Acute Communicable Disease Control Program

Special Studies Report

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Public Health
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2006 SPECIAL STUDIES REPORT

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INTEGRATION OF PUBLIC HEALTH NURSING INTO A REGIONAL TERRORISM INTELLIGENCE CENTER

BACKGROUND

The public health nurse (PHN) enhances Los Angeles County (LAC) Public Health's ability to respond to bioterrorism (BT) and other emergencies through consultation, coordination, and training services to health professionals, law enforcement, government officials, and community agencies. The PHN integrates disease surveillance into the Los Angeles Joint Regional Intelligence Center (JRIC), a multi-agency terrorism intelligence task force that includes representatives from the FBI, local law enforcement, public health and fire departments by providing accurate disease information and ongoing analysis of all threats including biological terrorism. According to *Healthy People 2010*, two of the leading health indicators are injury and violence, and mental health. Los Angeles County Public Health originally committed a full-time PHN to the Los Angeles Terrorism Early Warning (TEW) Group in 2003, prior to the absorption of TEW into the larger JRIC operation. The PHN ensures integration of the public health discipline into law enforcement investigations by providing estimates of possible cases of suspicious disease occurrences or outbreaks, populations at risk, and potential deaths, as well as information on management of outbreaks such as prophylaxis, treatment, and isolation.

Figure 1. Los Angeles Joint Regional Intelligence Center (JRIC): a multidisciplinary intelligence center

JOINT REGIONAL INTELLIGENCE CENTER (JRIC)

The Los Angeles Joint Regional Intelligence Center is a multidisciplinary, intelligence center (Figure 1) composed of public health, fire services, FBI, police and sheriff departments working in partnership with other local, state, and federal programs to share and analyze information, disseminate intelligence, and assist with the coordination of resources for a unified response to a terrorism event. The JRIC grew from an established, local center called the Terrorism Early Warning Group (TEW) that provided LAC stakeholders with local terrorism analysis and advisories.

This framework is based on a core foundation of shared information and collaborative efforts which can be used as a tool for full integration of PHNs into the medical intelligence analysis function of the JRIC.

This new approach to integration facilitates the access to public health information and increases multi-disciplinary response capability to potential BT events. The PHN provides real-time disease information to the FBI, law enforcement and fire agencies at daily JRIC briefings and can facilitate the access to public health subject-matter experts.

PUBLIC HEALTH NURSE ROLE

The PHN functions as an intelligence analyst by researching and studying known terrorist groups in order to assess their ability to develop and deploy biological and chemical weapons. The PHN currently possesses a Department of Justice security clearance that assists with the collection and assessment of terrorist threat information that is generally unavailable to most public health practitioners. The majority of the information that is gathered to conduct this intelligence analysis is through the monitoring and assessing open media sources, law enforcement bulletins and non-classified disease intelligence sources. Due to the education and experience inherent to the public health profession, the PHN participates in the planning and coordination of public health bioterrorism and emergency preparedness drills and exercises, ongoing response protocol development, and the development of after action reports that facilitate the synchronization of public health and public safety responses to terrorist attacks.

In this new area of practice, the PHN serving as a terrorism and medical intelligence analyst also serves as a link between public health and many other experts with a variety of disciplinary skills to increase resource capabilities in response to possible BT attacks. This approach strengthens preparedness and response capacity of the LAC public health system, and strengthens the relationship among the JRIC partners and respective representatives.

The PHN fully integrates with the JRIC bioterrorism threat analysis and response planning resources to address interests and concerns of public health in the collaborative approach in response to bioterrorism. The PHN facilitates JRIC accesses to public health information and subject-matter expertise, enhances sharing information, improves mobilization of community partners, promotes disease surveillance and joint investigation, and maximizes capacity and response capability to counteract bioterrorism attacks. The PHN works with experts from other public health disciplines such as mental health, environmental health, toxics epidemiology, radiation management, veterinary science and communicable diseases to ensure a better understanding of the public health role in community preparedness, and to be an advocate for the public health mission within the JRIC. The JRIC staff may need the expert analysis of intelligence related to a potential chemical, biological or radiological attack to validate the credibility of that information, and to recommend potential courses of action.

The PHN who is integrated into a regional terrorism intelligence center adheres to both the LAC and Minnesota practice models, and to the following core components of public health nursing that are currently being practiced. The Minnesota Public Health Nursing Interventions Model [1] provides PHNs with a guide to formulate and implement public health nursing plans. The model describes levels of practice with the various types of interventions that optimize delivery of public health services in society. The PHN integrates the surveillance, disease and health event investigation interventions into the analysis process by observing anomalies that may indicate the presence of a biological attack while presenting these findings in a multi-disciplinary, collaborative environment.

The LAC Public Health Nursing Practice Model [2] provides PHNs with a comprehensive framework to function within an interdisciplinary environment. The model allows PHNs to use public health nursing knowledge and skills with knowledge from other disciplines to meet the changing health needs of the community. The PHN assesses the reportable disease and outbreak investigations, investigates the possible connection between these events and terrorism threat information for any feasible connection to terrorism, reports findings to appropriate health and law enforcement individuals, develops protocols and strategies for analyzing and sharing these findings, links appropriate health and law enforcement entities and evaluates the validity of these strategies. This team approach offers PHNs access to a new network of counterterrorism and homeland security professionals that facilitate reliable exchange of information and foster collaboration among agencies to improve the overall response capability of public health to BT attacks.

CONCLUSION

The challenges posed by terrorism, the necessary integration of public health expertise into the law enforcement/intelligence community, and the importance of partnership and multi-agency, multidisciplinary collaboration to achieve common goals has created a new area of specialization for 21st century public health nurses. PHNs continue to integrate public health expertise into the JRIC through the application of the nursing process and by linking law enforcement and fire services with public heath subject-matter experts. PHNs should become familiar with the subject of medical intelligence gathering, assessment and analysis in order to meet the challenges of countering the threat of bioterrorism in their local community.

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SUSPECTED SMALLPOX CASE INVESTIGATION TRAINING

BACKGROUND

Smallpox is a serious, contagious, and often fatal infectious disease that was declared eradicated worldwide in 1980 by the World Health Organization (WHO). However, the events of September 2001 and October 2001 raised concern that the smallpox (variola) virus could be used as an agent of biologic terrorism. Since there has been limited experience among public health personnel in responding to smallpox cases, four smallpox case investigation training sessions were provided to Los Angeles County (LAC) Department of Public Health (DPH) Smallpox Response Team members to increase their knowledge and skills in responding to these situations. These trainings were offered to build Los Angeles County's smallpox preparedness capacity in conducting investigations and outbreak control for suspected smallpox cases.

METHODS

From April 2006 through May 2006, four suspected smallpox case investigation trainings were offered by the LAC DPH Acute Communicable Disease Control (ACDC) Program, Bioterrorism Preparedness and Response Section. The trainings were conducted by two physician specialists, three health educators, a public health nurse, and a Federal Bureau of Investigation (FBI) special agent.

The training was organized into four components that consisted of a comprehensive lecture, a hands-on demonstration of the Smallpox Aid Response Kit (SPARK), which is a "go-bag" that contains supplies including: personal protective equipment (PPE), laboratory specimen collection kit and procedures, case investigation forms, smallpox rash evolution guide, a digital camera, and laptop with wireless connection.

The objectives of the training were as follows:

- List the three major diagnostic criteria for smallpox;
- List three of five minor diagnostic criteria for smallpox;
- State how smallpox is transmitted;
- State the notification process for a suspected smallpox case;
- State the infection control precautions needed for a suspected smallpox case;
- Describe the functional role as a member of a public health smallpox response team in the initial evaluation of a suspected smallpox case;
- Describe two mechanisms by which a terrorist attack could be perpetrated using the smallpox virus and its relevance to the assessment of a smallpox case and;
- Describe the importance of chain of custody in evidence collection and transport.

Training participants received a packet of materials that included the notification and call-down process, risk assessment for smallpox using the Centers for Disease Control and Prevention (CDC) criteria, guides for distinguishing smallpox from chickenpox, standardized procedures for specimen collection, guidelines for evaluating a rash illness suspicious for smallpox, PPE donning and removal procedures, worksheets for evaluating a suspect smallpox case(s), checklists for investigating a suspected smallpox case, clinical and non-clinical resource guides, and a list of the SPARK items. The chain of custody issues for specimen collection and joint investigation with DPH and the FBI were reviewed. A copy of The Joint Bioterrorism Investigation Memorandum of Understanding between DPH, FBI, and LAC Sheriff was then given to the participants.

The target audience for this training was DPH staff physicians, public health investigators, nurses, and other staff who would respond to assess and investigate suspect smallpox case(s) in LAC. Smallpox-vaccinated LAC public health workers were contacted by telephone and e-mail to participate in one of the four training sessions. Participants consisted of clinical (physicians and nurses) smallpox-vaccinated individuals and non-clinical vaccinated individuals.

To evaluate changes in the knowledge and skills of the participants, pre-tests and post-tests were administered at the training. The pre-test and post-test included 10 questions consisting of true/false and multiple choice questions. There was an additional section of three short answer clinical exam questions for clinical staff only. Analysis of the pre-tests and post-tests was conducted with the SAS Software program. In addition, pre-tests and post-tests were grouped by the four different sessions. In an effort to maintain confidentiality of the participants, names and identification numbers were not used.

The planning and evaluation process of the training were based on the Continuing Medical Education (CME) and Continuing Education Unit (CEU) activity guidelines. The California Medical Association approved the activity for 2.0 CME category 1 credits. The California Board of Registered Nursing approved the activity for 2.0 CEU contact hours. The CME Program Evaluation and LAC Public Health Nursing Administration Evaluation were conducted for all four training sessions. The evaluation measured if the training objectives were met and also requested general comments about the training. Participants were asked to submit their views on how the information will be applied to their public health duties to improve effectiveness. Further, participants were asked to list the two most pertinent pieces of information they learned from the training. To assist with future programs, participants were also asked to indicate future needs and topics they would like to have reviewed.

RESULTS

There were 45 clinical and 10 non-clinical staff participants that completed the training. Only pre-test and post-test pairs completed by clinical staff participants were analyzed (n=42). The Paired T-test was calculated for the pre-tests and post-tests utilizing the SAS Software program. Analysis revealed that there is a statistical significance between pre-tests and post-tests ($p<0.0001$). The mean scores out of 100% of the pre-tests were: Group I = 69.4, Group II = 69.4, Group III = 63.4, and Group IV = 70.4. A majority of participants scored below 70% on the pre-test.

An analysis of the post-test revealed improvement in knowledge with the following scores: Group I = 86.2, Group II = 86.2, Group III = 87.8, and Group IV = 90.2. Overall, post-test mean scores ranged from 86.2 % to 90.2% which increased from the pre-test mean score of 70%. Participants that were non-clinical staff members (n=10) did not participate in the clinical exam questions. Therefore, their results were not calculated in the mean scores of the pre-test and post-test.

Table 1. Pre-Test and Post-Test Results of Clinical Staff Participants

		Mean Scores			95% C.I.			
Groups	# of participants (n=42*)	Pre-Test	Post-Test	Difference	Lower	Upper	T Value	P Value
1	12	69.4	86.2	18.5	14.2	22.8	9.42	<0.0001
2	12	69.4	86.2	18.5	14.2	22.8	9.42	<0.0001
3	9	63.4	87.8	24.3	19.3	29.4	11.07	<0.0001
4	9	70.4	90.2	17.6	12.4	22.7	7.87	<0.0001

* Based on pairs matched for completed tests in order to conduct analysis.

CONCLUSION

Suspected smallpox case investigation trainings were provided to smallpox vaccinated public health workers in LAC to improve knowledge and skills in responding to suspect and initial smallpox case(s). A total of 45 clinical and 10 non-clinical public health staff members completed the training. The Paired T-test was calculated for the pre-tests and post-tests utilizing the SAS Software Program. Analysis revealed that there was a statistical significance between pre-tests and post-tests ($p<0.0001$). A majority of the

participants scored below 70% on the pre-test. However, post-test scores showed improvement in knowledge with mean scores ranging from 86.2% to 90.2%.

The training included an overview of the notification and call-down process, risk assessment for smallpox using CDC criteria, systematic approach to evaluating a febrile vesicular or pustular rash illness using CDC diagnostic algorithms, and information about isolation and infection control precautions. Participants had the opportunity to become familiar with transmitting digital photos via wireless laptop. A hands-on demonstration of the Smallpox Aid Response Kit (SPARK), laboratory specimen collection procedure, and a discussion about the chain of custody issues for specimen collection were reviewed.

In evaluating the four training sessions, 92% to 100% of participants thought that the course objective to state the notification process for a suspected smallpox case was fully met. In addition, 85% to 100% of the participants thought that the objective to describe the functional role as a member of the public health response team in the initial evaluation of a suspected smallpox case was fully met. Some of the general comments about the training were: very well done, excellent overview, comprehensive, practical, instructive, and straight forward presentation with good information. Overall, a majority of the participants agreed that they would recommend future sessions, such as this, to their colleagues. In the near future, a yearly refresher course will be conducted as a self-study module so Smallpox Response Team members can maintain their skills and knowledge.

BOTULISM SUMMARY
LOS ANGELES COUNTY, 2006

Botulism is a rare but serious paralytic illness caused by a nerve toxin produced by the bacterium *Clostridium botulinum* (and rarely other species). There are three main kinds of botulism. Foodborne botulism is caused by eating foods that contain the botulism toxin. Wound botulism is caused by toxin produced from a wound infected with *Clostridium botulinum*. Infant botulism (also known as intestinal botulism) is caused by consuming the spores of the botulinum bacteria, which then grow in the intestines and release toxin. All forms of botulism can be fatal and are considered medical emergencies. Foodborne botulism can be especially dangerous because many people can be poisoned by eating a contaminated food.

A total of seven patients were reported with suspected botulism in 2006 to Los Angeles County (LAC) Department of Public Health (DPH), only two of which were confirmed with the disease (Table 1). Most suspects were male (n=6), most were Hispanic (n=6) and ages ranged from 10 to 63 years (mean=45). Four suspect cases were injection drug users (IDUs), including the two confirmed cases. Antitoxin was administered to four suspect cases based on their risk factors and presenting signs and symptoms.

The LAC Public Health Laboratory (PHL) performed analyses on specimens from five suspect cases. After investigation, only two cases were confirmed as wound botulism. This report excludes cases of infant botulism, which is monitored by the California State Department of Health Services (DHS).

CASE REPORTS

Confirmed Wound Botulism (n=2): Two of the four cases of IDUs reported with possible botulism were confirmed; both were Hispanic males, and both were confirmed by demonstration of botulinum type A toxin in serum.

Probable Wound Botulism (n=2): The other two IDUs were domestic partners who presented to hospital together with typical botulism signs and symptoms; both had obvious injection abscesses that were cultured. They were admitted for diagnostic work-up and treatment; wound cultures were obtained, but pre-treatment sera were not submitted for testing. The male was treated with antitoxin; a post-treatment serum sample was negative for botulinum toxin. The female suspect was admitted but not treated with antitoxin. Their wound cultures were negative for clostridia. They left the hospital against medical advice.

Other Central Nervous System Disease (n=3): A 10 year-old boy with cerebral palsy had been receiving periodic therapeutic injections of BoTox® (toxin type A) to relieve muscle spasms. A month prior to report, the brand of toxin was changed to Myobloc® (toxin type B) without knowledge of the treating physician. These products are not bioequivalent (i.e., the same dosage has different physiological effects) and the dosage was not decreased accordingly. After the last treatment, the physician noted the onset of bilateral facial nerve weakness, ptosis, floppy neck, and lax palate, as well as noisy breathing; a full neurological assessment was made difficult by his preexisting disorder. He was being evaluated for sleep apnea when the pharmaceutical oversight was discovered. Serum tested five weeks after the last injection was negative for botulinum toxin; however the findings are consistent with medically induced (iatrogenic) botulism. Confusion between the two forms of therapeutic botulinum toxin has been noted previously, and package inserts for both products draw attention to this point.

Two patients reported with possible botulism were found to have another neurological disorder. A man was assessed for possible botulism but ultimately diagnosed with Guillan-Barré syndrome (GBS) after showing clinical improvement with administration of IVIG; he also had a history of a recent diarrheal illness, not uncommon with GBS. The final suspect had a clinical presentation compatible with botulism and no history of wounds or self injection; he was treated with antitoxin for possible foodborne botulism. Serum and stool were negative for toxin, and stool was negative for clostridia; no suspect foods were found in the home.

Table 1. Suspected Botulism Cases, LAC DPH, 2006

Age/ Sex	Race/ Ethnicity	Month of onset	Injection drug user	Serum test*	Stool test¶	Wound culture	Anti-toxin	Diagnosis
10 M	Asian	Dec. 05	N	Neg.	--	--	No	Cerebral palsy; possible iatrogenic botulism
62 M	Hispanic	Feb.	Y	Type A	--	--	Yes	Wound botulism, type A
47 F	Hispanic	Aug.	Y	--	--	Neg.	No	Probable wound botulism
47 M	Hispanic	Aug.	Y	--	--	Neg.	Yes	Probable wound botulism
43 M	Hispanic	Nov.	N	--	--	--	No	Guillain-Barré syndrome
52 M	Hispanic	Dec.	Y	Type A	--	Neg.	Yes	Wound botulism, type A
57 M	Hispanic	Dec.	N	Neg.	Neg.	--	Yes	Unknown

Pos – test was performed and result was positive
Neg – test was performed and result was negative
* Botulinum toxin screen by mouse bio-assay
¶ Botulinum toxin screen by mouse bio-assay; culture for clostridia.

COMMENTS

Botulism testing using the mouse bio-assay is available only in the LAC PHL and state or Centers for Disease Control and Prevention (CDC) laboratories. Antitoxin is available in California only upon release by designated public health physicians in ACDC or the California DHS. For these reasons, reporting of hospitalized cases is felt to be complete. However, under-detection of mild cases is possible.

Botulism is one of seven biological agents classified as “Category A” for bioterrorism preparedness, requiring the highest priority for reporting. Heightened concern over bioterrorism should lead to increased consultations with Public Health for possible botulism cases.

ACUTE *TRYPANOSOMA CRUZI* INFECTION IN ORGAN TRANSPLANT RECIPIENTS IN LOS ANGELES, CALIFORNIA, 2006

BACKGROUND

This report describes two cases of acute Chagas disease in heart transplant recipients at two separate local hospitals in Los Angeles County in February 2006. Chagas disease is a life-long infection caused by the parasite *Trypanosoma cruzi (T. cruzi).* Most infected persons are asymptomatic and undiagnosed. Triatomine (i.e., Reduviid or kissing) bugs transmit the parasite through infected feces. *T. cruzi* may also be transmitted congenitally or by an infected blood transfusion or organ transplantation. Although serologic testing of organ, tissue, and blood donors is performed in areas of Latin America where Chagas disease is endemic, there is no *T. cruzi* screening test licensed in the United States (U.S.). However, seroprevalence studies have documented the presence of *T. cruzi* antibodies in U.S. blood [1] and organ donor populations [2]. In the U.S., there is one previous report of *T. cruzi* transmission through solid organ transplantation where three organ recipients were infected [3].

CASE REPORTS

Case 1:

A 64 year-old male with idiopathic cardiomyopathy received a heart transplant on December 11, 2005. He was treated with enhanced immunosuppression in January 2006 for suspected organ rejection. On February 11, 2006, he was readmitted with anorexia, fever, and diarrhea of two weeks duration. A peripheral blood smear revealed *T. cruzi* trypomastigotes, blood cultures were positive for *T. cruzi*, and endomyocardial biopsy specimens contained amastigotes. The patient was interviewed about natural exposures, and the organ procurement and transplantation records were reviewed. He had no risk factors for pre-existing *T. cruzi* infection. He was seronegative for *T. cruzi* antibodies but positive for *T. cruzi* DNA by polymerase chain reaction (PCR), indicating recent infection. After initiation of nifurtimox therapy, his parasitemia rapidly cleared. However, the patient expired on April 30, 2006 from acute rejection.

To identify the source of infection, a trace-back was conducted on blood products transfused to the organ donor and heart recipient. All available blood donors tested negative for *T. cruzi* antibodies by immunofluorescence assay (IFA) and radioimmunoprecipitation assay (RIPA). The organ donor, who was born in the U.S. but had traveled to a Chagas-endemic area of Mexico, originally tested borderline positive for *T. cruzi* antibodies by IFA. The donor had received multiple blood products prior to his death; therefore it was believed that IFA might not be sensitive enough to pick up *T. cruzi* antibodies. A follow-up test using RIPA was done which confirmed the presence of *T. cruzi* antibodies.

Three additional patients received solid organs from the same donor. These patients remain *T. cruzi*-seronegative by IFA with no evidence of parasitemia by PCR. They continue to be monitored.

Case 2:

A 73 year-old male with ischemic cardiomyopathy received a heart transplant on January 3, 2006. The patient was re-admitted to the hospital on February 22, 2006 with complaints of fever, fatigue, and an abdominal rash. A thin blood smear revealed *T. cruzi* trypomastigotes, and blood cultures were positive for *T. cruzi*. Organ procurement and transplantation records were reviewed. The patient had no risk factors for pre-existing *T. cruzi* infection. He was seronegative and PCR-positive for *T. cruzi*, indicating recent infection.

The patient's rash and parasitemia resolved after 10 days of nifurtimox treatment. He remains hospitalized. Endomyocardial biopsies thus far have not revealed trypanosomes, and he remains seronegative by IFA for *T. cruzi*.

The source of infection was investigated with the same methods used for Case 1. All available blood donors tested seronegative for *T. cruzi*. The organ donor born in El Salvador first tested negative for *T. cruzi* antibodies by IFA but had a follow-up test with RIPA due to the amount of blood products transfused to the organ donor and possible hemodilution. The donor then tested positive for *T. cruzi* antibodies.

There were three other solid organ recipients from the same donor. These patients remain *T. cruzi*-seronegative by IFA with no evidence of parasitemia by PCR. They continue to be monitored.

These are the fourth and fifth cases of reported *T. cruzi* transmission through solid organ transplantation in the U.S. *T. cruzi* prevalence in the U.S. varies by region and may be higher than previously appreciated, especially in Los Angeles County, where a substantial proportion of donors have emigrated from Chagas-endemic countries. Because organ donors are frequently transfused, infection may be transmitted to recipients either by transfusion or transplant. Currently, there are no national policies recommending blood, organ or tissue donor screening for *T. cruzi*. Available diagnostic tests have variable sensitivity and specificity and there is no licensed screening test. However, evaluation of potential serologic tests for blood screening is currently being conducted.

Physicians and laboratorians should maintain an index of suspicion for *T. cruzi* infection in organ transplant recipients who exhibit fever in the absence of obvious opportunistic and bacterial infections. Acute Chagas disease in severely immunocompromised patients is of special concern, because the clinical course is often severe and rapidly progressive. If it is suspected, manual review of blood smears should be performed. Acute Chagas disease should be treated as early as possible in the course of infection with nifurtimox (obtained from the CDC Drug Service, telephone 404-639-3670) and benznidazole (not available in the U.S.).

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RESPONDING TO URGENT CASE REPORTS: TESTING THE LOS ANGELES COUNTY DISEASE REPORTING SYSTEM

Since the 9/11 event and subsequent anthrax attacks, strengthening the ability of Local Public Health Agencies (LPHAs) to detect and respond to bioterrorism as well as natural disease outbreaks has become a national priority. In response to this priority, the Centers for Disease Control and Prevention (CDC) issued guidance that clarified LPHA responsibilities for receiving and responding to urgent disease case reports [1]. This guidance detailed four primary recommendations: 1) a single, well-publicized telephone number to receive urgent case reports; 2) a phone triage system to process urgent case reports; 3) capabilities to receive urgent case reports 24 hours a day, 7 days a week and 4) a trained public health (PH) professional to respond within 30 minutes of receiving the report. Lacking from this guidance was the provision of tools or methods that LPHAs could use to evaluate and test their disease reporting system to identify areas that were working well and areas that needed improvement.

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

BACKGROUND

Los Angeles County maintains a disease reporting system capable of receiving reports 24 hours a day, 7 days a week via an 888 toll-free disease reporting hotline (Figure 1). In addition to the hotline, urgent disease reports can also be called in directly to Acute Communicable Disease Control Program (ACDC) or Immunization Program (IP).

Calls received through the 888 toll-free number during normal business hours—Monday to Friday, 8am to 5pm—go directly to the LAC Department of Public Health Morbidity Unit. If a caller is requesting information or assistance related to infectious disease the call is transferred to ACDC. Calls are then triaged based on whether the caller is a healthcare provider and the exact nature of the call.

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

METHODS

The RAND technical manual organizes the evaluation of a disease reporting system into four levels. The Level 1 test is designed to only test how quickly a response to an urgent disease report is received. Subsequent testing levels build on this basic test by evaluating other, more complex aspects of a disease reporting system.

A Level 1 test for LAC was planned for April 2006. Test callers were selected from a Public Health program unrelated to the county disease reporting system. Callers were required to attend a training session that gave an overview of the RAND study, explained the design of the test being conducted in LAC and provided specific training on how to perform test calls. This training included an instructional session as well as an interactive one. Once completed, callers signed up to perform between one to three test calls during the test month.

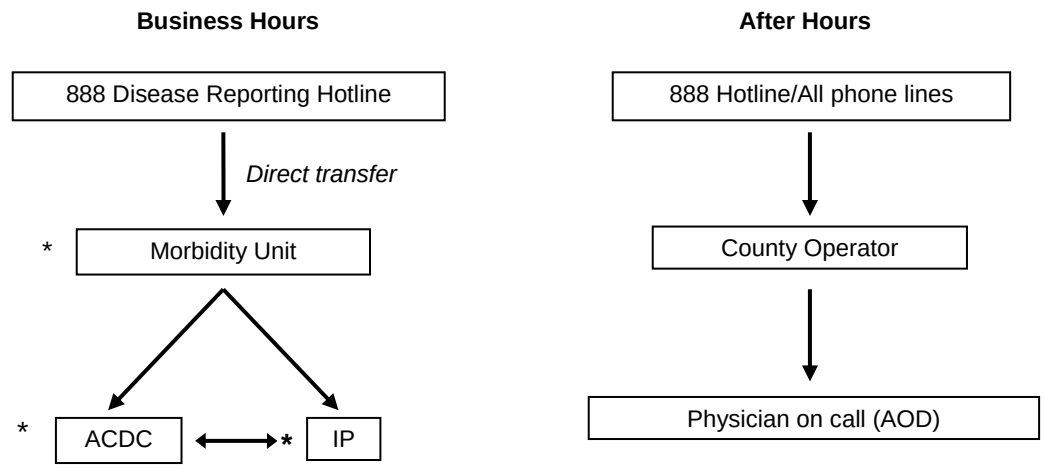
Each call process consisted of three phases: 1) initiating a call, 2) reaching an action officer[1] (AO) and 3) debriefing. A call was initiated when a test caller phoned the disease reporting system, used a lead-in (a short message designed to move the call to an AO) and asked to speak to an AO. The caller would either be transferred directly to the AO (a warm transfer) or be asked to leave a message for the AO (callback). Once the caller reached an AO and confirmed that the person was responsible for handling urgent disease case reports, the AO was "debriefed" (i.e., informed that the call was only a test and that no further action was required).

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

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

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

Figure 1. Disease Reporting Schematic
(urgent reports)



RESULTS

During the month of April 2006, a total of ten test calls were made to the disease reporting system. Contact with an AO was made within 30 minutes for eight calls (Table 1), while two calls yielded no contact. Response times for successful calls ranged from 4 to 15 minutes with a mean of 8.25 minutes

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

from initiating the phone call to reaching an AO. Of the eight successful calls, seven (88%) were warm transfers.

Two calls were not able to connect with an AO within the 30 minutes recommended by CDC. In the first call, the caller was transferred to an AO's voicemail instead of being transferred to an alternate AO who was available to speak with the person immediately. The voice outgoing message did, however, leave an alternate number to use in the case of an emergency. The test caller used this number, insisted on speaking with someone and eventually reached an AO within 30 minutes. The initial AO was out of the office for the entire day, although they did return the call the next business day.

The second call was made to the 888 toll-free disease reporting hotline at the end of the business day on a Friday. The phone rang numerous times without being answered and eventually went to a recorded message that asked the caller to "remain on the line for the next available agent". After remaining on hold for 15 minutes, the test caller ended the call. The caller made two additional attempts and was on hold for approximately eight minutes each time. A live person was never reached.

Table 1. Successful Call Line List

Call #	Type of Call	Time of Call	Out-come	Time on hold			Total Time to reach AO
				County Operator	Morbidity Unit	ACDC/IP	
1	After Hrs	Early Morning	WT	7 min	----	----	9 min
2	Business Hrs	Afternoon	WT	----	0 min	6 min	10 min
3	After Hrs	Late Evening	WT	2 min	----	----	4 min
4	Business Hrs	Afternoon	WT	----	0 min	5 sec	4 min
5	After Hrs	Afternoon	WT	3 min	----	----	5 min
6	After Hrs	Early Evening	CB	6 min	----	----	13 min
7	Business Hrs	Late Morning	WT	----	----	3 min	15 min
8	Business Hrs	Afternoon	WT	----	0 min	4 min	6 min

WT=Warm Transfer; CB=Callback

Improvements: At the end of the test period, call transfer protocols were reviewed with ACDC front office staff. Protocols were developed such that healthcare providers calling about a specific patient would not be forced to leave a message on voicemail, but would be transferred to a live person for assistance. In addition, all staff were encouraged to leave an alternate number on their voicemail so that in an emergency situation, callers have another option for reaching a live person.

Telephone services were contacted and asked to ensure that calls were being appropriately forwarded to the county operator at the conclusion of business hours. It was also clarified that staff must be available to answer phones in all county departments through 5pm on weekdays as the automatic transfer of phone calls to county operator does not occur until 5pm precisely.

DISCUSSION

The test of the LAC disease reporting system showed that the current system works very well. The county already had a system set up to receive reports 24 hours a day, 7 days a week and a toll-free hotline specific for receiving urgent disease case reports. While more than one number for disease reporting does exist, the 888 toll-free number has been well-publicized (e.g., rolodex inserts, phone stickers, pens, etc) by the county and is the number public callers and healthcare providers are given when asked where they can report cases of disease.

Most test calls reached an AO within 15 minutes; well under the 30 minute standard recommended by the CDC. The phone triage system functioned smoothly with most calls being transferred directly to an AO.

Test callers reported back that both Morbidity Unit and ACDC staff were pleasant and professional on the phone. While there were a few problems with the phone numbers, they were resolved quickly with minimal disruption.

Additional testing of the disease reporting system will be conducted over the next one to two years, with each subsequent test increasing in difficulty until the most comprehensive and complex test has been performed. Subsequently, tests varying in difficulty and scope will be conducted annually for quality assurance purposes.

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PEARLS OF SICKNESS: A MULTISTATE EPIDEMIC OF *VIBRIO PARAHÆMOLYTICUS* LINKED TO CONTAMINATED OYSTERS FROM WASHINGTON STATE

BACKGROUND

In June 2006, routine disease surveillance by the Los Angeles County (LAC) Department of Public Health (DPH) Acute Communicable Disease Control (ACDC) Program uncovered a sharp increase in the number of cases of *Vibrio parahæmolyticus* infection. *Vibrio parahæmolyticus (V. parahæmolyticus)* is a species of comma-shaped bacteria that thrives in seawater or brackish water. People commonly become infected with *V. parahæmolyticus* through ingestion of contaminated water or undercooked shellfish. Shellfish include oysters, mussels, clams and scallops. Symptoms of vibriosis include profuse diarrhea, fever, abdominal cramps, nausea, vomiting, headache and severe fatigue. Illness duration extends from 1 to 7 days and incubation ranges between 4 to 30 hours, but usually 12 to 24 hours [1].

The endemic rate for *V. parahæmolyticus* infection is approximately 15 cases per year, with most of those cases occurring between late May and early October [2]. However, starting in mid-June ACDC began to receive more reports of infection than expected. Due to the apparent swell in incidence, ACDC investigated the rising cases of *V. parahæmolyticus* infection and found they coincided with increased incidence of vibriosis in Washington State.

METHODS

General investigation: Cases of *V. parahæmolyticus* are reportable to ACDC and are tracked. For each report received, the physician listed on the report was contacted and interviewed about the case. Medical records such as history and physical, infectious disease consultation and discharge summary were requested from hospitals for hospitalized cases. Cases were interviewed about symptoms and risk factors, particularly consumption of certain seafood items. LAC Environmental Health Services investigated reports in which consumption of raw seafood was implicated.

Case definition: An outbreak case was defined as any person meeting all of the following three criteria:

1. Is a Los Angeles County resident with *V. parahæmolyticus* infection confirmed by the LAC-PHL.
2. Ate raw shellfish harvested from Puget Sound, WA between July 1 and July 20, 2006.
3. Had onset of gastrointestinal symptoms within 72 hours following ingestion of the shellfish..

Environmental Health Inspection: Because many of the vibriosis cases reported eating at restaurants throughout California, multiple environmental health jurisdictions were requested to assist in the investigation. In addition to LAC Environmental Health Services, the following counties participated in the investigation: San Diego, Santa Barbara, Orange County and San Francisco. Each county inspected the restaurants or vendors; confirmed receipt and sales of raw oysters; and copied invoices and shellfish tags to determine the source of the oysters.

RESULTS

Cases: ACDC obtained reports on 14 vibriosis cases infected with *V. parahæmolyticus* and residing in LAC between June 15 and August 15, 2006. Figure 1 shows onset dates for *V. parahæmolyticus* infections from July 1 to August 2; the time frame encompasses the vibriosis epidemic, but also includes endemic cases not related to oyster consumption. Eleven *V. parahæmolyticus* cases (79%) recalled eating raw oysters or scallops, while 3 cases denied eating raw oysters prior to onset of symptoms. Forty-seven percent of cases were male. Cases had a mean age of 48 years with a range of 25 to 86 years.

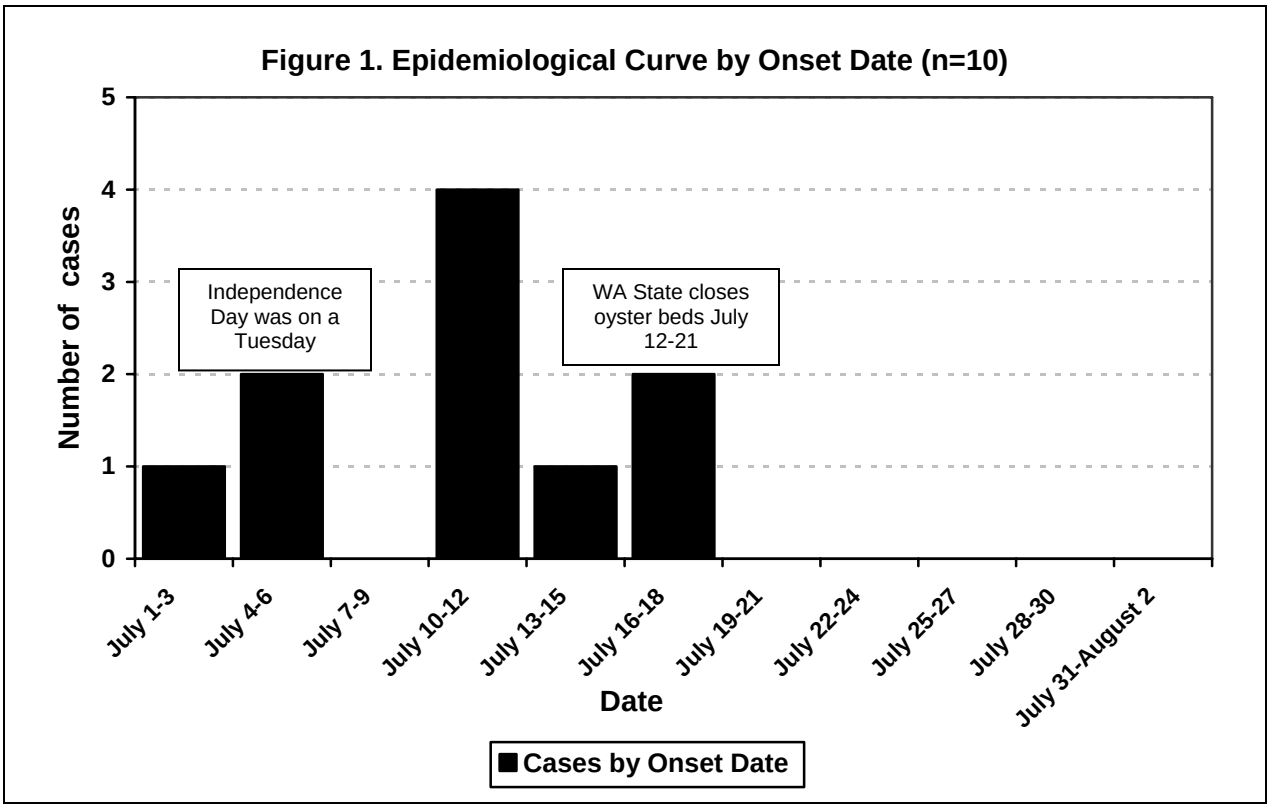

Table 1. Profile of Selected *V. parahæmolyticus* Cases				
Age / Sex		**Onset date**	**Implicated seafood**	**Purchase location**
55	F	June 10, 2006	Raw scallops	Los Angeles – restaurant
47	F	July 2, 2006	Raw oysters	San Francisco – Pier 39
31	M	July 4, 2006	Raw oysters	San Diego – restaurant
25	M	July 10, 2006	Raw oysters	Century City – restaurant
48	F	July 10, 2006	Raw oysters	Santa Barbara – Stearns Wharf
43	M	July 10, 2006	Raw oysters	San Francisco – restaurant
34	F	July 14, 2006	Raw oysters	Los Angeles – supermarket
86	M	July 17, 2006	Raw oysters	Sonoma – private retreat
38	F	July 17, 2006	Raw oysters	Los Angeles – restaurant

Table 1 outlines the age, gender and onset date of selected vibriosis cases and shows the implicated seafood item and its point of purchase. The first case in Table 1 typifies LA County seasonal vibriosis case histories; a female case ate scallop ceviche at a Mexican restaurant, although she is not part of the

subsequently became ill. The second case linked to this epidemic was a man who had traveled to San Diego with friends. He dined on raw oysters at a popular beachfront hotel as part of a large dining party. The third case linked to this epidemic was a young man who had eaten raw oysters at a restaurant in Century City in LAC. He was treated by a private physician and later diagnosed with vibriosis. One case linked to this epidemic became ill following home consumption of raw oysters. She and her partner purchased shucked oysters from a supermarket and ate them raw. Her partner experienced some gastrointestinal symptoms, but was not diagnosed with vibriosis. Three other cases were associated with raw oyster consumption outside of LAC; the remaining cases ate raw oysters at commercial food establishments in LAC.

Laboratory: The LAC PHL, bacteriology unit confirmed 12 cultures positive for *V. parahæmolyticus*. One case each was confirmed by Santa Cruz County and Orange County PHLs.

Environmental Health Investigations: LAC Environmental Health Service Food and Milk Program inspected one restaurant in Century City and one supermarket in Westwood based on case reports. Both establishments had sold raw oysters harvested from various beds in Puget Sound, Washington State.

Santa Barbara County Environmental Health inspected a restaurant on Stearns Wharf and confirmed their oyster supply had been harvested also in Puget Sound, Washington State.

San Francisco Environmental Health could not complete the inspection because the two cases reportedly ate at restaurants on Fisherman's Wharf, but neither could recall which specific restaurant.

San Diego County Environmental Health completed an outbreak investigation based on the report received from ACDC. The vibriosis case reported dining with a large group of friends at a hotel restaurant, and while he was the only person to be diagnosed with vibriosis, several members of his party became ill with similar symptoms following the meal. All of those who were ill reportedly ate raw oysters. The tags for that particular lot of oysters indicated they were harvested, again, from Puget Sound, Washington State.

Halt of Supply: Between July 12 and 21, 2006, the state of Washington issued public warnings and closed several oyster beds in Puget Sound in response to the public health threat. Following the closures of the oyster beds, the number of cases of vibriosis (including all *Vibrio* species) reported in Los Angeles County fell back to endemic levels.

DISCUSSION

After thorough investigation, the LAC DPH determined that the epidemic of vibriosis due to infection with *V. parahæmolyticus* was caused by environmental contamination of oysters harvested from Puget Sound in Washington State. The summer of 2006 was one of the warmest recorded for the United States since 1895 [4]. As a result, water temperatures in Puget Sound were also above normal. *V. parahæmolyticus* tends to thrive in warmer conditions, which led to proliferation of the bacteria in the water. Oysters and other filter-feeding marine life concentrate the bacteria in their bodies, and if the shellfish are not cooked properly, the bacteria may cause illness.

The onset of four cases in LAC coincided with Independence Day celebrations, three of whom reported traveling outside of LAC for the holiday. This is significant because in some cultures oysters are a special occasion food item consumed during celebrations. Two peaks of disease incidence surround July 4, 2006. The holiday occurred on a Tuesday, which led to some people taking an extended weekend before or after the holiday. Several cases who became ill outside the holiday period had eaten oysters as part of other festivities including business meetings, family gatherings, parties and romantic liaisons.

LIMITATIONS

This investigation was limited by a few factors. There was recall bias among some cases due to the retrospective nature of the data collection. Several cases were unable to positively identify the restaurant

where they had eaten oysters. The standardized questionnaire administered to the cases asked specifically about seafood and seawater exposure, which may have biased the cases' answers.

Despite the multiple health jurisdictions involved in this epidemic, no additional warnings regarding the consumption of raw oysters and other seafood were officially made in California by either state or local health departments. Epidemiological data related to this outbreak of *V. parahæmolyticus* from LAC and other parts of California were not included in a bulletin posted to the CDC Morbidity and Mortality Weekly Report [3]. Because the source of the contaminated oysters was in Puget Sound, much of the higher-level oversight of the investigation was covered by Washington state authorities.

RECOMMENDATIONS

While it is legal to sell and serve raw oysters in LAC, the DPH recommends that people do not consume raw or undercooked oysters. Current California health codes dictate that commercial food establishments that serve raw oysters originating from the Gulf of Mexico display prominent warnings in both English and Spanish, detailing the health risks associated with raw seafood consumption and sales of oysters from this region are restricted between April 1 and October 31 each year. However, there is no such regulation for oysters taken from other locations or for other raw shellfish.

Also, LAC DPH recommends that clinicians treating patients for profuse diarrhea and other symptoms consistent with vibriosis ask their patients about seafood consumption and recreational water exposure. If patients admit to a recent history of either activity, clinicians should take a stool specimen for culture. Culture for vibriosis species is not done routinely on all stool cultures. Vibriosis (stool) culture must be requested by Doctor's order and the lab has to use TCBS agar.

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2006 HUMAN HANTAVIRUS INFECTIONS IN LOS ANGELES COUNTY RESIDENTS

BACKGROUND

Hantavirus pulmonary syndrome (HPS) was first recognized in 1993 after an outbreak of acute respiratory failure in young people in the Four Corners area of southwestern United States (U.S.). The case fatality rate among these cases was 76% [1]. Fortunately, recent Centers for Disease Control and Prevention (CDC) surveillance data reports a decline in the case-fatality rate of 30 to 40% [2]. HPS is characterized by a febrile illness associated with bilateral diffuse interstitial edema of the lungs developing within 72 hours of hospitalization in a previously healthy person. The causative agent of HPS is Sin Nombre virus, a previously unknown hantavirus that was both documented in individuals with HPS in New Mexico and rodents within their dwellings [1]. Sin Nombre virus (SNV), a lipid enveloped single stranded RNA virus of the family Bunyaviridae, is genetically distinct from other known hantaviruses that cause hemorrhagic fever with renal syndrome in Europe and in Asia [3].

Several hantaviruses that are pathogenic for humans have been identified in the U.S. [3]. In general, each virus has a single primary rodent host. The deer mouse *Peromyscus maniculatus* (*P. maniculatus*) is the primary rodent host and reservoir for Sin Nombre virus (SNV). *P. maniculatus* has been found in almost every state and province in the U.S. and Canada, except in the southeastern U.S. and the Atlantic seaboard.

Hantavirus infection is invariably related to contact with rodent reservoirs, but the duration of contact with infectious materials and dose necessary for disease transmission are not well understood. Most human infection is felt to be acquired through inhalation of aerosolized feces, urine or saliva from the infected mice. Case-control studies have found that the most commonly associated risk of hantavirus infection is contact with rodent excreta. Because most contact with infectious materials results from the ubiquitous presence of rodents, determination of the exact exposure can be difficult. The estimated incubation period has ranged from 1 to 5 weeks [4].

Since HPS was first identified in 1993, the CDC has confirmed 438 cases of HPS reported from 30 states among residents of 32 states through March 2006 [2]. Most cases have been reported in the Southwest especially New Mexico, Colorado, and Arizona. However, 43 cases have been reported to the CDC from California (CA) as well. Most cases in CA have been documented on the CA-Nevada border in the Sierra Nevada mountain range. However, environmental surveillance data has shown *P. maniculatus* serologically positive for SNV infection throughout southern and northern CA. There are usually from 0 to 5 cases documented each year in CA. Although Los Angeles County (LAC) residents have been previously identified with SNV infection, the cases were thought to have acquired infection outside of LAC.

In 2006, two cases of fatal SNV infection were documented in LAC residents. The first case was most likely acquired in Mono County, CA in an area where the human HPS had been previously documented. The second case of HPS was most likely acquired in the Antelope Valley of LAC. Although hantavirus infection had been documented in deer mice from past annual environmental surveillance data in the Antelope Valley, no human cases of HPS had been previously documented.

CASE REPORTS

Case 1: A 52 year-old male with history of hypertension, sleep apnea, and morbid obesity presented to a medical center in Reno, Nevada (NV) with complaints of progressive shortness of breath, wheezing, coughing and increased sputum production for the past three weeks. Prior to seeking care in Reno, this patient had spent one month camping in the family trailer with his wife at Robinson Creek campground, located in the Sierra-Nevada Mountain Range within Mono County, California.

Upon initial evaluation at the medical facility in Reno, the patient was noted to have an O_2 saturation at 90% on 10L of oxygen with a chest radiograph showing hypo-inflation with atelactasis versus infiltrates.

The patient's admitting diagnoses included: chronic obstructive pulmonary disease, pneumonia, and rule-out myocardial infarction. Within five days of his hospitalization, it was apparent that both his renal and pulmonary functions were deteriorating. He developed renal failure, creatinine of 2.4 mg/dl with hematuria and also required mechanical ventilation. Additionally, he developed thrombocytopenia with a platelet count of 61,000. The patient was placed on broad spectrum antibiotics initially and cared for in the intensive care unit. In addition to routine blood, urine, and sputum culture, additional infectious disease work-up was requested to include: hantavirus serological testing, blood smears for *Borrelia* sp., urinary *Legionella* antigen, and serological testing for West Nile virus and Rocky Mountain Spotted Fever. All blood, urine, and sputum cultures showed no growth and serological testing was negative with the exception of hantavirus serology which was strongly positive. Acute hantavirus (SNV specific) titers initially performed at the State of Nevada Public Health Laboratory were notable for an IgG $\geq$ 1:6400 and IgM $\geq$ 1:6400, consistent with acute hantavirus pulmonary syndrome. No additional convalescent hantavirus titers were obtained on this patient. These serological results were additionally confirmed at State of California Viral and Ricketsial Disease Laboratory (VRDL). The patient ultimately died of fulminant respiratory failure within 11 days of admission. No autopsy was conducted on this case.

Case 2: On July 22, 2006, a previously healthy sixteen year-old Hispanic male was initially seen at an outpatient clinic with a one-day history of high fever and headache. His evaluation consisted of blood cultures, complete blood count, blood chemistries and a computerized tomography head scan. All tests were normal and the patient was discharged home. The patient was seen again on July 24, 2006 due to persistent fevers, progressive shortness of breath, and severe headache. His evaluation revealed a bilateral pneumonia, thrombocytopenia, elevated hemoglobin and severe hypotension. He was subsequently admitted to an inpatient medical center with a diagnosis of sepsis and pneumonia and later requiring mechanical ventilation. On July 26, 2006, he was seen by an infectious disease specialist who placed him on broad spectrum antibiotics and also treated with a new "sepsis" drug (Xigris). The working diagnoses included: adult respiratory distress syndrome (ARDS), septic shock, and rule out meningitis. A spinal tap was not performed due to low platelet counts. On July 26, 2006, the infection control practitioner from the inpatient medical center reported the case as an "unusual occurrence" to the Los Angeles County Department of Public Health Acute Communicable Disease Control (ACDC) Program. After reviewing the medical chart and additional discussion with the infectious disease specialist on this case, additional infectious disease work-up was recommended which included testing for: WNV, HIV, Hantavirus, and urinary *Legionella* antigen. All labs were unrevealing including blood cultures, serologic testing for WNV, HIV, other viral pathogens, as well as *Legionella*. The patient's serum specimen was sent to the state of California VRDL and acute serological results were strongly consistent with acute SNV infection with IgM $\geq$ 1:1600 and IgG $\geq$ 1:6400. Despite aggressive medical care, the patient died 19 days after his admission to the medical center.

During the six week period before the onset of his illness the patient completed his junior year of high school, and worked at a nearby fast food restaurant. He had quit his job at a local fast food restaurant the first week in July. His parents could not recall the patient complaining of seeing with rodent dropping or rats or mice during his time working. However, during the first week in July, his last days on the job were spent cleaning the store room behind the kitchen. Other summer activities included rabbit hunting, visits to a regional park and odd jobs gardening and painting were confined to the Antelope Valley. During this period he resided with his family in a mobile home and at a nearby friend's home, where no infestations of rodents were reported.

METHODS

Medical chart review was completed on the two reported cases of suspected HPS. The family of Case #2 was extensively interviewed by a physician from ACDC and investigators from the LAC Environmental Health Vector-borne Disease Surveillance Unit for possible sources of exposure to hantavirus. Serological testing for both human and rodents for hantavirus infection was conducted at the State of CA VDRL using ELISA methodology.

Case Definition: A confirmed case of HPS is a febrile illness characterized by bilateral interstitial pulmonary infiltrates and respiratory compromise usually requiring supplemental oxygen and clinically

resembling acute respiratory disease syndrome (ARDS). The typical prodrome consists of fever, chills, myalgia, headache, and gastrointestinal symptoms. Typical clinical laboratory findings include hemoconcentration, left shift in the white blood cell count, neutrophilic leukocytosis, thrombocytopenia, and circulating immunoblasts [5].

The appropriate laboratory criteria for diagnosis are:

- detection of hantavirus-specific immunoglobulin M or rising titers of hantavirus-specific immunoglobulin G, or
- detection of hantavirus-specific ribonucleic acid sequence by polymerase chain reaction (PCR) in clinical specimens, or
- detection of hantavirus antigen by immunohistochemistry

A field investigation was conducted by California Department of Health Services (CDHS) Vector-borne Disease Section to determine the source of hantavirus-infected deer mice surrounding infection in Case #1. The LAC Environmental Health Vector-borne Disease Surveillance Unit conducted rodent trapping in multiple locations within the Antelope Valley that Case #2 frequented. Investigation consisted of trapping of rodents and obtaining serum from deer mice, *P. maniculatus*, and completing serological testing and PCR testing for hantavirus infection.

RESULTS

Human Serological Results: Only acute serological evaluations were obtained from both Case #1 and #2 during their initial evaluation. Both cases had strongly positive acute IgM and IgG consistent with recent hantavirus (SNV-specific) infection. The first case was found to have an IgM $\geq$ 1:6400 and IgG $\geq$ 1:6400 and the second had an IgM $\geq$ 1:1600 and IgG $\geq$ 1:6400.

Autopsy Findings and RT- PCR Evaluation: No autopsy was performed on Case #1. Autopsy on Case #2 revealed severe pulmonary edema consistent with ARDS and cerebral edema. Both pulmonary and renal tissues obtained at autopsy did not reveal hantavirus RNA upon RT-PCR.

Environmental Health Investigation

Case #1: On August 3, 2006 staff of the CDHS Vector-borne Disease Section (VBDS) initiated a site inspection and rodent surveillance at Robinson Creek Campground in Mono County. The first stop was the Bridgeport District Ranger Station on August 3. VBDS staff consulted with the District Ranger and campground hosts and informed them of the purpose of the visit. Several campground visitors expressed concern to VBDS staff about rodents that they had observed entering their campers or recreational vehicles. VBDS staff observed fresh mouse droppings under the sofa-bed of one guest's vehicle. VBDS staff offered safety tips on avoiding exposure to SNV to many campers.

Ninety folding traps were set at several campsites and inside buildings. A total of 81 rodents were collected. Serum specimens for SNV serologic testing were collected from 41 deer mice (*P. maniculatus*) and 2 mountain voles (*Microtus montanus*). Seven of the deer mice were trapped within the two campsites the case-patient occupied. Serum antibodies to SNV were detected in 19 of 41 deer mice and 1 of 2 voles, including 4 of the 7 trapped from the case-patient's campsites.

Case #2: On August 14-16, 2006, staff of the LAC Vector-borne Disease Surveillance Unit (VBDSU) visited the case-patient's residence to conduct visual evaluation and rodent surveillance. No rodents were captured in 20 traps set over-night at the patient's residence. Eight rodents, including three *P. maniculatus*, were captured in 53 traps set nearby at a friend's residence. Visual inspection of the friend's mother's worksite, and a regional park where the patient reportedly frequented revealed no evidence of rodent activity. Visual evaluation of the patient's worksite demonstrated nine surrounding habitats conducive to deer mouse presence.

LAC VBDSU conducted a second round of rodent surveillance on August 21-23, 2006. Six rodents, including one *Peromyscus* sp., were collected in 40 traps set in a field near the friend's residence. Two rodents, including one *Peromyscus* sp., were captured in 10 traps set near the patient's work site. No rodents were collected in 20 and 22 traps set at the patient's residential mobile home park and school, respectively.

Serum specimens from five *Peromyscus* sp. were collected and tested at VDRL. Only one of the five collected specimens was positive for hantavirus. The positive specimen was collected in a field adjacent to the residence of the patient's friend and was also found to positive for hantavirus by RT-PCR evaluation of pulmonary tissue of the deer mouse.

DISCUSSION AND PREVENTION

In 2006, two cases of hantavirus infection were confirmed in LAC residents. Both cases had onset dates in late spring and summer which is the usual peak period for hantavirus infection. The first case, most likely acquired in hantavirus exposure in Mono County, while the second case probably acquired infection within the Antelope Valley. Previous CA hantavirus pulmonary syndrome cases have been documented to have been acquired in Mono County, CA, however, this is the first time that human hantavirus infection has ever been documented within LAC.

The first case was documented in a known endemic area for hantavirus infection in the CA- Nevada border in the Sierra-Nevada Mountain Range. We can speculate that with the first case, exposure was probably peridomestic, likely associated with live deer mice and their excreta during a camping trip at Robinson Creek campground in Mono County. The second case was most likely acquired in the Antelope Valley area of LAC. Exposure probably occurred from rodents located at the patient's friends' residence. Field surveillance data documented one of five trapped deer mice (*Peromyscus* sp) had been infected with hantavirus by both serological and PCR testing. Although only one deer mouse was trapped that was positive after an extensive investigation, it is very possible that exposure could have been 4 to 8 weeks prior to the field investigation when the infected deer mouse population was at a much higher level.

Unfortunately, both cases were fatal. There is still no established antiviral therapy that has proven effective in the treatment of HPS. Treatment remains supportive with aggressive management in the intensive care unit with ventilator support and fluid management and use of ionotropic pressers agents as needed. Therefore, prevention of hantavirus exposure is critical. The best available approach to disease control and prevention is risk reduction through environmental modification and hygiene practices that deter rodents from colonizing the home and work environment, as well as safe cleanup of rodent waste and nesting material. Rodent control in and around the home remains the primary strategy in preventing hantavirus infection by undertaking such measures as keeping food and water covered and stored in rodent-proof container and keeping pet food and trash in rodent-proof containers. Additionally, various precautions outside the dwelling include disposing of trash, placing woodpile and stack of lumber at least 100 feet from the dwelling, and removing excess brush and shrubbery close to the home. Making homes rodent-proof is also an important preventive strategy. All gaps and holes inside and out of the home ≥¼ inch should be sealed. Gaps and holes are common around windows and doors and between the foundation of the home and ground. Further guidance to workers, campers and hikers with frequent exposure to rodents can be found in a recently MMWR devoted to HPS risk reduction [6].

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TRANSESOPHAGEAL ECHOCARDIOGRAPHY, INSUFFICIENT CLEANING PRACTICES AND LAX EQUIPMENT MAINTENANCE, AND *ESCHERICHIA COLI* - A BREAKDOWN IN INFECTION CONTROL

INTRODUCTION

Escherichia coli (*E. coli*) is a rod-shaped, gram-negative bacillus normally found in the lower gastrointestinal tract and is part of the normal intestinal flora. In hospital settings, *E. coli* most commonly causes urinary tract infections. Respiratory tract infections due to *E. coli* are uncommon, though there have been several published reports that chronicle *E. coli* pneumonia in the pediatric intensive care unit (ICU) [1]. Outbreaks of respiratory tract infections with gram-negative organisms have been increasingly reported due to contamination of medical equipment including bronchoscopes which are directly inserted into the respiratory tract. Transesophageal echocardiography (TEE) is normally done by inserting the instrument into the gastrointestinal tract (the esophagus) and is used during cardiac surgery to better visualize the posterior of the heart. The gastrointestinal tract is considered "dirty" and medical equipment should receive high-level disinfection.

On May 30, 2006, Los Angeles County (LAC) Department of Public Health, Acute Communicable Disease Control (ACDC) Program received a report from the hospital infection control professional that nine cardiac surgery patients were culture positive (blood or sputum) with *E. coli* infections that occurred in early May 2006. The positive cultures occurred from 1 to 4 days after surgery. This report describes the ensuing investigational study to determine the source of the outbreak.

METHODS

Setting: The study was conducted in a 370-bed acute care hospital in LAC which specializes in cardiology and orthopedic care.

Cohort Study: This was a hospital-based cohort study of individuals who underwent valve replacement, coronary artery bypass graft (CABG), both or any other cardiac procedure in May 2006. During this period, a total of 26 cardiac procedures were performed.

Cases were defined as patients who had a cardiac procedure in May that tested positive for *E. coli* within seven days of the procedure and had either a matching pulsed-field gel electrophoresis (PFGE) pattern or matching antibiotic susceptibility pattern. Controls were defined as patients who had a cardiac surgery procedure in May and did not test positive for *E. coli*.

A standardized chart abstraction tool was developed to collect information on demographics; culture results; pre-operative, operative, and post-operative procedures; surgical staff, medications, bed location, and ICU staff during and after the operation until the first positive culture for *E. coli* (cases) or for four days after surgery (controls).

The antibiotic susceptibility profiles of the *E. coli* infections in the cases were reviewed. Susceptibility to amikacin, cefazolin, cefepime, cefotaxime, ceftazidime, imipenem, nitrofurantoin and piperacillin/tazobactam was tabulated.

Environmental: Environmental surveillance cultures of the cardio-vascular ICU (CVICU) were obtained by hospital infection control staff from May 26 to June 2, 2006 and by Public Health staff. Cultures of the TEE equipment were obtained by hospital staff and LAC Public Health Laboratory (PHL) staff.

Laboratory Investigation: Available *E. coli* isolates from cardiac surgery patients and from environmental surveillance were submitted to the LAC PHL for microbiological analysis.

The LAC PHL completed PFGE analysis on *E. coli* clinical (case and control) and environmental isolates. PFGE was performed using the standardized methods of the PulseNet USA protocol [2]. PFGE pattern

comparisons were performed visually and using BioNumerics software, version 4.0 (Applied Maths, Belgium).

Statistical Analysis: Data were analyzed using SAS, version 9.1 (Statistical Analysis Software, Cary, NC). Logistic regression was used to generate relative risks (RRs) and corresponding 95% confidence intervals (CIs) to evaluate potential risk factors. χ^2 test was used to compare groups while Fisher's exact test was used when appropriate. The mean surgery time was calculated and compared between cases and controls. A two-tailed *P* value of 0.05 or less was considered statistically significant.

Infection Control Measures/Investigation of Implicated Re-useable Medical Device: After the first site visit on May 31, 2006, ACDC issued interim recommendations including adding antibiotic coverage from gram-negative organisms for cardiac surgery patients, collecting surveillance cultures (sputum) on all intubated CVICU patients, collecting environmental cultures, and culturing the TEE equipment and removing it from use. CVICU and operating room procedures, infection control standards, and procedures for cleaning the TEE equipment were all assessed. When not in use, the TEE probe is stored in a closed case on top of the refrigerator in the cleaning room of the CV operating room (CVOR) office. The TEE equipment was visually inspected and the manufacturer was contacted regarding routine maintenance provided.

RESULTS

Cohort study: Of the nine case-patients seven had positive sputum cultures, one had a positive blood culture, and one had both a positive sputum and blood culture for *E. coli*. All the cultures occurred 1 to 4 days after surgery. All were treated with antibiotics after positive culture.

The distribution of ages and gender was similar between cases and control (Table 1). However, more controls were at home prior to surgery, had elective surgery than cases (Table 1), and did not have valve replacements. Cases also had a longer mean duration of surgery time (p=0.06) (Table 3).

Table 1. Characteristics of Post-Cardiac Surgery Patients with *Escherichia coli* Infection (Cases) versus without (Controls)

Variable	Cases (n=9)		Controls (n=17)		p-value
	n	(%)	n	(%)	
Age					
<50	-	-	1	5.9	0.1319
50-59	3	33.3	4	23.5	
60-69	2	22.2	6	35.3	
70-79	3	33.3	4	23.5	
80+	1	11.1	2	11.8	
Sex					
Male	4	44.4	13	76.5	0.1167
Female	5	55.6	4	23.5	
Prior Surgery Location					
Home	-	-	4	23.5	<0.0001
Ward	5	55.6	10	5.8	
Emergency Room	1	11.1	2	11.8	
Intensive Care Unit	2	22.2	-	-	
Other	1	11.1	1	5.9	
Procedure Type					
Valve	1	11.1	3	17.7	0.014
CABG	4	44.4	9	52.9	
Valve + CABG	2	22.2	-	-	
Other	2	22.2	5	29.4	
Status					
Urgent	2	22.2	3	17.6	<0.0001
Emergent	1	11.1	-	-	
Elective	4	44.4	12	70.6	
Other	-	-	1	5.9	
Missing	2	22.2	1	5.9	

* Values may not add up to totals due to missing values.

Table 3. Comparison of Procedure Duration for Cases and Controls

Procedure Duration	Cases	Controls	p-value
Mean (minutes)	351.4	270.8	0.055
Median	343	297	
Range	(300,455)	(75,414)	

Data for potential risk factors collected for cases and controls was analyzed to yield RRs and 95% CI (Table 2). None of the analyzed risk factors were statistically significant. Surgical staff, including surgeons, assistants, anesthesiologists, nurses, perfusionists, respiratory therapists and CVICU nurses were also analyzed, but no particular staff member emerged as a source of the infection. Pharmacy data for cases and controls was also analyzed, but did not yield a medication that may potentially be associated with the infection.

Table 2. Risk Ratios and Corresponding 95% Confidence Intervals (CI) For Potential Risk Factors for Patients with *Escherichia coli* Infection (Cases) versus without (Controls)

Risk Factor	RR	95% CI	P-value
Procedure Type			
Valve+CABG*	2.40	0.18,32.9	0.5122
CABG	1.33	0.10,17.1	0.8253
Valve	Referent	-	-
TEE			
Yes	0.47	0.08,2.6	0.3905
No	Referent	-	-
Bronchoscopy			
Yes	1.07	0.08,13.9	0.9579
No	Referent	-	-
OR Room			
14	1.80	0.29,11.2	0.3905
12	Referent	-	-
Surgery Status			
Urgent or emergent	3.00	0.42,21.3	0.2720
Elective	Referent	-	-
Vancomycin			
Yes	2.15	0.2,23.2	0.5268
No	Referent	-	-
TEE Post Surgery			
Yes	0.72	0.06,8.5	0.7956
No	Referent	-	-

* Includes "Other" category

Environmental Cultures: Twenty-three environmental cultures were collected by hospital staff, including the TEE probe, which was cultured on June 2 and again on June 8. The TEE probe tested positive for Klebsiella pneumoniae on June 2 and tested positive for *E. coli* on June 8. Four additional cultures were taken from the TEE probe, TEE gel, gel cap, and outside of the cap by PHL staff. All samples were sent to the PHL. All environmental cultures were negative for *E. coli* except for the TEE probe.

Laboratory: Thirteen clinical specimens (from *E. coli* positive CVICU patients in May and June) and one environmental specimen (TEE) were submitted to the PHL for PFGE testing. PFGE was performed using the standardized methods of the PulseNet USA protocol [2]. PFGE pattern comparisons were performed visually and using BioNumerics software, version 4.0 (Applied Maths, Belgium). Strain typing analysis revealed that three patient isolates and one infection control isolate (TEE) had an indistinguishable PFGE pattern with *Xba*I and *Bln*I enzymes. Three patient isolates were subtypes of the predominant strain type, differing by a total of one to four bands, and six isolates had band differences of $\geq$7, indicating that these six are not part of the outbreak [3].

Infection Control Review: The hospital had one TEE probe dedicated to the two cardiac surgery operating rooms. Cardiac surgery patients regularly had the TEE inserted at the beginning of a procedure and the scope remained inserted for the entire duration. The TEE probe was cleaned between each patient with disinfectant and recorded; however, incorrect recording and poor disinfection technique was observed. Visual inspection revealed cracks in the ring of the TEE (Figure 1, 2). The TEE probe was removed from patient care and returned to the manufacturer.

Figure 1.

Figure 2.

DISCUSSION

Reports of *E.coli* infections acquired in hospitals are typically described in the context of urinary tract [3] or ventilator-associated infections [4]. Respiratory tract infections due to *E. coli* are uncommon.

Here, a hospital outbreak of *E. coli* respiratory infections among post-cardiac patients due to a reusable medical device, the TEE probe, was described. After an extensive literature search, this is the only other outbreak due to the TEE equipment that could be gathered.

The TEE equipment is used to visualize the posterior aspect of the heart during cardiac surgery. Professional organizations, medical equipment manufacturers and disinfectant manufacturers all provide instructions on the cleaning and disinfection of these items. Reprocessing of flexible endoscopes is standard practice in many health care settings, and the appropriate cleaning, disinfection, storage and maintenance of these devices can be a lengthy and complicated process. Frequently, endoscopes have been linked to nosocomial outbreaks [5-7].

It is the responsibility of the facility to ensure that reusable medical devices are properly cleaned and disinfected prior to each patient use. In addition, staff must be trained (and retrained) in the proper use, cleaning, storage and maintenance of the device. Staff knowledge is crucial to the infection control bottom line, and annual competency should be documented.

It is critical that reusable medical devices are properly cleaned prior to disinfection. Rutala and Weber reference the Spaulding classification for reusable medical items as critical, semi-critical and non-critical on the basis of the degree of risk of infection [8]. The TEE equipment is considered a semi-critical item since it is in contact with mucous membranes, and high level disinfection using chemical disinfectants is the minimum requirement. Prior to disinfection, the item should be rinsed with sterile water, filtered water, or tap water, followed by an alcohol rinse. The item should be thoroughly dried prior to storage.

The hospital has a policy and procedure "Cleaning TEE Transducer" outlining the appropriate cleaning principles such as "…the transducer must be cleaned and inspected before and after each transesophageal echocardiography examination…should be inspected for perforations or tears in the outer casing…".

The TEE equipment consists of a transducer probe and a motor housing with articulation knobs followed by a cable ending at the connector. The probe is covered by a hard, black, smooth plastic with depth markings. The CVOR transducer showed visible fraying and deterioration in the area surrounding the outer aspect of the transducer probe neck, and fraying with a white string protruding from the inner aspect.

ACDC was initially told that the TEE is inspected quarterly on-site by the manufacturers' representative. However, the hospital was unable to provide documentation of the manufacturers' quarterly maintenance.

The Centers for Disease Control and Prevention (CDC) Guidelines for Environmental Infection Control in Health Care Facilities Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC) 2003 advises that "manufacturers should provide care and maintenance instructions specific to their equipment" [9].

After reviewing the literature, other than 1 report of 2 cases of *Legionella* after TEE, no other report of respiratory, or other infections, associated with TEE was found. Nosocomial infections in ICUs are almost always associated with the use of an invasive device [1]. Richards et al. found that infections at three major sites represented 68% of all reported infection (primary bloodstream, 28%; pneumonia, 21%; and UTIs, 15%); 84% of all episodes of nosocomial pneumonia were related to mechanical ventilation [1]. In another study, device-related sources were responsible for 43% of all hospital-acquired bacteremia [10].

In the analysis of the data, no one particular factor emerged as a probable risk factor. This was surprising, since after obtaining the PFGE results, which implicated the TEE probe as the point source, it was expected to be confirmed by the statistical analysis. A possible explanation may be that the results of the analysis depend solely on the quality of the data. Because of the busy nature of the OR and the many surgical procedures, procedures such as TEE may not be documented and recorded in patient medical charts. As a result, upon chart review, data may be inaccurate and may thus reflect in the final analysis. Since PFGE is the gold standard method and has high reproducibility and discriminatory power [11], the interpretation relied on the PFGE results, which were used for the typing of *E. coli* isolates.

The TEE probe was implicated as the cause of this outbreak due to multiple reasons, including the matching PFGE isolates from the TEE and the cardiac patients exposed to the TEE, the epidemiology of *E. coli* infection in the cardiac patients, the cracked surface of the TEE which would have allowed safe harbor for bacteria even during disinfection, and the correlation between exposure duration to TEE and the increased likelihood of *E.coli* infection.

Interestingly, though post-cardiac surgery patients began developing *E. coli* infections in the beginning of the year at this facility, the PFGE only showed that half of the patients with the same antibiotic resistance profile had the same PFGE. Additionally, two patients had one strain that matched exactly the outbreak strain and another isolate that differed by two bands. This may be attributed to multiple strains of *E. coli* that survived on the TEE; however, there were only one culture because the TEE was removed from use and cleaned by the time it was cultured.

Other notable findings include the rapidity of the *E. coli* growth; many patients were positive within a day of surgery. However, it is still not clear how the bacteria migrated from the esophagus or oropharynx to the trachea/bronchi given that the patients were intubated during the time that the TEE was in the patient and for those who remained intubated, there should have been a sufficient seal with the TEE to block the spread of oropharyngeal flora to the lungs. For those who were extubated, it is possible that their oropharynx was so contaminated by the bacteria with the TEE passing through their mouth that it was able to gain access to their lungs.

This study has several limitations. As previously mentioned, the quality of a study depends on the accuracy of its data. Selective survival bias may also exist in this study. The longer surgery time might be a function of the emergent nature of the surgeries for the case patients, who might have been more likely to have surgery after ICU stay, resulting in an increased susceptibility to *E. coli* infection.

This study highlights the importance of a close relationship between hospitals and their local health departments. ACDC was notified of the outbreak by an astute hospital infection control practitioner. Due to complete cooperation and frequent communication, the point source of the outbreak was quickly identified and suggested control measures were implemented, thereby preventing additional infections. This study also demonstrates the necessity for hospitals to maintain better surveillance, especially in this case where *E. coli* infections are unusual in cardiac surgery patients. It is also necessary for hospitals to review infection control policies and procedures for “semi-critical” equipment, since such equipment has been linked to outbreaks of extended-spectrum beta-lactamase, hepatitis B and C [12,13]. Lastly, hospitals need to examine their equipment for deterioration per the manufacturers’ recommendations and hospital policy. In fact, once the TEE was identified as the source of the outbreak, the hospital visually inspected other scopes at the facility and found that some had evidence of erosion that had not been reported previously and were removed from patient use.

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A CASE-CONTROL STUDY ON RISK FACTORS OF SKILLED NURSING FACILITIES FOR NOROVIRUS OUTBREAKS IN LOS ANGELES COUNTY, 1999–2005

BACKGROUND

Los Angeles County (LAC) experienced an upsurge in the number of norovirus (NV) outbreaks reported in skilled nursing facilities (SNFs) from 2002 to 2004 [1]. Noroviruses (also called caliciviruses and Norwalk-like viruses) are small, round, relatively hardy single-stranded RNA viruses that are estimated to cause 23 million cases of acute gastroenteritis and 50% of all foodborne outbreaks in the United States each year [2,3]. Although humans are its only reservoir, NV is highly contagious with an estimated infectious dose of 10 to 100 viral particles [2-4]. Outbreaks thus tend to occur in institutions and in crowded settings that facilitate person-to-person or fecal-oral transmission, such as in schools, restaurants, and nursing homes [1].

The steadily aging population, and a marked rise in the popularity of alternative living arrangements such as assisted living and continuing care retirement facilities among the healthy elderly in the past 10 to 15 years, suggest that the resident populations of nursing homes are comprised of older and sicker individuals than ever before [5,6]. Although the distinction is not always made, SNFs differ from traditional nursing homes in that SNF residents in general endure more severe health complications that necessitate more intense medical care and equipment. Although NV is not typically fatal, the symptoms—vomiting, diarrhea, stomach cramps, fever, and nausea—for as long as 24 to 60 hours may cause serious health complications for those within the already medically compromised SNF resident population [3].

While there is little to no documentation in the literature on predictors of NV in institutionalized settings, one study of respiratory and gastrointestinal (GI) illness outbreaks in New York State SNFs has suggested that facility size, staffing patterns, and employee sick leave policies are important predictors for NV outbreaks [7]. This study aims to examine these NV outbreak-associated factors in addition to staff-resident and resident-resident interactions in order to help determine possible prevention measures which may reduce susceptibility to NV outbreaks among LAC SNFs.

METHODS

SNFs in which a GI outbreak had occurred from July 1, 1999 to June 30, 2005 were identified by using the Visual Confidential Morbidity Report (VCMR) database of the Los Angeles County (LAC) Department of Public Health (DPH). Data from 1999 were used because this was when the Public Health Laboratory (PHL) initiated the usage of reverse transcriptase polymerase chain reaction (RT-PCR) techniques to test stool specimen samples for NV [3]. Missing data and data discrepancies were resolved using archived outbreak investigation paper records such as epidemiology forms completed by public health nurses (PHNs) and laboratory reports. Each SNF eligible for the study was checked against an established LAC DPH Acute Communicable Disease Control (ACDC) Program Hospital Outreach Unit database to ensure that the facility contained or was entirely a SNF.

Classification of case and control SNFs depended on outbreak definitions. A “NV confirmed” GI disease outbreak had at least one LAC PHL-confirmed stool sample positive for NV. A GI disease outbreak was “NV probable” if lab specimens were either not collected or found negative for NV, but the investigating PHN still implicated NV because of poor stool specimen quality and because the symptoms, duration, and incubation periods were consistent with NV. These criteria reflect that the viral loads in stool samples from infected individuals are not consistently detectable. SNFs with at least one confirmed or probable NV outbreak during the study period formed the case SNF population. Only SNFs that had participated in the reporting process at least once, for non-GI outbreaks, were selected as controls, reducing the possibility of including SNFs that had actually experienced but neglected to report NV outbreaks. One control SNF for each case SNF was cumulatively sampled from the pool of eligible control SNFs.

Introductory solicitation for study participation was conducted by telephone. An introduction letter comprised of a description of NV and of the study, along with a twenty-five question survey was mailed or

faxed to each SNF that had agreed to participate. The questionnaire centered on: 1) facility, 2) staff, and 3) resident characteristics, as well as 4) infection control practices. While changes in any of these SNF characteristics would not necessarily guarantee that a NV outbreak would occur, they might affect the chance that NV is brought into the SNF and also, once introduced, the chance that the virus would gain a foothold and cause an outbreak.

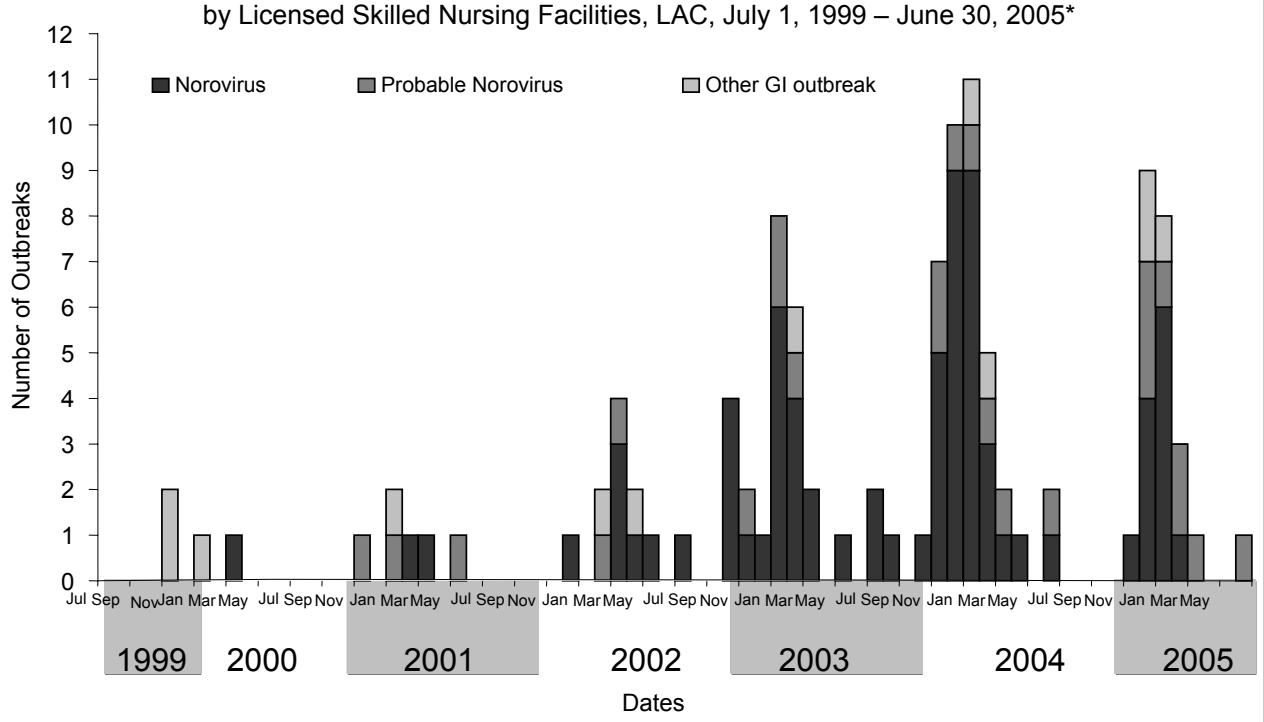
Questionnaires sent to case SNFs were pertinent to the month prior to their last reported NV outbreak, which in this study is referred to as the "surveyed month," to capture the characteristics that may have precipitated the NV outbreaks in case SNFs. The "surveyed year" refers to the time period from July 1 to June 30, between which the corresponding surveyed month falls. Each control SNF was randomly assigned a month/year of interest to which its survey would pertain, such that the month/year would correspond to the surveyed month of a case SNF.

Questionnaires were administered and collected over a six-month period. Microsoft Access was used for database management. All data analysis was conducted using SAS Version 9.1. Continuous variables with non-normal distributions were analyzed for differences between case and control SNFs using the non-parametric Mann-Whitney Rank test, and continuous proportion variables were tested by computing z-statistics for tests of proportions. A statistical model was also created, based on the hypothesis that increasing the level of staff-resident and resident-resident mixing would increase the chance of a reported NV outbreak. Odds ratios and 95% confidence intervals (95% CI) were calculated for the predictors in this model, with case or control status as the outcome of interest, using logistic regression.

RESULTS

As of August 2005, there were 417 licensed LAC SNFs in the LACDPH ACDC Hospital Outreach Unit database. Of the 113 GI disease outbreaks reported among these LAC SNFs during July 1, 1999 to June 30, 2005, 75 of these were classified as confirmed NV outbreaks, 24 as probable NV outbreaks, and 14 were attributed to other types of GI diseases (Figure 1). Ninety-nine confirmed or probable NV outbreaks occurred in 76 SNFs. Of the 76 SNFs that reported at least one confirmed or probable NV outbreak during the study period, 74% experienced onsets after July 1, 2003.

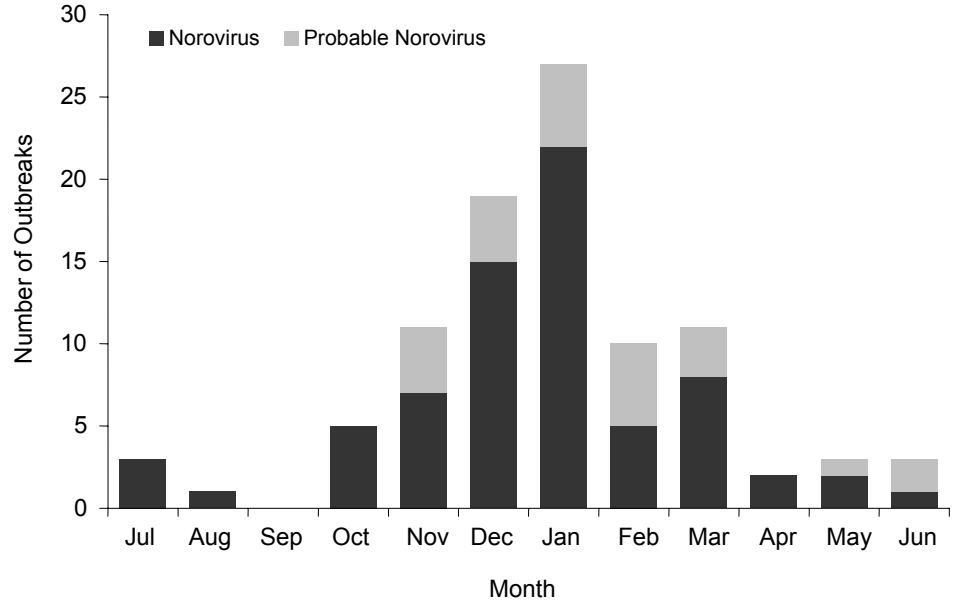
Figure 1. Viral Gastrointestinal Outbreaks Reported
by Licensed Skilled Nursing Facilities, LAC, July 1, 1999 – June 30, 2005*



*Onset dates were not available for all outbreaks – 110 of 113 viral GI outbreaks are shown (74 of 75 NV confirmed outbreaks, 24 of 24 probable NV confirmed outbreaks, and 12 of 14 other GI outbreaks). Some facilities reported multiple outbreaks.

The number of viral GI outbreaks generally increased over time, with three, five, 18, 34, and 31 reported viral outbreaks in 2000, 2001, 2002, 2003, and 2004, respectively (Figure 1). The proportion of NV confirmed or probable viral GI outbreaks reported by SNFs increased from 64% before 2002, to 92% after 2002. Outbreaks tended to occur during the winter months, from October through March with peaks in January and December (Figure 2).

Figure 2. Onset Months for Norovirus Outbreaks (N=101) Reported by Licensed Skilled Nursing Facilities, LAC, July 1, 1999 – June 30, 2005



Since five of the 76 unique SNFs meeting the case definition were no longer in operation by the time study participation was solicited, 71 SNFs formed the case population for this study, of which all agreed to participate in the study. Of 84 SNFs that met the control definition, 71 were randomly selected for recruitment into the study, of which sixty-eight (96%) agreed to participate. The response rate was higher in general for case SNFs compared to control SNFs—a total of 39 (55%) case facilities and 35 (51%) control facilities that initially agreed to participate in the study returned questionnaires. Administrators and Directors of Nursing were most commonly denoted as primary respondents. Case and control SNFs had similar distributions for the time periods (NV season or off-season, per year) of which the returned questionnaires were concerned, limiting the differential bias due to the seasonality of NV. The most commonly reported outbreak diseases of the control SNFs that returned the study questionnaire were scabies, pneumonia, and methicillin-resistant *Staphylococcus aureus* (MRSA).

Case and control SNFs were not substantially different when examining the numbers of staff by type during the surveyed months, except in that case SNFs employed a higher median of 11 food workers versus 8 in control SNFs during the month prior to the outbreak than (p=0.02). While only marginal differences were observed for other staff such as registered nurses (RNs), certified nursing assistants (CNAs), and custodial workers, case SNFs consistently employed numbers greater than (or equal to, in the case of custodial workers) those of control SNFs for each category. Staff-related facility stress indicators such as the numbers of new staff per surveyed month or year were not substantially different between case and control SNFs when examining individual indicators and were also too small to meaningfully compare (ranging from zero to three).

Case SNFs tended to have a greater number of rooms with a greater number of beds than control SNFs. Although the median numbers of residents reported during the surveyed months were the same for case

and control SNFs (94), case SNFs reported a 1% greater median percentage of beds filled than did control SNFs (93% versus 92%), an indication that the number of residents with respect to SNF capacity, as opposed to the absolute number of residents, may better indicate the effects of crowding in the chance for a NV outbreak.

Case SNFs in general also reported greater resident-to-resident and resident-to-staff interaction opportunities than control SNFs. For instance, case SNFs reported a greater percentage than control SNFs of residents who utilized day rooms (63% versus 50%), wore diapers (75% versus 66%), and were handfed by staff (23% versus 22%). Case SNFs also reported a smaller percentage of residents who ate meals in their own rooms, versus eating in dining halls with other residents (17% versus 23%). As with the staff-related facility stress indicators, resident-related facility stress indicators such as the mean number of residents, new residents, or residents per nurse during the surveyed months compared to the surveyed years were not different for case and control SNFs.

In terms of infection control practices, case SNFs and control SNFs were similar in that custodial workers and CNAs cleaned diarrhea and vomitus more often than RNs in both case and control SNFs. NV education for staff was also similar between case and control SNFs. However, while almost all SNFs reported using gloves, more case SNFs than control SNFs reported not using masks (56% versus 42%), eye protection (82% versus 73%), aprons (62% versus 42%), and bleach or approved cleansers (51% versus 38%) to clean diarrhea and vomitus.

Table 1. Comparison of Infection Control Polices for Case and Control Skilled Nursing Facilities (SNFs) During the Month Prior to a Norovirus Outbreak, Los Angeles County, July 1, 1999 – June 30, 2005.

	No. SNFs (Baseline risk)**			Response rate*	
Characteristic	**Cases**	**Controls**	***p*†**	**Cases**	**Controls**
SNFs that lacked the following specific AGI (acute gastrointestinal illness) policies:					
Staff sent home if ill on job	8 (20.5)	8 (24.2)	0.78	39 (100)	33 (94)
Staff required to stay home if ill	9 (23.1)	9 (27.3)	0.79	39 (100)	33 (94)
Resident care (RNs, CNAs, other healthcare) staff assigned to AGI residents	26 (66.7)	21 (63.6)	0.81	39 (100)	33 (94)
Housekeeping staff assigned to AGI resident rooms	25 (64.1)	22 (68.8)	0.80	39 (100)	32 (91)
Unnecessary staff restricted from contact w/ AGI residents	14 (35.9)	19 (57.6)	0.10	39 (100)	33 (94)
AGI residents isolated	15 (38.5)	17 (48.6)	0.48	39 (100)	35 (100)
Movement of AGI residents restricted	8 (20.5)	11 (32.4)	0.29	39 (100)	34 (97)
Toilets of AGI residents sanitized	8 (20.5)	11 (32.4)	0.29	39 (100)	34 (97)
Carpets sanitized after soiled	20 (51.3)	19 (55.9)	0.81	39 (100)	34 (97)
Staff handwashing emphasized	6 (15.4)	9 (27.3)	0.25	39 (100)	33 (94)
Resident handwashing emphasized	3 (7.7)	5 (14.3)	0.46	39 (100)	35 (100)
Visitor handwashing emphasized	6 (15.4)	5 (14.7)	1.00	39 (100)	34 (97)

* Percentage that completed question of 39 case SNFs and 35 control SNFs that returned surveys
** Baseline risk is calculated as percentage of SNFs with characteristic; this calculation was affected when SNFs did not answer the pertinent question
† *p*-value reflects test of distribution similarity at α=0.05

More control SNFs than case SNFs reported that sick pay was unavailable for RNs (26.5% versus 16.7%), CNAs (23.5% versus 16.2%), custodial workers (29.4% versus 18.9%), and food workers (29.4% versus 19.4%) during the surveyed months. Some responses to infection control practice questions, however, were opposite of what was expected. For instance, although having staff handwashing policies

should reduce the number of illnesses brought into and transmitted within SNFs, more control SNFs than case SNFs reported lacking such policies during the surveyed month (Table 1). Except for policies requiring healthcare staff assignment to residents with acute gastrointestinal illness (AGI) and visitor handwashing, more control SNFs than case SNFs reported lacking policies meant to limit AGI.

Table 2. Bivariable (crude) and logistic regression (main effects) odd ratios of staff-resident and resident-resident interaction predictors for having a Norovirus outbreak among skilled nursing facilities (N=74), Los Angeles County, July 1, 1999 – June 30, 2005.

Predictors	Crude OR (95% CI)	Main effects OR (95% CI)*
Average daily resident census during year	1.021 (0.972-1.073)	0.910 (0.806-1.027)
No. residents using diapers during month	1.049 (0.989-1.113)	1.061 (0.939-1.199)
No. residents handfed by staff during month	1.081 (0.982-1.190)	1.034 (0.898-1.190)
No. residents bathed themselves during month	0.953 (0.842-1.079)	0.946 (0.820-1.091)
No. residents using day rooms during month	1.065 (0.995-1.140)	1.105 (1.003-1.217)
No. residents taking meals in own rooms during month	1.023 (0.951-1.100)	1.011 (0.908-1.126)
No. residents visited other residents during month	1.006 (0.906-1.117)	1.003 (0.865-1.189)

* ORs obtained using logistic regression, rescaled to reflect 5-unit changes

** For case SNFs, "month" refers to month prior to last reported NV outbreak. For control SNFs, "month" values were assigned to correspond to those of the case SNFs. "Year" refers to July 1-June 30, between which the "month" in question falls.

Table 2 gives the results of the logistic regression model, which demonstrates that increasing staff-resident interactions (having more residents requiring diapers and more residents requiring handfeeding by staff) could increase the risk of a NV outbreak in the following month. According to the model, if all other predictors were held constant, adding five more residents who use diapers into a SNF would increase that SNF's odds of reporting a NV outbreak by 6% in the next month. Conversely, increasing independence of residents from staff was also shown to have a protective effect: if the other model predictors were held constant, increasing the number of residents who bathed themselves by five would result in a five percent decrease in the odds of reporting a NV outbreak in the next month. The model thus demonstrates that increasing resident-resident interactions was associated with an increased risk of reporting NV outbreaks as well. Similarly, if all other predictors were held constant, increasing the number of residents who used day rooms and visited other residents by five would result in an 11% and 0.3% increase in the odds of reporting at least one confirmed or probable NV outbreak in the following month. Increasing the number of residents taking meals in their own rooms had a negligible effect. This may be because while residents who take meals in their rooms may interact with fewer residents, they may have greater interactions with staff. As expected, the model also demonstrates that increasing the number of residents who bathe themselves reduces the odds of reporting a NV outbreak.

DISCUSSION

The results of this study indicate that case SNFs might have had greater potential for NV outbreaks because they tended to have more residents per room than control SNFs. A greater median number of food service workers employed in case SNFs during the month prior to the outbreak (p=0.02) suggests that food service workers may act as a point of entry or transmission for NV into SNFs. To reduce this possibility, SNFs might establish or reinforce NV education and prevention practices among food workers, including those of outside companies contracted for food preparation and custodial services.

Although the availability of sick pay was associated with a reduction in the incidence of disease outbreaks, policies meant to limit AGI were comparable or counter intuitively present more frequently in case SNFs than control SNFs. The distributions of staff NV education were similar between case and control SNFs as well. While the effectiveness and frequency of the education might have differed between the two groups, this study suggests that policy establishment and norovirus education alone are not sufficient for effective infection control. Particularly in regards to using bleach and approved cleaners,

the results of this study indicate that infection control practice is at least as important as having infection control policies to prevent NV. Control SNFs reported using additional protective equipment while cleaning diarrhea and vomitus more frequently than did case SNFs. In addition to wearing gloves while cleaning diarrhea and vomitus, using other types of protection may be substantially important for preventing NV outbreaks. Therefore, while employing a greater number of workers in direct contact with residents (namely RNs and CNAs) might increase the risk of NV transmission within SNFs, employing more workers may be beneficial if good infection control is practiced. In addition to establishing and implementing sick pay policies, AGI control policies [8], and NV education programs, the results of this study suggest several methods of prevention:

- Education and infection control training should occur in September in anticipation of the rise in outbreak incidence beginning in October. SNFs should train or retrain staff periodically to ensure knowledge and practice of effective infection control; reinforcement of infection control practices should follow in November and December to offset NV outbreak peaks in December and January.
- SNFs with many three-bed rooms should reinforce infection control practice, particularly just before and during the October to March NV season.
- Education on NV should include food workers and custodians, especially those of contracted outside companies as many SNFs use contractors for food service and facility maintenance.
- SNFs should provide adequate personal protective equipment such as gloves, masks, eye protection, and aprons as well as proper training in the use of this equipment. In addition, the training should reinforce the use of bleach and approved cleansers when cleaning up diarrhea and vomit from residents with AGI.
- Common rooms such as day rooms in SNFs need to be monitored and well-cleaned especially after incidents of vomiting and diarrhea.
- Practice of good hygiene by staff should be reinforced during staff-resident interactions such as diapering, bathing, and feeding to prevent NV from spreading to other residents.

In the planning of this study a sample size calculation using EpiInfo software indicated that, with 45 case SNFs and 45 control SNFs, if 67% of case SNFs had a risk factor for reporting a NV outbreak, only odds ratios of at least 4.0 would achieve statistical significance at the 95% confidence level. With at most 39 case and 35 control SNFs, statistical significance was not stressed in the presentation of the results of this study, as much was the comparison of numbers, medians, and percentages between case and control SNFs. While the selection criterion for control SNFs greatly reduced the pool of potential control SNFs, those selected into the study seemed representative of the case SNFs in terms of response rates and median numbers of beds. Although survey questions referred to specific periods of time in order to prevent collecting responses concerning the state of the SNFs after rather than before outbreaks, some SNFs acknowledged utilizing more recent data or guessing answers when record retrieval was difficult or impossible. The resulting temporal bias is most evident in the attenuated and even reversed-from-expected responses to questions related to AGI policies.

A prospective study on SNFs would provide better measurements of possible risk factors and predictors of NV outbreaks by limiting temporal and recall bias. Furthermore, predictors of outbreaks can be measured over time so that changes or trends in these factors might be analyzed as effects rather than studying the immediate predictor status before the outbreak. More importantly, time between the predictor and the onset of the outbreak can be measured or estimated more accurately. In this retrospective study, while the exposure-predictor questions referred to a month prior to the outbreak date, respondents might have provided answers referring to one day to thirty days prior, or even well before or after the reference date. Since prospective studies are generally resource intensive, such a study would ideally have multiple outcomes such as diseases common to SNFs. Nevertheless, further studies, retrospective or prospective, can improve prevention efforts, such as infection control practices and staff education, to reduce the number of outbreaks experienced by the SNF resident population.

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SALMONELLA HIDUDDIFY GASTROENTERITIS IN A NEWBORN NURSERY

BACKGROUND

There are over 2400 known serotypes of *Salmonella* [1] *Salmonella Hiduddify*, also known as *Salmonella I 6, 8:1z28:1, 5*, is an uncommon serotype in the United States. The PulseNet national data base does not contain any patterns for this serotype, other than those recently submitted by Los Angeles County (LAC). No PulseNet patterns were even a close match. This serotype was last identified in LAC twenty years ago in an infant case. One study reported finding this serotype in dogs in Nigeria and suggested these animals as a source for transmission of salmonellosis to humans and domestic animals [2].

On October 24, 2006, LAC Department of Public Health (DPH) Acute Communicable Disease Control (ACDC) Program was notified by the infection control professional (ICP) of two infant cases diagnosed with salmonellosis who were both cared for in the Level II nursery in an acute care hospital (Hospital A). On the same day ACDC initiated an investigation and worked together with the ICP to determine the extent of the outbreak, risk factors for disease, and any steps needed to prevent further infections.

METHODS

The hospital ICP reviewed the medical charts and provided clinical information to ACDC. District public health nurses (DPHNs) visited the cases and their families in the home and gathered data related to possible exposures and risk factors. Stool specimens were collected from caregivers and other family members for culture. A segment of reptile animal skin was also cultured from one case patient house. ACDC staff visited Hospital A to assess the physical layout of the nursery and gather additional information from staff. The LAC Public Health Laboratory (PHL) performed serotyping and molecular epidemiology using pulsed field gel electrophoresis (PFGE) on three isolates.

Case Definition: An outbreak-associated case was defined as an infant with culture-confirmed *Salmonella Hiduddify* (*S. Hiduddify*) infection who was cared for in the Level II nursery at Hospital A in October 2006.

RESULTS

A total of three confirmed cases of *S. Hiduddify* were identified, the two hospitalized newborns at Hospital A and a sibling of Infant #1. The two newborns met the case definition.

Infant #1: The infant was born at Hospital A by scheduled cesarean section on October 10, 2006. She was coupled in-room with her mother. The infant's father and two siblings were observed by hospital staff to visit frequently. The infant had a blood-streaked stool on October 12, 2006 and was subsequently moved to the Level II nursery and placed in contact isolation. The child was breast fed but also received premixed formula in individual-use bottles. The infant was treated and discharged home on October 20, 2006.

The home of Infant #1 was assessed and investigated by the DPHN. The father made drums in an adjoining workshop using animal skins, including reptile skins, imported from Africa. The skins were soaked and then stretched to construct the drums.

Stool cultures of the parents and siblings of Infant #1 detected the infant's one year-old sibling as positive for *S. Hiduddify*; the sibling had not been symptomatic. The infant's mother was positive for *S. I 9,12:a:__* (incomplete serotype); she reported having had symptoms of diarrhea and fever for two days in August 2006. The infant's father and a seven year-old sibling were negative on stool culture and asymptomatic. DPHNs educated the family regarding salmonellosis, stressing transmission prevention with emphasis on hygiene and possibility of contaminated clothing related to the handling of reptile skins in the home. A small sample of cleaned and dried skin, identified by the father as iguana skin, was provided by the father. The type of processing done on the skin before collection was unknown. This skin was cultured in the PHL for *Salmonella*; the result was negative.

Infant #2: The infant was born normal spontaneous vaginal delivery (NSVD) at Hospital B on October 14, 2006 and transferred to Hospital A on the same day due to respiratory problems. After spending three days in the neonatal intensive care unit (ICU), the infant was moved to the Level II nursery on October 17, 2006. She was breast fed but also had formula in 4 oz. bottles. This infant was discharged to home on October 19, 2006 but returned with fever and diarrhea the next day to the Hospital A emergency room.

The home of Infant #2 was also assessed and investigated by the DPHN. No other family members had been ill. There had been no travel or exposure to reptiles. Stool culture results for the infant's mother and father were negative. DPHNs educated the family regarding salmonellosis, stressing transmission prevention.

The two infants were together in the same nursery between October 17 and October 19, 2006. The ICP provided information on Level II nursery staffing. One medical team—four interns and one resident—cared for both babies during that time period. Five nurses cared for the infants; two nurses floated from the labor and delivery unit and one from the pediatric ICU.

No other infants were symptomatic in the Level II nursery. No hospital staff was symptomatic. The hospital infection control committee chair decided to test all infants who were in the Level II nursery between October 17 and October 19, 2006 and associated staff for *Salmonella*. Six infants and twenty-nine hospital staff members were tested; all results were negative. Not all staff members were tested due to intern rotations.

ACDC conducted a site visit on October 27, 2006 to review the layout of the Level II nursery. The actual room was being remodeled and was not in use at the time of the visit. Originally the room was set up in a horseshoe formation, with basinets being evenly spaced around a central room. Two or three nurses would be assigned to care for up to four infants. Two reclining sleeper chairs were placed in one section, away from the basinets; an electric breast pump was situated between the chairs. Parents were encouraged to stay with their infants and mothers to use the reclining chairs while holding and nursing their infants. When parents visit, they must wash hands for three minutes; they do not gown. Each mother has her own breast pump kit. The reclining chairs were not routinely cleaned after each use. Contact isolation does not require a one-to-one nursing ratio. Only premixed, portioned, ready-to-use formula is used at Hospital A. Per hospital staff, the families of the two infants were not observed to commingle. Both mothers did use the reclining chairs.

Three isolates were available for PFGE, including the isolates from the two cases, plus the isolate from the one year-old sibling of Infant #1. PFGE patterns for the three isolates were similar if not indistinguishable to each other using both Xba 1 and Bln 1 enzymes. PFGE differentiation could not be assessed because there were no patterns for comparison in the PulseNet national data base.

CONCLUSIONS

An outbreak of salmonellosis associated with Hospital A Level II nursery occurred during October 2006. This outbreak was identified by the hospital ICP.

S. Hiduddify is rare in California, but it is seen in Africa [2]; the origin of the animal skins used by the father of Infant #1 was West Africa. The negative culture of the skin sample did not rule out the possibility of other skins being the source of the infection. Based on the onset date and other available information, Infant #1 was infected during a family visit to the nursery and not at the time of birth. The father and siblings were asymptomatic, and only the one year-old sibling was positive for *S. Hiduddify*. It is possible that the one year-old infected Infant #1, while being held in the same bed or parent's lap or during manipulation of her diaper. Another possibility is that the father or mother was shedding the bacteria at the time of their visits. Although the mother had a different serotype she may have been carrying two serotypes of S*almonella*. She may have infected the infant during care or feeding and then cleared this serotype by the time public health screening was conducted.

Infant #1 was the likely source for Infant #2 with transmission occurring during care or via an item shared by the infants or the mothers. Outbreaks with transmission via contaminated equipment have been documented [3]. Person-to-person transmission via hospital staff and parents has also been documented [4] [5]. The parents may have had a role in transmission; however, they were not observed to commingle. Although infant formula has been the source of large *Salmonella* outbreaks in the past [6], it is unlikely that formula was the source of this outbreak based on the small number of cases and the type of formula used at this hospital.

ACDC provided Hospital A with recommendations to improve infection control practices among mothers and visiting families, as well as environmental cleaning of shared equipment and furniture.

LIMITATIONS

Limitations for this investigation include small number of cases, lack of information on PFGE differentiation, and incomplete histories on the culture-positive family members.

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AN OUTBREAK OF *ELIZABETHKINGIA MENINGOSEPTICA* ASSOCIATED WITH COLISTIN USE IN A RESPIRATORY HOSPITAL, LOS ANGELES COUNTY 2006

INTRODUCTION

Elizabethkingia meningoseptica is Gram-negative rod rarely found in the human microflora [1] but is ubiquitous in freshwater, saltwater, and soil [1,2]. It has most often been cited as a nosocomial infection among neonates [3-6]. Transmission is usually waterborne, often involves a medical device that has been contaminated or not adequately sterilized [7-12], and has been associated with infection in intensive care units [10-13]. Of particular concern, *E. meningoseptica* has demonstrated multi-drug resistance in previous studies [1,6,9,14-16].

On March 27, 2006, the Acute Communicable Disease Control (ACDC) Program of the Los Angeles County (LAC) Department of Public Health (DPH) was informed of an outbreak in a 69-bed respiratory acute-care hospital involving eight patients with positive cultures of *E. meningoseptica* since January 2006. The patient population was mostly ventilator-dependent and admitted for respiratory failure. Hospital infection control observed that eight of ten patients who received colistin were culture positive for *E. meningoseptica*.

METHODS

ACDC and the respiratory hospital collaborated to establish surveillance, collect data, and implement control measures. Hospital laboratory data since January 2005 was collected, and a standardized questionnaire was developed to review patient charts and medication lists. Active surveillance started in April 2006. Throughout surveillance, hospital infection control monitored hand hygiene and infection control practices among hospital staff. In addition, patient and staff cohorting, contact isolation precautions, terminal cleaning, hand hygiene education, and review of various procedures such as sterilization, routine cleaning, and pharmacy compounding were implemented. During the outbreak period, investigators conducted multiple unannounced site visits to the facility to assess compliance with these interventions.

To determine if the outbreak extended beyond the respiratory hospital, the Centers for Disease Control and Prevention (CDC) and California Department of Health Services (CDHS) were contacted. Through the Health Alert Network of LAC DPH an inquiry to all acute-care hospitals in LAC was issued to survey increases in *E. meningoseptica* between January 2005 and March 2006.

A case-control study was performed to determine the causes of the nosocomial outbreak. A case was defined as a patient within the respiratory hospital who had a positive culture of *E. meningoseptica* identified by the hospital laboratory and had no positive cultures of *E. meningoseptica* in the previous two months of hospital stay. The presence of new symptoms such as fever and increased white blood cell count distinguished infection from colonization. Comparing intensive care unit (ICU) admission, medical procedures, prior medications, co-infections, recent pathogens, and antibiotic resistance, an unmatched analysis using Mantel-Haenzel statistical calculations was performed to calculate odd ratios and 95% confidence intervals (95% CI). Fischer's exact tests were used to calculate 95% confidence intervals when numbers were less than six. Wilcoxon rank sum tests were performed to determine statistical differences between medians. SAS version 9.1 was used to perform statistical analyses, including multivariable logistic regression.

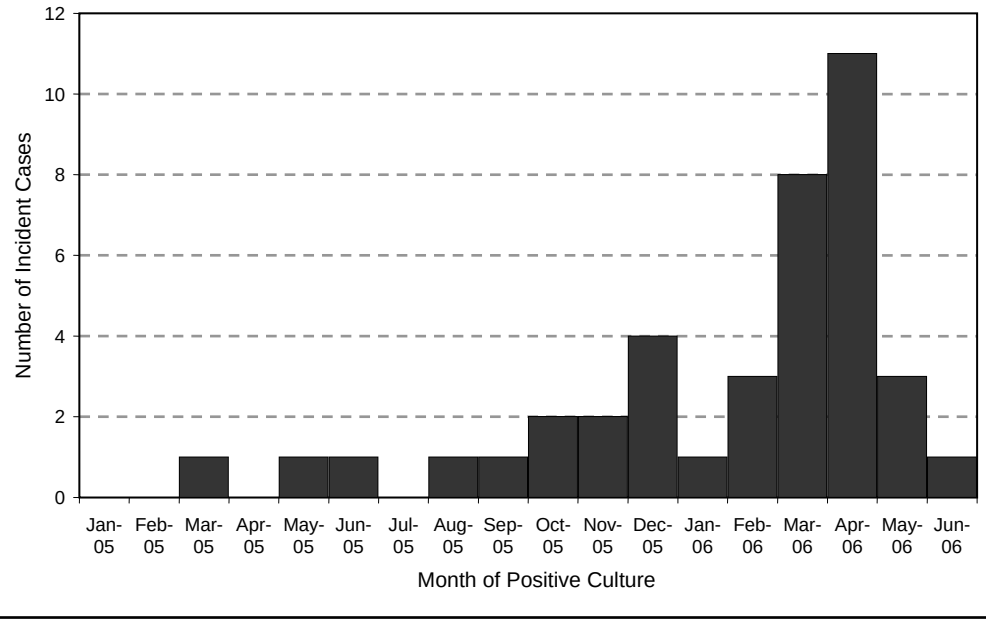
In addition, the LAC Public Health Laboratory (PHL) tested one isolate of *E. meningoseptica* for susceptibility to colistin, and from the respiratory hospital pharmacy, tested a sample of dry powder colistin, a pre-mixed colistin 3-cc syringe, a sterile 3-cc Safety Lok syringe, and a sample of the sterile water used for injections.

The Environmental Health Program (EH) of LAC DPH, Los Angeles Department of Water and Power (LA DWP), and ACDC collected multiple environmental samples to investigate possible sources of *E. meningoseptica*.

RESULTS

A total of 40 incident cases were identified by the hospital laboratory between January 2005 and June 2006 (Figure 1). One infected patient-case in December 2005 cleared infection in January but became colonized in April 2006. Thirty-five (87.5%) cases had positive sputum cultures, four (10.0%) cases had positive blood cultures, and one (2.5%) case had positive cultures from sputum and blood specimens. While small increases in incidence occurred in the winter of 2005, the occurrence of eight cases in March 2006 triggered notification of Public Health about the outbreak. With two deaths attributed to *E. meningoseptica*, case fatality was 7.1%. During unannounced site visits investigators observed respiratory therapy staff to be noncompliant with hand washing practices on multiple occasions. In addition, general infection control practices were inconsistent particularly with regard to contact precautions. Investigators noted that the use of gowns and gloves by hospital staff increased with awareness that they were being observed.

Figure 1. Number of Incident Cases (N=40) by Month of Positive Culture in an Outbreak of *Elizabethkingia meningoseptica* in Respiratory Hospital, LAC, 2005-2006



CDC and CDHS confirmed that there were no concurrent outbreaks anywhere else with this organism, and survey results from 22 (21.4%) of 104 hospitals in LAC showed no evidence that the outbreak extended beyond the index hospital. Of the 22 responding hospitals, none observed any atypical increases of *E. meningoseptica* among their patients since January 2006 and 19 hospitals provided the number of patients with *E. meningoseptica* by the month of positive culture since January 2005. The total number of *E. meningoseptica* positive patients from the 19 hospitals was 24.

Outbreak investigators collected information on all patient-cases occurring in 2006, including both incidences of the patient-case who was infected in December 2005 but then colonized in April 2006. Among 27 patients there were 28 incident cases and 23 controls. Sixteen (69.6%) controls eventually became cases. Of the 28 cases, 19 (67.9%) were determined to be infected and nine (32.1%) colonized. Cases and controls were similar in age, gender, and factors for immunosuppression (Table 1).

Table 1. Characteristics of Cases (n=28) and Controls* (n=23), *Elizabethkingia meningoseptica* Outbreak in a Respiratory Hospital, LAC, Dec. 2005 – Jun. 2006

Characteristic	Cases (n=28)	Controls* (n=23)
Median** years of age at admission (range)	76 (48 - 89)	76 (62 - 89)
Females to males (ratio)	19 : 9 (2.1 : 1)	16 : 7 (2.3 : 1)
Diabetes (%)	16 (57.1%)	15 (65.2%)
Cancer (%)	10 (35.7%)	7 (30.4%)
Steroid medication (%)	5 (17.9%)	3 (13.0%)
Chemotherapy (%)	2 (7.1%)	1 (4.3%)

* 16 (69.6%) of 23 controls became cases.
** Wilcoxon rank sum score t approximation p-value=0.65.

Possible risk factors for colonization or infection by *E. meningoseptica* were analyzed in an unmatched case-control study (Table 2). Among the medical procedures that were possible sources of *E. meningoseptica*, only colistin, tracheotomy, and ICU admission had strong statistically significant associations with becoming a case. Patients receiving inhaled or injected colistin had 22.2 times greater odds of becoming a case (95% CI of 4.3 - 115.8). Tracheotomy patients had 11.8 times greater odds of becoming a case (95% CI of 1.3 - 551.5), and patients admitted to the ICU had 3.8 times greater odds of becoming a case (95% CI of 1.1 - 12.5).

Table 2. Possible Risk Factors for Colonization or Infection by *E. meningoseptica* (EM) Among 28 Cases and 23 Controls, EM Outbreak in a Respiratory Hospital, LAC, Dec. 2005 – Jun. 2006

	Number (%)		
Possible risk factors	Case, N=28	Controls, N=23	Odds ratio (95% CI)
Mechanical ventilator	27 (96.4)	18 (78.3)	7.5 (0.7 - 367.5)
Nebulizer	28 (100.0)	20 (87.0)	Undefined
Bronchoscope	7 (25.0)	4 (17.4)	1.6 (0.3 - 8.5)
Central line	17 (60.7)	9 (39.1)	2.4 (0.8 - 7.4)
Central vein catheter	10 (35.7)	6 (26.1)	1.6 (0.5 - 5.3)
Arterial catheter	0 (0.0)	0 (0.0)	Not applicable
Bladder catheter	3 (10.7)	1 (4.4)	2.6 (0.2 - 144.8)
Other catheter	6 (21.4)	3 (13.0)	1.8 (0.3 - 12.6)
Dialysis	5 (17.9)	2 (8.7)	2.3 (0.3 - 26.0)
Foley	26 (92.9)	20 (87.0)	2.0 (0.2 - 25.1)
Parenteral nutrition	3 (10.7)	0 (0.0)	Undefined
Gastrointestinal tube	21 (75.0)	14 (60.9)	1.9 (0.6 - 6.4)
Nasogastric tube	12 (42.9)	6 (26.1)	2.1 (0.6 - 7.0)
Tracheotomy	27 (96.4)	16 (69.6)	11.8 (1.3 - 551.5)
Tracheotomy care	27 (96.4)	19 (82.6)	5.7 (0.6 - 54.9)
Enteroscopy	9 (32.1)	5 (21.7)	1.7 (0.5 - 6.1)
Other respiratory procedures	6 (21.4)	1 (4.4)	6.0 (0.6 - 288.3)
ICU admission	16 (57.1)	6 (26.1)	3.8 (1.1 - 12.5)
Colisitin	19 (67.9)	2 (8.7)	22.2 (4.2 - 115.8)

All 47 environmental samples (30 surface samples, 17 water samples) and all colistin samples were negative for *E. meningoseptica*.

DISCUSSION

Increasing multi-drug resistance in Gram-negative bacteria, increasing prevalence of these bacteria, and the decline in the discovery of new antibiotics have led researchers to look at older drugs for effective treatment [17]. Polymyxins, particularly colistin, have been cited as the only available active antibiotics for multidrug-resistant Gram-negative bacteria such as *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, and *Klebsiella pneumoniae* [18-21]. Despite concerns of adverse effects of nephrotoxicity and neurotoxicity, use of colistin has increased and found success in the treatment of multidrug-resistant Gram-negative bacterial infections [22-24].

The finding that colistin had the strongest statistical association with *E. meningoseptica* in this outbreak was interesting. Because *E. meningoseptica* was not cultured from the colistin or any of the environmental samples, the source of *E. meningoseptica* remained unknown.

Although different studies have found *E. meningoseptica* to have varying susceptibilities to different antibiotics, the outbreak strain of *E. meningoseptica* was resistant to most of the antibiotics tested in these studies [4,6,14-16]; the *E. meningoseptica* strain cultured during this outbreak was resistant to colistin. Hence, as *E. meningoseptica* is rarely seen among nosocomial infections, the colistin seems to have acted as a selective factor that allowed *E. meningoseptica* to emerge in the respiratory hospital. Given that *E. meningoseptica* has appeared as a human pathogen only among people with lowered or under-developed immunity, been associated with outbreaks in ICUs, and manifested most frequently as pneumonia among non-neonates, the respiratory hospital that experienced this outbreak was an ideal setting for flourishment of *E. meningoseptica*. In a 1987 study, six weeks after polymyxin B was introduced to a medical/surgical ICU, nine patients over 2.5 months tested positive with *E. meningoseptica* [14]. Similarly, the source of the outbreak was not identified but polymxyin B was suspected to have caused a selective environment for the emergence of *E. meningoseptica*.

Although the source of *E. meningoseptica* in this setting was not identified, transmission by hospital staff was the most likely cause for this outbreak. General infection control practices were inconsistent particularly with regard to hand washing and contact precautions. Between April 22 and May 9, 2006 there was a 17-day period without a positive culture. However, compliance with contact precautions declined and four more cases occurred during May and June.

Dealing with *E. meningoseptica* in a hospital requires appropriate surveillance and infection control. Although distinguishing infection from colonization can be difficult because this pathogen occurs among the immunocompromised, identification of patients with *E. meningoseptica* allows cohorting of patients and staff to help prevent transmission. Physicians should be reminded to culture symptomatic patients when bacterial infection is suspected and prescribe antibiotics judiciously especially during outbreak situations. Moreover, antibiotic susceptibility tests of isolates should include new antibiotic therapies to ensure effectiveness of treatment. Also, environmental samples should be taken during outbreak situations as *E. meningoseptica* to determine a source of transmission. Most importantly, infection control policies and procedures should be reviewed, updated if necessary, and enforced among all staff.

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AN OUTBREAK OF *PSEUDOMONAS AERUGINOSA* IN A NEONATAL INTENSIVE CARE UNIT, LOS ANGELES COUNTY, 2006

BACKGROUND

Pseudomonas aeruginosa (PA) is a gram-negative rod-shaped bacterium that is commonly found in soil and water. It is one of the leading causes of hospital-acquired pneumonia in high-risk patient populations such as in intensive care units [1]. In the hospital setting, *PA* has been found to colonize both manual and sensored non-touch faucets, although at a higher rate in the latter [2,3].

On December 4, 2006, the Los Angeles County (LAC) Department of Public Health (DPH) Acute Communicable Disease Control (ACDC) Program was notified of eight infants in a local neonatal intensive care unit (NICU) tested positive for *PA* in a four-day period, from November 28, 2006 through December 1, 2006. An epidemiologic investigation was begun and continued through February 1, 2007.

METHODS

Setting: The neonatal intensive care unit (NICU), is a state-of-the-art facility with 28 beds. The unit is divided into 4 pods with 6 beds each and an isolation area containing space for 4 additional patients. The isolation area is separated from the main NICU pods by a staff hallway. Other areas of the unit include a nursing station, family waiting area, family scrub room, and staff and family restrooms.

Case Definition: A case was defined as a patient in the NICU that had a *PA* positive blood, nasopharyngeal (NP), endotrachael (ET) or rectal specimen culture that matched the outbreak strain by pulsed-field gel electrophoresis (PFGE) from November 28, 2006 through February 1, 2007.

Case Identification: Blood and respiratory cultures were taken on clinically symptomatic patients on November 28, 2006. NP or ET and rectal surveillance cultures were completed on all NICU patients not previously cultured on December 4, 2006 and on December 5, 2006. Surveillance cultures were collected two times a week through January 2, 2007. They continued once weekly through February 28, 2007. Rectal, blood, NP or ET cultures were collected on all patients upon NICU admission starting December 6, 2006.

Environmental Cultures: Numerous environmental cultures were obtained by the hospital and ACDC from NICU high-use areas and from devices used by patients and families. These included laryngoscope blades, sinks, multi-use nebulizers, isolate humidifiers, ventilators and ventilator circuit lines, a breast pump, and an ice-machine.

In addition, select medicaments (i.e., total parenteral nutrition, lipids, insulin, dopamine, dobutamine, ampicillin, cefotaxime, hydrocortisone, dextrose and surfactant) were cultured by the hospital.

Faucet Cultures: Restrictive flow devices (RFD) (aerators and non-aerated laminar flow devices) on faucet fixtures were removed and cultured throughout the hospital. Thirty-seven RFDs from patient areas outside the NICU (n=296) and 24 RFDs within the NICU (n=24) were cultured for *PA*. NICU RFDs cultured were from the nurses station, restrooms, family scrub room, and patient pods.

Water Cultures: Three water samples were collected from two different sensored non-touch faucets in common areas of the NICU and were analyzed for *PA* by the LAC PHL.

Molecular Epidemiologic Investigation: PFGE patterns were completed on all available patient, environmental, and faucet isolates by the LAC PHL.

Infection Control Evaluation and Measures: The unit was voluntarily closed to new admissions on December 4, 2006. Infection control measures implemented included: contact precautions for cases per hospital protocol; cohorting of cases and providing dedicated staff to each cohort; obtaining disinfected

laryngoscope handles and blades from central cleaning; using single-dose medication vials/bottles when possible; re-educating NICU staff regarding infection control issues; completing terminal cleaning upon infant discharge; ensuring all staff member finger nails are short and without artificial nail applications; and using sterile water for bathing of infants.

During the temporary closure, emergency admissions were housed in the isolation suite until patient stabilization and transfer to another hospital NICU.

The unit re-opened on December 19, 2006 to new admissions.

RESULTS

Case Patient Characterization and Cultures: Isolates obtained from patient cultures taken between November 28, 2006 and December 5, 2006 showed that eight patients had matching PFGE patterns. Three of these patients died. An additional patient died who was found positive for *PA* during the outbreak period but whose isolate was unavailable for PFGE analysis.

PFGE patterns of patient isolates obtained revealed 4 different strains of *PA*. Eight patients had strain A (outbreak strain), 4 strain B, 1 strain C, and 1 strain D. Two *PA* positive patients did not have isolates available for PFGE analysis.

Environmental Cultures: Thirty-six environmental cultures obtained by the hospital were negative for *PA* with the exception of a laryngoscope blade, which was positive for *PA* and *Serratia marcescens*. PFGE analysis revealed that the laryngoscope positive strain matched the outbreak strain (Strain A). All medicaments tested for *PA* were negative.

Five of twenty-five (20%) environmental cultures collected by ACDC were positive for *PA*. These cultures were from five of five NICU sink basins. PFGE analysis on these positive cultures also revealed that they matched the outbreak strain.

Faucet Cultures: The culture results from 22 NICU RFDs revealed that 12 NICU non-aerator laminar flow devices were positive for *PA*. These included all the infrared sensored faucet non-aerator laminar flow devices from the pods (n=11) and the parents scrub room (n=1). All the non-sensored gooseneck faucet RFDs (n=5) were negative for *PA*. PFGE analysis revealed that 12 of 12 *PA* positive cultures matched the outbreak strain.

Six (n=37) infrared sensored faucet non-aerator laminar flow devices in patient areas outside the NICU were culture *PA* positive. Two of these were from the Labor and Delivery Unit located on the same floor as the NICU. The PFGE results on these cultures were unique and different from all other PFGE results. Four (n=30) were from faucets on other patient floors. PFGE analyses revealed that two of these positive cultures matched the outbreak strain. The remaining two positive cultures were unique and different from all other PFGE results and from each other.

Water Cultures: Water samples collected from two different sinks in common areas of the NICU on December 18, 2006 were negative for *PA*.

CONCLUSION AND FINAL RECOMMENDATIONS

Hospital staff stated that the cleaning practice for NICU laryngoscope blades included a tap water rinse and that this practice started in early 2006. At that time, NICU respiratory therapy staff began cleaning laryngoscope blades with a cleaning solution and tap water rinse rather than sending them to central supply for reprocessing. Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines, state that laryngoscope blades are considered semi-critical devices and should be cleaned with high-level disinfection [4].

The vehicle in this outbreak was likely a laryngoscope blade rinsed with tap water. The possible source was tap water as *PA* positive RFDs matching the outbreak strain were found on hospital wards outside the NICU. Laryngoscope blades, as multi-use devices, should undergo high-level disinfection between patient use and should not be rinsed with tap water.

Since the outbreak was investigated and infection control measures implemented, including using only blades from central supply that have undergone high-level disinfection, there have been no further cases of the outbreak strain detected. The role of non-aerated laminar flow devices and sensored faucets should be studied to determine their role in transmission of nosocomial infections.

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FOLLOW-UP SURVEY OF SIDE EFFECTS OF SINGLE DOSE CIPROFLOXACIN FOR PROPHYLAXIS OF MENINGOCOCCAL DISEASE IN A LOS ANGELES COUNTY HIGH SCHOOL

BACKGROUND

On November 14, 2006, two cases of invasive meningococcal disease (MD) occurring in students attending the same high school (HS) were reported to the Los Angeles County (LAC) Department of Public Health Department (DPH). One case was culture-confirmed with *Neisseria meningitidis* serogroup B bacteremia and the other was later PCR-confirmed with serogroup B meningococcal meningitis (culture-negative). The two students did not know each other and did not share common classes, friends or school activities. Following the confirmation of these cases, the LAC DPH stood up two point-of-distribution (POD) clinics to dispense prophylaxis for students and teaching staff at the HS who may have had contact with these students. The first clinic was held on the evening of November 14th, and an additional clinic the morning of November 15th. Parents and students were notified about the clinics through the school's automated phone message system, internet page, and a letter to parents. School officials released the names of the two ill students during the first clinic after obtaining parental consent, in an effort to identify the direct contacts that would require prophylaxis. Despite this, over 3000 persons were evaluated and 2861 persons were provided with single-dose ciprofloxacin prophylaxis.

As part of the routine public health follow-up of individual suspected and confirmed cases of invasive meningococcal disease, all contacts are evaluated for prophylaxis and educated on the symptoms of invasive MD. Mass prophylaxis is usually not considered except in situations which meet the Centers for Disease Control and Prevention (CDC) criteria for meningococcal outbreaks, defined as three or more cases within a three month period occurring in an institutional setting such as a school or among military [1]. The decision to provide prophylaxis on a mass basis rather than only to known close contacts of the case must be weighed against the risk of high numbers of reports of serious side effects associated with the prophylactic antibiotic, including anaphylaxis, to local health facilities, as well as the possibility of antimicrobial resistance developing within a contained community. In this situation, the decision was made to provide prophylaxis to self-identified close contacts through a distribution clinic because neither student could be interviewed to identify close contacts in a timely manner; and the extent of *N. meningitidis* carriage in this population could not be ascertained. Further, ciprofloxacin is generally well tolerated, having been utilized successfully without adverse events in other HS settings in California where mass prophylaxis had been required [California CD Brief, March 4, 2001]. Moreover, *N. meningitidis* has been rarely observed to be resistant to ciprofloxacin.

The use of ciprofloxacin in the pediatric and adolescent population has been limited because irreversible joint damage has occurred as a side effect in juvenile animal studies. Despite this, ciprofloxacin has been commonly used for children and adolescents when other treatment is not an option. Irreversible joint damage has never been found to occur [3-6]. District public health personnel documented only two major adverse events immediately following the clinic—two (0.07%) students developed rash without anaphylaxis. However, a number of adverse events may have gone unreported.

Two weeks after the POD clinics were held, LAC DPH conducted a follow-up survey study of all students and teaching staff of the high school in order to quantify possible side effects related to single-dose ciprofloxacin in an adolescent population and to evaluate the reasons such a large number of students and staff chose to receive prophylaxis despite being at low risk. Such a study would detect any minor or unreported adverse events that were not documented during the clinic or by another healthcare provider. Further, the results of the study may help provide information for future public health responses to both institutional outbreaks of infectious disease as well as bioterrorism events.

METHODS

As part of school policy, parents were notified prior to student participation in a follow-up POD clinic survey. Parents, students, and teaching staff were notified of the upcoming survey one week in advance via an automated phone message system and an announcement on the school's webpage. The survey was distributed to all HS teaching staff and students during their homeroom period on November 28, 2006. Completed surveys were collected by HS staff through December 3, 2006. Survey data included: demographics, the date of POD clinic attendance, reasons for attendance, side effects of single dose 500 mg ciprofloxacin, type of contact with the case students, health status at the time of the clinics, perception of risk of a variety of health conditions, and knowledge of MD. Respondents were asked to rate the importance of reasons for clinic attendance on a scale from 1 to 5, 1 being not important and 5 being very important. They were asked to rate their perception of risk of various health conditions on a similar scale as previously noted. The health conditions included meningitis and ranged from rare conditions such as avian influenza (referred to as "bird flu" on the survey) and cancer to more common conditions such as being in a traffic accident. Part of their knowledge of MD was assessed by asking students to identify the correct modes of transmission of MD. Data were entered into Microsoft Access and analyzed with SAS 9.1. Because of the known differences in the side effects and attitudes between adults and adolescents, the student and staff were analyzed as two separate populations. The differences in proportions were evaluated by chi square analysis and Fisher's exact test.

RESULTS

Surveys were distributed to 2888 students in attendance the day of the survey and 105 teaching staff in 105 homeroom classes. A total of 1717 completed surveys were returned (n=1649, or 57%, of students and n=68, or 65%, of teaching staff). All parents allowed the participation of their child on the survey. Twenty-seven surveys were excluded (2%) from the analysis because they did not contain enough information due to missing or inappropriate answers. A majority of the returned surveys (n=1690, 98%) from students and staff were available for analysis. Of these, 1624 (96%) were completed by students and 66 (4%) were completed by staff. Only results from the analysis of student surveys will be presented in this report.

Among all students who completed the survey, 49% were male and 50% were female. Students were distributed evenly among ninth to eleventh grades (26% to 28%), but there were slightly fewer 12th graders (18%). This is significantly different from the distribution of students at the high school ($p<0.0001$). The race/ethnicity distribution was 49% white, 33% Asian, 8% Latino, 6% were mixed race or other, and 2% were black. The distribution of whites, Asians, and Latinos is also significantly different from that of the high school ($p<0.0001$). Most of the students who completed the survey (n=1445, 89%) attended the clinics. More females than males attended the clinics (91% versus 87%, $p=0.0038$) All racial/ethnic groups attended the clinics at similar proportions (85% to 91%), with the exception of blacks, with only 74% reporting clinic attendance ($p=0.0231$) (Table 1).

The mean ratings of reasons for attendance among students ranged from 2.13 for having "contact with one of the sick students" to 3.97 for "parents told me to". Only 24% of student respondents rated the importance of having contact with the ill students as a 4 or 5. "Heard about it in the media" was rated second to last at 2.56 with only 30% of students rating its importance at 4 or 5 (Table 2).

Table 1. Differences in Characteristics of Students Completing Survey and Attending POD Clinics

			Surveyed Students				
		All HS Students n (%) (n=2962)	Total n (%) (n=1624)	p-value	Attend POD Clinics n (%)* of Surveyed Students (n=1445)	Did Not Attend POD Clinics n (%)* of Surveyed Students (n=179)	p-value
Gender	Male	1469 (50)	795 (49)	0.8578	689 (87)	106 (13)	0.0038
	Female	1493 (50)	817 (50)		745 (91)	72 (9)	
	Unknown	--	12 (1)	--	11 (92)	1 (8)	--
Grade	9th	782 (26)	419 (26)	<0.0001	366 (87)	53 (13)	0.1922
	10th	735 (25)	440 (27)		385 (88)	55 (12)	
	11th	742 (25)	459 (28)		416 (91)	43 (9)	
	12th	703 (24)	292 (18)		266 (91)	26 (9)	
	Unknown	--	14 (1)	--	12 (86)	2 (14)	--
Race	Asian**	829 (28)	530 (33)	<0.0001§	480 (91)	50 (9)	0.0231
	Black***	--	27 (2)		20 (74)	7 (26)	
	Latino	237 (8)	135 (8)		117 (87)	18 (13)	
	White	1807 (61)	799 (49)		714 (89)	85 (11)	
	Mixed/Other***	89 (3)	104 (6)		88 (85)	16 (15)	
	Unknown	--	29 (2)	--	26 (90)	3 (10)	--

* Percentages tabulated across rows, not columns.
** Includes Filipinos in surveyed students but excludes Filipinos among all HS students.
*** Includes mixed race and American in surveyed students but excludes Black, American Indian, Filipino, and Pacific Islander among all HS students.
§ Chi square test performed only among Asian, Latino, and White race categories.

Of the 1445 students who attended the clinics, 1390 (96%) took the ciprofloxacin. Table 3 lists the main side effects experienced by 608 students (44%) after taking the antibiotic. Most (69%) were able to recall an onset time. Among these, 57% reporting experiencing side effects from one to six hours after ingesting the single dose of ciprofloxacin. The median onset time was three hours. A greater proportion of females reported side effects compared to males (49% versus 39%), (p=0.0002). The most common side effects reported were headache (20%) and stomachache (12%), followed by sore throat, restlessness and muscle pain (each at 6%). Other notable side effects occurring less commonly were nausea/vomiting (5%), itching (3%), rash (2%), difficulty breathing (2%), and one case of face swelling. No joint pain was reported.

Table 2. Reasons for Clinic Attendance among Students

Reason for Attendance	Mean Rating of Importance	% Rated 4 or 5
Parents told me to	3.97	71
Heard phone message/ Received letter from school	3.34	51
Fear of serious illness or death	3.24	48
Friends did it	2.87	36
Advised by physician	2.63	35
Heard about it in the media	2.56	30
Had contact with one of the sick students	2.13	24

There was a significant difference in the proportion that reported side effects in those already ill compared to those who were not ill (60% versus 40%, p>0.0001). The most common side effects among those who were not already ill at the time of the clinics included: headache (17%), stomachache (10%), followed by restlessness, muscle pain, sore throat and nausea/vomiting (each at 4%) (Table 3).

Table 3. Reported Side Effects Among Students Who Took Single Dose Ciprofloxacin (500mg)*

	All n (%) (n=1390)	No Illness Report at Time of POD Clinics n (%) (n=1153)	Illness at Time of POD Clinics n (%) (n=237)
≥1 Side Effect	608 (44)	465 (40)	143 (60)
Fever	48 (3)	28 (2)	22 (9)
Cough	72 (5)	33 (3)	39 (16)
Sore Throat	83 (6)	44 (4)	39 (16)
Headache	281 (20)	191 (17)	90 (38)
Watery Eyes	40 (3)	26 (2)	14 (6)
Stomachache	166 (12)	116 (10)	50 (21)
Itching	40 (3)	27 (2)	13 (5)
Rash	21 (2)	10 (<1)	11 (5)
Diarrhea	33 (2)	21 (2)	12 (5)
Nausea/ Vomiting	67 (5)	42 (4)	25 (11)
Difficulty Breathing	22 (2)	11 (<1)	11 (5)
Muscle Pain	79 (6)	45 (4)	34 (14)
Anxiety	24 (2)	12 (<1)	12 (5)
Restlessness	80 (6)	51 (4)	29 (12)
Tired	32 (2)	29 (3)	0 (0)
Muscle Stiffness	5 (<1)	4 (<1)	1 (<1)
Face swelling	1 (<1)	1 (<1)	0 (0)

*Students can have more than one side effect

A considerable number of students completing the survey (n=282, 17%) reported experiencing symptoms from other illnesses at the time the POD clinics were set up (Table 3). This is the same prevalence of illness among students who attended the clinic and took the antibiotic. There was no significant difference in the prevalence of illness between students who attended and did not attend the POD clinics. Among those who took the antibiotic, coughing was mentioned most frequently (n=110, 8%) as a symptom experienced at the time of the clinic. Fifty-one (4%) mentioned a headache and 70 (5%) mentioned a stomachache (Table 4).

Table 4. Reported Symptoms from Illness Experienced by All Students at the Time of the POD Clinics*			
Symptoms	All Students n (%) (n=1624)	Took Ciprofloxacin n (%) (n=1390)	Did Not Take Ciprofloxacin n (%) (n=282)
Total Ill	282 (17)	237 (17)	45 (16)
Fever	82 (5)	68 (5)	14 (6)
Cough	138 (9)	110 (8)	28 (12)
Headache	58 (4)	51 (4)	7 (3)
Stomachache	81 (5)	70 (5)	11 (5)
Sneezing	65 (4)	54 (4)	11 (5)

*Students can have more than one side effect

The majority of all student respondents (n=1223, 75%) had no contact with either of the cases. Only 50 (3%) reported sharing an item such as a cigarette, food or drink—activities that would put these students at highest risk for MD. The most frequent type of contact reported was being in the same class with the cases (n=158, 10%). Other types of contact listed included indirect relationships to the cases (e.g., friends of siblings) (n=67, 4%) and having casual direct contact with the cases (n=43, 3%).

Table 5 lists adverse health conditions, including meningitis, in decreasing order of mean rating of perceived risk. The students rated their risk of meningitis very low (mean of 1.49) relative to the other listed health conditions. Very few (5%) rated their risk as a 4 or 5.

Table 5. Perceived Risk of Various Health Conditions		
Health Condition	Mean Rating of Perceived Risk	% Rated 4 or 5
Common cold	3.41	49
Other injury	2.86	31
Flu	2.68	27
Traffic accident	2.54	21
Food poisoning	2.14	12
Cancer	1.77	9
Obesity-related disease	1.73	10
Meningitis	1.49	5
Bird flu	1.35	3

Sixty-nine percent (n=1113) of student respondents reported not having knowledge of MD prior to the incident. These students attended the clinic in a larger proportion than those who reported having some knowledge of MD (90% versus 87%, p=0.032). Students who incorrectly identified touching objects touched by case students as a transmission mode attended the POD clinic more often (92% versus 86%, p =0.0007).

DISCUSSION

The POD clinics provided public health officials with a rare opportunity to detect side effects of single dose ciprofloxacin in a healthy adolescent population. The follow-up survey conducted two weeks after the clinics were held enabled documentation of a 44% overall rate of side effects, or a rate of 40% among students who were not already ill at the time of the clinic. These included both minor side effects as well as more serious ones that may have been related to anaphylaxis. The survey results also helped public

health to deduce the main reasons for participation in a prophylaxis clinic involving a single dose of an oral antibiotic in a high school setting.

The overall frequency of side effects from ciprofloxacin reported in this adolescent population (44%) is similar to that reported for this age group in the Physicians Desk Reference (PDR), which reported a rate of 41% from a clinical trial among complicated urinary tract infection patients prescribed ciprofloxacin [2]. The frequencies of individual symptoms in this population differ substantially than what is listed in the PDR and other pediatric studies. The most commonly reported side effects associated with ciprofloxacin among children and adolescents are gastrointestinal (including nausea, diarrhea, vomiting, and abdominal pain), central nervous system (headache and restlessness), and dermatologic symptoms. This study reports headache in 17% of healthy students, stomachache in 10%, and no joint-related disorders. In the PDR, gastrointestinal symptoms occurred in 15% of patients, musculoskeletal symptoms in 9.3%, abdominal pain in 3.3%, and headache in less than 1% [2]. A few other pediatric studies have shown similar rates of gastrointestinal symptoms that have ranged up to 14.5%. Neurological symptoms, which may include headache, in these same studies, however, range only up to 4.8% [5]. Most other studies report much lower rates of specific symptoms: abdominal pain ranged from 1% to 5% and headaches from 0% to 4% [4-6]. The frequency of joint disorders in these studies, however, are higher than this findings and ranged from 1% to 22% [3-6].

Prior to the implementation of the survey, only two adverse events were documented—two students with rash who required oral Benadryl®. The survey revealed multiple other occurrences of rash and itching (2% and 3%, respectively) as well as breathing difficulties (2%) and a case of facial swelling—all possible anaphylactic reactions to ciprofloxacin which were not reported to public health prior to the survey. The frequency of these symptoms falls within range of other referenced pediatric studies. Itching and rash, for example, are seen in about 2% of patients in these published studies. Vomiting occurred in 2% to 5% of patients [2,4,6].

The high rates of adverse events seen in this study compared to previously published pediatric studies can be explained by the use of ill or hospitalized populations in these studies. In this patient setting, study participants are most likely in a controlled environment where interactions with substances commonly consumed by adolescents such as caffeine and nicotine are limited or nonexistent. Ciprofloxacin can act to increase the effects of caffeine in particular, and this most commonly reported symptoms are also known side effects of caffeine, including headache, stomachache or abdominal pain, and restlessness and anxiety [2]. In addition, the lack of serious illness in this study population may have promoted detailed recall of minor symptoms that may be overlooked or unimportant in an ill population. It has been documented that even among healthy persons who were not taking any medications, minor symptoms such as headache, fatigue, and drowsiness, are common [7]. Benign bodily symptoms such as these may be mistakenly attributed to side effects of medication. This phenomenon would be emphasized as the high school population was in the midst of the fall/winter “cold and flu season” and already experiencing a general illness rate of 17% at the time of the clinic.

Conversely, there is a superior ability to detect side effects in patient populations because of the availability of healthcare professionals and special monitoring. Further, the follow-up time in these patient population studies ranged from 20 days to 6 weeks, longer than the two week follow-up period of this study, enabling a greater window of time to detect side effects. These populations also underwent longer treatment courses and higher doses of ciprofloxacin whereas this student population took only one single dose.

Few associations were found to be significant that could explain the high rates of attendance and subsequent acceptance of antibiotic prophylaxis. A minority of surveyed students (25%) had any contact with the students, and much fewer (3%) had direct contact that may put them at risk for MD. Accordingly, having contact with the case students did not factor heavily in their decision to attend the clinic. Interestingly, experiencing current symptoms of illness was not a factor in either attendance or intake of antibiotic. Having better knowledge of meningitis and the methods of transmission was some indicator of attendance and antibiotic intake. Though the students understood that they were at low risk of meningitis, rating it nearly last only before avian influenza, a large majority of the student population attended the

clinic. Because “fear of serious illness or death” was rated relatively high, it appears that students and staff felt that even at low risk, the consequence was serious enough to warrant prophylaxis.

Evidence suggests that school and public health officials may have inadvertently encouraged all students and staff to seek prophylaxis. Hearing the school’s telephone message or receiving the letter from the school administrators was rated among the highest as an important reason for attending the clinics. It has been suggested that parents and students were highly influenced by the advice of their personal physicians or the message given by the media, namely, that there was a “meningitis outbreak”, despite the fact that public health officials made it clear that one confirmed case and a suspected case did not meet the definition of an outbreak. However, “advised by a physician”, as well as “heard about it in the media” even more so, had lower mean ratings of importance. Furthermore, the health announcement the HS administration initially composed did not specifically focus enough on close contacts and may have also communicated heightened fear and risk. Though the names of the case students were released in order to limit attendance, they were announced to parents and students as the first clinic was already underway. Finally, the structure of the POD clinic itself did not alleviate the high attendance as it was designed more for distributing medication rather than assessing risk and need.

A major limitation of the study was the lack of a placebo group to determine if symptoms reported were a side effect of ciprofloxacin alone. This would not have been feasible or appropriate in a public health response setting without prior approval from an Institutional Review Board. In such a study, factors such as interactions with additional consumed substances or the background prevalence of illness would be controlled for. The survey was implemented two weeks after the clinic event, increasing recall bias of reported symptoms, particularly as most symptoms had an onset within six hours after ingestion of the antibiotic. The lag time in survey implementation may also have influenced the response rate of the survey: only 57% of students in attendance that day completed the survey. The surveyed students were not representative of the school as there were differences in rates of participation among grade levels and race/ethnicity groups. Lastly, the survey was self-administered without the presence of public health staff, which could have decreased the validity of many answers, especially the self-report of symptoms.

Despite these limitations, the results of this study fell within range of adverse events found in previous studies. As adverse events from ciprofloxacin in pediatric populations have often been studied in patient groups, this study added insight on how ciprofloxacin may affect a healthy population. Though the occurrence of side effects approached the higher range of published rates, the side effects were minor and most did not require medical attention. The lack of any joint-related side effects also further supports the safety of ciprofloxacin in the pediatric population as seen in previous studies, especially in the setting of single dose usage. These results provide a realistic assessment of the frequency and severity of side effects that would be useful for other situations of mass prophylaxis, for both common outbreaks as well as bioterrorism events.

Additionally, the results of this study indicate that parents and students are reasonable and rational in the face of the threat of a serious disease and are highly influenced by the advice of school officials. Public health officials must work closely with schools to explain the risk of disease and advise on appropriate prophylaxis distribution. Presenting a balanced message by communicating the risks of unnecessary use may encourage more prudent use of the antibiotic prophylaxis.

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PROPHYLAXIS OF HIGH SCHOOL STUDENTS WITH CIPROFLOXACIN FOLLOWING TWO CASES OF INVASIVE MENINGOCOCCAL INFECTION AT A LOS ANGELES COUNTY HIGH SCHOOL, NOVEMBER 14-15, 2006

Over the past 10 years, Los Angeles County (LAC) Department of Public Health (DPH) has confirmed 40 to 60 cases of invasive meningococcal disease annually. Outbreaks of invasive meningococcal disease, defined as three or more cases within three months [1] within a circumscribed community (e.g., school) or group of individuals sharing a common exposure, have been rare events in LAC, with the last outbreak noted in 2001 among attendees of a nightclub [2]. As part of routine public health follow-up, all contacts to both confirmed and suspected cases are evaluated for prophylaxis and educated on the symptoms of invasive meningococcal disease; meningococcal isolates are serotyped and may be genotyped by Pulsed Field Gel Electrophoresis (PFGE) at the LAC Public Health Laboratory.

On November 14, 2006, one culture-confirmed case of *Neisseria meningitidis* (*N. meningitides*) bacteremia (serogroup B) in a high school student and an additional case of suspected meningococcal meningitis (culture-negative) in a critically ill teenager were reported to the LAC DPH by the same community hospital. Medical record review and interviews with family members revealed that both teenagers had symptom onset on November 12, 2006. Both cases attended the same school, but did not know each other, share classes together, or participate in similar activities such as clubs and/or sports teams. Further diagnostic work-up revealed that the culture negative meningitis student had PCR-positive cerebral spinal fluid (CSF) for *N. meningitides*, serogroup B (California Microbial Disease Laboratory) despite negative blood and CSF cultures.

On the same day, after consultation with high school officials and California Department of Health Services Division of Communicable Disease Control, the LAC DPH held a point-of-distribution (POD) clinic at the students' school to dispense prophylaxis in anticipation of a large turnout. Two clinics were held, one on November 14 from 6 to 9 p.m. and an additional clinic the following day from 8 a.m. to 2 p.m. Parents and students were notified about the POD clinics through the school's automated phone message system, internet page, and a letter to parents, advising only close contacts of the students to obtain prophylaxis. Although the students' names were made public (after parental permission was granted) in an effort to identify only those students who had direct contact with the two ill students, over 3000 students and teachers were evaluated and 2861 persons were provided with prophylactic medication (ciprofloxacin 500 mg orally in a single dose). Two teens experienced allergic reactions—skin rash with itching—and were treated with diphenhydramine. Additionally, five students attending the POD were referred to local hospitals for evaluation of symptoms suggestive of meningitis; one received a lumbar puncture. No student had meningitis and all five were discharged.

Two weeks after completion of the POD, a follow-up survey was distributed to all students and staff at the school. The goals of the survey were to quantitate the possible side-effects related to single-dose ciprofloxacin in an adolescent population and to evaluate the reasons why so many students and school staff chose to receive prophylaxis despite being at low risk. The survey results are presented in a separate article within this Special Studies Report. At six weeks after the symptom onset of the cases, no additional meningococcal cases associated with this high school had been documented.

DISCUSSION

LAC DPH successfully held a POD clinic to provide antimicrobial prophylaxis rapidly to contacts of one culture-confirmed case of meningococcal bacteremia and one suspected case of meningococcal meningitis within 24 hours of notification to the DPH. Although ACDC recommended that prophylaxis be provided only to persons with close contact to the cases (e.g., shared drinks, cigarettes, secretion), nearly 2900 students and staff received prophylaxis. Factors that may have contributed to this very large participation included:

- the school administration composed the school health announcement to parents and students that was not specific enough to focus on close contacts;

- additionally, the county supervisor's office for this region issued a press release, advising LAC residents of a "meningitis outbreak", despite the fact that the DPH determined that one confirmed case and a suspected case did not meet the definition of an outbreak.

At the time of POD formation, it was not known if the case of bacterial meningitis was caused by *N. meningitis*, although PCR diagnostics revealed Group B meningococcus in the CSF of the suspect case by the time of the second clinic. This meningitis case remained culture-negative; thus PCR proved to be a very important diagnostic tool in providing bacteriologic and serogroup information.

Ciprofloxacin was chosen for prophylaxis because it can be administered in a single dose and is generally well tolerated. Despite experience from large setting, school outbreak prophylaxis distributions (California CD Brief, March 4, 2001) and its widespread use in the treatment of uncomplicated gonorrhea infection in adolescents [3], ciprofloxacin in adolescents is still not supported in the Pediatric Red Book [4,5] or the Physicians Desk Reference (PDR) [6]. The survey documented only two adverse events (0.07%) in students who developed rash without anaphylaxis and were successfully treated with diphenhydramine. This is less than the 1% frequency noted in the PDR [6].

By all accounts, the POD clinic was successfully and efficiently executed by public health officials, parents, and school administrators who participated and observed. The clinic's success can be attributed to recent bioterrorism-related preparedness exercises that have stressed rapid organization of POD clinics for vaccines and antibiotics. Other helpful factors included having school officials, a public health pharmacist, public health nurses, a public health medical director, and the health officer on site.

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MYCOBACTERIUM CHELONAE INFECTIONS FROM A TATTOO PARLOR LANCASTER, CALIFORNIA 2006

BACKGROUND

This report describes three cases of *Mycobacterium chelonae* infection in customers who received tattoos in February 2006 at the same tattoo parlor in Lancaster, California. *Mycobacterium chelonae* is rapid growing and ubiquitous in the environment such as soil and water, including tap water. It is associated with infections of the skin, lung, bone, joint, nervous system and eye. It manifests as localized soft-tissue and skeletal infections in otherwise health individuals and more disseminated disease in immunocompromised patients. Transmission can occur from incidental environmental inoculation such as subcutaneous exposure to contaminated water. This mode of exposure is possible during the act of tattooing.

The state of California currently has no tattooing regulations; however the Los Angeles County Code does have Department Regulations on Body Art requiring the use of specific dyes, inks and pigments and only sterile water as a dilutant. Most cities within Los Angeles County including Lancaster did not adopt the Los Angeles County Regulations. Additionally, tap water is sometimes used to dilute inks during the tattooing process. Mycobacterium species are common in tap water and may lead to subsequent skin infections. Therefore, this report has implications for future regulation of tattoo parlors.

METHODS

Case Investigation: On March 24, 2006 the Los Angeles County (LAC) Department of Public Health (DPH) Acute Communicable Disease Control (ACDC) Program received a report of a 25 year-old male patient with an arm abscess positive by fluorescent staining for mycobacterial species. The patient had recently obtained a tattoo on February 12, 2006. Onset of infection occurred two days later and consisted of painful, itchy red papules over the gray areas of his tattoo. He saw a physician multiple times and received antibiotics with no resolution. A skin biopsy was taken on March 15, 2006 and a culture was taken on March 27, 2006. The culture was positive for *Mycobacterium chelonae*.

The tattoo artist reported two other recent tattoo recipients with similar looking infections. Both received the tattoo from the same tattoo parlor and artist. The two recipients were notified, interviewed and skin biopsies were collected on March 30. Both cultures were positive for *Mycobacterium chelonae*. Two patients have been prescribed Clarithromycin (Biaxin) for six months and one patient has been prescribed Azithromyacin for three months. No physical limitations have been noted in any of the patients.

Case Finding: A client list from the tattoo parlor was obtained to commence case finding. No other clients have reported any symptoms consistent with Mycobacterium species infections to date. However, the client list was not complete and many of those listed were missing contact information. A health alert was also sent out to all physicians on March 24, 2006 to ask them to report any tattoo related skin infections from the Antelope Valley region. Additionally, a letter was written to all dermatologists, pediatricians, family care practitioners, urgent care doctors and internal medicine doctors in Antelope Valley asking them to report any tattoo related skin infections. There have been no other reports of skin infections related to tattoos from this tattoo parlor or others in the region.

Environmental Investigation: On March 24, 2006, ACDC Program inspected the tattoo parlor. Environmental specimens were obtained for culture using both agar-based media and 7h9 MGIT broth media. Photographs were taken of the tattoo parlor specifically in areas where contamination could occur. Specimens taken included the sink spout, the water cooler's spout, the tattoo instruments, the ink, receptacles for water used for cleaning instruments and diluting colors and other ointments used to clean and soothe the skin before and after tattooing. Environmental samples including the exterior and interior sink faucet, the sink drain and the water cooler's spout and basin were all positive for *Mycobacterium gordonae*. Other samples had no evidence of Mycobacterial species.

Additionally, an informal environmental inspection took place using the terms of Los Angeles County Code Title 11 chapter 11.36, Department Regulations for Body Art. This inspection was not official as tattoo parlors in the Antelope Valley are not registered or regulated by the LAC DPH Environmental Health Branch.

On March 31, 2006 a draft of the Environmental Health report of recommendations was sent to the tattoo parlor. Tattooists at the parlor were not registered as body art technicians in LAC and they do not have proof of having completed bloodborne pathogen disease transmission prevention training. There were ashtrays in the work area filled with cigarettes and there was no clear separation between the autoclave and ultrasonic device which may allow cross-contamination. The floors of the tattoo parlor were not smooth or cleanable and were not sanitized on a regular basis. There was no hand-wash sink in the workstation and no hot water under pressure provided in the sink in the bathroom.

An interview with the tattoo artist revealed that he used tap water to shade the paints when tattooing the three patients. Specifically, he may have used the drinking water from the water cooler or water from the bathroom sink of the tattoo parlor. Usually distilled water is used; however the artist stated that if no distilled water is available, other water might be used.

DISCUSSION

Los Angeles County regulations require sterile potable water to be used during the tattoo process only. Specifically section 525.00 states:

"(a) All inks, dyes, and pigments used to alter the color of skin in the conduct of body art shall be specifically manufactured for such purpose, approved, properly labeled as to its ingredients, manufacturer and lot number in accordance with applicable FDA requirements, and shall not be contaminated or adulterated. The mixing of such inks, dyes or pigments or their dilution with potable sterile water is acceptable, unless prohibited or not recommended by its/their manufacturer.

(b) Inks, dyes and pigments prepared by or at the direction of a body art technician for use in body art activity shall be made exclusively of non-toxic and non-contaminated ingredients approved by the department or FDA."

However, as noted previously, this tattoo parlor is in Lancaster which has not adopted the ordinance nor is registered with the county. Only unincorporated regions of Los Angeles have adopted the ordinance. Additionally, although the state of California is currently drafting Body Art Regulations; these regulations do not contain guidelines for ink dilution.

At this time ACDC Program recommend that Lancaster and other incorporated areas adopt the Los Angeles County ordinance and register with the county and that the drafted State Body Art Regulations include guidelines on ink dilution. The tattoo parlor is slowly making changes and the tattoo artist who performed the tattoos that facilitated the infections is no longer working at this establishment. Although the exact cause of this outbreak was not determined, Mycobacterium species were found in two water sources. It is likely that this outbreak could have been prevented if the tattoo parlor was up to code and if only sterile water was used in the tattooing process.

UNIVERSITY PANDEMIC INFLUENZA PLANNING SUMMIT

OVERVIEW

On April 28, 2006, the Acute Communicable Disease Control (ACDC) program of the Los Angeles County (LAC) Department of Public Health Services (DPH) held a pandemic influenza planning summit with select representatives (e.g., student health center directors, risk management, directors of student affairs) of many Los Angeles-area universities. To focus and prioritize the scope of the summit, invitations were limited to universities that maintain on-campus housing. Representatives from 17 universities as well as key LAC DPH staff attended. Prior to attending, university representatives were asked to submit a brief survey summarizing the characteristics of their campus (Table 1) and whether they have included pandemic influenza as a part of their emergency preparedness planning.

The summit agenda consisted of three informative presentations followed by a tabletop discussion. The three presentations provided information on: differentiating seasonal, avian, and pandemic influenza; understanding issues specific to avian influenza; and, detailing advanced information and guidance on pandemic influenza and planning especially for universities. Guiding the subsequent tabletop discussion was a series of hypothetical pandemic influenza-related scenarios that may impact universities (Table 2). The tabletop provided a forum for the university representatives to suggest steps they might undertake before, during, and after an influenza pandemic. In addition, the tabletop served to generate suggestions for materials that LAC DPH can provide to assist universities with their pandemic influenza planning (Table 2). In addition, many informative handouts were also provided including: supplemental information on influenza and pandemic influenza, pandemic planning checklists, and lists of public health resources.

BACKGROUND

Pandemic influenza has the potential to cause tremendous impact on health and welfare globally, nationally, and locally. Recently, the need to prepare for a pending pandemic became more critical following the emergence of an Asian strain of avian influenza A H5N1 (commonly known as “bird flu”). The continuing spread of H5N1 in wildlife, and the continued animal outbreaks and human cases, has heightened concerns that this viral strain will eventually mutate and cause a pandemic. But unlike seasonal influenza, which circulates annually, and as such, has predetermined activities for preparation and response (i.e., established risk-groups and protocols for vaccination and treatment, etc.), pandemics are unpredictable—the onset, severity, and full range of characteristics of a pandemic are unknown. This inherent uncertainty, coupled with continual scientific advancements, responses, and changes in circumstances, greatly complicates planning.

There are many factors unique to universities, and the students that they serve, that make preparing for a potential pandemic a critical part of their emergency planning. Foremost is the fact that university students commonly live in close communal quarters (i.e., dormitories, sororities, etc.); these living arrangements typically include factors that can further the spread of illness such as sharing restrooms and eating in large-communal facilities. Moreover, college students do not typically maintain ideal hygiene and often engage in activities that can foster the spread of illnesses (i.e., sharing personal items, etc.). Accordingly, the introduction of a highly contagious illness, such as influenza, has the potential to spread rapidly, and within a short time, affect many. In addition, college campuses are known for uniting individuals from diverse countries—universities frequently invite visiting scholars, students often travel to unusual foreign lands—which can increase the likelihood of potentially introducing a novel illness.

Finally, another unique facet of universities is their system of centralized healthcare. Students (and sometimes staff) typically rely on the university student health center as their primary healthcare resource. In the event of a pandemic, the university student health center may be responsible for providing for the health and welfare of the majority of the students, and others, on their campus.

RESULTS

Prior to attending, university representatives were asked to submit a brief survey summarizing the characteristics of their campus and the steps they have completed to prepare for an influenza pandemic—of the 17 universities represented at the event, 14 university summaries were completed.

Student Profile: The universities represented at the summit are responsible for a large portion of the Los Angeles-area population—the combined enrollment from the 17 universities exceeds 200,000 students. In addition, large portions of those students live on-campus—on average well over 2,000 students live on each campus (Table 1). In addition, should travel be suspended, many students will likely be forced to stay on campus—the universities attending this summit reported thousands of students are out-of-state residents or international students.

Table 1. Student Profile of Summit Participating Universities

Student Demographics	Total*	Mean	Median	Range (Min.–Max.)
Student Enrollment	184,198	14,169	8,300	350–35,625
Campus Residents	37,492	2,884	2,100	125–8,998
Out-of-State Students	19,933	1,661	1,272	100–5,000
International Students	14,362	1,104	500	10–6,881

* Since only 14 of the 17 schools completed the survey, the total numbers of student enrollment listed here underestimates the 17 universities represented at this event.

Emergency Planning: University representatives were asked whether their campus has established an all-hazards emergency plan—all 14 universities that responded noted that they have such a plan for their campus. However, when asked if their campus presently has a pandemic influenza plan (either separately or as an adjunct to their all-hazards plan) only one university said they did; eight universities stated that they had developed some pandemic planning, but their plans were presently incomplete; and, five universities stated that they presently had no pandemic influenza plan.

Student Health Center and Influenza Vaccination Profile: The participants were also asked the average number of primary care visits their student health center attends to yearly; on average, the health centers reported 16,678 student visits (median 10,000 visits), but there was also a very broad range in reported visits (range: 325 to 50,000 visits). The majority of the attending universities provide influenza vaccination for their students and others on campus. Only three of the 14 responding universities do not provide influenza vaccination. Of the remaining 11 schools, four provide vaccination free of charge, and seven charge a nominal fee. Of the universities that provide vaccination, most extend coverage to health center staff (76%), faculty (61%) and campus staff (53%).

Excerpts from the Tabletop Discussion: To guide the tabletop discussion, a series of four scenarios were developed describing different pandemic-influenza events that may affect universities (Table 2). The scenarios followed the World Health Organization's (WHO) pandemic phases* and were used to prompt discussion and debate regarding pandemic influenza planning and response. In addition, the scenarios helped to identify materials and resources that LAC DPH could provide to assist universities during these various events.

* As described on www.who.int/csr/disease/avian_influenza/phase/en/index.html.

The most common item that the representatives from the universities requested of LAC DPH was information and guidance—at every stage, the representatives noted that they would most value the expertise of LAC DPH to best respond to the scenario; the information should be easily accessed, simple to understand, and available in formats that can be easily disseminated for their use (i.e., in multiple languages, specific for students, specific for people who may travel, etc.).

Table 2. Tabletop Scenario and Suggestions for Pandemic Planning Assistance

Pandemic Phase:* Transmission Summary	Hypothetical Scenario Synopsis	Discussion Topics	Suggestions for Planning Assistance
3: No human-to-human transmission. No human cases in the US.	A student from your campus dies from influenza H5N1 infection while visiting family abroad. How do you quell fears and correct misinformation on your campus?	• What similar past campus events can provide guidance for responding to *this* event? • What are the key facets of this event that need to be included in campus communications? • What facets of pandemic planning should be instituted at this stage?	• Provide talking points (streamlined message maps) to inform and summarize the situation and frequent updates for posting on websites. • Provide updated contact information and relevant resources. • Develop educational materials and posters for health centers and other campus locations.
5: Large clusters of human-to-human transmission. Cases in the US. No cases on your campus.	Major human outbreaks from a novel influenza A virus have been identified. Outbreaks are occurring in neighboring cities, but not yet in LA, and not on your campus. What activities are paramount at this time?	• How can campuses health centers enhance their surveillance? • Should campuses activate their Incident Command Structure at this stage? • Should campuses stockpile antivirals and masks? If so, what are their strategies for their use? • What infection control practices should be recommended? Do campuses have methods of isolating sick students who reside on campus? • What methods of alternative education are available (i.e., web-based lessons, etc.)?	• In addition to the suggestions described for Scenario 1, establish a toll-free information hotline and create educational materials including responses to frequently asked questions and other talking points for campus representatives. • Develop posters to assist in identifying symptomatic patients and to request that they wear masks to limit the spread of illness due to coughing and/or sneezing. • Assist campuses in defining and implementing their Incident Command Structure to ensure ease of operations during the possible spread of illness to the campus.
6: Large clusters of human-to-human transmission. Cases in the US. Cases on your campus, including some of the summit participants.	The previously described pandemic-related illness has now reached the LA-area and your campus, including some of the representatives at the summit. How should activities change at this time?	• Because some of the summit participants were classified as "sick," their duties were described as well as any responsibilities that could not be performed if they were unexpectedly absent. • Other aspects of continuity of operations were discussed (i.e., what activities could and couldn't be redirected, what campus tasks and responsibilities were essential versus what could be postponed, etc.). • What supplies and/or preparations does your campus have for this type of emergency? • Would your campus be able to monitor absenteeism and illness? Are their any groups that may be overlooked?	• Since information and available resources will likely rapidly change, a centralized website (perhaps one with private access to maintain confidential information) would be a valuable tool for monitoring the epidemic and disseminating information including potential changes in treatment, affected groups, available materials.
Post-Pandemic: Peak in incident cases ended.	The first major wave of pandemic-related illness has subsided. Secondary waves of illness are likely. What activities should be conducted at this time?	• What resources are available on your campus that may be of use during this period (i.e., counseling services, etc.)? • At what point would your campus return to "business as usual"?	• Summary reports describing many facets of the pandemic (i.e., "lesson learned") would be valuable—especially if there are issues relevant to universities, their population and/or geographic area. • Guidance for how to prepare for future waves of illness and resources to assist in recovery and future response.

* World Health Organization Pandemic Phases (www.who.int/csr/disease/avian_influenza/phase/en/index.html).

DISCUSSION

Overall, the summit was very well-received—the participants were grateful for the opportunity to attend, were pleased with the materials and information that was provided, and requested future summits and updates as relevant. In response, LAC DPH developed a confidential university-specific web-portal to: store information (including the materials provided during the summit), allow universities to share information including their pandemic influenza plans, and post and respond to questions that may arise. In addition, LAC DPH has developed many educational materials such as posters to hang in student health centers to assist in identifying patients with novel respiratory viruses and to facilitate infection control. Finally, a follow-up summit was held six months later to provide updated information and materials.

A CASE OF PLAGUE IN URBAN LOS ANGELES

BACKGROUND

Plague was first recognized in the United States in San Francisco in 1900, and appeared in Los Angeles County in 1908. The disease was likely introduced to western United States ports via infected rats and humans who traveled on ships from Asia. Outbreaks in rats and subsequent human epidemics followed the introduction of plague to both San Francisco and Los Angeles. Since the early epidemics, sporadic human plague cases in California have been associated with epizootics (animal disease outbreaks), most commonly among California ground squirrels. No previous human cases have been associated with epizootics in wild rabbits in southern California. Despite the presence of sylvatic plague in many areas of the western United States, human infection in an urban setting without known risk behaviors is an urgent public health concern. The last previous human case of *Yersinia pestis* (*YP*) infection in Los Angeles County (LAC) occurred in 1984 in a veterinarian with established exposure to an ill cat.

CASE PRESENTATION

In April 2006, the Los Angeles County (LAC) Department of Public Health (DPH) received a report from an infectious disease (ID) physician of a positive blood culture for *Yersinia pestis* (*YP*) taken from a woman who lived in an urban area of Los Angeles. This 28 year-old previously healthy female was admitted to a local inpatient medical center with a three day history of fever and a severely painful right axillary swelling (bubo); she had no pulmonary symptoms. All chest radiographs were negative. Her preliminary diagnosis was “probable” abscess due to methcillin resistant *Staphylococcus aureus.*

On the third hospital day, the hospital laboratory reported to the clinician a presumptive identification of *YP* from an admission blood culture. Initially requiring aggressive therapy for shock, she improved enough after excision and drainage of the mass and antibiotic therapy to be discharged six days later. She recovered fully without sequelae. The case was queried in detail by ID consultants regarding any potential plague exposures. Beyond vaguely noting residential infestation with rodents and feral cats, she firmly denied any direct animal contact or travel outside of her densely urban locale. Within hours, LAC DPH was notified of the case by telephone and facsimile, which in turn notified the California state health department and the Federal Bureau of Investigation, because *YP* is category A bioterrorism agent.

METHODS

Case and contact interviews were conducted in person using a standardized questionnaire. The case and her family were interviewed repeatedly regarding potential exposures to animals and locations enzootic with *YP*; potential exposure sites were evaluated and animals were collected and tested for *YP*. Environmental investigations were conducted including interviews, general environmental assessment, trapping for animals, and serologic tests of animal serum. LAC Public Health Laboratory (PHL) tested the blood isolate by direct fluorescent antibody (DFA), polymerase chain reaction (PCR), and phage lysis. Sera from rabbits and deer mice were tested for plague at the California Department of Health Services (CDHS) Microbial Diseases Laboratory using a hemagglutinin assay (HA). Rabbit carcasses were tested for plague by the Centers for Disease Control and Prevention (CDC). Pulsed field gel electrophoresis (PFGE) analysis was done on human and animal *YP* isolates by CDC. Close contacts of the case and hospital staff were screened and offered prophylactic antibiotics.

RESULTS

In initial interview, the case denied any travel outside her immediate residence, except to walk her son to the local school. A second interview revealed that the case had visited a large park in Los Angeles that has many wild animals. In the early 1980s surveillance by LAC DPH in this park detected plague positive California mice, a ground squirrel and a Norway rat. The case was unsure of the dates she visited the park but thought it was 3 to 4 weeks prior to her onset, which was outside of the range for *YP* incubation period.

The blood isolate was positive for *YP* by DFA, PCR probes and the phage lysis test. Twelve hospital staff, including surgical residents and laboratory technicians, were screened by the hospital occupational health clinic and offered chemoprophylaxis because respiratory precautions were not taken during aspiration and excision of the bubo or during handling of the specimen in the laboratory. The household contacts were assessed by public health nursing staff—16 persons who lived on the premises were screened and offered antibiotic prophylaxis; 11 received doxycycline for 7 days, 5 received sulfamethoxazole/trimethoprim for 7 days; one person did not take prophylaxis as she was pregnant.

LAC DPH Environmental Health Vector Management staff assessed the property as not being good harborage for rats or ground squirrels, although feral cats were observed. Traps set for rodents inside and outside of the home yielded no competent *YP* vectors. Sera from two feral cats were tested and found negative for *YP*.

Day trapping activities in the local park frequented by the case yielded 34 California ground squirrels, which were flea infested. Serologic tests of squirrel sera showed no antibodies to *YP.*

After extensive re-questioning, the husband of the case reported that he and his friends hunted rabbits in the Mojave area of Kern County in early April 2006; the case did not go hunting and did not skin the rabbit but had handled the raw rabbit meat prior to cooking. On the hunting trip, the husband observed approximately 5 rabbits dead on the ground. A rabbit die-off in that region was also reported in May to California Department of Fish and Game by a local utility worker. Inspection of the hunting site by vector biologists from CDHS, Kern County Environmental Health and LAC Environmental Health revealed signs of a die-off at the time of hunting; five rabbits were obtained for testing. Trapping yielded 25 deer mice (*Peromyscus sp.*) and two jack rabbits. Five deer mice sera were positive by HA and one rabbit carcass was positive by DFA and culture for *YP*. PFGE results showed that the rabbit and human isolates had indistinguishable patterns and were unique when compared with 363 distinct patterns in the CDC database representing over 1,100 PFGE entries.

CONCLUSIONS

This confirmed human plague case was likely caused by handling the carcass of an infected wild rabbit collected in the area of a recent plague epizootic. Rabbits are known to transmit plague to humans, through either infected fleas or contact with blood when dressing a dead animal. Symptoms were compatible with bubonic plague and development of sepsis, but because the case resides in an urban area, plague was not in the initial differential diagnosis which resulted in inadequate infection control precautions during the hospital stay. Plague should be considered upon clinical assessment of persons who have been in an endemic area or have handled mammals taken from endemic areas. Repeated interviews may be needed to reveal risk factors when disease occurs in an non-endemic area. Public education regarding risk of plague in endemic areas is needed.

Bioterrorism was ruled out early in the investigation, as the case had limited exposure outside the home and an apparently natural infection. Nevertheless, the FBI was informed of the case and investigation as per protocol for cases infected with potential agents of bioterrorism.

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RISK FACTORS FOR INVASIVE GROUP A STREPTOCOCCAL DISEASE IN LOS ANGELES COUNTY, 2004-2006

BACKGROUND

Infection with group A streptococci (*Streptococcus pyogenes*) may result in several clinical presentations, ranging from non-invasive disease, such as strep throat, to invasive disease, where the bacteria invade a normally sterile site. Although readily treatable with antibiotics, severe invasive infections require prompt treatment to prevent devastating sequelae. Severe sequelae include necrotizing fasciitis (NF), otherwise known as "flesh eating disease," and streptococcal toxic shock syndrome (STSS), which is characterized by a rapid onset of hypotension and multi-system involvement. Other clinical symptoms, often overlapping, include bacteremia, cellulitis, and pneumonia.

Invasive group A streptococcal (IGAS) infections cause substantial burden and mortality. In 2005, an estimated 10,400 cases and 1,350 deaths occurred in the United States [1]. The case fatality rate of IGAS infections is 12 to 13%, increasing to 30 to 80% in persons with severe infections [2]. Known risk factors include age, diabetes, Human Immunodeficiency Virus (HIV) infection, injection drug use (IDU), cardiovascular disease, and other chronic conditions [3].

The risk factors of Los Angeles County (LAC) IGAS cases were reviewed and compared to the prevalence of these risk factors in the general population to determine specific populations at greatest risk for IGAS infection. Based on this study in LAC, diabetes was the most prevalent risk factor observed in IGAS cases. Risk factors in older adults included chronic diseases, while risk factors in younger adults included alcoholism and blunt trauma. The prevalence of nosocomial IGAS infection, IDU, and HIV was lower in LAC IGAS cases when compared to national data.

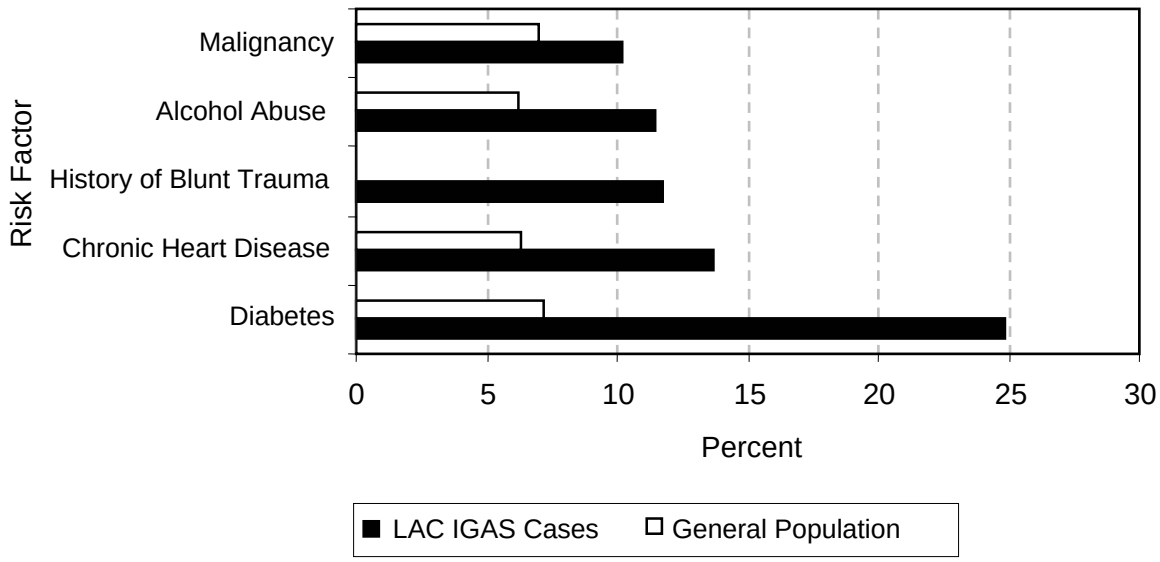
METHODS

IGAS is a reportable condition in LAC. An IGAS case is defined as a LAC resident who has *Streptococcus pyogenes* isolated from a normally sterile body site or from a non-sterile site if associated with STSS or NF. In 2004, a questionnaire was created to collect detailed demographic, clinical, and risk factor information for each reported case. IGAS cases reported and investigated by March 1, 2007 with disease onset from January 1, 2004 to December 31, 2006 were reviewed and analyzed to identify risk factors associated with IGAS infection. By univariate analysis, the prevalence of risk factors in LAC IGAS cases was compared to that of the general population, using data from multiple surveillance systems, including the Behavioral Risk Factor Surveillance System (BRFSS), the National Health Interview Survey (NHIS), the Los Angeles County Health Survey (LACHS), and US census.

RESULTS

From 2004 to 2006, a total of 516 cases were reported in LAC, with risk factor information available for 80% of the cases (n=410). From 2004 to 2005, the average incidence rate of IGAS infection in LAC was lower than the average rate reported in the United States (1.7 versus 3.5 cases per 100,000) [1]. However, the average case fatality rate from 2004 to 2005 was higher than the national average (18% versus 13%). During the three-year period, IGAS infection occurred more often in males (62%), adults aged 45 years and older (61%), Latinos (40%), and Whites (40%). Risk factors in older adults included chronic diseases, while risk factors in younger adults included alcoholism and blunt trauma. The most common risk factors reported included diabetes (25%), chronic heart disease (14%), blunt trauma (12%), alcohol abuse (12%), and malignancy (10%) (Figure 1). Specific trends and analyses are highlighted below.

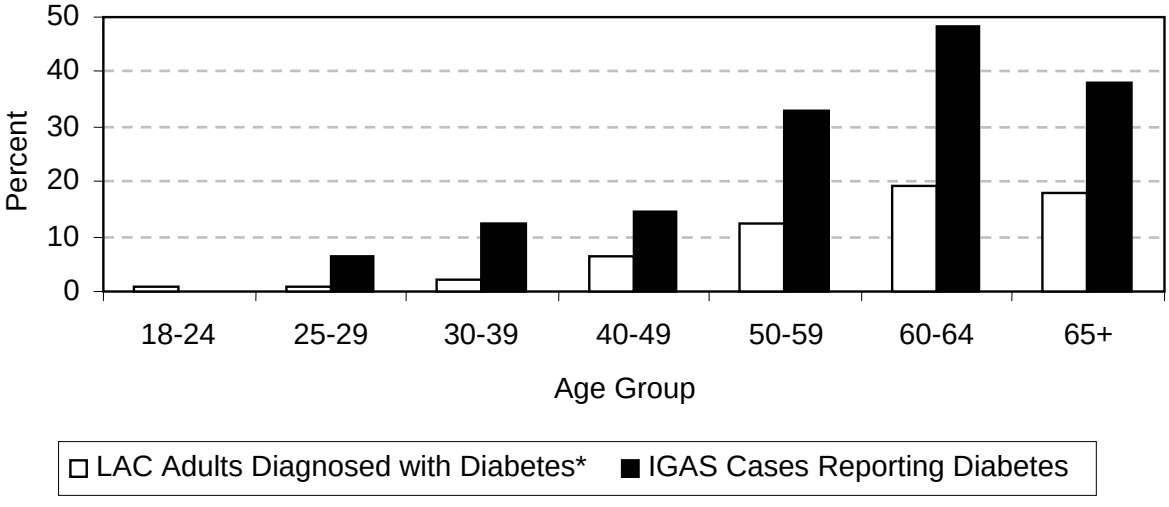
Figure 1. The Prevalence of Risk Factors in LAC IGAS Cases Compared to the General Population, 2004-2006



* No prevalence data available for blunt trauma in the general population.

Diabetes: From 2002 to 2003, seven percent of LAC adults reported being diagnosed with diabetes [4]. In contrast, the overall percentage of IGAS cases with diabetes was 3.5 times higher, as one in every four cases (25%) was also diabetic. The greatest number of IGAS cases with diabetes occurred in persons aged 45 years and older. However, in all racial groups (data not shown) and for persons over 25 years, the percentage of IGAS cases with diabetes was greater than the corresponding LAC diabetes prevalence by age (Figure 2) [4]. In particular, the percentage of IGAS infections in persons aged 25 to 39 years with diabetes was much higher than expected based on the underlying prevalence of diabetes in this age group.

Figure 2. Prevalence of Diabetes in LAC and IGAS Cases by Age



* 2002-03 Los Angeles County Health Survey; Office of Health Assessment and Epidemiology, Los Angeles County Department of Public Health.

Chronic Heart Disease and Malignancy: As the majority of IGAS infections occur in older adults, it is not surprising that many of the top reported risk factors include existing chronic diseases. Chronic heart disease was the second most reported risk factor (14%) and one in every three IGAS cases over 65 years reported this condition (33%). In contrast, the prevalence of coronary heart disease in the United States is lower (6%), with 18% of adults aged 65 to 74 years and 26% of persons over 75 years reporting coronary heart disease [5].

Overall, 10% of IGAS cases reported a malignancy compared to the national prevalence of 7% [5]. Interestingly, the percentage of IGAS cases with malignancy in LAC is higher in younger age groups and lower in older age groups when compared to the national cancer prevalence. Malignancy was reported in 7% of IGAS cases aged 20 to 44 years compared to the United States prevalence of 2% in those aged 18 to 44 years and was highest in persons aged 45 to 64 years (14% in LAC IGAS cases versus 8% in the United States). In IGAS cases 65 years and older, malignancy occurred in 13% of cases, which is lower than the national cancer prevalence of 19% in persons 65 to 74 years and 25% in persons 75 years and older. Additionally, the percent of female IGAS cases with malignancy (14%) was higher than both the national prevalence (7%) and the percentage of male IGAS cases with malignancy (8%).

Alcohol Abuse and Blunt Trauma: From 2004 to 2006, there has been an increase in the number of IGAS cases reporting a history of blunt trauma or alcohol abuse (data not shown). The majority of IGAS cases younger than 20 years have no risk factors reported (72%). However, a history of blunt trauma was the most reported risk factor in children IGAS cases aged 1 to 19 years, ranging from 32% in children aged 1 to 4 years to 27% in children aged 5 to 19 years.

In IGAS cases aged 20 to 44 years, alcohol abuse was reported more than any other risk factor (20%), more than double the percentage of Californians reporting heavy drinking in 2005 (10% in persons 18 to 24 years, 7% in persons 25 to 34 years, and 4% in persons 35 to 44 years) [6]. Among LAC adults, the percentage of males reporting alcohol abuse was more than 3 times higher than the percentage of females (16% versus 5%). Comparatively, in 2005, 8% of men and 5% of women reported heavy drinking in California [6].

Other: In contrast to what other studies have reported [3,7], HIV infection or IDU was infrequently observed in LAC IGAS cases. In one study, 7% of adult IGAS cases reported HIV infection and 24% reported a history of IDU [7]. In contrast, HIV and IDU were reported in 2% and 6% of LAC IGAS cases, respectively. In addition, only 2% of LAC IGAS cases were nosocomial, compared to 5% in the United States and 14% as reported in Canada [2].

DISCUSSION

By conducting IGAS surveillance in LAC, risk factors of persons presenting with IGAS infection can be identified which may assist in the timely diagnosis and treatment of these infections. With the recent increase in community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA), diagnosing IGAS in persons presenting with skin infections is challenging, especially since one of the most commonly prescribed antibiotics for CA-MRSA is not indicated for treating IGAS infections.

In LAC diabetes was the most prevalent risk factor, especially in adults aged 45 years and older. In older adults, risk factors for IGAS included chronic heart disease and malignancy, while a history of blunt trauma and alcohol abuse are reported more often in younger age groups. Physicians should recognize risk factors for IGAS infection and counsel their diabetic and older patients with chronic disease about their increased risk for IGAS and other infections. In addition, IGAS should be considered in younger patients, especially those with a history of trauma or alcoholism.

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USING SPATIAL SATSCAN™ STATISTICS IN SYNDROMIC SURVEILLANCE TO ENHANCE ILLNESS CLUSTER IDENTIFICATION

BACKGROUND

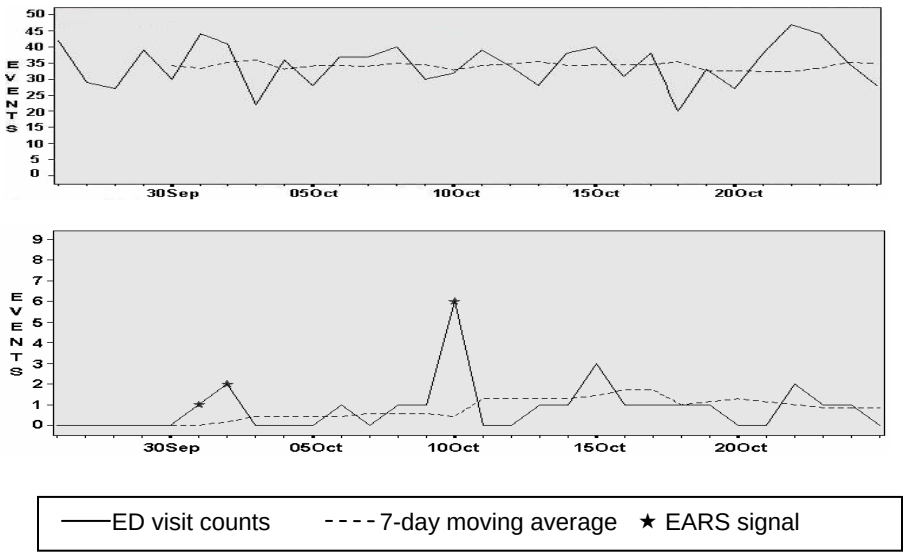
The Bioterrorism (BT) Surveillance Unit of the Los Angeles County (LAC) Department of Public Health, Acute Communicable Disease Control (ACDC) program conducts syndromic surveillance for early event detection and ongoing health events in near real-time. The syndromic surveillance system receives daily Emergency Department (ED) data representing over 40% of ED visits in LAC. These data are automatically classified into five major syndrome categories: gastrointestinal, neurological, rash, respiratory, and influenza-like illness. Syndrome-specific, ED-specific signals are generated when daily visits exceed thresholds determined by the Centers for Disease Control and Prevention (CDC)'s Early Aberration Reporting System (EARS) algorithm. In addition, SaTScan™ statistics are calculated using patient home zip codes to detect syndrome-specific spatial clusters. This report describes the utility of using both temporal and spatial analyses for assessing a rash signal and a neurological signal in 2006.

METHODS

Rash Signal: On October 10, 2006, syndromic surveillance detected a rash signal of six visits at one ED—two over the threshold (Figure 1). The small increase did not cause a substantial deviation in the total number of rash-related visits for all EDs. The line list, however, revealed that five of the patients resided in one zip code and synonymously cited chief complaints of "fever", "hair loss", and "rash." SaTScan™ analysis not only detected the rash cluster, but also served to emphasize that seeing five rash-related ED patients from this particular zip code on the specific date was extremely unusual (p=0.001) (Figure 2). Since the SaTScan™ cluster only included five rash patients, this implied that the sixth patient did not reside close enough to be included in the significant cluster. As also was insinuated by comparing chief complaints, this suggested that the sixth patient was probably an unrelated case.

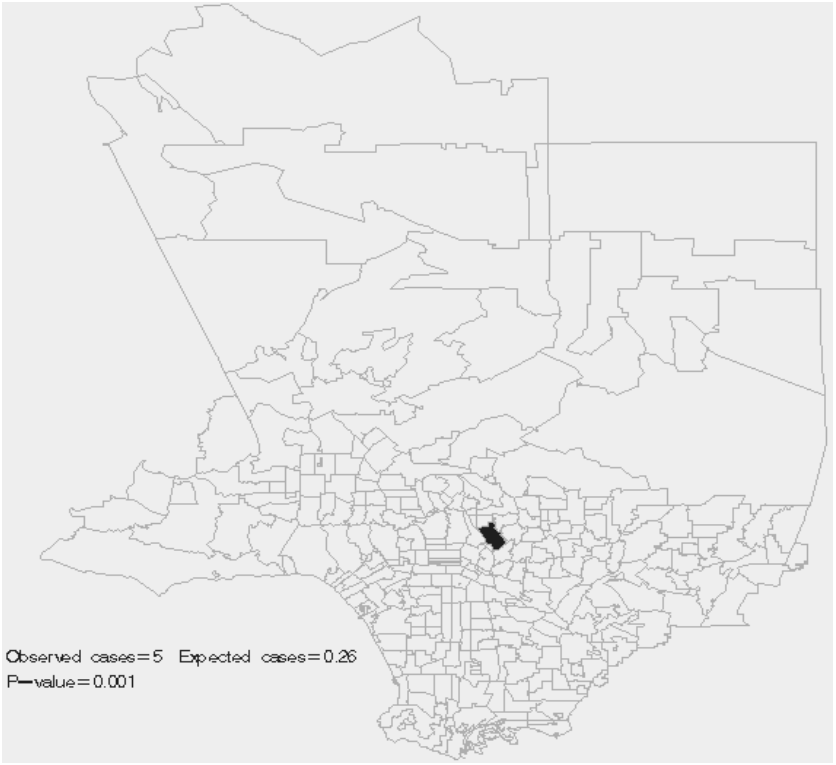
The subsequent ACDC Hospital Outreach Unit (HOU) investigation revealed that all five patients were diagnosed with scabies and were from the same household, consisting of a father, mother, and three children. All were treated and discharged with thorough scabies education and instructions to receive follow-up care from a primary medical physician.

Figure 1. Rash Syndrome ED Visit Counts for All Participating EDs (top) and in the Specific ED that Generated a Signal (bottom), with 7-Day Moving Average Trend Lines (dashed)



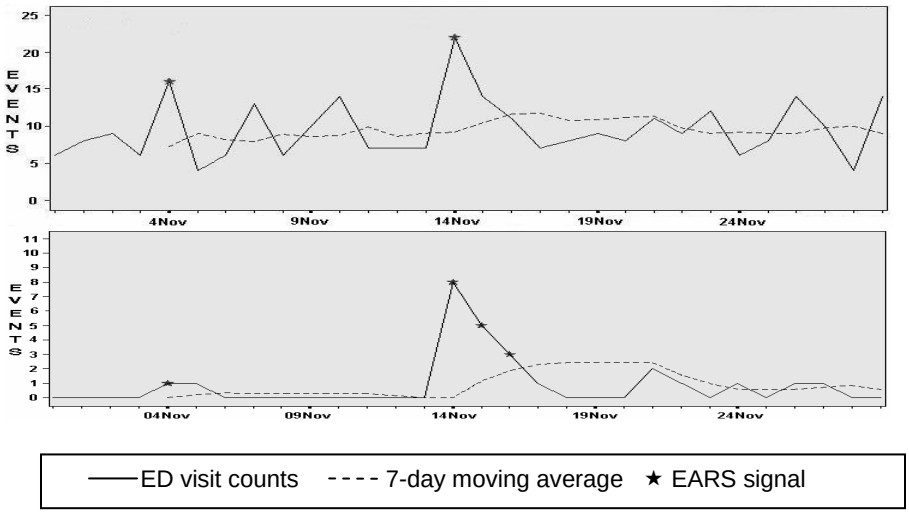
It is unknown how the patients were originally infected, but some or all had been symptomatic for weeks before visiting the ED. Although there was potential for a scabies outbreak, syndromic surveillance did not detect any rash-related unusual activity in subsequent days. The case was closed the following day, when rash syndrome counts returned to temporally and spatially normal levels.

Figure 2. Map of Rash Syndrome Cluster of Patient Residence Zip Codes on October 10, 2006 for All Participating EDs



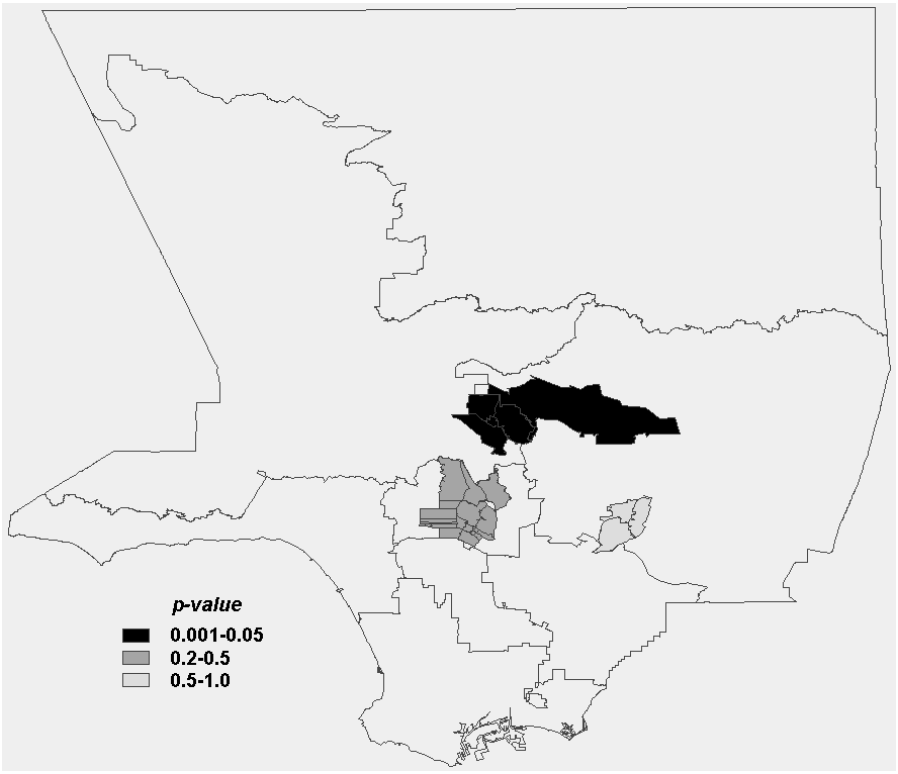
Neurological signal: On November 14, 2006, ACDC was alerted to a high school student who was symptomatic for meningitis. Syndromic surveillance subsequently detected five neurological syndrome visits over the threshold at one ED located in the vicinity of the high school (Figure 3). Unlike the scabies signal, this increase was large enough to cause a substantial aberration in the combined neurological syndrome counts across all EDs. Five of eight neurological syndrome patients were classified as meningitis-related due to having chief complaints which included “fever,” “headache,” or “meningitis.” Four patients cited “meningitis exposure.”

Figure 3. Neurological Syndrome ED Visit Counts for All Participating EDs (top) and in the ED Closest to the Event (bottom), with 7-Day Moving Average Trend Lines (dashed)



SaTScan™ also detected a substantial cluster of neurological syndrome patients from six adjacent zip codes in the vicinity of the high school on the same day (p=0.001) (Figure 4). Two additional neurological syndrome clusters were identified, albeit statistically weak (p≥0.2). Enhanced surveillance was thus expanded to neighboring EDs even if signals at those EDs were not detected. No additional meningitis-related visits were verified. Meanwhile, public health officials organized mass prophylaxis for all students potentially exposed to the index case. Eight more possibly meningitis-related visits to the same ED occurred over the next two days, of which five reported "meningitis exposure" and in some cases, specifically cited the high school in their chief complaint. The number of possible meningitis-related ED visits and SaTScan™ spatial statistics returned to normal on subsequent days, providing affirmation that a meningitis outbreak was successfully averted.

Figure 4. Map of Neurological Syndrome Cluster of Patient Residence Zip Codes on November 14, 2006 for All Participating EDs



DISCUSSION

SaTScan™ is a tool for analyzing syndromic surveillance ED data that enhances ED-specific temporal (count-based) analysis. Since patient zip codes may not always correlate with which EDs were visited, SaTScan™ analysis may detect significant clustering in locations far from the hospital EDs at which temporal signals may be detected. It is also possible that SaTScan™ can detect substantial patient clusters when no ED-specific temporal signals are generated. This may occur if many people residing in an area become ill but choose to visit EDs in different locations.

Since SaTScan™ utilizes patient home zip code data, it may not be effective for detecting clusters if many zip code data are missing or if causative exposures took place far from home. However, when patient residence zip codes reflect the locations of their exposure, SaTScan™ may significantly improve the depiction of health events given by ED-specific temporal data alone. SaTScan™ not only corroborated the ED-specific rash signal, but also provided a quantitative basis with which the sixth rash patient could be excluded from the cluster. In the instance of the meningitis signal, SaTScan™ demonstrated its ability to help direct the locations to which surveillance should be expanded. Syndromic surveillance is thus amplified when SaTScan™ statistics are utilized in conjunction with ED-specific temporal signals to illustrate the spatial scope of health events and monitor subsequent days for secondary outbreaks.

SaTScan™ is a trademark of Martin Kulldorff. The SaTScanTM software was developed under the joint auspices of (i) Martin Kulldorff, (ii) the National Cancer Institute, and (iii) Farzad Mostashari of the New York City Department of Health and Mental Hygiene.

EMERGENCY DEPARTMENT SYNDROMIC SURVEILLANCE AND POPULATION-BASED HEALTH MONITORING IN LOS ANGELES COUNTY

BACKGROUND

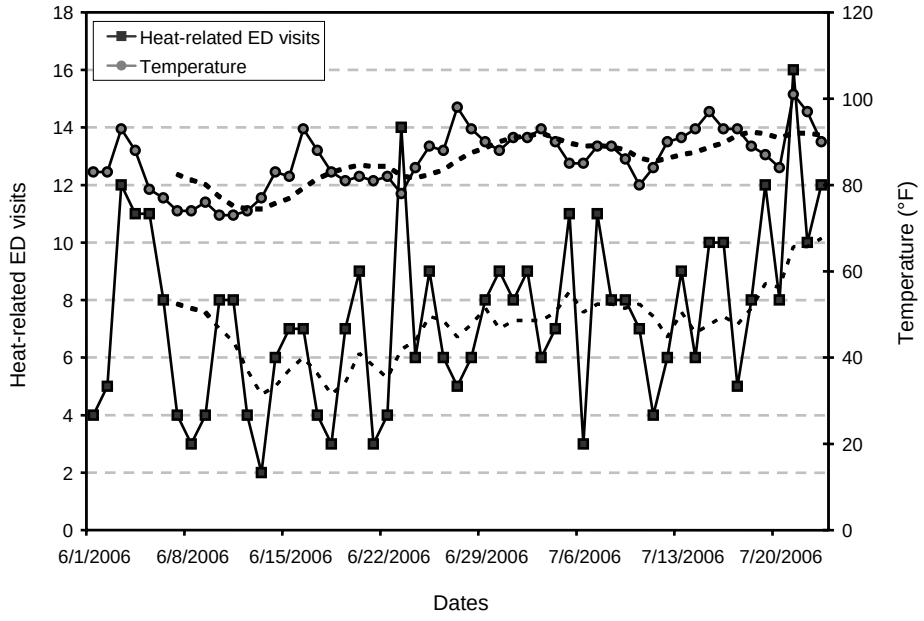
The Bioterrorism (BT) Surveillance Unit of the Los Angeles County (LAC) Department of Public Health (DPH), Acute Communicable Disease Control (ACDC) program analyzes Emergency Department (ED) data on a daily basis. The development of this system was primarily for early event detection and surveillance of ongoing health events in near real-time. Currently, the hospital EDs participating in syndromic surveillance monitor over 40% of the ED visits in LAC. Through an automated process, ED data from the previous day are collected and evaluated for aberrations in count and spatial distribution by utilizing the Centers for Disease Control and Prevention (CDC)'s Early Aberration Reporting System and SaTScan™ statistics. ED admitting chief complaints are classified using a SAS-based language processing code into five major syndrome categories: gastrointestinal, neurological, rash, respiratory, and influenza-like illness. Other complimentary systems used for surveillance include: Reddinet, which provides a daily tabulation of total ED visits from 65 participating hospital EDs, as well as ED-related hospital admittances, ICU admittances, and deaths; over the counter medicine sales provided by the Real-time Outbreak and Disease Surveillance laboratory; and LAC Coroners' mortality data. A daily report summarizing syndromic surveillance results and any signals generated is sent to key stakeholders seven days a week.

The syndromic surveillance system is automated, near real-time, population-based, and enables the surveillance of health indicators that would otherwise be difficult if not impossible for both hospital and ACDC staff. Typical usage of the system may be extended for various enhanced surveillance activities by creating additional syndrome categories tailored to specific illnesses or conditions. This report describes examples of how ED data was harnessed in 2006 to detect and monitor ED visits related to: 1) a summer heat wave, 2) a beach sewage spill, and 3) *E. coli* associated with contaminated bagged spinach. These examples demonstrate the flexibility of syndromic surveillance in capturing ED visits related to infectious and non-infectious, broadly defined and specific illnesses.

METHODS

Heat-related ED visits: While June 2006 was characterized by relatively normal temperatures for the month, July 2006 was the warmest July on record in many parts of California, during which a sustained heat wave caused a flood of ambulance calls, hospitalizations, and deaths due to heat-related illnesses [4]. Temperatures in LAC varied by region—downtown Los Angeles experienced 17 days during which maximum temperatures met or exceeded 90 degrees, while Woodland Hills experienced 24 days of triple digit temperatures [5].

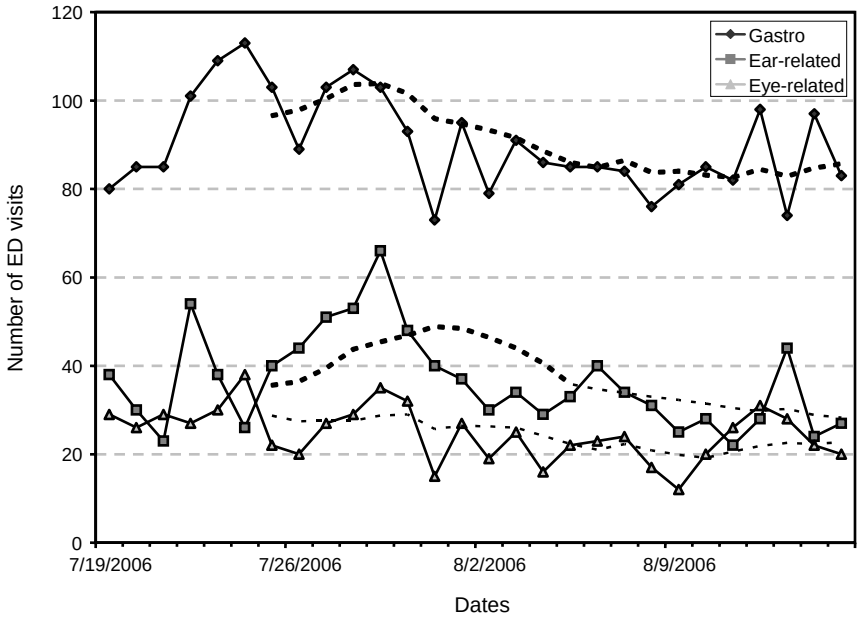
Figure 1. Daily Heat-Related ED Visits from 16 Hospital EDs in LAC, and Temperature Data from the Metro Area from June 1, 2006 to July 23, 2006, Overlaid by Seven-Day Moving Average Trend Lines



In order to estimate and track heat-related morbidity in LAC, the BT Unit monitored ED surveillance data from 16 hospitals in LAC to detect heat-related visits from June 1, 2006 to July 23, 2006. Patients with chief complaints containing key words such as: “heat exhaustion”, “dehydration”, “sun stroke”, “hyperthermia”, “overheat”, “heat rash”, and “feel hot” were classified as heat-related visits. Daily average temperatures for the LAC metro area were obtained from the website, weather.com and were analyzed for correlation with the number of heat-related ED visits. The ED data showed that the average number of heat-related visits per day substantially increased from 6.6 in June, to 8.3 in July (p=0.04). Daily heat-related ED visit counts were weakly correlated with temperature (r=0.35), although this may be in part because some heat-related ED visits may not have occurred on the day of exposure (Figure 1).

Health monitoring following raw sewage spill: On August 8, 2006, 20,000 to 30,000 gallons of raw sewage spilled near Ballona Creek and Marina Del Rey due to complications from a broken sewage line in Culver City, prompting the closure of two miles of beach [3]. While water tests indicated that bacteria returned to safe levels by August 10, 2006, beaches were not closed until 24 hours after the spillage ensued, exposing beachgoers to potentially high levels of bacteria. In response to this public health concern, syndromic surveillance was used to monitor increases in gastrointestinal, ear-related, or eye-related illnesses throughout LAC during this period, since these were the syndrome categories most likely to be experienced by those exposed to the sewage spill. Visits with chief complaints such as “otitis”, “ear pain”, and “ear ache” were classified into the ear-related category, while visits with chief complaints such as “conjunctivitis”, “eye pain”, “pink eye”, and “red eye” were classified as eye-related visits. Patients under two years of age were excluded.

Figure 2. Daily ED visits in 17 Syndromic Surveillance Participant ED Hospitals from July 19, 2006 to August 15, 2006. Historical Data (Data Prior to August 8, 2006) was Retrospectively Plotted for Baseline Comparison, along with Seven-Day Moving Average Trend Lines



There did not appear to be any increasing trend in ear-related, eye-related, or gastrointestinal ED visits subsequent to the sewage spill (Figure 2). Although it is possible that the syndromic surveillance was not sensitive enough to detect a change in ED visits resulting from the spill, the simplest explanation is that a substantial increase in morbidity did not occur. Given that the sewage was diluted once entering the ocean, and given that many viruses are unstable in an ocean environment, it was unlikely that many individuals would develop illnesses from their exposure, much less develop illnesses so severe as to necessitate visits to the ED. Corroborating evidence of this was provided by the LAC Environmental Health Division's Food and Milk Program, which interviewed 23 of 30 individuals who submitted foodborne illness reports during the days following the sewage spill. All denied visiting LAC beaches within three days prior to the onset of their illness.

Spinach outbreak: A widely publicized national *E. coli* outbreak related to spinach consumption resulted in 204 infected individuals in 26 states as of October 18, 2006, in which there were 102 hospitalizations and three fatalities [1,2]. Although the epidemiologic investigation concluded that contaminated spinach was not distributed within California, the BT Unit proceeded to conduct surveillance of any ED visits in LAC that were potentially related to the outbreak. Syndromic surveillance analyzed data from September 15, 2006 to December 11, 2006. The chief complaint and diagnosis fields were tagged if they contained the words "*E. coli*" or "Spinach" or the ICD-9 codes for *E. coli*. In all, the syndromic surveillance system detected 13 spinach outbreak-related ED visits in seven EDs. Of these, eight visits were reported in September, followed by two visits each in October and November, and only one visit in December. No additional suspect ED visits were subsequently found. All 13 patients were followed up by the ACDC foodborne unit, and none were diagnosed with *E. coli* infection. Eventually, only two residents of Shasta and Riverside counties in California were confirmed positive for the *E. coli* strain related to the outbreak [1,6].

DISCUSSION

While syndromic surveillance was initially developed for early detection of bioterrorism events, it has also been proven to be useful as an overall monitor of the public's health. No other system was or is now capable of providing a depiction of the public health impact of the 2006 summer heat wave, sewage spill, and the multi-state *E. coli* outbreak on LAC residents; much less a temporal and spatial statistics-based assessment utilizing as much population-based data as was generated by the system, and in as near to real-time. Syndromic surveillance is also the only system capable of consistently generating and analyzing syndrome specific data without requiring additional steps for the hospital EDs once connected to the system. This may be especially important during a large-scale outbreak, for which classic methods of surveillance data collection (e.g., mandating the reporting of specific illnesses), may be time and resource expensive for both reporting medical providers and County epidemiologists who must manually tabulate incoming data.

Syndromic surveillance is not without its imperfections. Mild illnesses are difficult to capture, since they may not cause people to visit EDs. Other underlying medical conditions may cause symptoms similar to those of the illness of interest, and since only some hospital EDs transmit diagnosis data or provide a key that can be used to relocate patient records, it is currently impossible to completely eliminate misclassifications of syndrome categories. However, this should not affect the system's capability to assess changes in incidence, assuming that the same percentage of data is misclassified at any time when querying the same syndrome definition. For instance, assuming that the baseline number of heat-related ED visits established in June was applicable for July as well, syndromic surveillance was able to detect an increase in heat-related ED visits for the month, which corresponded with the increase in temperature. Syndromic surveillance also served in this capacity to provide assurances that the risks for potential outbreak events caused by the sewage spill and *E. coli* spinach contamination were stabilized.

Syndromic surveillance offers an easily configured and rapidly accessible population-based surveillance mechanism for illnesses that may otherwise not be rapidly quantifiable in LAC and surpasses other systems that cannot generate as much data as is collected and analyzed in as timely a manner to detect and monitor specific illnesses.

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VARICELLA OUTBREAK EPIDEMIOLOGY IN AN ACTIVE SURVEILLANCE SITE, 1995-2005

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ABSTRACT

We report on varicella disease outbreaks identified in an active surveillance site from 1995 to 2005 and describe trends and characteristics of the outbreaks. Cases of varicella were reported to the active surveillance project and outbreaks were defined retrospectively as ≥5 varicella cases epidemiologically linked to a common setting occurring within one incubation period. Outbreaks were grouped by calendar year. From 1995-1998 to 2002-2005, varicella outbreaks significantly decreased in number, from 236 to 46 ($p<0.001$); in size, median number of cases per outbreak from 15 to 9 ($p<0.001$); and duration, from 44.5 days to 30 days ($p<0.001$). The median age of outbreak cases increased from 6 to 9 years ($p<0.001$). The one-dose varicella vaccination program has been successful with decreasing the number of outbreaks and cases; however, challenges remain with controlling outbreaks among vaccinated persons and targeting vaccination efforts to susceptible older age groups.

This article has been accepted for publication in the Journal of Infectious Diseases supplement devoted to varicella.