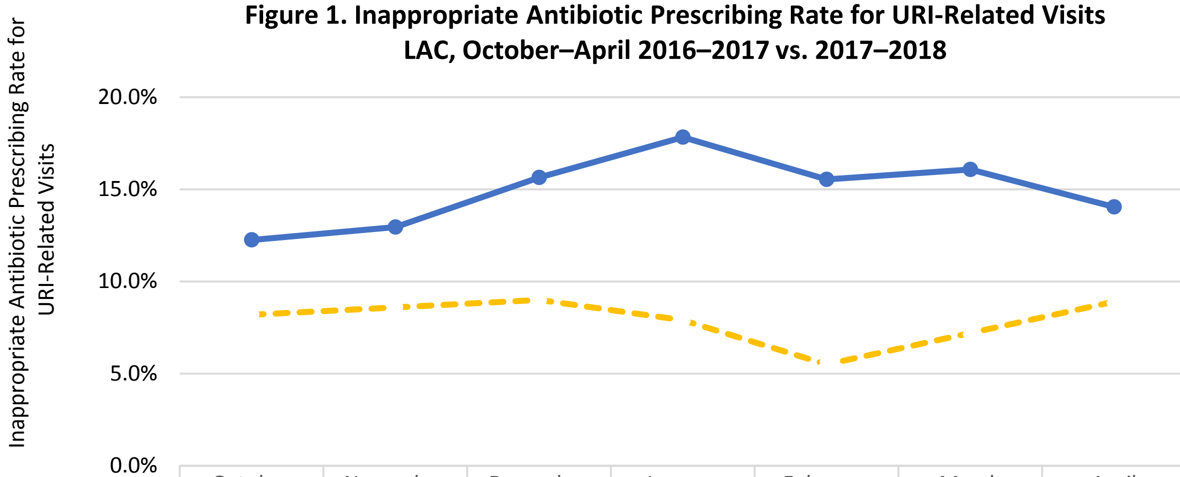
Association Foundation Alliance Working for Antibiotic Resistance Education[1] guidelines. The definition of URI was based on analysis of International Classification of Diseases[2] Tenth Edition encounter codes. Patients currently on immunomodulatory therapy were excluded from the analysis. To evaluate implementation process characteristics, a key informant interview was conducted.

RESULTS

A total of 20 primary care and 3 urgent care clinics, representing 208 providers, participated in TAP OUT (see Methods). The baseline estimated inappropriate antibiotic prescribing rate for URI was 15.5% amongst all prescribers (range: 0-100%). During the intervention period, the estimated inappropriate prescribing rate decreased to 7.6% (51% reduction, p<0.0001). Monthly rates during both periods are described in Figure 1.

Several key implementation elements of implementation were identified, such as leadership buy-in and on-site peer champions. Visible and recurring prescribing reminders were useful. To improve adoption, the ASP was integrated into existing workflow. Costs were limited and related to information technology resources to analyze prescribing data and create feedback reports.

Figure 1. Inappropriate Antibiotic Prescribing Rate for URI-Related Visits
LAC, October–April 2016–2017 vs. 2017–2018



	October	November	December	January	February	March	April
2016-17	12.3%	13.0%	15.6%	17.8%	15.5%	16.1%	14.1%
2017-18	8.2%	8.6%	9.0%	7.9%	5.5%	7.2%	8.9%

DISCUSSION

The TAP OUT antimicrobial stewardship program was shown to successfully decrease inappropriate antibiotic prescribing for acute upper respiratory infection diagnoses. The program compiled low-cost, highly effective interventions into a program that met all CDC Core Elements of Outpatient Stewardship. Further, the program focused on interventions aimed at altering prescriber behavior, rather than patient

[1] Physicians for a Healthy California (PHC). Alliance Working for Antibiotic Resistance Education (AWARE). https://www.phcdocs.org/aware/

[2] World Health Organization (WHO). Family of International Classifications. http://www.who.int/classifications/en/

education or ordering restrictions in the electronic health records. Interventions targeting prescribing behavior change of healthcare providers have been demonstrated to be effective in decreasing overall and inappropriate antibiotic prescribing [7]. This project adds to the scant literature on how antibiotic stewardship programs can be implemented in outpatient settings.

When planning and implementing the stewardship program, many barriers were identified to changing healthcare providers' prescribing behaviors. Concerns regarding patient satisfaction and competing priorities were discussed with the clinics' medical director. In addition, obtaining patient encounter data to measure the effectiveness of the program involved lengthy discussions with the clinic information technology staff. However, buy-in from clinic champions was key in deciding which stewardship strategies would work in their unique setting. The clinics were motivated to lower their antibiotic prescribing rate for URI as it is tied to Centers for Medicare and Medicaid Services reimbursement.

There are some limitations of the project. First, all sites were part of the same medical network; thus, certain implementation results may not be generalizable to the general primary and urgent care population. Second, because each patient visit was de-identified, we could not link patient visits to understand the full medical history. It is possible that subsequent visits indicate a bacterial etiology, but this would not have been able to be assessed through a single visit record. Lastly, results were dependent on electronic health record and billing data, which are imperfect for performance measurement, though have demonstrated validity [8].

Having demonstrated effective implementation of the stewardship program, LAC DPH will disseminate best practices to outpatient providers county-wide. We hope to study the effects of the stewardship program on other infection types, including urinary tract infections.

REFERENCES

1. Fleming-Dutra KE, Hersh AL, Shapiro DJ, et al. Prevalence of Inappropriate Antibiotic Prescriptions Among US Ambulatory Care Visits, 2010-2011. JAMA. 2016;315(17):1864–1873. doi:10.1001/jama.2016.4151
2. Hicks LA, Bartoces MG, Roberts RM, et al. US outpatient antibiotic prescribing variation according to geography, patient population, and provider specialty in 2011. Clin Infect Dis 2015; 60:1308–16.
3. Goossens H, Ferech M, Vander Stichele R, Elseviers M. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. The Lancet 2005;365(9459):579-587. https://doi.org/10.1016/S0140-6736(05)17907-0.
4. Barlam TF, Cosgrove SE, Abbo LM, et al. Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. Clinical Infectious Diseases: An Official Publication of the Infectious Diseases Society of America. 2016;62(10):e51-e77. doi:10.1093/cid/ciw118.
5. Sanchez GV, Fleming-Dutra KE, Roberts RM, Hicks LA. Core Elements of Outpatient Antibiotic Stewardship. MMWR Recomm Rep 2016;65(No. RR-6):1–12. doi: http://dx.doi.org/10.15585/mmwr.rr6506a1.

6. Arnold SR, Straus SE. Interventions to improve antibiotic prescribing practices in ambulatory care. Cochrane Database of Systematic Reviews 2005, Issue 4. Art. No.: CD003539. doi: 10.1002/14651858.CD003539.pub2.
7. Meeker D, Linder JA, Fox CR, et al. Effect of Behavioral Interventions on Inappropriate Antibiotic Prescribing Among Primary Care Practices: A Randomized Clinical Trial. JAMA. 2016;315(6):562–570. doi:10.1001/jama.2016.0275.
8. Linder J, Kaleba E, Kmetik K. Using Electronic Health Records to Measure Physician Performance for Acute Conditions in Primary Care: Empirical Evaluation of the Community-Acquired Pneumonia Clinical Quality Measure Set. Medical Care 2009; 47(2), 208-216.

2017 SYMPOSIUM ON INFECTION PREVENTION CONTROL IN SKILLED NURSING FACILITIES

OVERVIEW

On September 28, 2017, the Los Angeles County Department of Public Health (LAC DPH) Acute Communicable Disease Control (ACDC) program held a symposium for key county skilled nursing facility (SNF) staff responsible for infectious disease outbreak prevention and control. This is the second annual SNF symposium ACDC has held. For information on the first symposium, see ACDC's 2016 Special Report.[1] Presentations and related materials for both the 2016 and 2017 symposiums are archived on the ACDC SNF webpage.[2]

During the 2017 symposium, representatives from local SNFs included directors of nursing, administrators, and infection preventionists. Due to the large number of SNFs in LAC, over 315, attendance was limited to two representatives per facility. The goals of the symposium were to improve partnerships between SNFs and LAC DPH as well as to improve prevention and control of infectious diseases in SNF settings. The symposium also strived to implement antimicrobial stewardship programs and better management of multidrug-resistant organisms (MDROs) in SNFs. Other topics covered included: immunization recommendations for healthcare personnel and residents, reporting requirements for Carbapenem-resistant Enterobacteriaceae (CRE), and how to protect employees from blood-borne pathogens and aerosol transmissible diseases.

SUMMARY

A total of 108 attendees from 65 local SNFs attended the day-long event. In addition, the event included 23 attendees from ACDC, the Association for Professionals in Infection Control and Epidemiology (APIC) Greater LA Chapter, representatives from several nursing home consulting companies, nursing home corporate consultants, laboratory serving SNFs, and partnering agencies.

The topics for the 2017 symposium focused primarily on the prevention and control of infectious diseases that are common in SNF settings and greatly impact the vulnerable population cared for in these settings. The presenters were representatives from ACDC, LAC DPH's Vaccine Preventable Disease Control (VPDC) Program, guest speakers from UCLA, and other organizations. The agenda was as follows:

[1] ACDC. 2016 Special Studies Report.
http://publichealth.lacounty.gov/acd/pubs/reports/2016SpecialStudiesReport.pdf
[2] ACDC. Skilled Nursing Facilities: Infection Prevention Resources and Guidelines.
http://publichealth.lacounty.gov/acd/SNF.htm

AGENDA	
8:00 am – 8:30 am	**Registration** Breakfast & Coffee
8:30 am – 8:50am	**Introduction & Welcome** *Harriett Pitt, RN, BSN, MS, CIC* - ***Moderator*** LAC DPH – Acute Communicable Disease Control *Sharon Balter, MD* Chief, LAC DPH Acute Communicable Control Program
8:50 am – 9:50 am	**Prevention and Management of Carbapenem-resistant Enterobacteriaceae and other Multi-Drug Resistant Organisms** *Dawn Terashita, MD, MPH* LAC DPH – Acute Communicable Disease Control
9:50 am – 10:00 am	**Break**
10:00 am – 11:00 am	**Immunization for Health Care Personnel and Residents at Skilled Nursing Facilities** *Melanie Barr, RN, MSN, CNS* LAC DPH – Vaccine Preventable Disease Control
11:00 am – 12:30 pm	**Protecting Skilled Nursing Facility Employees from Blood-borne Pathogens and Aerosol Transmissible Diseases** *Kevin Riley, PhD, MPH* UCLA Labor Occupational Safety and Health Program
12:30 pm – 1:15 pm	**Lunch**
1:15 pm – 2:30 pm	**Antimicrobial Stewardship: Doing Our Part to Help Solve the Problems in Healthcare** *James McKinnell, MD* LAC DPH – Acute Communicable Disease Control
2:30 pm – 2:40pm	**Break**
2:40 pm – 3:40 pm	**Progress and Outcome Metrics for a Collaborative Antibiotic Stewardship Program Between Cedars-Sinai and Local Skilled Nursing Facilities to Improve Management of UTIs** *Haoshu (Hali) Yang, Pharm D* Cedars Sinai Medical Center
3:40 pm – 4:00 pm	**Closing Remarks & Evaluations**

In addition to presentations, each attendee received a folder with *APIC Infection Prevention Guide to Long-Term Care* and the following materials:

- LAC List of Reportable Diseases and Conditions
- CDPH Pneumococcal Vaccine Timing Flow Chart- For Adults

- LAC DPH: Infection Prevention Transfer Form
- Additional Resource Materials for Infection Prevention & Control
- Listing of Useful Resources and Websites
- Packets with
    - Influenza Outbreak Prevention and Control Guidelines
    - Scabies Prevention and Control Guidelines: Acute and Long-Term Care Facilities
    - Norovirus Outbreak Prevention Toolkit
    - Health Education Materials for Influenza and Scabies
- Antibiotic Stewardship materials – posters, educational brochures, etc.
    - "Treat True Infections, Not Colonization" Poster (English)
    - "Reassess Antibiotics at 48 Hours" Poster (English)
    - "Cold or Flu. Antibiotics Don't Work for You." (English/Spanish)

Overall, the symposium was very well received, and the representatives from the SNFs urged LAC DPH to continue to hold additional trainings to provide further guidance on topics viral to SNFs. ACDC plans to hold another symposium in 2018 as these trainings have become an annual event.

OUTBREAK OF EPIDEMIC KERATOCONJUNCTIVITIS CAUSED BY HUMAN ADENOVIRUS TYPE D53 IN AN OPTOMETRY CLINIC, 2017

BACKGROUND

On June 22, 2017, the Los Angeles County Department of Public Health (LAC DPH) was notified by a medical epidemiologist at Hospital X of seven patients seen at an optometry clinic (Clinic A) on June 8, 2017 who later developed symptoms of epidemic keratoconjunctivitis (EKC).[1] This report prompted a cluster investigation by ACDC.

EKC is caused by adenovirus.[2] It is a contagious, severe form of conjunctivitis that can cause pain and blurry vision for up to four weeks [1]. EKC associated with adenovirus is a frequent cause of outbreaks in eye care settings. Adenovirus is concerning as a healthcare-associated infection due to its high transmission rate, significant ocular morbidity, and hardiness in healthcare environments [2]. Prior outbreaks have been associated with breakdowns in infection prevention practice, including eye drop administration, glove use, and instrument disinfection [3].

This report describes ACDC's outbreak investigation and the measures taken to prevent future infections and enhance patient safety.

METHODS

For this investigation, a ***case*** was defined as an individual who had symptom onset between June 5–July 3, 2017, and had either:

1) a diagnosis by an ophthalmologist or optometrist of EKC, adenoviral conjunctivitis, or viral conjunctivitis; or
2) laboratory confirmation of adenovirus from a specimen collected by conjunctival swab.

A ***healthcare-linked case*** was defined as a person with a diagnosis or laboratory confirmation (as described in 1 and 2 above) who had visited the optometry clinic (Clinic A) between June 5–July 3, 2017 and had symptom onset within ≤21 days of that visit.

A ***household case*** was defined as a household and/or family contact of another case, with a diagnosis or laboratory confirmation (as described in 1 and 2 above) and did not visit the clinic prior to symptom onset.

Case finding was conducted by phone and medical record review. Medical records from Clinic A were surveyed for all patients with an EKC diagnosis between June 7-July 3. To better understand if healthcare-linked transmission possibly occurred during the period when symptomatic EKC case patients presented at the clinic, all patients who visited the clinic during June 7-21 were called and asked if they were

[1] https://en.wikipedia.org/wiki/Keratoconjunctivitis
[2] https://www.cdc.gov/adenovirus/index.html

experiencing symptoms of EKC. Case characteristics and exposures were ascertained during medical record review.

On June 23rd, ACDC conducted an announced site visit to walk through the premises, observe infection prevention practices, interview staff members, and review infection prevention policies.

Cell culture isolates or conjunctival swab specimens from case patients were sent to the LAC DPH Public Health Laboratory (PHL) for conventional and shell vial culture and detection by fluorescent monoclonal antibody staining. Specimens from additional case patients were tested by viral culture at the laboratory of Hospital X. Specimens were then submitted to the California Department of Public Health Viral and Rickettsial Disease Laboratory (CDPH-VRDL) by PHL for adenovirus detection and molecular typing by sequence analysis of the hypervariable region of the adenovirus hexon gene and the adenovirus group-specific region of the fiber gene [4, 5].

RESULTS

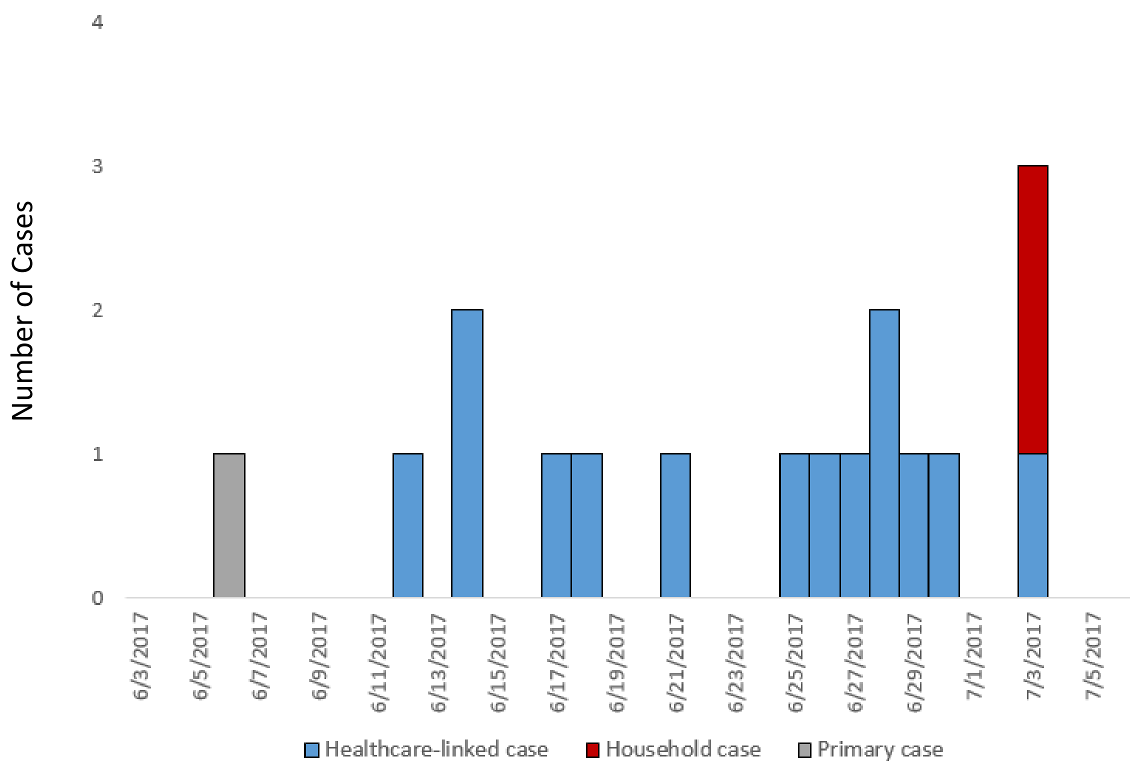
Medical record review identified 17 cases. Among 805 patients contacted by phone, none reported EKC symptoms. Fourteen patients met the case definition of a healthcare-linked case, and one patient appeared to be the source of introduction into the clinic (hereafter called the primary case). Two additional cases met the household case definition—both reported a symptomatic spouse prior to their illness.

The median patient age of cases was 62 years (range: 43–78 years), and 12 cases (70.6%) were women. No hospitalizations resulted from infection, though seven cases (41.2%) had more than one symptomatic visit to the clinic, a hospital emergency department, or an urgent care center. Cases presented with symptoms consistent with EKC, including redness (14, 82.3%) and discharge (13, 76.5%). The mean incubation period was 9 days (range: 5-19 days).

Review of healthcare-linked case-patient clinic visit dates prior to symptom onset revealed two apparent clusters. The primary case visited the clinic on June 7th with symptoms consistent with EKC, before the initial visits of seven additional case-patients on June 7th and June 8th. On June 20th, one of the case-patients from the first cluster visited the clinic with EKC symptoms. Another seven case-patients visited the clinic after this case-patient on June 20th and June 21st, prior to the onset of their EKC symptoms (**Figure 1**).

Medical chart review indicated common exposures among the 14 healthcare-linked case-patients—all were seen by the same optometrist in the same exam room following the primary case. No healthcare personnel reported EKC symptoms before or during the outbreak period. Among the 14 healthcare-linked case-patients, other exposures included slit lamp contact (13, 92.3%), tonometry (12, 85.7%), and multi-dose dilating eye drops (10, 66.7%). Use of multi-dose sodium fluorescein eye drops was noted for 6 (86%) cases in the first cluster and none in the second cluster. During the primary case's initial clinic visit on June 7th, the primary case received sodium fluorescein drops from a multi-use vial and had a slit lamp examination; the slit lamp is connected to the tonometer.

Figure 1.
Cases of Epidemic Keratoconjunctivitis by Date of Symptom Onset
Optometry Clinic, LAC, June 3–July 6, 2017
(N=17)



The clinic closed on June 22nd for intensive environmental cleaning of clinic surfaces and equipment, instrument cleaning and disinfection, and providing staff training on infection prevention. The clinic reopened the following day.

Several observations were made during the site visit to the clinic. Optometry Clinic A is part of Hospital X's medical network. Staff who provide care at the clinic include three optometrists, one ophthalmologist, and three optometric assistants. The clinic has three exam rooms and averages 1,300 patients per month. Clinic patients begin in the waiting area, then proceed to one of three exam rooms, each with its own slit lamp with tonometer. Site visit observations and staff interviews indicated gaps in infection prevention practices including: using multi-dose eye drops on multiple patients; occasionally touching the eye or surrounding area; and reprocessing tonometers with a 70% isopropyl alcohol wipe rather than the recommended 5-10-minute disinfecting soak with chlorine or ethyl alcohol [2].

Conjunctival swab specimens from four case patients, all symptomatic with conjunctivitis, were sent to the PHL culture—adenovirus was detected in two. Specimens from an additional 11 case-patients were tested at the laboratory of Hospital X, and adenovirus was identified in 6 by viral culture.

Of the eight case-patients positive upon culture, specimens were then submitted for human adenovirus (HAdV) detection and molecular typing—all 8 were positive for HAdV-D53. Subsequently, VRDL generated HAdV-D53 whole genome sequences (WGS) from one patient sample, which was nearly identical to a recently reported WGS of HAdV-D53 from Japan (GenBank sequence LC215428).

DISCUSSION

This report describes an investigation of a cluster of 17 patients in an optometry center infected with EKC. All cases had either visited the optometry clinic or were household contacts of clinic patients. In conjunction with ACDC's infection prevention assessments, analysis of the molecular testing for adenovirus indicate that a common source likely served as the mode of transmission between patients.

HAdV-D53 has been recognized as an agent of EKC outbreaks in Japan since 1980 [6, 7, 8] and in Germany since 2005 [9]. However, HAdV-D53 has not previously been reported to the United States National Adenovirus Type Reporting System and, to our knowledge, this is the first reported EKC outbreak associated with HAdV-D53 in the United States. We asked the index case about travel only. No travel was reported.

As the first documented EKC outbreak associated with HAdV-D53 in the United States, this outbreak highlights the need for rigorous implementation of recommended infection prevention practices in eye care settings. Based on our observations, we hypothesize that the virus was introduced to surfaces in the exam room by a symptomatic patient, and subsequent lapses in infection prevention practices led to transmission. Prior studies have demonstrated that adenoviruses may persist on environmental surfaces for several weeks [10]. Previous EKC outbreaks in eye care clinics have been linked to improper disinfection practices and lapses in hygienic protocols [3]. Observations found deficiencies in tonometer disinfection and multi-use eye drop administration. Enhanced infection prevention practices, including staff education on eye drop administration and longer slit lamp and tonometer disinfection times were implemented. No further cases were reported after July 3, 2017.

To prevent EKC transmission in eye care settings, recommended practices include the use of disposable tonometer tips, disinfectants efficacious against adenoviruses for tonometers and slit lamps, and single-use eye drops when available [2,11]. Adherence to recommended infection prevention practices is critical to avoid EKC and other healthcare-associated infections. LAC DPH plans to outreach to the optometry and ophthalmology provider community to educate regarding infection prevention.

REFERENCES

1. Lu X, Joshi A, Flomenberg P. Adenoviruses. In: Kaslow RA, Stanberry LR, LeDuc JW, editors. Viral Infections of Humans. New York: Springer; 2014. p. 99-121.

2. Rutala WA, Peacock JE, Gergen MF, Sobsey MD, Weber DJ. Efficacy of hospital germicides against Adenovirus 8, a common cause of epidemic keratoconjunctivitis in health care facilities. Antimicrobial Agents and Chemotherapy. 2006 50(4):1419-1424.
3. King, D, Johnson B, Miller D, et al. Adenovirus-associated epidemic keratoconjunctivitis outbreaks — four states, 2009-2010. MMWR Morb Mortal Wkly Rep. 2013 62(32):637-41.
4. McCarthy T, Lebeck MG, Capuano AW, Schnurr DP, Gray GC. Molecular typing of clinical adenovirus specimens by an algorithm which permits detection of adenovirus coinfections and intermediate adenovirus strains. Journal of Clinical Virology. 2009 46(1): 80-4.
5. Lu X, Erdman DD. Molecular typing of human adenoviruses by PCR and sequencing of a partial region of the hexon gene. Archives of Virology. 2006 151(8): 1587-1602.
6. Engelmann I, Madisch I, Pommer H, Heim A. An outbreak of epidemic keratoconjunctivitis caused by a new intermediate adenovirus 22/H8 identified by molecular typing. Clin Infect Dis. 2006 43: 64–66.
7. Aoki K, Ishiko H, Konno T, et al. Epidemic keratoconjunctivitis due to the novel hexon-chimeric-intermediate 22,37/H8 human adenovirus. J Clin Microbiol. 2008 Oct;46(10):3259-69.
8. Kaneko H, Aoki K, Ishida S, et al. Recombination analysis of intermediate human adenovirus type 53 in Japan by complete genome sequence. J Gen Virol. 2011 Jun;92(Pt 6):1251-9. Binder AM, Biggs HM, Haynes AK, et al. Human adenovirus surveillance—United States, 2003–2016. MMWR Morb Mortal Wkly Rep. 2017 66(39):1039–1042.
9. Killerby ME, Stuckey MJ, Guendel I, et al. Notes from the field: Epidemic keratoconjunctivitis outbreak associated with human adenovirus type 8 — U.S. Virgin Islands, June–November 2016. MMWR Morb Mortal Wkly Rep. 2017 66(30):811–812.
10. Rutala WA, Weber DJ, Healthcare infection control practices advisory committee. Guideline for disinfection and sterilization in healthcare facilities, 2008. Atlanta: Centers for Disease Control and Prevention, 2008. Available from: cdcgov/ncidod/dhqp/pdf/guidelines/Disinfection_Nov_2008pdf. Accessed June 25, 2017.

INVESTIGATION OF SURGICAL SITE INFECTIONS IN ORTHOPEDIC HIP AND KNEE REPLACEMENT POST-OPERATIVE AT AN ACUTE CARE HOSPITAL SETTING

BACKGROUND

Surgical site infections (SSIs) following orthopedic procedures, including joint replacement, are significantly rare since evidence-based infection prevention practices related to skin preparation, surgical technique, and prophylaxis of antibiotics are currently the standard of care in orthopedic surgery. In the most recent National Healthcare Safety Network[1] report which included data from 2006 to 2008, reported knee replacement postoperative infection rates ranged from 0.68% to 1.60% and hip replacement infection rates ranged from 0.67% to 2.4% [1]. While these infections are extremely uncommon, their impact can be significant. SSIs related to orthopedic surgical procedures are associated with increased healthcare costs, morbidity, and even mortality. Moreover, orthopedic SSIs can significantly impact a patient's quality of life including requiring a prolonged hospital stay and leading to physical limitations.

On December 15, 2016, a local hospital's infection preventionist (IP) notified the Los Angeles County Department of Public Health (LAC DPH) Morbidity Unit of a cluster of six cases of SSIs at an acute care hospital (Hospital A) occurring after orthopedic surgeries (knee and hip) from October to November 2016. The LAC DPH's Acute Communicable Disease Control Program (ACDC) reviewed the case information. Of the six SSIs, three resulted from knee surgeries and three from hip surgeries. Two of the six SSIs were classified as deep incisional and four were prosthetic joint infections. Onset of symptoms occurred between 24 to 41 days post-surgery. Cultures from wound sites grew different organisms for each patient. Subsequently, additional cases were reported to ACDC by the hospital's IP.

METHODS

Case Finding and Definition

For this investigation, a case was defined as a patient with an SSI following orthopedic surgery of knee or hip replacement at Hospital A from October 2016 through January 2017. ACDC reviewed patient medical records, including operating room (OR) records, as well as patient's laboratory and microbiology reports. In addition, the IP was instructed to call patients who had orthopedic surgery of the hip or knee within the time-period to inquire if they had experienced any signs and symptoms of infection or complications at their surgical site.

Investigation and Assessment of Risk Factors: Site Visits

Over the course of six months from February through June 2017, ACDC partnered with the California Department of Public Health (CDPH) Licensing and Certification program to conduct eight unannounced site visits at Hospital A. The site visits consisted of observations in the OR, OR storage area, and the central processing decontamination (CPD) room. During the visits, several significant lapses in infection control practices were noted and recommendations for control measures were provided.

[1] https://www.cdc.gov/nhsn/index.html

Case Control Study

A 1-to-3 matched case control study was conducted assessing a total of 8 cases and 24 controls. Cases were matched to controls by age and surgical site (hip or knee). Medical records were reviewed, including: preoperative history, nursing perioperative notes, the anesthesia report, operative notes, laboratory records, and discharge notes. Standardized chart abstractions were performed for all cases and controls.

RESULTS

Case Characterization

A total of eight patients met the case definition. Initially, there was a cluster of six cases of SSIs post-orthopedic surgery of knee and hip replacement that occurred between October 20, 2016 through November 23, 2016 based on the surgery date. During this time-period, the attack rate was up to 4.4%. Two additional cases occurred after procedures on January 10, 2017 and January 30, 2017.

Of the eight case patients, the average age was 68 years old (range: 54 to 86 years old); seven had multiple comorbidities, including history of osteoarthritis, hypertension, hyperlipidemia, diabetes, and obesity; five case patients had a BMI above 30. The case patients had an average American Society of Anesthesiologists score[2] of 3.1. The overall attack rate for this outbreak was 3.4% for the eight cases.

Of the eight SSIs, five were knee surgeries and three were hip surgeries. Cultures from wound sites grew different organisms for each patient, including methicillin-sensitive *Staphylococcus aureus*, methicillin-resistant *Staphylococcus aureus*, *Staphylococcus epidermis*, group G *Streptococcus*, *Staphylococcus capitis*, *Enterobacter* cloacae, and *Proteus mirabilis*.

The review of cases did not identify a single surgeon or staff member common to all cases. There was no single common skin preparation solution or irrigation solution identified.

Case Finding

All patients who underwent orthopedic surgery between October 2016 through January 2017 were either followed up at their post-operative appointment or contacted by the pre-operative staff to identify if they manifested signs and symptoms of infection at their surgical site. There were 181 patients with hip and knee surgeries between October to December 2016 who were followed up through post-op appointments or phone calls. From January to March 2017, 179 patients with hip and knee surgeries followed up through post-op appointments or phone calls. No additional cases were identified from the follow up post-op appointment or phone calls.

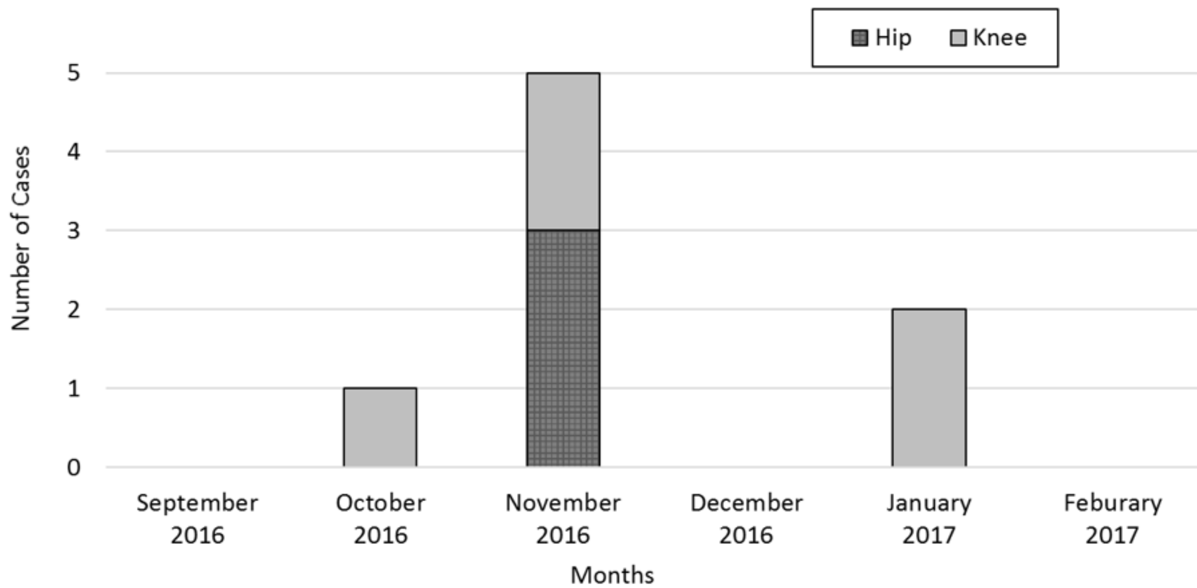
Background Surveillance Rate

In 2016, there were 2,073 surgeries performed at Hospital A and the total number of SSIs was 18 with an annual SSI rate of 0.86% (0.0086). There were 640 hip and knee orthopedic surgeries performed in 2016 with nine SSIs of knee and hip replacement an annual rate of 1.41% (0.0141). According to the National Healthcare Safety Network report with data from 2006 to 2008, knee replacement postoperative infection

[2] http://www.anzjsurg.com/view/0/ASAscore.html

rates range from 0.68% to 1.60% and hip replacement infection rates from 0.67% to 2.4%. During the peak of this investigation, there were six cases within 34 days (October 20, 2016 through November 23, 2016), with an attack rate of 4.4% and a total attack rate of 3.4% from October 2016 through January 2017 (**Figure 1**).

Figure 1.
Surgical Site Infections among Post-Orthopedic Surgery Patients
Hospital A, 2016–2017



Case Control Study

To identify possible risk factors associated with infection, ACDC conducted a case control study. A total of 24 controls were selected from patients who had undergone hip or knee arthroplasty during the outbreak period. A comprehensive medical record review was performed using a standardized chart abstraction tool, which included information on the patient's demographics, hospitalization, and surgical procedure.

The study found that patient demographics were similar between cases and controls. Cases and controls did not differ significantly with respect to American Society of Anesthesiologists score, length of hospitalization, day of week on which procedure was performed, anatomical site of procedure, or whether a tourniquet was placed. No significant commonalities among cases versus controls were found with respect to surgeon, other staff, instruments used, or prosthetics used.

Overall, we were unable to identify significant patient risk factors from the case control study. Scientific literature suggested that the utilization of immediate-use steam sterilization during a procedure may play a role in surgical site infections [2]. However, we were unable to inspect the role of immediate-use steam sterilization in this outbreak due to incomplete logs and printouts.

Final Recommendations

In addition to interim recommendations provided throughout this investigation, ACDC issued the following final recommendations to prevent or limit future infections:

- Ensure the early identification of new SSIs associated with hip and knee replacements through surveillance with immediate reporting of new cases to ACDC.
- Update policies and procedures in CPD and OR on an annual basis.
- Ensure the comprehensive documentation of immediate-use steam sterilization in the OR logs.
- Continue to monitor adherence to the policies and procedures in the CPD and ensure they are being followed by CPD staff.

DISCUSSION AND CONCLUSIONS

ACDC investigated eight cases of SSIs from multiple organisms following associated orthopedic (knee and hip replacement) surgeries. Cases were identified among patients during October 2016 through January 2017. The overall attack rate for this outbreak was 3.4% during this time-period. Despite multiple site visits by ACDC and CDPH Licensing and Certification as well as an outside consultant, we continued to observe lapses in infection control practices among the staff who worked in the CPD and OR core area. Following our recommendations, the facility improved competencies among their CPD staff by providing trainings on cleaning and sterilizing of the surgical instruments and documented the staff training. The overall cleanliness of the CPD and OR core area improved throughout the investigation and infection control practices also improved among the associated staff.

Based on our investigation, we hypothesized that multiple factors may have contributed to the outbreak of SSIs among the orthopedic patients, including improper cleaning and sterilization of the surgical instruments in the CPD and OR core area, use of immediate-use steam sterilization during procedures, staffing changes in CPD, and an increase in census of orthopedic surgeries. A case control study was conducted, but no significant risk factors were identified.

During the outbreak investigation, the facility's infection control staff, hospital administration, OR and CPD staff all contributed to the overall improvement of the conditions and infection control practices to reduce SSIs in the facility. The IP continued to be in contact with ACDC until December 1, 2017, to provide status on any new possible cases. No additional associated positive cultures reported since March 22, 2017.

REFERENCES

1. Edwards JR, Peterson KD, Mu Y, et. al. National Healthcare Safety Network (NHSN) report: Data summary for 2006 through 2008.Am J Infect Control. 2009 Dec;37(10):783–805. https://www.ncbi.nlm.nih.gov/pubmed/20004811
2. Centers for Disease Control and Prevention (CDC). Surgical Site Infection (SSI). Healthcare-Associated Infections. https://www.cdc.gov/hai/ssi/ssi.html Accessed July 2018.

3. Association for Professional in Infection Control and Epidemiology (APIC). Guide to the Elimination of Orthopedic Surgical Site Infections. An APIC Guide 2010. https://apic.org/Resource_/EliminationGuideForm/34e03612-d1e6-4214-a76b-e532c6fc3898/File/APIC-Ortho-Guide.pdf Accessed July 2018.
4. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. Am J Infect Control. 1999 Apr;27(2):97-132; quiz 133-4; discussion 96. https://www.ncbi.nlm.nih.gov/pubmed/10196487

LOS ANGELES COUNTY HEPATITIS A OUTBREAK AMONG PERSONS EXPERIENCING HOMELESS OR USING ILLICIT DRUG

BACKGROUND

In 2017, Los Angeles County (LAC) experienced an outbreak of hepatitis A virus (HAV) occurring primarily among persons experiencing homelessness or with illicit drug use (IDU). This outbreak occurred in the context of several other large outbreaks in California[1] and nationally.[2] The largest hepatitis A outbreak in California occurred in San Diego County, where the outbreak began in March of 2017 and resulted in 582 confirmed cases by the time the local health emergency ended in January 2018 and mostly involved persons experiencing homelessness or IDU.

Given the proximity to San Diego County and the extensive travel between LAC and San Diego, the LAC Department of Public Health (DPH) closely monitored for potential HAV introduction and spread in LAC. In July 2017, hepatitis A illness was identified in two homeless persons in LAC who had lived in San Diego at the time of acquiring the virus. A health advisory was released to inform healthcare professionals.[3] In September 2017, HAV also was identified in two LAC residents experiencing homelessness who did not have any links to an outbreak-associated region. Because this possibly indicated local HAV transmission LAC DPH declared a local outbreak of hepatitis A and a health alert was issued.[4] Subsequently, LAC DPH held a webinar[5] in November and issued a health alert update in March 2018.[6]

The Incident Command System (ICS) was activated to coordinate the LAC DPH hepatitis A outbreak response. The ICS leadership identified 4 strategies for controlling the outbreak:

1. Enhancing surveillance and case containment
2. Increasing vaccination
3. Improving sanitation
4. Educating community and stakeholders

The primary objective of this report is to describe the epidemiology of the hepatitis A outbreak cases identified through enhanced surveillance in LAC in 2017. Secondarily, the report will briefly summarize results of the activities to increase vaccination, sanitation, and education.

METHODS

Enhanced Surveillance

The Acute Communicable Disease Control Program of LAC DPH initiated enhanced surveillance to identify acute HAV cases among the homeless and drug using populations from June through December 2017.

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[1] https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Immunization/Hepatitis-A-Outbreak.aspx
[2] https://www.cdc.gov/hepatitis/outbreaks/2017March-HepatitisA.htm
[3] http://publichealth.lacounty.gov/eprp/Health%20Alerts/DPH%20HAN%20Hep%20A%207.31.17%20LAHAN%20revised.pdf
[4] http://publichealth.lacounty.gov/eprp/Health%20Alerts/DPH%20HAN%20Hep%20A%20Outbreak%20091917.pdf
[5] http://publichealth.lacounty.gov/eprp/Health%20Alerts/Hep%20A%20enduring%20webinar%20flyer%20111417.pdf
[6] http://publichealth.lacounty.gov/eprp/Health%20Alerts/HAV%20outbreak%20update%203.15.18%20final.pdf

Case Definitions

- **Minimal Criteria**: Confirmed acute hepatitis A virus (HAV) infection meets the Counsel of State and Territorial Epidemiologists (CSTE) case definitions for an acute case of hepatitis A:[7] (1) discrete onset of any sign or symptom consistent with acute viral hepatitis (fever, headache, malaise, anorexia, nausea, vomiting, diarrhea, and abdominal pain), and (2) jaundice and/or elevated serum aminotransferase levels, and (3) immunoglobulin M (IgM) antibody to hepatitis A virus (anti-HAV) positive.
- **Confirmed Outbreak Case**: A person who meets the CSTE clinical case definition and is laboratory confirmed, OR, a case that meets the clinical case definition and occurs in a person who has an epidemiologic link with a person who has laboratory-confirmed hepatitis A. Cases were either identified as homeless, homeless and using illicit drugs, men who have sex with men (MSM) and using illicit drugs, using illicit drugs or homeless secondary cases. Cases were counted if they were exposed in another county but had onset in LAC.

Case Identification

The California Code of Regulations (Title 17, Section 2500) requires healthcare providers to report acute hepatitis A cases within one working day of identification.[8] In addition, most LAC clinical laboratories automatically report positive hepatitis A IgM antibody tests via the electronic laboratory reporting (ELR) system.

In response to the outbreak, providers were requested to immediately report suspected/confirmed hepatitis A in a person experiencing homeless to facilitate:

- timely interview by LAC DPH staff before cases are discharged to the street and potentially lost to follow-up,
- identification of contacts who could benefit from preventive therapy, and
- case placement in a recuperative care facility during the infectious period to prevent further disease transmission.

Case Investigation

A supplemental form was created for interviewing persons experiencing homelessness or using illicit drugs. It was expected that data from the supplemental forms could guide the ICS leadership response to the outbreak by better defining the epidemiology of outbreak-associated cases and characterizing risk factors for disease.

Laboratory Testing

Clinical laboratories were contacted to determine if serum samples were available for all confirmed cases identified as homeless and/or using illicit drugs. If available, specimens were submitted to the LAC Public Health Laboratory (PHL) for shipment to the California Viral and Rickettsial Disease Laboratory (VRDL) for confirmation and genetic sequencing of HAV.

[7] https://wwwn.cdc.gov/nndss/conditions/hepatitis-a-acute/case-definition/2012/
[8] http://publichealth.lacounty.gov/acd/docs/ReportableDiseaseListSept2018.pdf

Vaccination Outreach

Increasing the proportion of the at-risk population immune to hepatitis A through vaccination was identified as the best tool for preventing hepatitis A illness and decreasing HAV transmission. Vaccinations were included as a service provided by LAC DPH supported street outreach teams targeting homeless persons. Vaccination was also promoted to persons who had close frequent contact with homeless people including first responders, persons who serve food to the homeless, and sanitation personnel. The LAC jail systems offered vaccine to new inmates. LAC DPH community clinics offered vaccines at no charge to those at risk. Health insurance plans and community providers were engaged in the campaign, with the larger health plans offering hepatitis A vaccine to at-risk members at no charge through walk-in clinics. Vaccines were also distributed by LAC DPH to community providers that serve at-risk populations.

Hygiene and Sanitation Outreach

LAC includes 88 cities as well as large unincorporated areas. LAC DPH coordinated with all cities and other county departments such as the Departments of Public Works, Parks and Recreation, and the Sheriff to improve sanitation conditions for persons experiencing homelessness.

Many homeless persons in LAC have created makeshift structures and dwellings which serve as their homes, often creating these in clusters in a small area which is then recognized as a homeless encampment. Due to poor access to hygiene facilities, living in a homeless encampment can serve as a major risk factor to acquire and transmit HAV. LAC DPH, in partnership with Los Angeles Homeless Services Authority (LAHSA) and Department of Public Works, conducted surveys of homeless encampments throughout LAC to assess where additional toilets, showers, and hand washing facilities were most needed, and developed plans with cities to increase toilet, shower and hand washing facilities in these areas.

In close partnership with the LAHSA, LAC DPH Environmental Health (EH), inspected and provided educational materials to homeless shelters across LAC. The educational materials provided guidance on the proper cleaning of facilities and laundering of bedding to protect homeless residents from acquiring and transmitting HAV. A toolkit was developed with template resources and policies for staff at homeless shelters to support their efforts to improve sanitation conditions in their shelters. Additionally, teleconference calls were held to address real life questions and concerns among shelter providers.

Finally, since transmission of HAV among food handlers is of heightened concern, there was a concerted effort to assure that restaurants across LAC were aware of the outbreak and taking measures to reduce the risk of transmission among their workers.

Educational Outreach

The educational outreach efforts aimed to educate key community groups and stakeholders as quickly as possible. The outreaches consisted of holding in-person group meetings, sending informational letters, stakeholder targeted teleconferences, and targeted education of healthcare professionals. A major public awareness campaign was launched, including strategic engagement with the media to support broad dissemination of information, and print media advertisement throughout various public transportation bus and rail lines to promote awareness, hand-washing and vaccination. The countywide 211 information line staff were trained, and the 211-line was used as a primary source for answering questions from the public. The engagement with media included various press briefings, teleconferences, and press releases. Educational materials targeting specific at-risk populations were prepared in English, Spanish, and other threshold languages. Examples of health education materials developed include those targeting first responders, employees with direct contact with homeless people, food handlers, and men who have sex with men. Our educational outreach materials were posted on our webpages.[9]

RESULTS

Epidemiology of Outbreak Cases

From May 1 to December 31, 2017, 17 total outbreak cases were identified that met the confirmed case definition (**Table 1**). The first identified outbreak-associated case had symptom onset during the week of May 28 and the last case had symptom onset during the week of December 17. Of the 17 outbreak-associated cases that developed symptoms while in LAC, 13 were LAC residents with three being secondary cases identified as part of outbreak at a mental health hospital (**Table 1**). Three IDU cases also identified as men who have sex with men (MSM). The median age of all cases was 36 years (minimum-maximum: 24-64 years); 15 (88%) were male; 14 (82%) cases were white (**Table 2**). Most cases were from SPA 4 (n=7, 41%) and SPA 7 (n=5, 29%), 11 (65%) cases were hospitalized, and there were no deaths.

Table 1. Confirmed Outbreak-Associated Hepatitis A Cases in LA County, May 1 to December 31, 2017 (N=17)

	LAC Residents, n	Non-LAC Residents, n	Total, n (%)
Homeless	4	1	5 (29%)
Homeless_IDU	2	3	5 (29%)
IDU	1	0	1 (6%)
IDU_MSM	3	0	3 (18%)
Secondary cases[a]	3	0	3 (18%)

Abbreviations: IDU, illicit drug use; MSM, men who have sex with men

[a] Associated with an outbreak-associated homeless case

[9] http://publichealth.lacounty.gov/acd/Diseases/HepA/Materials.htm

Table 2.
Demographics of Confirmed Outbreak-Associated Hepatitis A Cases
LAC, May 1–December 31, 2017
(N=17)

Demographics	No.	%
Age group (years)		
15-34	6	35%
35-44	6	35%
45-54	3	18%
55-64	2	12%
Gender		
Female	15	88%
Male	2	12%
Race/Ethnicity		
Asian	0	0%
Black	0	0%
Hispanic	2	12%
White	14	82%
Unknown	1	6%

Laboratory Results

Of the 17 outbreak-associated cases, serologic specimens were available for 13 cases to send to VDRL for serologic confirmation and viral sequencing. Of the 13 cases with specimens provided to VDRL for testing, 10 cases had genotype 1b (the genotype associated with the San Diego outbreak), two cases were 1a, and virus was not detected for one case (specimen was drawn more than 4 weeks after onset). All ten genotype 1b genotype cases were homeless (**Table 3**).

Table 3.
Hepatitis A Outbreak Cases Among Homeless and Illicit Drug Users Genotype Results
LAC 2017
(N=17)

	Genotype Test Results			
Risk Group	Genotype 1b No.	Genotype 1A No.	Negative No.	No Specimen No.
Homeless	2	0	1	2
Homeless and IDU	5	0	0	0
IDU	0	1	0	0
IDU and MSM	0	1	0	2
Secondary Cases*	3	0	0	0
TOTAL	**10**	**2**	**1**	**4**

*Linked to an outbreak-associated homeless case.

Vaccination Outreach

LAC DPH conducted 486 vaccination outreaches, including 297 that targeted homeless populations, 28 at substance use treatment centers, 82 for first responders, and 14 at the jails. A total of 33,866 hepatitis A vaccine doses were either administered by LAC DPH (12,393 doses) or distributed to community partners (14,800 doses) to administer to at-risk persons. During the outbreak response, hepatitis A doses were administered for 7,395 for homeless persons, 777 for persons at substance use treatment centers, 10,964 for jail inmates and parolees, and 6,160 for first responders.

Hygiene and Sanitation Outreach

As part of the outbreak response, EH distributed hepatitis A educational flyers to over 37,000 food facilities. All homeless shelters are regularly inspected through the EH Housing and Institutions Program. A total of 52 homeless shelters were inspected during the outbreak and provided with information on hepatitis A including the importance of proper hand washing by food handlers.

Education Outreach

Immediately after declaring a local outbreak, LAC DPH engaged 17 distinct stakeholder groups, including city leaders, homeless service providers, healthcare providers, substance user disorder treatment providers, first responders including police and fire agencies, veteran's affairs agencies, schools and colleges, mental health service providers, and LGBTQ providers. Over 100,000 individual stakeholders received letters and educational information and were invited to participate in targeted teleconference calls. Additionally, over the course of the next 4 months, over 500 in-person educational training outreach sessions were conducted at various community settings, including with homeless service providers, substance use disorder providers, jails, and first responder agencies. Within the first two weeks of the response efforts, there were over 80 news print articles and 14 televised segments covering the Hepatitis A outbreak and response efforts in LAC.

DISCUSSION

The number of hepatitis A cases in persons experiencing homeless or using illicit drugs in LAC was substantially lower than the number of cases observed in San Diego. It is unclear why the hepatitis A outbreak remained contained in LAC, despite having a larger population of persons experiencing homelessness and a lower number of vaccines distributed compared with San Diego. One possible reason for the successful containment of the outbreak in LAC could be the activation of ICS early in the outbreak. The ICS structure facilitated improved coordination of the outbreak response across all relevant LAC DPH Programs, and it assisted with recruiting and targeting additional resources towards the outbreak control activities.

According to CDC, the incidence of hepatitis A among adults in the United States has increased since 2014. Paradoxically, the increased hepatitis A incidence might be a consequence of the US childhood vaccination policy. According to the National Health and Nutrition Examination Survey, the percentage of U.S. adults immune to hepatitis A infection has declined from 1999–2006 to 2009–2012. Prior to the licensure of the hepatitis A vaccine in 1995, there were regular large hepatitis A outbreaks that resulted in immunity among exposed adults. Those outbreaks ceased with universal vaccination of children for hepatitis A. As a result, there is now a large population of adults who are not immune to hepatitis A because they were too old to benefit from the changes in childhood hepatitis A vaccine policy, but they are not old enough to have been exposed to the historic hepatitis A epidemics. The growing population of adults not immune to hepatitis A represents a population susceptible to future hepatitis A outbreaks.

Although the hepatitis A outbreak of 2017 appears to have ended, the conditions that predisposed the outbreak persist in LAC, such as the large population of persons experiencing homelessness who are not immune to hepatitis A and who do not have access adequate hygiene and sanitation services. Therefore, LAC DPH will remain vigilant for acute HAV cases and respond immediately to control potential outbreaks.

NOROVIRUS SUSPECT FOODBORNE OUTBREAK AT A LOS ANGELES COUNTY RESTAURANT

BACKGROUND

On December 18, 2017 the Los Angeles County Department of Public Health (LAC DPH) received a Foodborne Illness Report (FBIR)[1] from the Corporate Wellness Coordinator of a fast food chain restaurant. One of their restaurants, restaurant A (RA), identified gastrointestinal illness in 11 employees. Most of the cases occurred during the week of December 10, 2017 with symptoms including diarrhea, weakness, vomiting, and body aches. Between December 13th to December 21st, LAC DPH received 12 more FBIRs describing 17 additional persons with similar gastrointestinal illness. Three ill employees of RA were also employees of a neighboring restaurant, restaurant B (RB). The LAC DPH Acute Communicable Disease Control program (ACDC) launched an investigation to explore the scope of the outbreak, identify possible risk factors, and determine the necessary procedures to prevent further spread of illness.

METHODS

ACDC coordinated the investigation of illness at both restaurants. First, ACDC partnered with the Corporate Wellness Coordinator for RA to assemble a line list for all employees. ACDC then gathered information on menu items offered for consumption at RA and developed three types of questionnaires. The first was a standard questionnaire for patrons of RA to gather information on date and foods consumed at RA, plus symptom type, onset, and illness histories. These interviews were conducted by telephone and the contact information (for both cases and controls) was obtained from the multiple FBIRs submitted to ACDC. The second standard questionnaire was drafted for employees of RA to gather information on job duties, foods consumed during a typical work shift, symptom type, onset, and illness histories. These interviews were also conducted by telephone. The third standardized questionnaire was drafted for employees of RB to gather job duty, food and symptom histories. These questionnaires were emailed to the RB manager for distribution to all employees of that restaurant. In addition, ACDC staff conducted a site visit and dropped off stool collection kits to staff of RA.

The LAC DPH Environmental Health Services (EHS)[2] Wholesale Food and Safety (WFS) conducted an inspection of RA to observe food handling, cooking, and cleanliness practices. WFS contacted RB to collect employee illness information considering that there were employees that worked in both places.

Management from RA cooperated with the investigation, made employees available for interviews, and coordinated the distribution, pick-up, and recollection of stool kits from employees for delivery to Community Health Services (CHS).[3] Service Planning Area 4 served as the collection point for stool specimens collected from RA employees by RA management. These samples were then picked up by courier and delivered to the Public Health Laboratory (PHL). The PHL tested all submitted stool specimens

[1] http://www.publichealth.lacounty.gov/EH/SSE/FoodMilk/reportillness.htm
[2] http://publichealth.lacounty.gov/eh/index.htm
[3] http://www.publichealth.lacounty.gov/chs/index.htm

using a BioFire FilmArray™ Gastrointestinal Panel and a norovirus reverse transcription polymerase chain reaction (RT-PCR).[4]

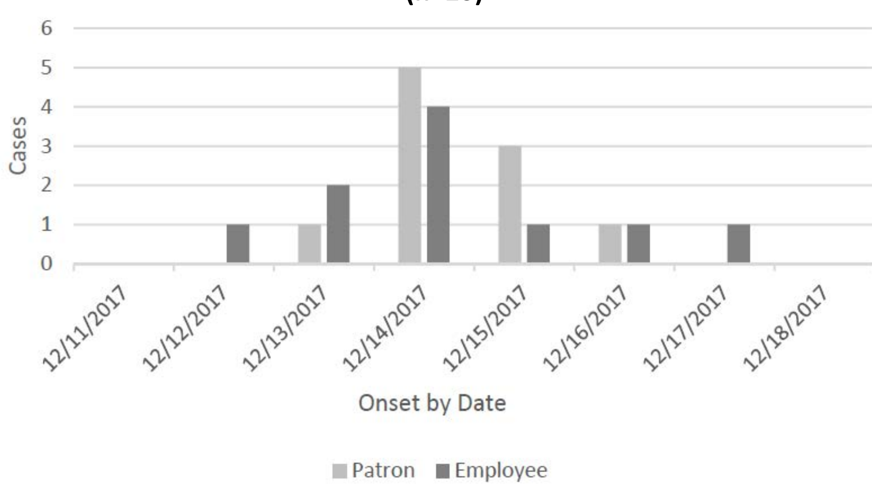
ACDC defined a case as any individual who ate at RA anytime between December 10–15, 2017 and: a) tested positive for norovirus, or b) was symptomatic with diarrhea and vomiting, or c) was symptomatic with diarrhea or vomiting plus two of the following symptoms: nausea, fatigue, headache, body aches, chills, and fever. If cases reported an incubation time of less than 12 hours or greater than 48 hours, they were excluded from analyses, as this did not fit the known incubation period for norovirus. A control was defined as any asymptomatic individual who ate at RA between December 10–15, 2017 and did not have a positive laboratory result for norovirus.

RESULTS

RA is a fast food establishment that prepares fresh food orders for the public in an assembly line fashion with each grouping of ingredients, chosen by the patron, placed into the meal by separate line staff, and are not heated after preparation. Food can be eaten in the restaurant or taken to-go. There is one restroom in the restaurant for both employees and restaurant patrons to share. ACDC interviewed all 29 RA employees, and stool was collected on 25 of the employees (86%). Three employees of RA also worked next door at RB. In view of this connection, the employees of RB were interviewed for illness history—16 of the 21 RB-only employees were interviewed (76%).

All told, ACDC interviewed 61 persons, which included employees from RA and RB, as well as RA patrons. Of these 61 interviews, 23 (38%) met the case definition, and 11 were included as controls. The remaining 27 were excluded from the analysis because they did not meet the case definition. The dates of onset for the 23 people who met case definition ranged from December 12–17, 2017 (Figure 1).

Figure 1.
Norovirus Epidemic Curve at Restaurant A by Onset Date
LAC, 2017
(n=20)



[4] https://www.medicinenet.com/script/main/art.asp?articlekey=22766

Cases

A total of 23 individuals met the case definition. This included 13 RA employees, 1 RB employee, and 9 RA patrons. Laboratory confirmation for norovirus was obtained for 16 of the 23 cases (69%). Of the 23 cases, 61% were female (Table 1). Case ages ranged from 14 to 48 years with a median of 23 years. Most cases were between the ages of 20 to 49 years. The three most common symptoms were: nausea (87%), vomiting (78%), and fatigue (74%). Only two cases had a fever ≥ 102° F (9%). The median incubation was 28 hours with a range of 12 to 48 hours. The median duration was 2 days with a range of 8 hours to 5 days (Table 2).

Table 1.
Case Demographics
(N=23)

	n	Percent
Male	9	39%
Female	14	61%
Age Group	0	0%
<1	0	0%
1-4	0	0%
5-9	0	0%
10-19	6	26%
20-49	17	74%
50-74	0	0%
>74	0	0%
Median Age	23 Years	Range: 14-48 Years

Table 2.
Cases Reported Symptoms
(N=23)

Symptom	n	Percent
Diarrhea	16	70%
Bloody Diarrhea	0	0%
Abdominal cramps	15	65%
Nausea	20	87%
Fatigue	17	74%
Chills	12	52%
Body Aches	13	57%
Headaches	13	57%
Fever	5	22%
Fever ≥ 102˚F	2	9%
Dizziness	10	43%
Vomiting	18	78%
Asymptomatic	3	15%
Median Duration=2 Days (Range: 8 hours-5 Days)		
Median Incubation=28.5 Hours (Range: 12 Hours to 48 Hours)		

Food Analysis

Statistical analyses of the food items eaten by restaurant patrons and employees are shown in Table 3. Foods from RA were analyzed by arrangement (i.e. burrito, bowl, quesadilla, taco) as well as by individual ingredients available for inclusion into these arrangements. No food items were statistically associated with illness at the $p \leq 0.05$ level.

Inspection

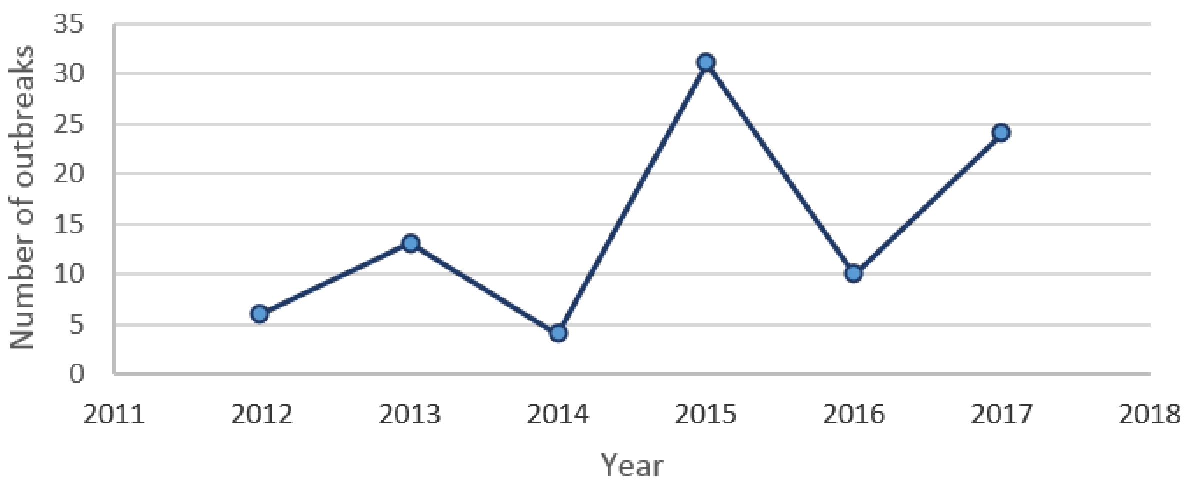
The EHS WFS inspection of RA revealed the following violations: 1) inadequate immersion times for sanitizing food use utensils, and 2) potentially hazardous foods held at unapproved temperatures. All violations were addressed and corrected immediately by restaurant management during the inspection. Food items held at unapproved temperatures were disposed of at the time of inspection.

Table 3. Food Items Eaten							
	Cases (N=23)			Controls (N=11)			
Food Item	**Percent**	**N**	**N**	**Percent**	**n**	**N**	**p-value**
Burrito	30%	7	23	27%	3	11	1.000
Bowl	39%	9	23	36%	4	11	1.000
Taco	9%	2	23	0%	0	11	1.000
Quesadilla	13%	3	23	9%	1	11	1.000
Queso Burrito	4%	1	23	0%	0	11	1.000
Flour Tortilla	30%	7	23	27%	3	11	1.000
Corn Tortilla	9%	2	23	0%	0	11	1.000
Chips	39%	9	23	36%	4	11	1.000
Steak	30%	7	23	18%	2	11	0.682
Carnitas	9%	2	23	0%	0	11	1.000
Chicken	57%	13	23	55%	6	11	1.000
Barbacoa	4%	1	23	27%	3	11	0.089
Sofritas	4%	1	23	9%	1	11	1.000
Brown Rice	39%	9	23	55%	6	11	0.475
White Rice	61%	14	23	64%	7	11	1.000
Black Beans	57%	13	23	45%	5	11	0.717
Pinto Beans	39%	9	23	18%	2	11	0.271
Fajita Veggies	57%	13	23	36%	4	11	0.465
Queso Dip	30%	7	23	18%	2	11	0.682
Tomato Salsa	70%	16	23	45%	5	11	0.262
Red Chili	30%	7	23	36%	4	11	1.000
Green Chili	26%	6	23	55%	6	11	0.138
Sour Cream	57%	13	23	27%	3	11	0.152
Corn Salsa	57%	13	23	36%	4	11	0.465
Lettuce	57%	13	23	36%	4	11	0.465
Monterey Jack Cheese	74%	17	23	91%	10	11	0.384
Guacamole	78%	18	23	64%	7	11	0.425

DISCUSSION

This is a laboratory confirmed outbreak of norovirus of unknown origin. The PHL reported that all the confirmed norovirus samples from this outbreak belong to the same genotype, GII.P16-GII.2. Norovirus is part of the family Caliciviridae. It is highly contagious and can transmit disease with as few as 18 viral particles [1]. Infected individuals can even shed the virus before they know they are ill [1]. Norovirus is most often transmitted via a fecal oral route with illness onset 12–48 hours after ingestion of contaminated food, direct person-to-person contact, or contact with contaminated surfaces. The virus can be spread to the environment via the stool or vomitus of infected people [1]. It is the most commonly reported cause of gastrointestinal (GI) illness in the United States and worldwide [1]. Norovirus infections can occur year-round, but about half of all cases occur between December and February in the northern hemisphere [2]. CaliciNet, a database designed to collect surveillance data about this family of viruses, reported that California had the highest number of confirmed norovirus outbreaks (44) between the months of September 1, 2017 and December 31, 2017 [2]. Surveillance data collected by LAC DPH for non-foodborne GI illness in LAC showed that the month of December 2017 had the second highest occurrence of GI illness outbreaks in the community for the last six years (Figure 2).

Figure 2.
Number of Non-Food GI Outbreaks For the Month of December
LAC, 2012–2017



The method by which this outbreak spread is unclear. The most likely means of transmission is through a food item contaminated by an ill employee. This theory is supported by the finding that the first few persons to become symptomatic in this outbreak were food preparation employees for RA. Most RA employees reported eating at the restaurant during every shift. Another possibility is that this illness was passed from person to person as infected individuals could have touched potentially contaminated common surfaces while dining, working or living together, or sharing the same bathroom with infected individuals. This web of work, home, social, and public connections among RA and RB employees prevented ACDC from being able to identify a definitive source of this outbreak.

PREVENTION AND EDUCATION

To prevent the spread of illness in their facility, RA management implemented an in-house norovirus protocol which, in part, included: disposing of all ready to eat foods in the kitchen, enacting employee hand washing monitoring every 30 minutes, providing employee education on the spread of norovirus, and implementing a complete disinfection of the kitchen. RA also immediately removed ill employees from work with three days paid leave per policy and called all other employees due to arrive at work to check for symptoms of illness.

ACDC provides education on norovirus during and/or after interviewing both patrons and employees. In addition to the inspection, EHS WFS provides the restaurant with literature about norovirus and how to prevent its spread in a restaurant setting.

LIMITATIONS

One limitation of this investigation was that all the RA employees reported eating at the restaurant during every shift worked. With norovirus having an incubation range of 12–48 hours, it was difficult to know which meal likely exposed individuals to norovirus. Employees reported when they last worked prior to illness, and this was verified by the electronic time-keeping report provided by RA. Some cases could recall exactly what they ate. Others had a more general recall, such as being able to name the types of foods they might typically eat during the work week; however, they were unable to specify which days specific food items were eaten. These limitations made it difficult to determine accurate incubation times as measured from specific meals consumed as well as the ability to ascertain which if any foods might be implicated in the outbreak.

CONCLUSION

This was an outbreak of norovirus with no specific source identified. There have been no further complaints against RA at this specific location beyond December 29, 2017. ACDC, in conjunction with EHS WFS, will continue to monitor for future reports of illnesses.

REFERENCES

1. Center for Disease Control and Prevention (CDC). About norovirus. http://www.cdc.gov/norovirus/hcp/clinical-overview.html Accessed July 2018.
2. Center for Disease Control and Prevention (CDC). Reporting and surveillance for norovirus: CaliciNet. https://www.cdc.gov/norovirus/reporting/calicinet/index.html Accessed July 2018.

FIRST PROBABLE LOCALLY-ACQUIRED CHAGAS DISEASE CASE LOS ANGELES COUNTY, 2017

INTRODUCTION

Chagas disease, or American trypanosomiasis,[1] is a parasitic infection that is caused by the protozoan *Trypanosoma cruzi* found only in the Americas where approximately 8 million people are infected [1]. The estimated 300,000 infections in the United States (US) are mainly attributed to residents who have migrated from Latin American countries [1–3]. Transmission is usually linked to poor housing conditions in which the insect vector, triatomine bugs,[2] thrives and is commonly associated with rural areas of Latin America [1]. Less than 50 locally transmitted human infections have been documented in the US since the first case was identified in 1955 [4,5]. Of the two known locally transmitted cases in California, only one experienced acute disease. This case was a resident of Tuolumne County who was diagnosed with Chagas disease in 1982 [6–8]. The other case was an asymptomatic infection in a resident of Ventura County. This report describes the first documented case of acute Chagas disease with probable local transmission in Los Angeles County (LAC).

BACKGROUND

Trypanosoma cruzi is transmitted to humans primarily through contact with the feces of infected blood-feeding triatomine bugs (family Reduviidae), also called “kissing” or “conenose” bugs. In California, the primary reservoir is the woodrat (*Neotoma sp*)[3] [9]. At least 23 additional species of mammalian wildlife also have been documented as animal reservoirs for the parasite in US [6]. Other modes of transmission include blood transfusion, organ transplantation, and vertical (mother-to-child) transmission [1]. Chagas disease has an acute and chronic phase. Acute disease can be mild or asymptomatic and parasites may be found in the circulating blood. Symptoms may consist of fever, malaise, and swelling around the site where the parasite entered the skin or mucous membranes. The chronic phase of Chagas disease may also be asymptomatic, and during this time few or no parasites are found in the blood. An estimated 20–30% of chronic cases will develop debilitating or life-threatening dysfunction of the heart and/or digestive

[1] https://www.cdc.gov/parasites/chagas/epi.html
[2] https://www.cdc.gov/parasites/chagas/gen_info/vectors/index.html
[3] https://www.britannica.com/animal/woodrat

tract. People who are immunosuppressed may experience reactivation of Chagas disease, with a corresponding resurgence of parasitemia [1].

CASE INVESTIGATION

In September 2017, a patient with travel history to a Latin American country approximately 18 months prior, was reported to the LAC Department of Public Health (DPH) with a positive rapid diagnostic test for malaria. The patient was admitted to an acute care hospital with ongoing fever and rash. Blood smears did not detect malaria parasites but instead revealed *T. cruzi* parasites. Commercially available IgG antibody testing for *T. cruzi* also returned positive. Smear review and molecular testing by polymerase chain reaction (PCR) performed at the US Centers for Disease Control and Prevention (CDC) confirmed *T. cruzi* infection. Though only one of two serological tests at CDC routinely performed for confirmation were initially reactive, additional testing by immunofluorescence assay (IFA) later confirmed the infection (**Table 1**).

Table 1.
Diagnostic Blood Tests of Chagas Case
LAC, 2017

Date of Collection	Type of Test	Result of Test	Laboratory
9/12/17	Parasite Blood Exam	Detected	Hospital
9/13/17	*T. cruzi* Immunoglobulin G (IgG) Immunoassay (IA)	Reactive	Commercial
9/12/17	PCR	Detected	CDC
9/13/17	*T. cruzi* Enzyme immunoassay (EIA)	Reactive	CDC
9/13/17	Trypomastigote excreted-secreted antigen (TESA)	Non-reactive	CDC
9/13/17	*T. cruzi* Immunofluoresence Assay (IFA)	Reactive (1:256)	CDC

The patient had no pertinent past medical history. Thirty-five days prior to admission he was treated with trimethoprim-sulfamethoxazole for a lesion on his shoulder, diagnosed as cellulitis. Five days later he developed fever to 39.4°C with an erythematous, non-pruritic rash over the trunk and limbs, headache, and a dry cough. He was seen by several physicians during multiple emergency room visits and was treated with antibiotics and steroids, including prednisone and hydroxychloroquine. Upon CDC confirmation of Chagas disease, the patient initiated benznidazole therapy that was provided as part of an expanded access investigational new drug (IND) protocol operated by the CDC. Results of PCR testing performed six weeks after completion of therapy were negative.

The patient was born and raised in southern California and had been residing in a rural area of western LAC for the past 17 years. The patient reported occasionally seeing triatomine bugs in his home in recent years. He also reported ticks on his pet dogs and a neighbor who kept sheep. He described a current rat infestation in his home and had been handling dead rodents to dispose of them after trapping. The patient also previously lived in other domestic and international locations where Chagas disease is not endemic. Approximately 20 to 25 years prior, he took frequent short trips to Baja California, Mexico. Earlier in 2017, he traveled to other parts of California, but reported staying in well-built structures and denied insect exposures. His most recent foreign travel occurred 18 months prior to admission. On this trip, he visited a Latin American country in which Chagas disease is endemic, but stayed in an enclosed, air-conditioned dwelling with doors and screens. He denied insect bites or exposures there and was well between the time of his return and the presenting illness.

The LAC DPH and California Department of Public Health (CDPH) conducted an environmental investigation at the patient's residence and surrounding areas. Inspection of the property revealed evidence of rodents inside the home (i.e., droppings) and openings on the exterior that were large enough to allow rodent entry into the walls of the house. Rockwork around the house and climbing ivy provided attractive harborage for triatomines. An attempt to collect triatomine bugs in late September was unsuccessful. However, CDPH investigators were able to trap five rodents in late October: two *Peromyscus boylii* (brush mice) and three *Neotoma macrotis* (woodrats). Rodent blood and tissue specimens that were sent to the University of Georgia for analysis did not yield positive results for *T. cruzi* infection.

DISCUSSION

This is the first confirmed case of Chagas disease documented in LAC that was acquired via probable local vector transmission. The diagnosis was confirmed by a positive blood smear and PCR indicative of acute infection with *T. cruzi* and supported by an appropriate clinical presentation. The rural environmental setting of the patient's home residence, where triatomine bugs are common, in addition to the patient's recollection of triatomine bugs inside his home, support the plausibility of vector-borne transmission. Environmental studies have shown that up to 36% of *Triatoma protracta*, California's most widespread and common triatomine bug, collected in LAC are infected with *T. cruzi* [10,11]. In homes, the bugs can find refuge in beds, upholstered furniture, and animal bedding, emerging nightly to feed upon people and their pets [12].

Confirmation of the location where the patient acquired his infection, either locally or abroad, is complicated by his travel history, medical history, and ambiguous serological testing results conducted at CDC. Because Chagas disease is often asymptomatic, it can be many years before the infection is recognized or chronic symptoms manifest. Recrudescence of a previously acquired infection is possible in the setting of steroid therapy. However, experts at the CDC believe that the level of immunosuppression that the patient received likely was not sufficient for such a response. Additional serological testing that was performed at the conclusion of the case investigation could not definitively define the timing of his infection. Additional serological testing in the following years may provide that evidence; however, even that is uncertain.

Locally transmitted vector-borne transmission of Chagas disease in the US is rare. However, human cases may not be well documented given variability in patient testing and reporting to local and state health departments. Only six states in the US mandate Chagas disease reporting, and it is not a reportable condition in California [13]. Without comprehensive human case surveillance, epidemiology and transmission risk of Chagas disease in LAC is not well known or defined. Though this is the first documented case of probable locally transmitted Chagas disease in LAC, there may have been prior cases that were missed due to underdetection of Chagas disease.

Experts have postulated that the low incidence of vector-borne transmission in the US may be explained by delayed defecation exhibited by local triatomine bugs (which would reduce transmission efficacy), by limited exposure to the vectors, and by low *T. cruzi* infection rates among triatomine bugs [11]. However, experimental studies have demonstrated that some triatomine bugs may defecate immediately upon feeding [14]. As construction, development, and suburbanization in LAC and the US encroaches upon woodrat and triatomine bug habitat, there will be increasing opportunities for residents to become exposed to *T. cruzi* and local prevalence studies indicate that vector infection rates are not insignificant in southern California [10,11]. Additionally, molecular studies show that local strains of *T. cruzi* are genetically similar to those in Latin America, suggesting that no differences in infectivity or virulence should be observed [10].

This case serves as an important reminder that local transmission of Chagas disease may occur more frequently than presumed in LAC. Local providers should include acute *T. cruzi* infection in the differential diagnosis of fever of unknown origin in patients with appropriate environmental exposure, even without travel to traditionally endemic areas. Similarly, providers should consider chronic Chagas infection in rural area residents of LAC with unexplained heart disease or symptoms consistent with gastrointestinal Chagas disease.

REFERENCES

1. Centers for Disease Control and Prevention (CDC). Parasites — American Trypanosomiasis (also known as Chagas Disease). https://www.cdc.gov/parasites/chagas/epi.html Accessed August 31, 2018.
2. Manne-Goehler J, Umeh CA, Montgomery SP, et al. Estimating the Burden of Chagas Disease in the United States. *PLoS Negl Trop Dis*. 2016;10(11):e0005033.
3. Bern C, Montgomery SP. An estimate of the burden of Chagas disease in the United States. *Clin. Infect. Dis.* 2009;49(5):e52-54.
4. Montgomery SP, Starr MC, Cantey PT, et al. Neglected parasitic infections in the United States: Chagas disease. *Am. J. Trop. Med. Hyg.* 2014;90(5):814–818.
5. Texas Health and Human Services. Infectious Disease Control Unit. Chagas Disease. https://www.dshs.texas.gov/idcu/disease/chagas/. Accessed August 31, 2018.
6. Bern C, Kjos S, Yabsley MJ, et al. Trypanosoma cruzi and Chagas Disease in the United States. *Clin. Microbiol. Rev.* 2011;24(4):655–681.
7. Navin TR, Roberto RR, Juranek DD, et al. Human and sylvatic Trypanosoma cruzi infection in California. *Am J Public Health*. 1985;75(4):366–369.
8. Hernandez S, Flores CA, Viana GM, et al. Autochthonous Transmission of *Trypanosoma Cruzi* in Southern California. *Open Forum Infectious Diseases*. 2016;3(4):ofw227.
9. Shender LA, Lewis MD, Rejmanek D, et al. Molecular Diversity of Trypanosoma cruzi Detected in the Vector Triatoma protracta from California, USA. *PLOS Neglected Tropical Diseases*. 2016;10(1):e0004291.
10. Shender LA, Lewis MD, Rejmanek D, et al. Molecular Diversity of Trypanosoma cruzi Detected in the Vector Triatoma protracta from California, USA. *PLoS Negl Trop Dis* [electronic article]. 2016;10(1). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4721664/. Accessed August 31, 2018.
11. Hwang WS, Zhang G, Maslov D, et al. Infection Rates of Triatoma protracta (Uhler) with Trypanosoma cruzi in Southern California and Molecular Identification of Trypanosomes. *Am J Trop Med Hyg*. 2010;83(5):1020–1022.
12. Shender L, Niemela M, Conrad P, et al. Habitat Management to Reduce Human Exposure to Trypanosoma cruzi and Western Conenose Bugs (Triatoma protracta). *EcoHealth*. 2016;13(3):525–534.
13. Bennett C, Straily A, Haselow D, et al. Chagas Disease Surveillance Activities — Seven States, 2017. *MMWR. Morbidity and Mortality Weekly Report*. 2018;67(26):738–741.
14. Klotz SA, Dorn PL, Klotz JH, et al. Feeding behavior of triatomines from the southwestern United States: an update on potential risk for transmission of Chagas disease. *Acta Trop.* 2009;111(2):114–118.

BOTULISM CASE REPORT SUMMARY
LOS ANGELES COUNTY, 2017

Botulism is a rare but serious and potentially fatal paralytic illness caused by a nerve toxin produced by the bacterium *Clostridium botulinum*. The bacterial spores that cause botulism are common in both soil and water and produce botulinum toxin when exposed to low oxygen levels and certain temperatures. There are five main kinds of botulism: 1) Foodborne botulism can be triggered by eating foods that have been contaminated with botulinum toxin. Common sources of foodborne botulism are homemade foods that have been improperly canned, preserved, or fermented. Though uncommon, store-bought foods also can be contaminated with botulinum toxin; 2) Wound botulism can be triggered by spores of the bacteria getting into a wound and making toxin. People who inject drugs have a greater chance of getting wound botulism in Los Angeles County (LAC). Wound botulism has also occurred in people after a traumatic injury such as a motorcycle accident or surgery; 3) Infant botulism can be triggered by the spores of the bacteria getting into an infant's intestines. The spores grow and produce the toxin, which causes illness; 4) Adult intestinal toxemia (also known as adult intestinal toxemia) botulism is a very rare kind of botulism that can be triggered by spores of the bacteria getting into an adult's intestines, growing, and producing the toxin (similar to infant botulism). Although the cause of this kind of botulism is unknown, people who have serious health conditions that affect the gut may be more likely to get sick; 5) Latrogenic botulism can occur if too much botulinum toxin is injected for cosmetic reasons such as for wrinkles or medical reasons such as for migraine headaches or cervical dystonia.

Because botulism infections may be fatal, they are considered medical emergencies; accordingly, reporting of suspected cases is mandated by the LAC Department of Public Health (DPH) immediately by telephone. Specialized antitoxin is used to treat botulism, which can only be released when authorized by LAC DPH or the California Department of Public Health (CDPH). Testing for case confirmation by mouse bioassay can be conducted at the LAC DPH Public Health Laboratory and matrix-assisted laser desorption/ionization time-of-flight (MALDI-TOF) is conducted by the Centers for Disease Control and Prevention (CDC). Clinically compatible cases with botulinum toxin detected by either mouse bioassay or MALDI-TOF are considered confirmed cases. The CDPH Division of Communicable Disease Control is responsible for the investigation and surveillance of infant botulism cases identified in the county and across the state. LAC DPH is responsible for reporting suspected cases of infant botulism to CDPH's Infant Botulism Treatment and Prevention Program[1] for their investigation.

The number of confirmed botulism cases (non-infant botulism) in LAC fluctuates from year to year. For the past five years, an average of three cases were confirmed annually. The botulism cases in LAC usually have injection drug use as a risk factor. Foodborne botulism in LAC is rare, in the past 10 years only one instance of foodborne botulism was reported with two associated cases confirmed (2012).

[1] https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/InfantBotulism.aspx

In 2017, nine cases of suspected botulism were reported in LAC including four out-of-county cases who received medical care at hospitals in LAC. These four out-of-county suspected cases were referred to the health department in the patient's county of residence. Upon notification and review of case history and symptoms, ACDC physicians authorized the release and use of botulism antitoxin for six suspected botulism cases, and the state released three antitoxins. Ultimately, two were classified as confirmed cases (laboratory-confirmed by MALDI-TOF, with negative mouse bioassay), and one was classified as a probable case (due to negative laboratory testing but with clinically compatible findings and history of injection drug use). Only two suspected cases were determined not to be botulism based on absence of risk factors, negative botulism testing, and an alternate diagnosis of acute flaccid myelitis and lithium toxicity.

A botulism outbreak was also investigated during 2017. In April 2017, public health authorities at the LAC DPH, the Orange County Healthcare Agency, and CDPH investigated an outbreak of botulism consisting of two cases, both adult residents of Orange County, and associated with an herbal tea product produced by a facility in LAC. LAC DPH released a press release,[2] health alerts[3] were disseminated to healthcare providers, warnings were issued to consumers in LAC, Orange County, and California, and the product was recalled.[4]

[2] http://publichealth.lacounty.gov/phcommon/public/media/mediapubhpdetail.cfm?prid=1652
[3] http://publichealth.lacounty.gov/hccp/alerts.htm
[4] http://publichealth.lacounty.gov/eh/recall/2017/recallList_May.htm

INFLUENZA SURVEILLANCE OVERVIEW: 2017–2018 SEASON SUMMARY

OVERVIEW

The traditional influenza surveillance season begins in October and ends mid-May of the following year, covering a 32-week period. Los Angeles County (LAC) uses the Centers for Disease Control and Prevention (CDC) Morbidity and Mortality Weekly Report (MMWR)[1] weeks to refer to surveillance weeks, with week 1 corresponding to the first week in January. The 2017–18 season (October 1, 2017–May 13, 2018) in LAC had higher influenza activity than the previous 5 influenza seasons. Peak activity occurred during week 52 (December 24–30, 2017) when 50% of respiratory specimens tested by sentinel labs were positive for influenza (**Table 1**). In addition, syndromic surveillance detected the highest proportion of visits to emergency departments for influenza-like-illness (ILI) during that same week (**Figure 1**). This season also saw the greatest number of influenza-associated deaths reported since these deaths became reportable in LAC in 2010. The greatest weekly number of influenza-associated deaths (N=54) occurred during week 1 (December 31, 2017–January 6, 2018). Of confirmed deaths with positive influenza test results received during the 2017–18 season, 66% were influenza A viruses (**Table 1**).

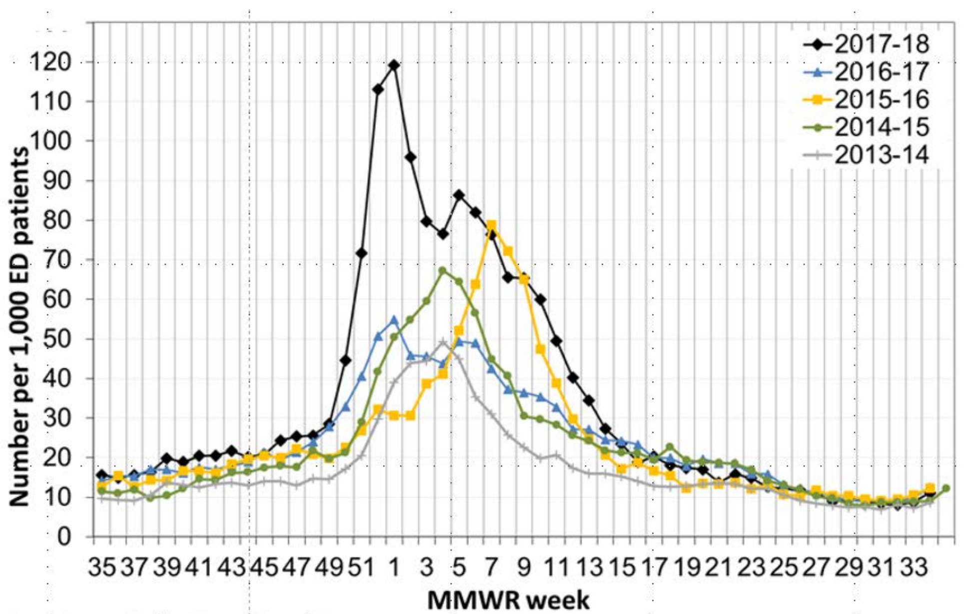
Table 1. Los Angeles County Influenza Surveillance Summary

	2017-18		2016-17
	Peak Week 52*	YTD**	
Sentinel Laboratory Data			
Positive Flu Tests/Total Tests	2971/5926	6,855/107,199	6,855/68,732
(Percent Positive Flu Tests)	0.501	0.172	0.1
Percent Flu A/B	87/13	66/34	92/8
Outbreaks†			
Community Respiratory Outbreaks	6	67	35
Influenza Confirmed Outbreaks	5	77	30
Total	11	144	65
Influenza-Associated Deaths †‡			
Pediatric Flu Deaths	0	2	1
Adult Flu Deaths	61	276	76
Total	61	278	77

*Week 52 corresponds to December 24-30, 2017.
The influenza surveillance year spans** (surveillance weeks 40-20)
†Numbers are provisional and subject to change
‡Confirmed influenza death is defined by a positive lab test, ILI symptoms, and clear progression from illness to death

[1] CDC. MMWR. www.cdc.gov/mmwr/index.html

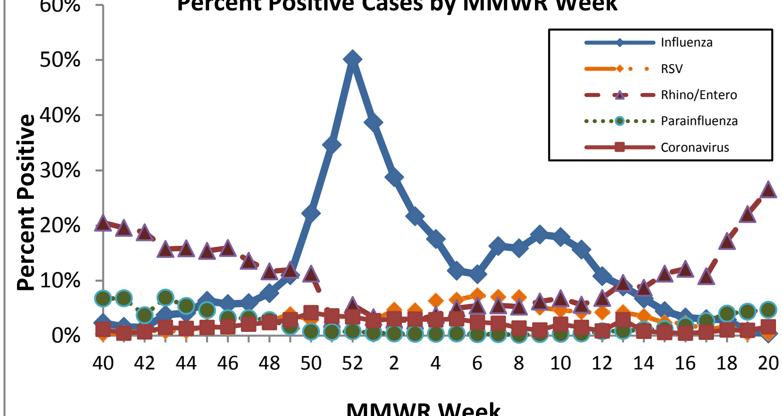
Figure 1.
Proportion of ILI Emergency Department Visits by MMWR Week
LAC, 2013–2018



SENTINEL LABORATORY DATA

Nine sentinel laboratories serving healthcare providers and institutions across LAC reported weekly influenza and other respiratory virus data to the LAC Department of Public Health (DPH) this season (**Figure 2**). Although individual cases of influenza are not reportable to LAC DPH, analyzing data from these sentinel labs provides information on influenza and other respiratory viruses circulating in the county. This season, a total of 107,199 respiratory isolate tests were reported to LAC DPH (**Table 1**). This season, influenza activity began to increase at the beginning of December, peaked at the during Week 52 (Dec 24–30, 2017) and stayed high through March. There was a decline in influenza activity in January and February, but activity trended upwards again in March corresponding with increased influenza B activity. Other viruses co-circulated with influenza, contributing to the overall impact of respiratory illness in LAC. During this season, the majority of influenza positive specimens were influenza A (66%).

Figure 2. Respiratory Viruses, LAC, 2016-17
Percent Positive Cases by MMWR Week

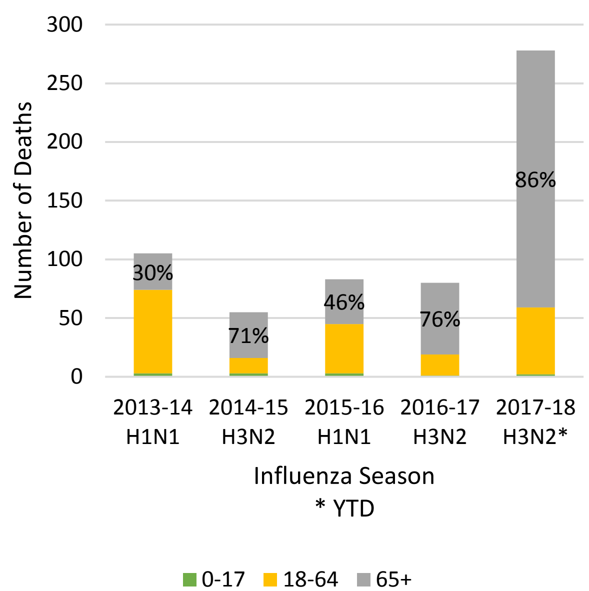


INFLUENZA-ASSOCIATED DEATHS

Since October 15, 2010, laboratory confirmed influenza fatalities of all ages and due to any strain are required to be reported to the ACDC within 7 calendar days.[2] Cases are reported to ACDC from physicians, infection prevention specialists at hospitals, the coroner's office, and via death certificate. A total of 278 influenza-associated deaths (IADs) have been confirmed in LAC this season.[3] There were more deaths reported this season than any season since LAC DPH initiated mandatory reporting.

The majority of deaths (79%) occurred in those 65 years of age and older (N=219), which is consistent with other influenza A H3N2 predominant seasons that more severely affect the 65 and older population (**Figure 3**). During influenza A H3N2 seasons, the 65+ age group accounts for a greater proportion of IADs compared to influenza A H1N1 predominant seasons (**Table 2**).

Figure 3. Influenza Deaths by Season 2012-2018



[2] LAC DPH. Reportable Diseases and Conditions. Title 17, California Code of Regulations, Section 2500 http://publichealth.lacounty.gov/acd/docs/ReportableDiseaseListSept2018.pdf
[3] This total is as of September 10, 2018 and is provisional and can change. The most up-to-date total is available at: http://publichealth.lacounty.gov/acd/FluData.htm

Table 2. Demographic Characteristics of Influenza Fatalities LAC 2012-2018							
		2017-18 N (%)	**2016-17 N (%)**	**2015-16 N (%)**	**2014-15 N (%)**	**2013-14 N(%)**	**2012-13 N (%)**
Age (years)	Median	75.7	82.5	62	81	56	68
	Range	9-105	4-102	1-103	1-101	0-89	0-100
	0-5	0	1 (1)	2 (2)	1 (2)	1 (1)	5 (7)
	6-17	2 (1)	0	1 (1)	3 (5)	3 (3)	3 (4)
	18-40	10 (4)	2 (3)	10 (12)	5 (9)	13 (12)	4 (6)
	41-64	47 (17)	16 (20)	31 (38)	8 (14)	59 (56)	22 (31)
	65+	219 (79)	61 (76)	38 (46)	39 (69)	30 (28)	36 (52)
Gender	Male	127 (46)	35 (44)	44 (54)	30 (54)	67 (64)	35 (50)
	Female	151 (54)	47 (56)	38 (46)	26 (46)	38 (36)	35 (50)
Race	Hispanic	66 (24)	16 (20)	27 (33)	16	48 (46)	29 (42)
	White Non-Hispanic	118 (42)	39 (49)	24 (29)	26	41 (39)	25 (37)
	Asian/Pacifc Islander	40 (14)	4 (5)	14 (17)	8	7 (7)	6 (9)
	Black	30 (11)	5 (6)	9 (11)	4	9 (8)	8 (12)
	Native American	0	0	1 (1)	1 (2)	0	0
	Unknown	24 (9)	14 (18)	6 (7)	1 (2)	0	2 (3)
Total Fatalities		**278**	**80**	**82**	**56**	**105**	**70**

RESPIRATORY OUTBREAKS

The total number of respiratory outbreaks confirmed in LAC decreased to 48, compared with 58 during the previous season. The majority of respiratory outbreaks this season occurred in schools or pre-schools (46%), followed by skilled nursing facilities (SNFs) (29%) (Table 3). Respiratory outbreak definitions vary by setting; however, in general, clusters of ILI (fever >100° F with cough and/or sore throat) is cause for investigation. Thirty-two respiratory outbreaks were confirmed in schools, daycare, and assisted living facilities. Of those, influenza was identified as the responsible pathogen in 11 outbreaks, with flu B accounting for the majority of them. In SNFs, influenza was identified in 11 of 14 respiratory outbreaks.

SYNDROMIC SURVEILLANCE

ACDC's Syndromic Surveillance Project monitors initial self-reported symptoms from patients presenting to participating emergency departments throughout LAC. These symptoms are categorized into different clinical syndromes according to specific code words. LAC's influenza surveillance looks at the syndrome of Influenza-like illness and includes symptoms such as: fever, congestion, sneezing, sore throat, runny nose, and cough. Similar to other indicators, there were more ILI emergency department visits this season than were reported in any of the last 5 seasons.

Table 3. Characteristics of Confirmed Community Respiratory Outbreaks, LAC 2012-2017						
	2017-18 N (%)	**2016-17 N (%)**	**2015-16 N (%)**	**2014-15 N (%)**	**2013-14 N (%)**	**2012-13 N (%)**
Total	**144**	**72**	**48**	**58**	**29**	**73**
Location						
Skilled Nursing Facility (SNF)	77 (53)	32 (44)	14 (29)	25 (43)	12 (41)	23 (32)
School or Pre-School	33 (23)	22 (31)	22 (46)	20 (34)	11 (38)	41 (56)
Assisted Living	28 (20)	15 (21)	8 (17)	12 (21)	3 (10)	6 (8)
Daycare/child care	3 (2)	2 (3)	2 (4)	1 (2)	1 (3)	3 (4)
Other	3 (2)	1 (1)	2 (4)	0	2† (7)	0
Etiology						
Influenza	113 (78)	37 (51)	22 (46)	37 (64)	7 (24)	17 (23)
Other Respiratory	1 (1)	8 (11)	2 (4)	1 (2)	0	1 (1)
Respiratory unknown etiology	30 (21)	27 (38)	24 (50)	20 (34)	22 (76)	55 (76)

MOBILIZING THE LARGEST COMMUNITY OUTREACH TO FIGHT MOSQUITO-BORNE DISEASES—LOS ANGELES COUNTY, 2017

BACKGROUND

According to the Centers for Disease Control and Prevention (CDC), Los Angeles County was one of the seven highest jurisdictions for potential Zika outbreak based on the extent of *Aedes* infestations, close proximity to the Mexico border, and high population density. LAC has also had a high number of West Nile Virus (WNV) cases compared to the population and relative to the United States over the past six years. Over the last 5 years, LAC has experienced yearly outbreaks of WNV[1] with an average of 221 cases per year, approximately 10% of the national burden (Table 1). Additionally, the significant spread and increased detection of *Aedes* mosquitoes in new local areas, coupled with the high volume of international travel and our dense population, provide the ideal elements for a potential local outbreak of dengue, Chikungunya, or Zika if these viruses are introduced into the environment by an infected traveler (Map 1). Despite these significant health risks, mosquito-borne disease knowledge, perceived risk, and prevention behaviors are low among residents in the county. In September 2017, the LAC Department of Public Health (DPH) organized and coordinated an unprecedented weeklong county-wide boots-on-the-ground outreach campaign (titled: It's Not Just a Bite!)[2] to distribute educational materials aimed to increase WNV and Zika awareness and knowledge as well as promote preventive action. This campaign was the largest door-to-door campaign ever implemented by LAC DPH to fight a communicable disease.

Map 1. Locations of Zika Cases & Aedes Mosquitoes

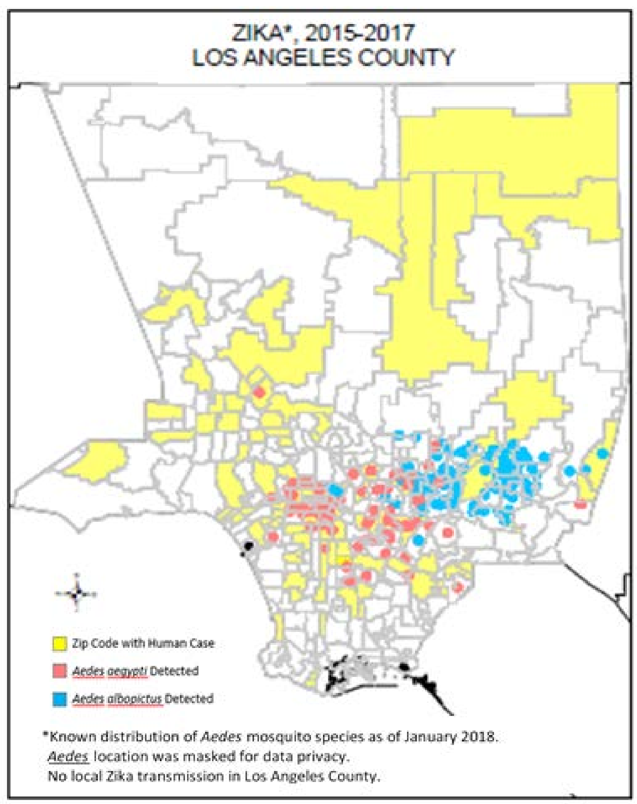


**Table 1.
Number of WNV Cases in the
United States and LAC, 2013-2017**

Total Cases	U.S.	LAC
2013	2900	165
2014	2549	218
2015	2520	300
2016	2437	153
2017	2249	268

[1] LAC DPH. ACDC. West Nile virus data LAC. http://publichealth.lacounty.gov/acd/WNVData.htm
[2] LAC DPH. ACDC. *It's Not Just a Bite*: Mosquito abatement and education campaign 2017. http://publichealth.lacounty.gov/acd/WNVBite.htm

METHODS

Under the emergency response structure, a central command center was organized with four area command centers to coordinate and monitor the event. Several materials were developed including: 1) educational materials for WNV, Zika, and general mosquito-borne disease knowledge, which were translated into multiple languages (English, Spanish, Chinese, Tagalog, and Korean); 2) just-in-time training materials; and 3) scripts for outreach volunteers as well as staff answering the phones. Over 300 County of Los Angeles staff volunteers were recruited from all departments and programs, most of whom did not routinely work with arboviral diseases. DPH deployed 100 two-person teams for 5 days to distribute posters and flyers to public venues across the county including city council halls, libraries, schools, parks and places of worship. The campaign led to the distribution of approximately 55,000 educational materials to over 14,000 venues (Table 2). Environmental Health inspectors further distributed materials during routine site visits at permitted facilities. A digital tool kit was disseminated to city contacts and partners throughout LAC to be used, distributed and printed according to local needs and resources. The on-the-ground effort was complemented by a social media campaign through online platforms such as Twitter, Instagram, and Facebook, which further increased reach of campaign and engaged residents online. The campaign attracted considerable press coverage and media attention which also amplified the reach of these important messages.

Table 2. Venues Reached in Countywide Campaign

Venue	Number
City council/District Office	233
Chamber of Commerce	85
Places of Worship	955
Schools	1,374
Parks	342
Libraries	233
Senior Centers & Residential Facilities	515
Organizations for Pregnant Women	318
Theaters & Outdoor Concert Venues	70
Stores, Pharmacies & Other	9,989
Total	**14,114**

RESULTS

To assess the reach and impact of the outreach campaign, in November 2017, DPH conducted a 27-question two-stage cluster community survey in four LAC cities. This was enacted in partnership with Department of Mental Health Promotores and public health students from the University of California Los Angeles Fielding School of Public Health, California State University Northridge, and University of Southern California. The survey questions assessed exposure to and recall of campaign messages and attempted to identify attitudes and behaviors regarding mosquitoes and mosquito-borne diseases. A total of 464 surveys were completed over two days. Approximately 60% of respondents reported exposure to the campaign through at least one of the following: posters, flyers, community meetings, social media, or news articles. Analyses showed that exposure to the materials was associated with a significant increase in awareness and knowledge of both WNV and Zika (Table 3). Table 4 shows modes of exposure that were significantly associated with increased awareness and/or knowledge of WNV and Zika. Those who reported exposure to campaign through posters, social media, or news articles had increased Zika awareness and/or knowledge. However, exposure to flyers or community meetings was not found to be associated with a similar increase. Exposure to posters was associated with increased WNV awareness and knowledge, but exposure to flyers, social media, news articles, and community meetings was not. The data did not reveal an increase in mosquito prevention behavior linked to the campaign among those surveyed. Multiple interventions sustained over time, particularly in specific types of materials, may be required to change habits, beliefs and actions regarding prevention of mosquito-borne diseases.

Table 3. Impact of exposure to the campaign			
	Exposed	Non-exposed	P-value
Zika			
Awareness	213 (65%)	116 (35%)	<0.001
Knowledge	212 (64%)	118 (36%)	<0.001
Concern	160 (66%)	81 (34%)	0.300
WNV			
Awareness	210 (63%)	126 (38%)	0.002
Knowledge	207 (62%)	127 (38%)	0.008
Concern	129 (62%)	79 (38%)	0.817
Engaged in mosquito prevention	222 (60%)	151 (40%)	0.240

Table 4. Impact of campaign by exposure types			
Zika awareness	**OR**	**95% CI**	
Social media	2.61	1.47	4.65
Poster	2.29	1.32	3.96
Zika knowledge			
News articles	1.90	1.22	2.95
Social media	1.84	1.16	2.92
Poster	1.73	1.09	2.74
WNV awareness			
Poster	1.96	1.14	3.38
WNV knowledge			
Poster	1.82	1.17	2.84

DISCUSSION

Overall, the It's Not Just a Bite! campaign was an extraordinary effort to reach and engage the diverse communities in LAC about mosquito-borne disease prevention. In an era where emerging and re-emerging pathogens are increasingly being identified and can spread at record speed through global trade and travel, it is essential for health departments to not only be able to detect these threats but to also be able to rapidly organize and mobilize staff to communicate and engage with the community. The LAC DPH mosquito-borne disease outreach campaign proved that extensive and rapid community outreach can be successfully accomplished through the mobilization of diverse public health staff and was a valuable learning exercise that can be adapted and quickly deployed for other emergency large-scale responses in the future.

BEYOND CASE COUNTS—CAPTURING A RECORD NUMBER OF DEATHS DUE TO WEST NILE VIRUS IN LOS ANGELES COUNTY BY ENHANCING MONITORING OF PATIENTS

BACKGROUND

In 2017, Los Angeles County (LAC) experienced a record-breaking 27 deaths due to West Nile virus (WNV).[1] That year 11% of the 254 known symptomatic patients stricken with this disease died. Even during the five previous years with unusually high average case counts of 202 cases per year, the number of deaths from WNV peaked at 24 (5-year average of 10.4 deaths per year, 5.3% of those ill).[2] The deaths occurred across racial and geographic boundaries, and had an age range of 59 to 96 years with half being above 75 years of age. Because WNV can often lead to long-term illness or death after a patient leaves the hospital, deaths from WNV infection can be missed with routine monitoring leading to an underestimate of the true impact of this disease.

In the last five years, LAC Department of Public Health (DPH) has received an average of 670 mosquito-borne disease reports per year. The LAC DPH had previously relied upon one investigator to follow up on these reports. Investigations were usually completed before discharge from hospitals and deaths were only captured through informal reporting from providers and family members. Without evidence of death, patients with unknown outcomes were assumed to have survived the disease. Through enhanced monitoring of patients, LAC DPH was able to identify a more accurate number of deaths, and a record number of fatalities from WNV therefore was identified in 2017.

FINDINGS

Grant funding for a new position enabled LAC DPH to conduct additional follow-up of WNV patients where survival was not known. From June through December 2017, a mosquito-borne disease investigator worked with hospital staff to ensure all (100%) discharge information reporting death or survival for hospitalized patients were reported and documented. If discharge information was not available due to prolonged hospital stays, the patient was flagged for additional follow-up in two weeks, at which time, the investigator again requested and reviewed patient discharge information. Repeated requests were often necessary due to lengthy hospitalizations that frequently occur with WNV. This process took a substantial amount of time and effort and increased the estimated hour that is required per case for initial review and confirmation by another hour, essentially doubling the work time for flagged cases. The investigator took on this additional workload while managing the investigations of over 30 cases of WNV a week, which resulted in the addition of 9 reported deaths out of approximately 80 patients. Without grant funding to support another investigator for Zika monitoring, it would have been necessary for the existing investigator to take on Zika investigation responsibilities and we might not have been able to identify the additional fatalities due to this disease. Additional follow-up of WNV survival would have become a lower priority, as it has been in the past, and could not have been completed.

[1] LAC DPH. ACDC. West Nile Virus and Other Arboviral Diseases: 2017. Los Angeles County Epidemiology Final Report. http://publichealth.lacounty.gov/acd/docs/Arbo2017.pdf

[2] LAC DPH. ACDC. West Nile virus data LAC. http://publichealth.lacounty.gov/acd/WNVData.htm

DISCUSSION

The enhanced monitoring of deaths carried out in 2017 highlights the health impact of WNV that was previously under-estimated in LAC. Many residents of our county become severely sick with WNV disease every year since LAC DPH first discovered the virus in the area in 2002. It has been difficult to bring attention and resources to a public health issue that is no longer a new problem and has been portrayed as mild to the majority of those infected, a perception that was supported by lower numbers of deaths. The high number of deaths in the 2017 season brought much needed attention to the severity of WNV and broader recognition that this disease is a dangerous and significant threat in LAC. Awareness has increased not only among public health officials but also among local governments and policy makers. Continuation of improved investigation procedures for WNV deaths will raise the level of concern, provoke new conversations on prevention and promote coordinated action to address the persistent threat of WNV in LAC.

LESSONS LEARNED

Considering the impact of a high number of deaths on the perception of WNV among health officials and the public, LAC DPH is prioritizing the thorough investigation of WNV survival. While LAC DPH still retains the additional investigator supported by grant funding for Zika and other infections for the 2018 season, we will continue to conduct follow-up of our WNV patients without known hospital discharge information and report deaths in a timely manner to boost awareness and promote WNV prevention and control efforts.

It was challenging for a single investigator to conduct enhanced monitoring of patients while conducting routine case investigations of over 250 WNV cases over the six-month WNV season in LAC. As this was the first time this follow up was conducted, there was no precedent and no estimate of additional workload this would entail. Going forward, it will be helpful to establish a protocol for follow up that others can easily follow step by step. In addition, we can explore documenting and reporting other serious effects of WNV illness such as long hospitalization stays and the need for rehabilitation. Without the support of the grant funding source, improved investigations of the effects of WNV could not be carried out and the additional vital information about the true and serious impact of this disease would not be fully recognized.

THE EXPANSION OF THE LOS ANGELES COUNTY WEB-BASED DISEASE SURVEILLANCE SYSTEM TO AN ENTERPRISE INTEGRATED REPORTING, INVESTIGATION, AND SURVEILLANCE SYSTEM

BACKGROUND

Brief History of web-Visual Confidential Morbidity Reporting System

Prior to 1999, the Los Angeles County Department of Public Health (LAC DPH) Acute Communicable Disease Control (ACDC) Program relied on telephone reports or paper-based reporting, via fax and mail. These reports were then subsequently manually entered for data collection of disease incidents. This low-technology reporting and tracking method required a significant amount of paperwork and person hours and potentially could cause reporting delays and quality control issues. Beginning in 2000, ACDC enacted a web-based, centralized repository for disease reports, laboratory reports, foodborne illness reports and outbreaks. The system is called the visual Confidential Morbidity Reporting (vCMR)[1] system.

vCMR serves as primary disease surveillance system for ACDC and as a disease repository for several LAC DPH programs. vCMR supports the rapid exchange of electronic public health information between community practitioners (through the web Community Reporting Module) and electronic laboratory reporting (ELR). The system provides ACDC with a cohesive surveillance system to rapidly detect, identify, and investigate reportable communicable diseases. Over the years, ACDC implemented key configurations and modifications to support LAC DPH's unique needs including maintenance of historical data and images, electronic laboratory reporting of national, state, and local disease. vCMR also capably supports various workflows which allow public health nurses, investigators, and health services to cooperatively share information and manage cases and outbreaks. LAC DPH's ability to develop vCMR with differing key configurations and modifications is reflective of the unique needs of a large local jurisdiction. Although vCMR supported some of the data management needs of these programs, there are several other LAC DPH programs that primarily use respective legacy database systems and paper-based forms. These programs include the Division of STD and HIV Programs (DHSP)[2], the Tuberculosis Control Program (TBCP)[3], and Veterinary Public Health (VPH)[4].

LAC DPH Evaluates an Electronic Enterprise Solution for Disease Surveillance and Investigation

In November 2013, an LAC DPH Executive Team formed the Share Disease Surveillance and Control System (SDSCD) Project. Participants collaborated with the LAC DPH Chief Information Office to develop a strategy and approach to implement a shared system for disease surveillance for DPH. Subsequently, in 2014, SDSCS Staff Committee evaluated health information and operational needs across DPH programs. From both a local and national perspective, it was determined that LAC DPH needed to unify its disease programs and provide an integrated enterprise solution that promotes information sharing and digitizing paper-based workflows.

[1] http://www.publichealth.lacounty.gov/acd/vcmr/Index.htm
[2] http://publichealth.lacounty.gov/dhsp/
[3] http://publichealth.lacounty.gov/tb/index.htm
[4] http://publichealth.lacounty.gov/vet/index.htm

LAC DPH programs including Community Health Services (CHS)[5], DHSP, Public Health Nursing Administration (NA)[6], Public Health Investigation (PHI)[7], TBCP, VPH, Vaccine Preventable Disease Control Program (VPDC)[8], Public Health Laboratory (LAPHL)[9], and Environmental Health[10] found that functions of vCMR can effectively meet many of their data needs.

In April 2016, SDSCS Staff Committee detailed their findings and recommendations in the SCSCS Executive Report. After extensive internal analysis of health information systems, workflow, organizational and IT infrastructure, and data and information needs along with external analysis of other public health information system vendors, the SDSCS Staff Committee recommended expansion of vCMR to migrate LAC DPH disease programs on to a common platform. vCMR proved to be the most efficient and economical solution for LAC DPH programs because it was originally designed for LAC and previous investments will be leveraged for future developments. Significant product upgrades and enhancements of vCMR will enable LAC DPH programs to retire legacy systems.

RESULTS

Decision to Upgrade vCMR to be the Enterprise Solution for LAC DPH Programs

In November 2016, the Interim Health Officer and SDSCS Executive Workgroup accepted the SDSCS Staff Committee's recommendation to expand vCMR. Accordingly, vCMR received a new name to reflect its new purpose—The Integrated Reporting, Investigation, and Surveillance System (IRIS). The IRIS Project includes:

- Migration to cloud-based computing technology
- Interfaces with Health Agency, State and partner systems:
    - LAC Department of Health Services' Online Real-time Central Health Information Database ORCHID
    - Electronic Case Reporting (eCR)
    - Electronic initial Case Reporting (EiCR)
- Additional enhancements
    - Improved security (e.g., multi-factor authentication)
    - Physician Portal (e.g., PHL orders)

The IRIS Project Team picks up where the SDSCS Staff Committee concluded and will plan, develop, test, and implement IRIS.

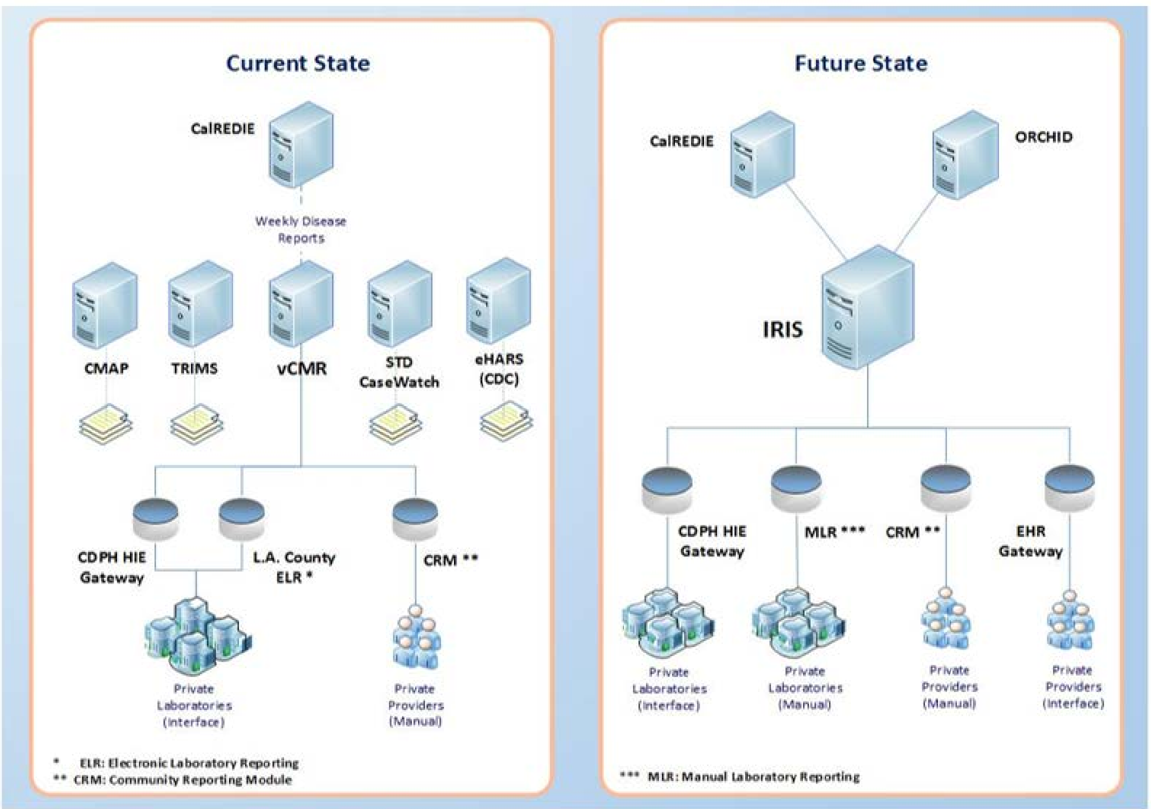
Collaboration among LAC DPH Programs and the Future of IRIS

The IRIS Project Team includes staff from Public Health Information Systems (PHIS), Internal Services Department (ISD), Project Management Office (PMO), County Council, Communicable Disease Control and Prevention (CDCP), and ACDC. The Team will begin meeting and collaborating with DPH programs to

[5] http://www.publichealth.lacounty.gov/chs/index.htm
[6] http://publichealth.lacounty.gov/phn/index.htm
[7] http://publichealth.lacounty.gov/phi/
[8] http://publichealth.lacounty.gov/ip/index.htm
[9] http://publichealth.lacounty.gov/lab/index.htm
[10] http://publichealth.lacounty.gov/eh/index.htm

gather business and functional requirements. The IRIS project team adopted a participatory approach to bring TBCP, DHSP, and VPH programs into IRIS. Other programs (CHS, NA, and PHI) will be given expanded access to and use of IRIS to conduct field work. Subject Matter Experts (SMEs) from each department are included in the planning and development of the IRIS project. The goal of this participatory approach is to ensure all programs have an opportunity to voice respective programmatic needs and establish realistic expectations of IRIS's capabilities for both current and future needs. The expected expansion of IRIS is displayed in Figure 1 below.

Figure 1.
IRIS Current and Future State



In November 2017, staff conducted a Joint Application Development (JAD) Session under the existing contract. The JAD sessions provided the basic IRIS system requirements and solutions and established regular meetings with each programs' SMEs. The IRIS project is now well underway to become the first integrated disease surveillance system for LAC DPH.

EVALUATION OF SYNDROMIC SURVEILLANCE IN DETECTING HEPATITIS A IN LOS ANGELES COUNTY

OVERVIEW

Beginning in November 2016, a hepatitis A virus (HAV) outbreak[1] was identified in San Diego County which subsequently spread to Santa Cruz, Los Angeles, and Monterey Counties. Infections primarily occurred among homeless individuals and those who use illicit drugs. Due to the proximity of Los Angeles County (LAC) to San Diego County and its own large homeless population, on September 19, 2017, the LAC Department of Public Health (LAC DPH) declared an outbreak of HAV[2] among persons who are homeless and/or use illicit (injection and non-injection) drugs. By October 10, 2017, LAC DPH identified 12 local outbreak-related HAV cases. To monitor the impact of the outbreak, LAC DPH's syndromic surveillance team created an HAV syndrome category and began querying local emergency department (ED) data to identify any increases in HAV-related visits.

METHODS

From January 1, 2017 through October 10, 2017, which corresponds to the Centers for Disease Control and Prevention (CDC) weeks 1–41, ED data from all participating syndromic EDs in LAC were queried for patients who reported symptoms and signs of HAV infection. For comparison, ED data from the full 2016 calendar year also was queried. The query consisted of key word searches primarily within the chief complaint field, and if available, from the diagnosis and triage note fields. Based on the CDC clinical description of hepatitis A,[3] the HAV syndrome category was defined as: jaundice (or elevated liver function tests) with nausea or vomiting. Any ED visit that mentioned a diagnosis of hepatitis A also met the syndrome criteria. The resulting line lists were reviewed, and the query parameters were periodically refined to exclude visits unrelated to hepatitis A. For instance, analyses excluded: patients with a previous history of HAV infection or vaccination for hepatitis A, those diagnosed with other types of hepatitis, and patients diagnosed with neonatal jaundice. The syndromic system also was queried for records that matched the 12 initial outbreak-related LAC cases by hospital and admission date. In addition, the chief complaint, diagnosis, and triage note fields were reviewed for any mention of homelessness or illicit drug use (IDU).

RESULTS

For the 2017 time-period (weeks 1–41), the LAC DPH syndromic system detected 158 ED patients meeting the HAV syndrome category criteria. Of these, 12.7% had a diagnosis of HAV, 53.8% had jaundice, 36.7% had elevated liver enzymes, 65.2% had nausea, and 65.8% had vomiting. In 2016, 170 ED patients who met the syndrome criteria were detected: 8.2% had a diagnosis of HAV, 64.1% had jaundice, 32.4% had elevated liver enzymes, 63.5% had nausea, and 71.2% had vomiting. In both years, no indications of homelessness or IDU were identified.

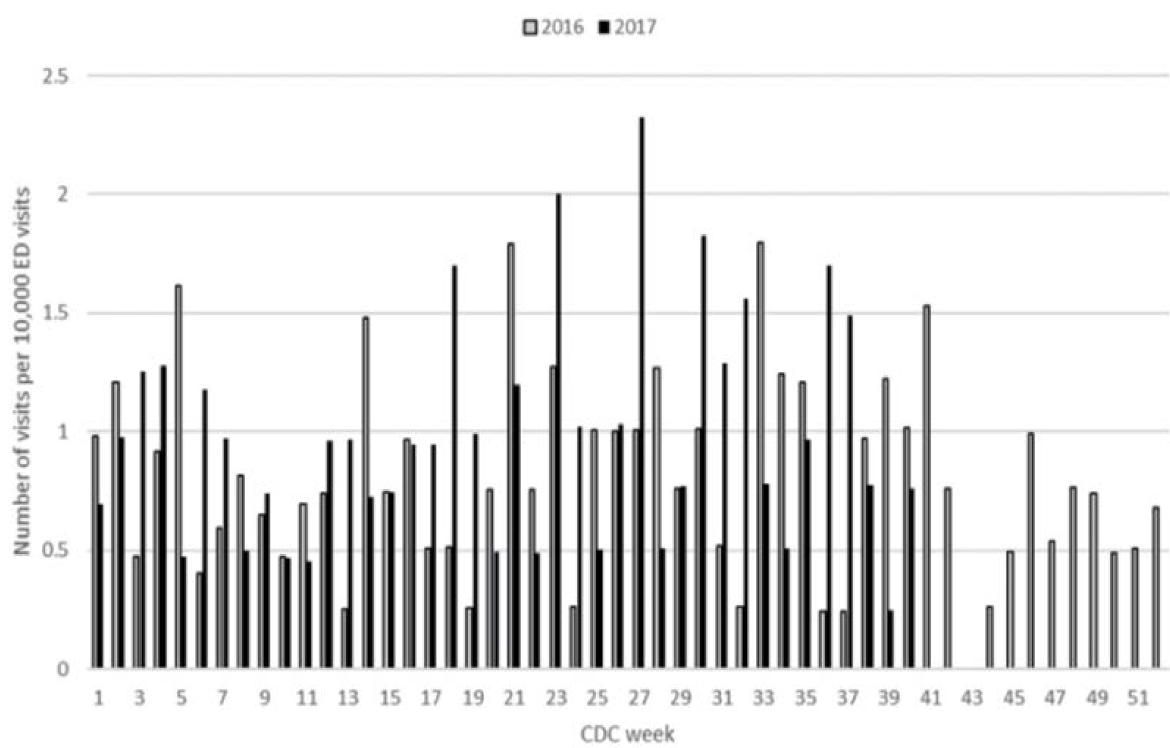
[1] https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Immunization/Hepatitis-A-Outbreak.aspx
[2] http://publichealth.lacounty.gov/eprp/Health%20Alerts/DPH%20HAN%20Hep%20A%20Outbreak%20091917.pdf
[3] https://wwwn.cdc.gov/nndss/conditions/hepatitis-a-acute/case-definition/2012/

Of the 12 initial and confirmed HAV outbreak-related cases in LAC, one-fourth (n=3) did not go to a hospital, thus did not have any syndromic data. Only two cases went to EDs that do not participate in LAC DPH syndromic surveillance, but a medical chart review showed that they would not have met the syndrome criteria. Of the remaining cases (n=7), all went to a participating syndromic ED, 43% (n=3) met the syndrome criteria, but none of their records included any mention of homelessness or IDU.

DISCUSSION

In 2017, a large hepatitis A outbreak in San Diego County, primarily among individuals who were homeless and/or illicit drug users, prompted the LAC DPH to create a HAV syndrome category and begin querying local participating ED data to monitor for any increases in HAV-related visits. In the end, no major outbreak of HAV occurred in LAC, and no major change was seen in the trend of HAV syndrome visits in 2017 as compared to 2016 (Figure 1). Use of a stricter syndrome definition, such as requiring a specific diagnosis of HAV, may result in underreporting, but may also provide a more accurate baseline for detecting increases and monitoring trends. While the query relied primarily on ED chief complaint, diagnosis and triage notes also proved useful in detecting HAV syndrome visits.

Figure 1.
Proportion of ED Visits Meeting Hepatitis A Syndrome Category Criteria
Los Angeles County, 2016–2017



LIMITATIONS

One of the challenges in monitoring HAV incidence is that the clinical signs and symptoms are very general and may be comparable with many other conditions. An emerging outbreak may not be detected above background levels unless the increase in ED patients with HAV is large or consolidated over time. In addition, variability in data quality in the free text fields such as chief complaint and triage notes may be problematic. Cases will be missed if data fields are not fully and accurately documented, if patients didn't go to a participating syndromic hospital, or if they don't go to a hospital at all. In addition, while many syndromic hospitals now report diagnosis information, this information may be delayed due to the time required for complete laboratory results. Further complicating these findings, none of the confirmed HAV cases that were known to be homeless included any mention of homelessness in their charts. This omission, as well as the omission of IDU status, indicate that these conditions are not currently reliably captured in the syndromic extraction of ED patient records.

CONCLUSIONS

Syndromic surveillance, despite its limitations, remains a valuable complement to electronic laboratory reporting and other traditional reporting mechanisms. Accordingly, LAC DPH will continue to employ syndromic surveillance to facilitate monitoring health issues and disease trends in our county.