Acute Communicable Disease Control Special Studies Report

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OUTBREAK OF *ALCALIGENES XYLOSOXIDANS* IN AN OUTPATIENT HEMATOLOGY OFFICE

On January 16, 2002, Acute Communicable Disease Control (ACDC) of the Los Angeles County Department of Health Services (LAC DHS) was notified by the hospital epidemiologist at Hospital A about a cluster of patients who had blood stream infections (BSI) with *Alcaligenes xylosoxidans* (Alcaligenes). Alcaligenes is a gram-negative, waterborne organism that has rarely been reported as a cause of outbreaks. All patients received outpatient chemotherapy at a single oncologist's office (Office B). A telephone survey of the microbiology laboratories of Hospital A and 4 surrounding hospitals was performed requesting a line listing of all patients with positive blood cultures for Alcaligenes in the past 3 months. One laboratory identified 3 cases of Alcaligenes BSIs, and Hospital A laboratory identified 7 cases; all 9 patients were associated with Office B (one case-patient had positive blood cultures reported from both laboratories). The other 3 hospitals reported that they did not have any Alcaligenes BSIs identified in the previous 3 months.

METHODS

Investigation into the outbreak concentrated on Office B.

Case-Control Study: A matched case-control study was performed to determine risk factors for infection. A case-patient was defined as a patient of Office B who had a positive blood culture for Alcaligenes between November 2001 and January 2002 found on retrospective laboratory review and who had a clear onset date of systemic symptoms (chills/fever/nausea/fatigue) as documented in the medical chart or by interview with the medical staff. Five to seven controls per case were selected. Controls were well patients of Office B randomly selected from those who attended the Office B for treatment on the same day as a case-patient, closest to onset of symptoms by case-patients. Variables included age, gender, underlying diagnosis, intravenous medications, and the presence of a central venous catheter (CVC).

Prospective Cohort Study: A prospective blood culture surveillance system was set up to identify possible unidentified Alcaligenes BSI or CVC colonization. All patients with CVC who attended Office B since November 2001 were sent a letter asking them to make an appointment at Office B to have a single blood culture drawn through the CVC. CVCs would be removed if the blood culture was positive.

Environmental Investigation: Numerous open multi-dose containers of heparin, saline, alcohol and iodine were collected for microbiologic analysis at the Public Health Laboratory (PHL) of the LAC DHS. Environmental samples of water and swabs from tabletops and healthcare workers' hands were also collected for microbiologic analysis.

Laboratory Investigation: Blood isolates of Alcaligenes from case-patients were obtained from Hospital A laboratory; for comparison, Alcaligenes isolates from a large local reference laboratory were also obtained. All isolates underwent analysis by pulsed-field gel electrophoresis (PFGE) at the LAC PHL. A CVC was sent to the Centers for Disease Control and Prevention (Atlanta, GA) to test for the presence of an Alcaligenes biofilm.

Infection Control: Staff members from ACDC made several site visits to Office B during January and February and continued to interview the staff by telephone in March and April. Staff members were interviewed for training, experience, and practices related to IV medication administration; procedures were observed.

RESULTS

Case-Control Study: The retrospective chart and laboratory review revealed a total of 9 patients with symptomatic Alcaligenes infection. The earliest onset date was November 19 and the latest was January 11. Case-patients were younger than controls (the mean age of cases was 63.5 years, range 41–73, the mean age of controls was 73.2 years, range 35–89; $p = 0.047$). Case-patients had different underlying diagnoses and different chemotherapy regimes. Seven case-patients with clear onset dates were selected for the case-control study. Significantly, on matched case-control analysis, all 7 case-patients had a CVC at the time of illness onset, versus 4 of 47 control patients ($p<0.0001$). (The 2 other patients, not included in the case-control study, also had CVC.)

Prospective Cohort Study: Twenty-nine patients with CVCs had blood cultures taken in February 2002. Three patients had cultures positive for Alcaligenes, two were intermittently symptomatic.

Environmental Investigation: Environmental cultures and cultures from open bottles did not reveal any Alcaligenes. A sample from an open saline bottle in the infusion room was positive for *Bacillus circulans* and a water sample was positive for *Moraxella* species.

Laboratory Investigation: PFGE of six Alcaligenes BSI isolates from the case-patients shared an identical pattern; 3 isolates from a local reference laboratory all had different PFGE patterns. The CVC taken from an asymptomatic patient identified on the prospective cohort study revealed a biofilm containing Alcaligenes. The PFGE of the biofilm matched that of the outbreak strain.

Infection Control: Multiple breaks in infection control were noted during the office visits, including:

- use of multi-dose vials of heparin and saline;
- allowing vials to be used over a period of days, sometimes without recording the open date;
- failure to use sterile gloves to put in peripheral intravenous lines (IV); and
- failure to wash hands between patients.

Untouched and opened multi-dose vials of heparin and saline were kept in patient examining rooms and on carts in the infusion/treatment room. Heparin and saline flushes were individually prepared by office personnel on an “as needed” basis. Interviews with staff revealed that patients with CVC received heparin and saline flushes before and after using the CVC for blood-draws or infusions. Patients without a CVC who needed blood samples drawn for tests did not receive a flush. However, patients without a CVC who needed blood-work done before receiving an infusion received a heparin and saline flush after a peripheral IV was placed.

CONCLUSION

The following facts led us to conclude that the cause of the outbreak was probably the re-use of a contaminated vial of heparin or saline leading to the formation of a CVC Alcaligenes biofilm and BSI in patients with CVC: 1) because the patients with CVC received significantly more saline flushes than patients with temporary peripheral IV, 2) because heparin and saline vials were reused, and 3) because the presence of a CVC can lead to biofilm production.

The heparin and the saline could have been contaminated from the first patient in November. Patients who received injections in November and December might not have become immediately ill. A biofilm could have developed over time, intermittently causing illness when the CVCs were manipulated. The finding of an asymptomatic patient with a CVC Alcaligenes biofilm supports this theory. The fact that ACDC could not demonstrate Alcaligenes in the heparin or saline samples taken for testing is not significant since a vial could have been contaminated several months prior and discarded by the time of the investigation.

There have only been a few recorded outbreaks of Alcaligenes xylosoxidans—all nosocomial and associated with contamination of a hospital product but none associated with a multi-dose vial [1–3]. However, nosocomial bacterial and viral outbreaks associated with multi-dose vials are well documented [4–7]. This outbreak reinforces the need for meticulous infection control.

FOLLOW-UP

With proper education of the staff and removal of multi-dose vials of heparin and saline, no further Alcaligenes BSI were reported from Office B.

During the course of the investigation other irregularities, which may not have had bearing on the Alcaligenes outbreak, were observed. It was determined that of the 4 or 5 employees of Office B who regularly accessed CVC, inserted peripheral IVs, mixed or administered chemotherapy, or drew blood, only one was a registered nurse with a California license. The rest were said to be trained as nurses or doctors in other countries but were not licensed in California. These workers functioned as medical assistants. Calls to several hospital-based oncology clinics revealed that their nurses were required to be licensed in California, have standardized training in oncology, pass a written test, and have annual refresher courses with competency standards.

Calls to several hospital-based oncology clinic pharmacies demonstrated that the community standard of care for compounding IV chemotherapy calls for either a pharmacist or a supervised pharmacy technician. Office B used a medical assistant with no formal training to compound the chemotherapy. It was also not clear that the standard of care for labeling medications or having them double-checked by trained professional was met.

A complaint was made to the California Medical Board, and a lengthy investigation ensued which found that the medical director of Office B was in violation of the standard of practice by using medical assistants to perform invasive procedures.

Based on this investigation, the Medical Board updated its frequently asked questions (FAQ) sheet on the roles and responsibilities of medical assistants during the spring of 2003 (see www.medbd.ca.gov/Medical_assFAQ.htm) specifically mentioning that medical assistants cannot administer chemotherapy or monitor patients when they have been given chemotherapy and that medical assistants are not allowed to access central lines or place peripheral IVs.

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DEVELOPMENT OF LOS ANGELES COUNTY SMALLPOX RESPONSE PLAN

BACKGROUND

On November 21, 2001, the Centers for Disease Control and Prevention (CDC) released its first interim guidelines to be used by states and local health departments for the development of response plans to a potential biological terrorist smallpox event. Early in 2002, the Director of Public Health directed appropriate staff to collaborate and develop a local plan for responding to a smallpox emergency should it occur in Los Angeles County (LAC). On January 8, 2002, a working group consisting of key managers of the following 11 programs met to initiate the planning effort: Acute Communicable Disease Control; Immunization Program; Community Health Services; Environmental Health; Public Health Investigation; Nursing Administration; Emergency Medical Services; Public Health Laboratory; Health Assessment and Epidemiology; Public Health Communications; and Organizational Development and Training.

Over the course of several months, the working group clarified and developed procedures to address many important issues. This included: command and control, emergency personnel and resource mobilization, surveillance and contact investigation activities, smallpox vaccination clinic operations, monitoring for adverse events to vaccination, isolation and quarantine, decontamination, risk communication, security, and training. The local response plan went through several iterations with a final draft completed September 2002.

OVERVIEW

The LAC Smallpox Preparedness, Response, and Recovery Plan (LACSPRRP) is organized into three major sections which correspond to the temporal unfolding of activities required to insure an adequate response to a smallpox event. The Preparedness Section addresses the legal authority for implementing all of the required activities described in the plan. This section, also, describes how the county will develop the capacity for vaccinating large numbers of people against smallpox; procedures for enhanced surveillance activities to detect the first case, and activities for enhancing the public health laboratory's capacity for collecting, handling, and testing specimens. This section also details the activities required to enhance the ability of local hospitals to participate in the response to a local smallpox emergency and details training activities for hospital as well as community based physicians and healthcare professionals regarding the diagnosis and treatment of suspect smallpox cases. Strategies for insuring adequate risk communication to the public via the media are also presented.

The Response Section lists criteria for activation of the plan and activation of departmental and county emergency operations centers; procedures for redeployment of staff including mutual aid personnel; instructions for the "incident command" management of the event; procedures for implementing vaccination operations, smallpox case and suspect case management, contact investigation, and surveillance and required quarantine activities. This section also lists the planning and intelligence activities that include the preparation of the incident command plan, analysis of epidemiological investigation and case data, and regular assessments of vaccination coverage levels. The Response Section ends by clarifying the logistical and support activities required for successful plan implementation and the specific financial tracking activities required for cost accounting purposes.

The last section of the LACSPRRP, Recovery, discusses the criteria for declaring an end to the smallpox emergency and the continued heightened surveillance activities that will continue to be maintained. This section also mandates an evaluation of the county's response to the smallpox emergency.

PREPAREDNESS VACCINATION

On November 22, 2002, the CDC requested that states and some of the larger counties, including LAC, develop and submit specific plans for vaccinating key public health and hospital healthcare workers who would be expected to respond to a smallpox emergency if such an emergency occurred. On December 9, 2002, the LAC Department of Health Services developed and submitted such a plan to the CDC; implementation of the vaccination plan began in January of 2003.

DESCRIPTION OF AN EMERGENCY DEPARTMENT-BASED SYNDROMIC SURVEILLANCE SYSTEM IN LOS ANGELES COUNTY*

BACKGROUND

Recent events have shown that there is critical need in public health for the accurate and timely detection of infectious diseases [1,2]. Prior to the events surrounding the terrorist attacks of September 11, 2001, most health departments relied on passive reporting of infectious disease, estimates of disease from secondary sources, self-reported disease from population surveys, or anecdotal information conveyed by colleagues. Unfortunately, this information often came in sporadically or was sufficiently delayed such that response time was severely hindered. In order to respond more effectively to suspect illness and potential disease outbreaks, better methods for timely detection must be developed [3].

Rapid identification of unusual clusters of acute illness in the general population is a fundamental challenge for public health surveillance. Numerous projects have been developed specifically to provide improved surveillance for detecting emerging infections in urban populations. One of the tools created for early recognition and response to an infectious disease event is syndromic surveillance. In syndromic surveillance, healthcare utilization patterns and symptoms are categorized into generalized syndromes, rather than confirmed diagnoses, and are monitored in real time for the first signs of an unusual disease event including a covert bioterrorist attack, which may appear as clusters of affected victims seeking health care [1,4].

In response to the World Trade Center attacks and anthrax-contaminated letters in the fall of 2001, Acute Communicable Disease Control (ACDC) began an infectious disease surveillance project in the fall of 2001. This system relied principally upon chief complaint data from emergency department patient records organized into syndromes of interest. Use of chief complaint data was appropriate because it has been shown to have good agreement with final diagnosis, which often takes considerably longer to determine [4]. Utilizing chief complaint data also offered the advantage of rapid implementation, since all hospitals are required to maintain logs and would have the potential to expand into a regional system of surveillance. In addition, many chief complaint logs already exist in electronic form and are immediately available, whereas diagnostic information may require additional time for coding, be entered at a later time, or exist in paper format only.

Many other health departments across the nation have begun similar surveillance systems. For instance, Connecticut monitors admissions to all its acute hospital and visits to emergency departments to detect any bioterrorism event [5], Massachusetts utilizes ambulatory-care encounters [6], and New York City analyzes data from fifteen sentinel emergency departments [7]. Many other health departments and medical centers are currently researching and implementing similar systems. In addition to emergency departments, other possible sources may include community physicians, public health laboratories, school and work force absenteeism, pharmaceutical and over-the-counter sales [8], nurse hot line call [9], and nursing homes [10].

The following describes the Los Angeles County (LAC) emergency department-based surveillance system for the period January 1, 2002 through December 31, 2002.

METHODS

Data Sources and Syndrome Categories: Staff from ACDC receives emergency department logs daily from two large metropolitan hospitals in the City of Los Angeles (Hospital 1 and Hospital 2). For each

* Adapted from Velikina R, Jones J, Aller R, Reynaldo S, et al. Description and Evaluation of an Emergency Department-Based Syndromic Surveillance System in Los Angeles County (*in development*).

daily log received, the patient's identification number, age, sex, chief complaint, and final diagnosis are entered into a database. Patient chief complaints are then classified into one of four categories: gastrointestinal (GI), respiratory, rash or neurological. Complaints not matching one of these four categories were excluded from analysis. The GI category includes complaints of nausea, vomiting, or diarrhea alone or together with gastritis or gastroenteritis. A complaint is categorized as respiratory if it includes influenza, acute bronchitis, acute pharyngitis, acute laryngitis, pneumonia, cough, viral syndromes, upper respiratory infections, sore throat, or acute sinusitis. Rash includes all rash complaints other than urticaria, hives, scabies, dermatitis, cellulitis or allergic reaction. Finally, a complaint is categorized under the neurological category if it includes new onset seizures, symmetrical facial paralysis/drooping, encephalitis, or meningitis.

Data Analysis: A thirty-day baseline was established for each of the four syndromes to detect fluctuations in the number of visits due to natural or unnatural events. A thirty-day baseline was chosen because it provides a comparison with minimal variation (as opposed to the previous day or week) but is still sufficiently sensitive to detect an event. If the current day observation exceeds 2 or 3 standard deviations beyond previous thirty-day average, a "signal" will be generated. The signal generated from the thirty-day average plus 3 standard deviations results in a more conservative alarm system than the thirty-day average plus 2 standard deviations. Analyses were conducted using both methods, in part to evaluate the optimal method for specific syndrome detection in LAC.

IF [Average count from previous 30 days + 2 or 3 standard deviations from previous 30] < [Current day's count] **THEN** "signal"

Positive signals are investigated by the ACDC clinical and epidemiological staff. If further clarification is necessary, the hospital infection control practitioner (ICP) is contacted to further investigate the case. If an unusually high number of cases is associated with a signal, emergency room staff are contacted for more detailed information on patient symptoms, disease progress, lab tests, and final disposition to determine whether the signal represents a one-day event or the beginning of an upward trend.

RESULTS

For 2002, Hospital 1 had a total of 6 signals utilizing the more conservative method (3 standard deviations) and 28 utilizing the less conservative method (2 standard deviations) across the syndromic categories (Table 1). Hospital 2 had 23 signals using the more conservative method and 73 using the less conservative method across the syndromic categories (Table 1). Both gastrointestinal and respiratory illness followed a seasonal pattern. Gastrointestinal visits fluctuated throughout the year. Respiratory visits peaked in the winter months and then began to decline, after which they picked up again around November. There were very few rash- and neurological-related visits, with no apparent seasonal trend.

Table 1. Number of Signals by Site, Syndrome and Signal Type, 2002

	Hospital 1		Hospital 2	
Syndrome	2 Standard Deviations	3 Standard Deviations	2 Standard Deviations	3 Standard Deviations
Gastrointestinal	10	1	16	2
Neurological	1	1	15	6
Rash	5	2	25	13
Respiratory	12	2	17	2
TOTAL	28	6	73	23

Gastrointestinal-Related Visits: There were a total of 1,100 gastrointestinal-related visits in 2002 from Hospital 1 and 4582 from Hospital 2. Hospital 1 had 10 signals using a 2 standard deviation method and one signal using a 3 standard deviation method (Figure 1). Hospital 2 had 16 signals using a 2 standard deviation method and two signals using a 3 standard deviation method (Figure 2). The following figures display findings based on a 3 standard deviation cut-off.

Figure 1. Number of Gastrointestinal-Related Daily Visits
Hospital 1, 2002

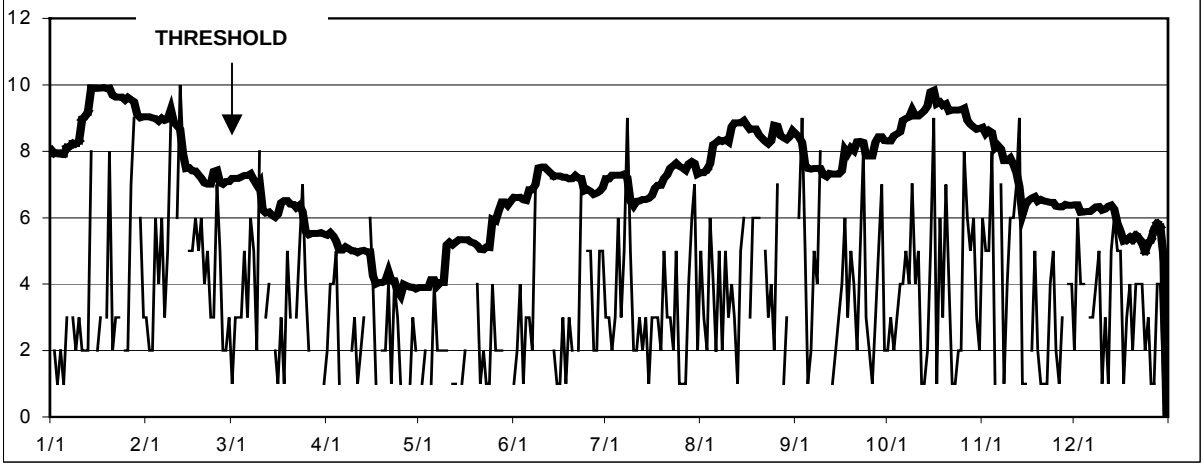
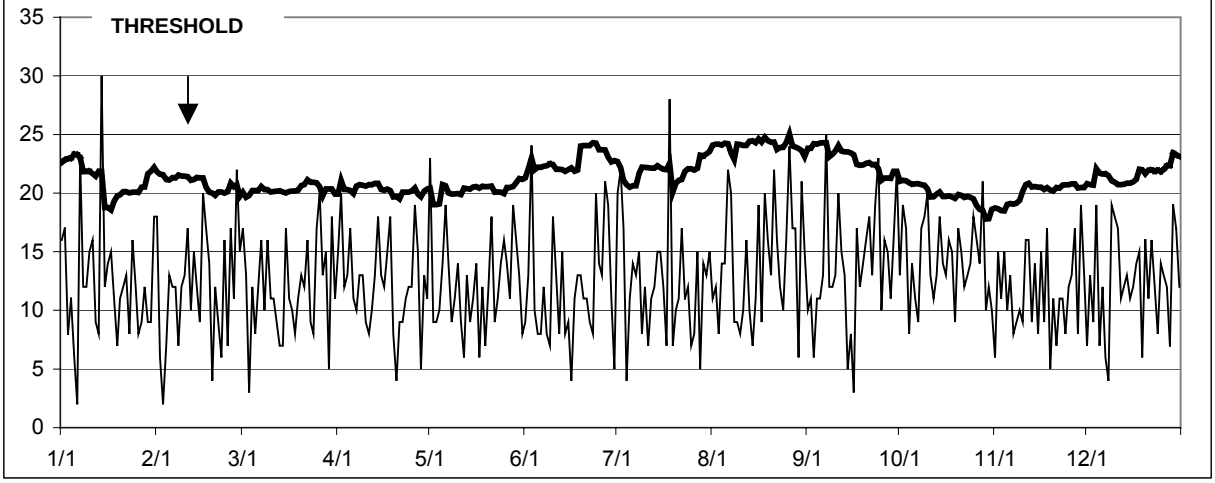
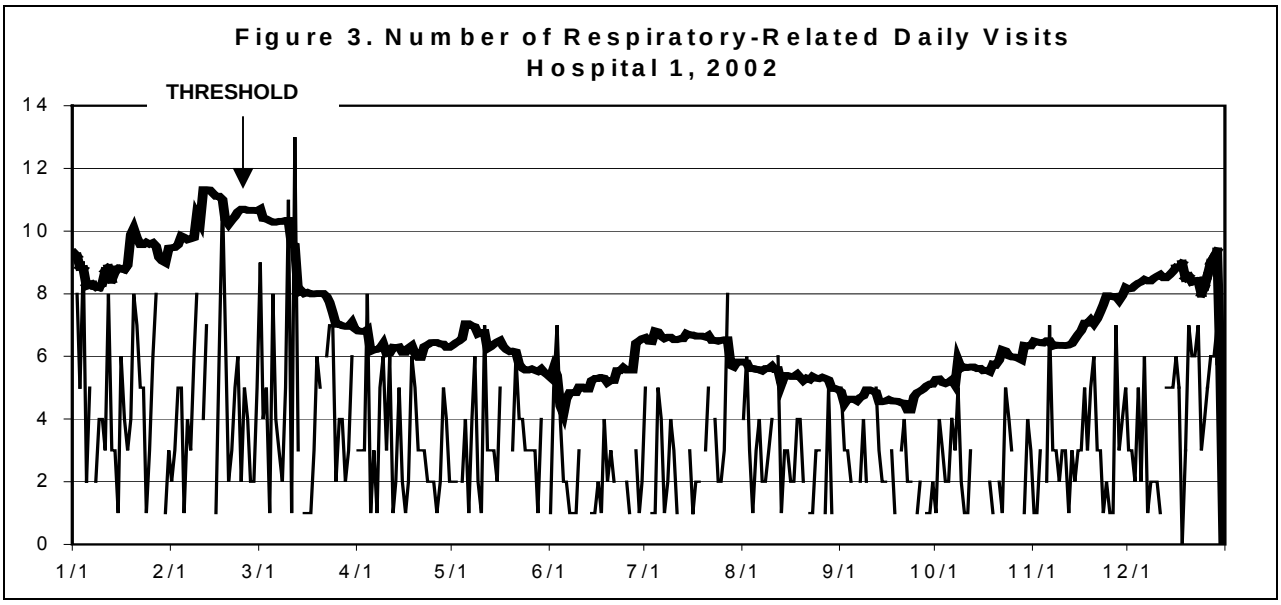
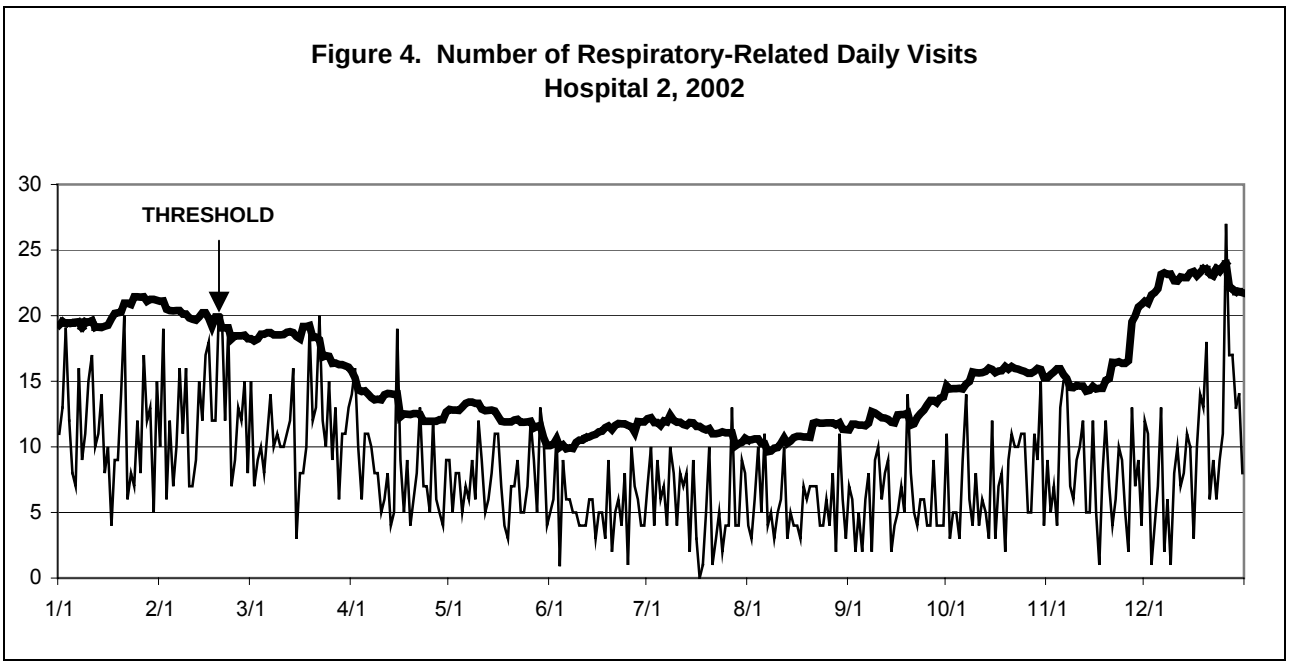


Figure 2. Number of Gastrointestinal-Related Daily Visits
Hospital 2, 2002

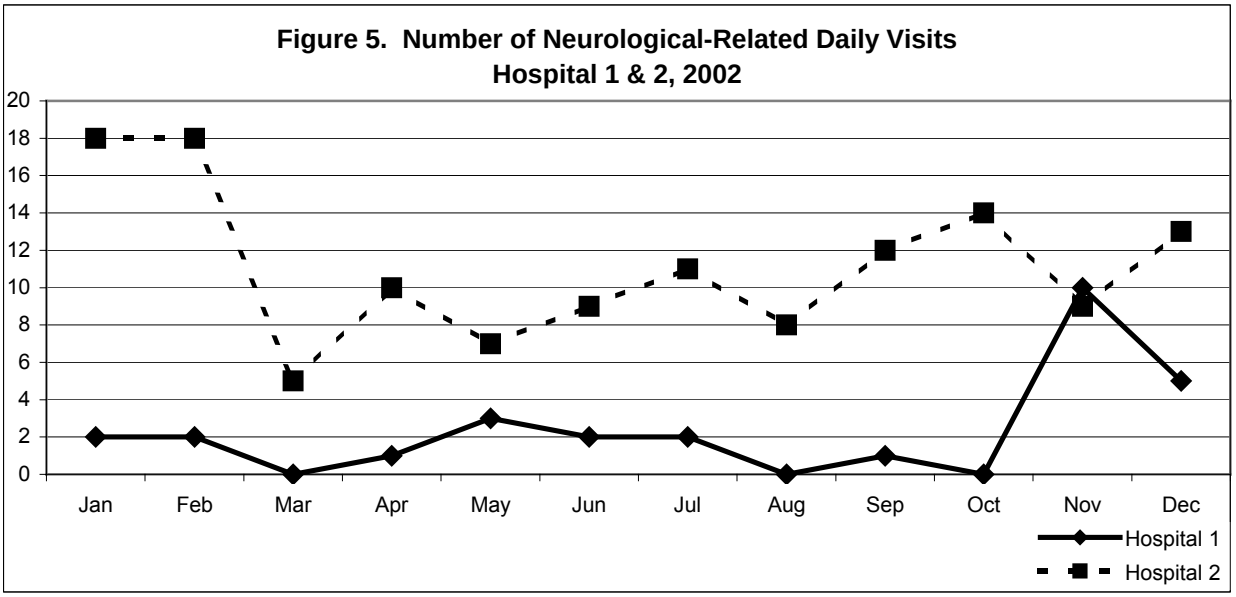


Respiratory-Related Visits: There were a total of 1,008 respiratory-related visits in 2002 from Hospital 1 and 2,989 from Hospital 2. Hospital 1 had 12 signals using a 2 standard deviation method and 2 signals using a 3 standard deviation method (Figure 3). Hospital 2 had 17 signals using a 2 standard deviation method and two signals using a 3 standard deviation method (Figure 4).

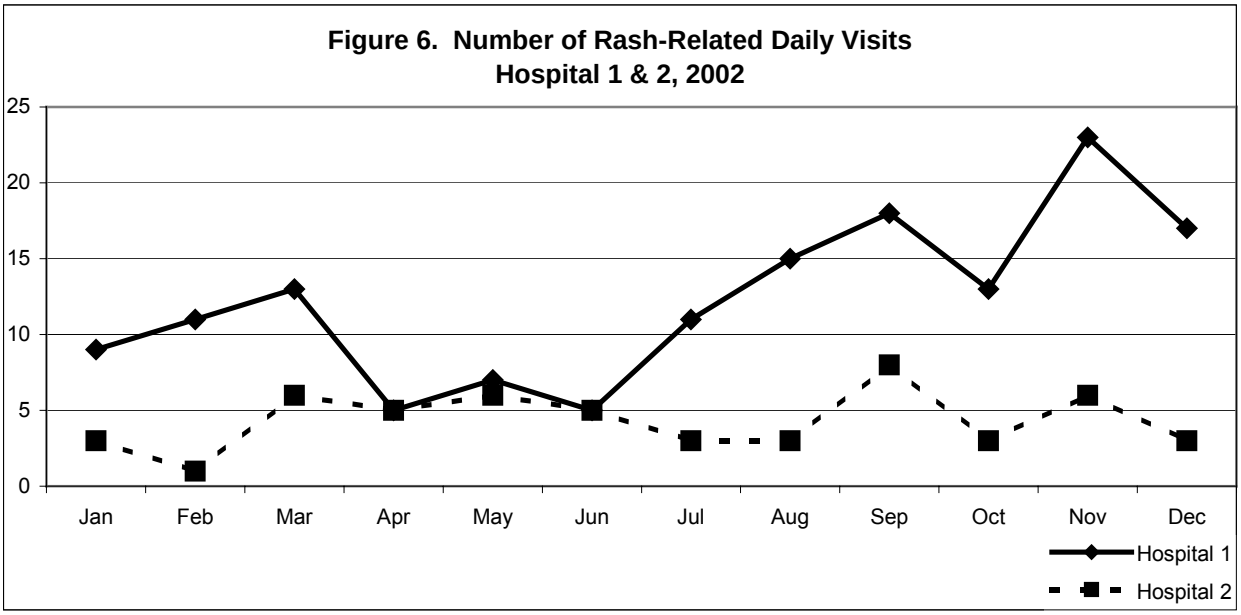




Neurologic-Related Visits: There were total of 28 neurologic-related visits in 2002 from Hospital 1 and 134 from Hospital 2. There was one signal using a 2 standard deviation method and one signal using a 3 standard deviation method for Hospital 1. Hospital 2 had six signals using a 3 standard deviation method. Because there were so few neurologic-related visits, they are presented grouped together by month (Figure 5).



Rash-Related Visits: There were a total of 147 rash-related visits in 2002 from Hospital 1 and 52 from Hospital 2. There were five signals using a 2 standard deviation method and two signals using a 3 standard deviation method for Hospital 1. Hospital 2 had 13 signals using a 3 standard deviation method. Because there were so few rash-related visits, they are presented grouped together by month (Figure 6).



CONCLUSION

Syndromic surveillance has the potential to become a useful tool in the early detection of a bioterrorist event or other emerging infectious disease outbreak. Establishing such a system can be cost-efficient, since all hospitals are required to maintain an ED log [11]. Syndromic surveillance also has the ability to assess a large number of episodes of illness for which no etiologic agents are identified, either because standard medical practice does not require that clinicians perform diagnostic tests, or because an unusual agent may fail to be detected by standard laboratory tests [12]. It is important to note that the specificity of an individual illness categorized as a "syndrome" need not be high, provided it is constant over time. The goal of a syndromic surveillance system is not to diagnose individual cases or find cases of reportable disease, but to detect emergent disease situations as rapidly as possible. Other advantages include circumventing the need for providers to initiate reporting and easy manipulation of the system for data analysis [11]. Lastly, syndromic surveillance has been shown to detect patterns and outbreaks that were not detected by traditional surveillance systems [13].

For a system to be a useful surveillance tool, it must be: simple, flexible, acceptable, have good data quality and predictive value positive, and be representative and timely [12]. In terms of simplicity, the LAC surveillance system involves few steps from the initial receipt of the emergency department log to the analysis of the data; however, it does require the time and labor of staff. Staff must review the emergency department log daily and determine whether the patients' chief complaints qualify to be classified into any of the four syndromic categories. The data must then be entered and analyzed which is time consuming. Since the purpose of this type of surveillance is to assess population health status in a real-time fashion, automating data submission and analyses would improve the system.

Another limitation is that the surveillance system is not sufficiently sensitive to detect an individual case. Because the surveillance system is based on a baseline of the number of cases of a particular syndrome during the previous thirty days, an individual case, even if due to bioterrorism, may not be sufficient to trigger a signal. Instead, a large outbreak of a particular syndrome that would result in a considerable increase in the number of patients seen in an ED would be necessary to produce a signal. Furthermore, sensitivity depends heavily on the syndrome. The surveillance system may require a large outbreak to detect the use of a gastrointestinal- or respiratory-related bioterrorist agent, but may require only 1-3 cases to detect a rash-or neurological-related agent, such as botulism, smallpox, or encephalitis since the frequency of neurological and rash syndromes is low. The system may be useful for the respiratory or GI syndromes, including anthrax, plague or tularemia, if they affect a wide geographic range and affect many individuals who seek care in an ED. Another limitation of the system is that it includes only 2 out of 82 emergency rooms in LAC and therefore, does not fully represent the population of LAC.

Although syndromic surveillance systems may be important in the early detection of a bioterrorist event, there is still much improvement that has to be made in order to optimize the effectiveness of such systems. Standardization of analytic methods as well as disease classification and categorization will aid in the interpretation of the analysis and will allow comparisons among different regions and states. Data mining of electronic data, such as exploring the utility of zip codes in assessing validity, will also help further the system. Most importantly, the effectiveness of the system must be assessed. The ability of syndromic surveillance to detect an infectious disease outbreak or bioterrorist event must be determined, whether through drills, models, real-life situations or other tools, before further refinement, such as complete automation, may be considered. Furthermore, demonstrated dual use benefits of syndromic surveillance would aid in establishing it as an integral to infectious disease detection. Until the system is established as a reliable tool, alert health care professionals will remain crucial to the early detection and timely response to infectious diseases.

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A VISIT TO A DAIRY FARM: CAMPYLOBACTERIOSIS AND RAW MILK

BACKGROUND

On September 10, 2002 a physician from a local university student health center reported a cluster of ill students who had visited a dairy farm in San Bernardino County and reportedly drank raw, unpasteurized milk. Approximately 20 students went to this farm and 8 of them reported to the student health center complaining of diarrhea; 2 of the students had stool cultures positive for *Campylobacter*. Acute Communicable Disease Control (ACDC) initiated an investigation to determine if there was any risk to the public's health and if control measures were needed.

METHODS

Case Definition: A case of outbreak-associated campylobacteriosis was defined as a person with culture-confirmed campylobacteriosis who visited the dairy farm during the weekend of August 30, 2002. A presumptive case was defined as a person with symptoms consistent with campylobacteriosis and a history of visiting the dairy farm during the weekend of August 30, 2002.

ACDC requested the student health physician provide a line list of ill students who went to the student health center for care and were part of the group that visited the dairy farm. ACDC interviewed students using a standardized questionnaire regarding exposure history and symptoms and other students who attended the weekend retreat. Stool was requested from symptomatic students who had not already submitted a specimen to the student health center. The Los Angeles County Public Health Laboratory tested the specimens for *Salmonella*, *Shigella* and *Campylobacter*. Confirmed cases and presumptive cases were reported individually as cases of campylobacteriosis. An analysis of risk factors was performed with available data. San Bernardino County Department of Public Health and the California State Department of Health Services were notified.

RESULTS

A total of 21 university students attended a work retreat during the weekend of Friday, August 30 to Sunday, September 1, 2002. The students stayed overnight at a church on Friday and Saturday nights. Groceries for meals were purchased at a local market on Friday evening.

Meals, which were exposures common to most attendees, did not include high-risk foods and no meal had a significant risk ratio (RR) for illness:

- Friday night snacks (RR = 1.00, p = 0.69) chips, salsa, veggies, dip, soda
- Saturday brunch (RR = 1.25, p = 0.53) muffins, bread, fruit, juices, bagels and cream cheese, peanut butter and jelly
- Saturday dinner (RR = 0.50, p = 0.10) pizza, salad, soda
- Sunday breakfast (RR = 0.58, p = 0.16) leftovers from brunch, cold pizza
- Sunday lunch (RR = 0.67, p = 0.26) leftover breakfast items, lunchmeat, lettuce and tomatoes

On Saturday afternoon the group visited a dairy farm owned and operated by the father of one of the students, where they were offered raw milk from a cooling vat. The raw milk was placed in a pitcher and then served in cups to those students who wanted it. Some students also petted calves, allowing the animals to suck or lick their fingers. Some students had contact with the dog or cats that lived on the dairy farm. After the farm visit, the students returned to the church for training exercises. Saturday evening they went together to a local Italian restaurant for dinner. Some students went swimming in a pool at the church. One student left after the training.

A total of 20 students responded to the questionnaire (95% response rate); 12 respondents reported illness. All ill students met the case definition for an attack rate of 60%. Only 4 students had *Campylobacter* culture positive stools and 8 additional students met the clinical case definition. The 12 cases ranged in age from 19 to 22 (median = 20.6 years); 6 (50%) were male. All (100%) cases reported having diarrhea; 11 (92%) reported having fever. Most (*n* = 9, 75%) reported having abdominal cramps; 2 (16%) reported having bloody diarrhea; 7 (58%) sought medical care; none were hospitalized. Reported onset dates ranged from September 1, 2002, to September 4, 2002. The mean incubation period was 2.4 days and the mean duration of illness was 4.7 days.

TABLE 1. Exposure Attack Rates

	EXPOSED			***NOT EXPOSED***				
Exposure	**Case**	**Non-case**	**Attack Rate**	**Case**	**Non-case**	**Attack Rate**	**Attack Rate Difference**	**RR (95% CI), *p*-value**
Raw Milk	12	4	0.75	0	4	0.00	0.75	Incalculable, 0.01
Calf	7	3	0.70	5	5	0.50	0.20	1.40 (0.67-2.94), 0.32
Dog	6	3	0.67	6	5	0.55	0.12	1.22 (0.60-2.49), 0.46

The majority of students who visited the dairy farm reported drinking raw milk (16 of 20, 80%). All 12 cases (100%) reported drinking the raw milk, with a significant p-value of 0.01 (the RR was not able to be calculated due to a zero cell). None of the other potential risk factors such as petting calves or dogs could account for more than 7 (58%) of the cases, and none of the RRs were significant.

The dairy was warned by the state Department of Food and Agriculture not to offer raw milk to farm visitors.

DISCUSSION

Drinking raw milk at the dairy farm was the only significant risk factor associated with illness and the most likely cause of the outbreak. The epidemic curve indicated a common source exposure and all 12 cases reported drinking the raw milk. Other non-significant risk factors included having contact with calves or other animals on the dairy farm.

Drinking unpasteurized milk was identified as the source of Cam*pylobacter jejuni* enteritis in an outbreak in Wisconsin in 2001 [1]. Unpasteurized milk is also a vehicle for transmission of other pathogens such as *Brucella* spp., Shiga toxin-producing *E. coli* (e.g., *E. coli* O157, *Salmonella* spp., *Mycobacterium bovis* and *Listeria monoctyogenes* [2]. While sale of raw milk is banned in 26 states, the sale of raw milk from an approved source is legal in the state of California.

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AN OUTBREAK OF *ENTEROBACTER GERGOVIAE* IN A NEONATAL INTENSIVE CARE UNIT

On May 29, 2002 an Infection Control Practitioner from Hospital A, called Acute Communicable Disease Control (ACDC) about a cluster of four infants in a neonatal intensive care unit (NICU) with cultures positive for *Enterobacter gergoviae*. The first case was on 3/18 and the next three cases occurred 5/6–5/24. Three cultures were from sputum and the other was from a wound. At that time, the hospital had already made the decision to cohort cases and staff, use contact isolation for cases, and test several batches of infant formula for *E. gergoviae* (all negative).

Prior to this cluster of four cases, there was a cluster of *E. gergoviae* in this NICU February to July, 2001 with a total of 15 cases identified (10 clinical cases: 2 blood, 6 sputum, and 2 urine; 5 were identified with surveillance cultures and were considered colonized). That outbreak had resolved with enhanced infection control precautions (contact precautions, cohorting infants and staff, staff education, surveillance). No new clinical cases had been reported after June 2001 and the last positive surveillance culture was in August 2001. The investigation was closed in September 2001 after the last infant with *E. gergoviae* had been discharged.

ACDC initiated an investigation in May 2002 to help determine the source of the outbreak and control its spread.

METHODS

Enhanced infection control: ACDC recommended intensified infection control teaching stressing the importance of handwashing. ACDC supported the decision by Hospital A to use contact isolation and cohorting staff and patients. ACDC provided guidance to medical staff at Hospital A to look for commonalities in procedures, personnel, and medications.

Case finding: ACDC recommended surveillance cultures of axilla, groin, stool, wound (if present) and sputum (if intubated) on all infants in the NICU when new cases were identified. Hand cultures were done on selected healthcare workers.

Laboratory: All available *E. gergoviae* isolates from Hospital A were sent to the Los Angeles County Public Health Laboratory for analysis by pulsed-field gel electrophoresis (PFGE). Additional available isolates of *E. gergoviae* from a reference laboratory were also submitted for PFGE.

RESULTS

Infection Control: The NICU staff was made aware of the situation. Multiple in-service trainings were given about the importance of handwashing and barrier precautions. Gloves were required for patient contact. Healthcare workers were observed for breaks in infection control technique. Hands were inspected for infection. None of the patients had undergone a common special procedure. However, all but one of the cases had been taken care of by Nurse A, who had also taken care of most of the infants associated with the outbreak in 2001.

Case finding: Surveillance cultures were done on 6/3 and all were negative. On 6/29 an infant had a wound culture positive for *E. gergoviae* and on 7/2 a second set of surveillance cultures was initiated; one infant had a positive stool culture. On 7/18 an infant had a positive sputum culture and was placed on contact precautions. This was the last positive *E. gergoviae* culture from the NICU. The doctors in the NICU thought that the last two cases (wound and sputum) were probably contaminants and did not cause disease in the infants.

Eleven healthcare workers, including Nurse A had hand cultures performed on 8/1–8/7. Nurse A had a positive hand culture for *Pseudomonas aeruginosa* but not *E. gergoviae*. Inspection of her hands revealed cracked nails. She was taken off work and referred to a dermatologist. Nail cultures taken by the dermatologist on 8/9 revealed both *P. aeruginosa* and *E. gergoviae*.

Laboratory: Six *E. gergoviae* isolates submitted from Hospital A had indistinguishable patterns by PFGE. Three *E. gergoviae* isolates from a large reference laboratory in LAC had different PFGE patterns. PFGE on the E. *gergoviae* from the nurse revealed that the isolate was similar if not indistinguishable in PFGE pattern to the outbreak strain by two enzymes.

Upon identification of *E. gergoviae*, the nurse was immediately removed from patient care. A decision was made by Public Health to prohibit her from direct patient care in any facility until she was treated with antibiotics and cultures of her fingernails no longer grew *E. gergoviae*. No more cases were identified after she was removed from patient care.

CONCLUSION

The outbreak of *E. gergoviae* was most likely linked to nail colonization in one nurse. During the first outbreak of *E. gergoviae* in 2002, her hands had been inspected and found to be neat and clean. However, she had nail polish at that time and this might have masked any ongoing infections. When her nails were inspected in 2002 in conjunction with the outbreak, they were described to have “thickening” with “uplifting” and blackish discoloration. Treatment with antibiotics and antifungal therapy markedly improved their condition and she successfully returned to work.

Several outbreaks associated with artificial nails have been reported and many hospitals have developed policies to ban the use of artificial nails for all healthcare workers who touch patients [1,2]. Furthermore, according to research summarized by the CDC, chipped fingernail polish may support the growth of larger number of organisms on fingernails [3].

Despite the numbers of infants with positive cultures for *E. gergoviae*, none of them died of the disease and a substantial number of cases were considered contaminants or were found on surveillance. ACDC consulted several other large reference laboratories in Los Angeles County about *E. gergoviae*. These laboratories rarely identify *E. gergoviae* and when they do it is mostly in sputum, wound, and urine cultures. We could identify only one other published report of an *E. gergoviae* outbreak (also in a NICU) associated with contamination of a parenteral dextrose saline product and a healthcare worker [4]. It appears to be a rare and relatively non-invasive organism (that is, not commonly found in the blood or CSF).

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HAS THE HEPATITIS A VACCINE AFFECTED DISEASE RATES IN LOS ANGELES COUNTY?

BACKGROUND

In 1995, the Food and Drug Administration (FDA) approved the first of two formulations of hepatitis A vaccine (HAV) to be used in persons two years of age or over. Initially, the Advisory Committee on Immunization Practices (ACIP) recommended the vaccine for persons at increased risk for contracting hepatitis A and for children living in areas with the highest rate of disease [1]. Persons at increased risk included travelers, men who have sex with men, injecting drug users, persons who have an occupational risk, and persons with clotting-factor disorders. In 1999, ACIP recommended routine vaccination for children living in areas having hepatitis A rates greater than 20 cases per 100,000. California was one of the 11 states that fit into this category.

As a result of the 1999 recommendations, the Vaccines for Children (VFC) Program began providing HAV in August 1999. The VFC Program is federally funded and, through state and local health departments, provides free vaccines to participating health care providers. These providers administer vaccines to children who are eligible for Medi-Cal and the Child Health and Disability Prevention (CHDP) Program, are American Indian or Alaskan Native, or do not have health insurance. Additionally, children whose health insurance does not cover vaccinations may go to federally qualified health centers and rural health clinics to receive vaccine provided by the VFC Program.

The number of acute hepatitis A cases in Los Angeles County (LAC) has decreased from 1998 to 2001. However, it is unclear whether this decrease is due to HAV administration. The objective of this study was to assess the relationship between HAV administration and hepatitis A incidence in LAC in persons 18 years of age and younger.

METHODS

Data Sources:

- Hepatitis A cases reported to the LAC Department of Health Services between 1998 and 2001.
- Daily Immunization Reports (DIRs) submitted by public health centers that provide VFC Program vaccines. These providers are required to report usage of publicly funded vaccine, by age of vaccine recipient, on the DIRs.
- The Medically Indigent Care Reporting System (MICRS) and American Insurance Administrators (AIA) data to obtain demographic information on persons using Public Health Clinics from 2000 to 2001. The MICRS collects information on indigent health care services provided by 26 California counties, including LAC [2].

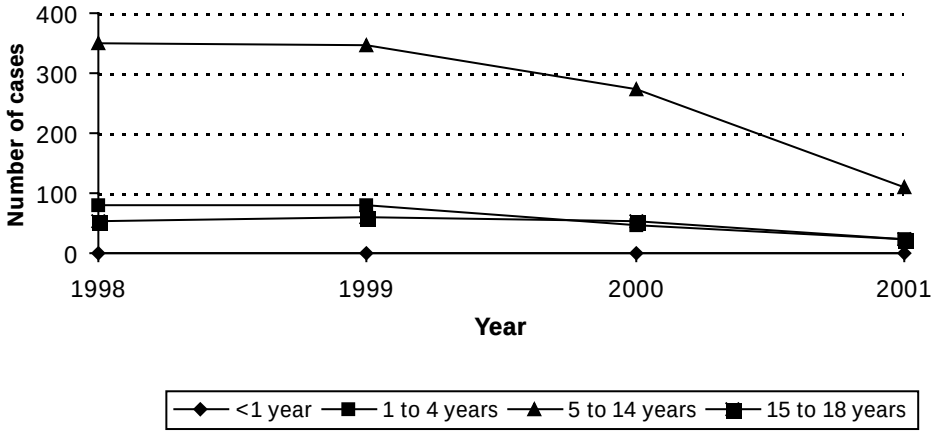
Analysis plan:

- The surveillance data was used to assess age and race case differences for 1998 through 2001.
- Hepatitis A vaccine data administered to recipients aged 18 and under were included in the analysis. Only the first dose of hepatitis A was considered in the analysis as it leads to greater than 97% seropositivity in children and few children get the second dose of the vaccine.
- The MICRS and AIA data were used to determine the age and ethnic distributions of persons utilizing LAC Public Health clinics. Because the DIRs only contain information on the age distribution of persons receiving vaccine in Public Health clinics, information from MICRS and AIA were compared to the DIR information in an attempt to determine the ethnic distribution of vaccine recipients.

RESULTS

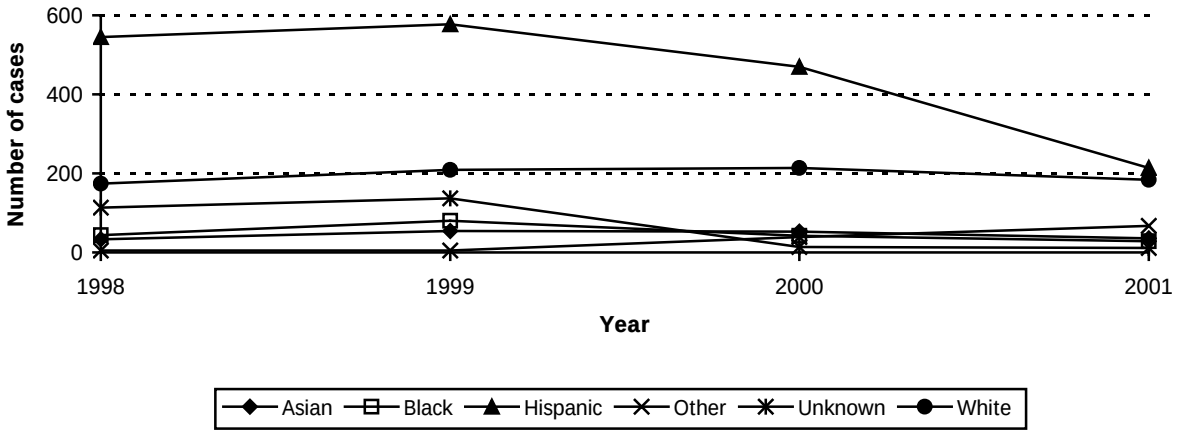
The number of acute hepatitis A cases decreased by 43% from 1998 to 2001. The largest decrease (71%) was in children aged 1 to 4 years (Figure 1). In 1998 there were 79 cases of hepatitis A in this age group and only 23 cases in 2001. The 5 to 14 year olds also experienced a large decrease in the number of reported hepatitis A cases. In 1998 there were 351 cases and 110 cases in 2001, a 69% decrease.

Figure 1. Reported hepatitis A cases, by age, LAC, 1998-2001



When taking ethnicity into consideration, Hispanics experienced the largest decrease (61%) in reported hepatitis A cases (Figure 2). Five hundred seventy-seven cases were reported in 1999 and only 214 in 2001. Children aged 5 to 14 made up the majority of the Hispanic hepatitis A cases for both years (51% and 43%, respectively), and experienced a decrease of 69% from 1999 to 2001 (Figure 3). Hispanic children aged 1 to 4 experienced a 70% decrease in hepatitis A cases, with 70 cases in 1999 and 21 cases in 2001.

Figure 2. Reported hepatitis A cases, by race, Los Angeles County, 1998-2001



Forty-four percent of LAC's population is Hispanic. Hispanics are also the largest ethnic group in the younger age categories (Figure 4). LAC public and non-profit clinics serve a predominately Hispanic population (Figure 5). In addition, the largest proportion of the LAC clinic clientele is 1 to 14 years old.

Since the inclusion of HAV in the VFC Program, vaccine administration increased from 21,102 doses in 1999 to 126,962 doses in 2000. HAV use in public and non-profit clinics increased in children under age 5 from 4,319 doses to 30,631 doses from 1999 to 2000 (Figure 6). HAV use in children aged 5-14 increased from 12,945 doses to 72,406 doses from 1999 to 2000. The decrease in the number of hepatitis A cases in Hispanic children aged 1 to 14 years coincides with the increase in vaccine use (Figure 7).

Figure 3. Hispanic hepatitis A cases, by age, Los Angeles County, 1998-2001

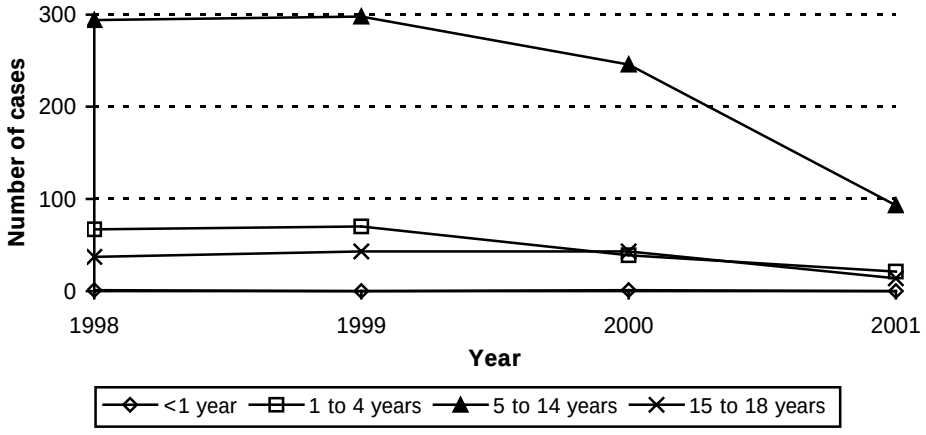


Figure 4. Age and Race Distribution in Los Angeles County, 2001.

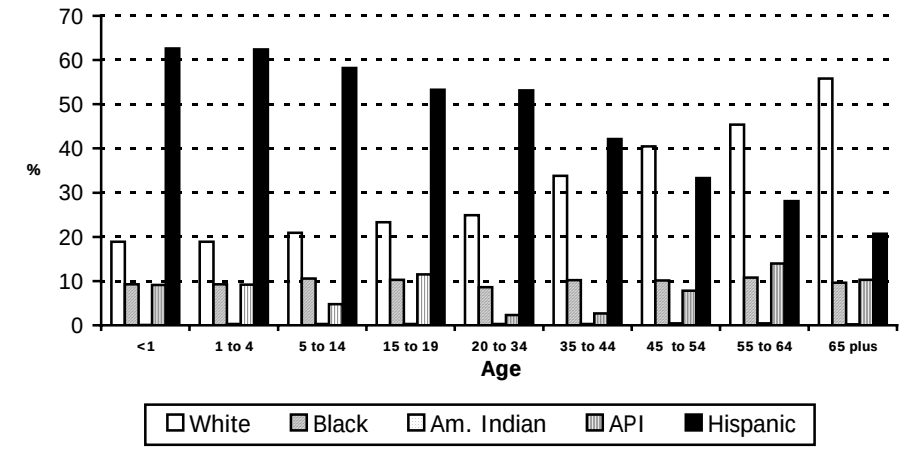


Figure 5. Racial distribution of Public Health Clinic patients.

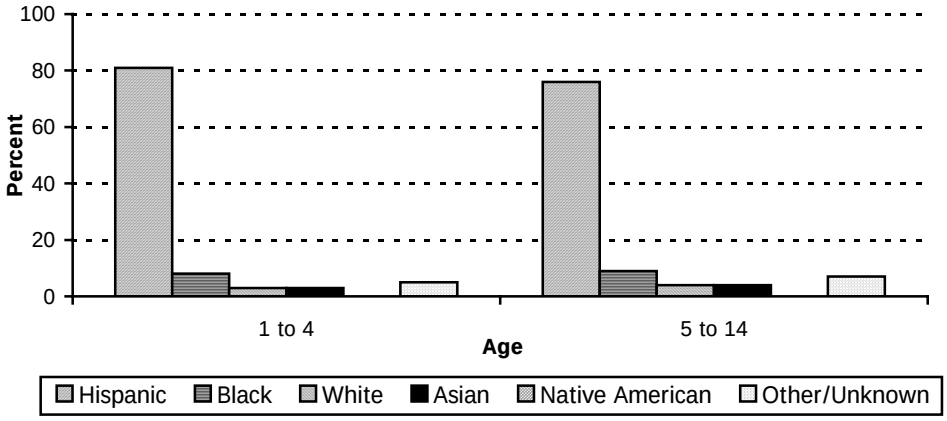


Figure 6. Hepatitis A vaccine usage, by age, Los Angeles County, 1999-2001

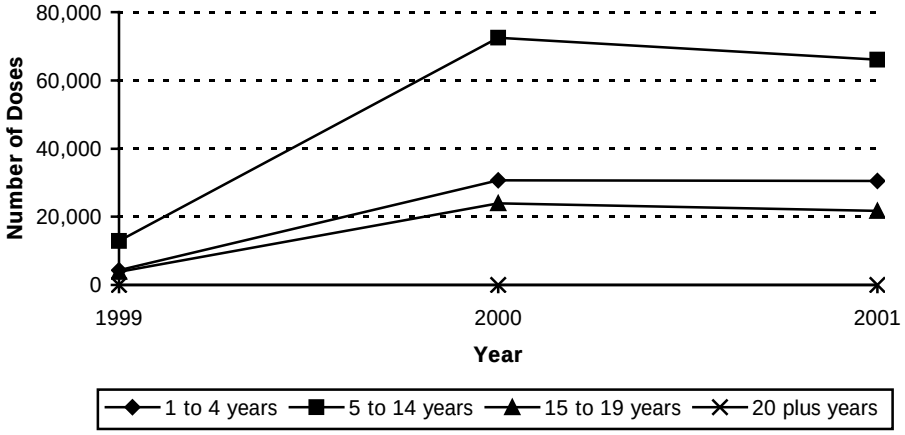
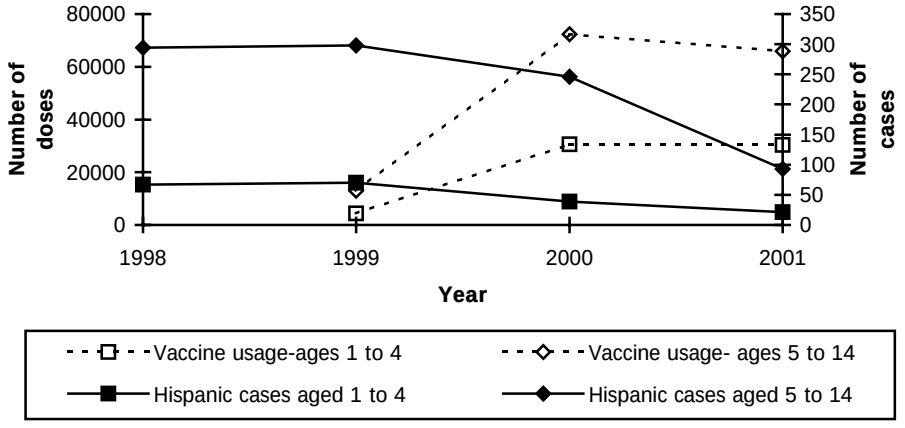


Figure 7. Cases of hepatitis A in Hispanics and overall vaccine usage, by age, Los Angeles County, 1998-2001



CONCLUSION

The introduction of HAV appears to be contributing to significant reductions in reported hepatitis A cases in LAC, particularly in Hispanic children. However, because information on race is not collected on persons receiving publicly funded vaccine, there is a possibility that the increase in HAV use is not occurring in the Hispanic population. Additionally, if the reported cases of hepatitis A in LAC were not reported by the Public Health clinics, the decrease in hepatitis A cases in the Hispanic population could be due to fewer Hispanics seeking care at non-Public Health clinics (and not getting reported) rather than there being an actual decrease. Additional studies are needed to confirm the link between vaccine usage with the decrease of disease in Hispanic children.

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AN OUTBREAK INVESTIGATION OF NOSOCOMIAL LEGIONELLOSIS

BACKGROUND

On March 6, 2002, the Infection Control Practitioner (ICP) at a local hospital consulted with ACDC regarding two hospital-acquired cases of legionellosis (LD) occurring in patients at their facility. The hospital had previously reported these cases using the standard Confidential Morbidity Report and was concerned once the second case was identified. Additionally, the hospital had contracted a private environmental testing company to test its water supply, which was completed on March 11. ACDC advised the hospital to begin a laboratory review for missed positive laboratory specimens indicating LD cases and to conduct a six-month retrospective review of hospitalized patients looking for nosocomial pneumonia cases that might have been due to LD. At this point, no new LD cases were identified and the hospital water samples were negative for *Legionella*.

Due to the heightened awareness, a third case of LD was diagnosed, but this case was determined by ACDC to be community-acquired. After a fourth LD case was reported on March 17, the hospital took the initiative to test the shower hoses of 3 case-patient rooms, as well as remove the shower handles from showers on one ward of the 4th floor. This location was selected because all case-patients had spent time on this ward prior to becoming ill.

On March 20, ACDC gave recommendations to the hospital to initiate active prospective LD surveillance. Additional testing of the water supply of patient rooms was conducted by the same private environmental testing company. This was completed on March 22. In addition, ACDC sent a second set of recommendations to the hospital on March 28. At that time, the hospital removed the shower handles from the other 4th floor ward.

In consultation with the California State Department of Health Services, ACDC initiated an investigation of this cluster of Legionnaires' disease on March 29.

METHODS

An initial site visit was conducted to review case-patient charts, evaluate the hospital plumbing system, and collect water samples for testing by the LAC Public Health Laboratory (PHL). Additionally, consultants from the CDC, the Los Angeles City Department of Water and Power (DWP), LAC Health Facilities, the PHL, and other *Legionella* experts were contacted for technical advice.

Recommendations made in the previously mentioned letters (dated March 20, March 22, and March 28) were augmented with additional letters sent on March 31, June 6, and June 19. The intent of these recommendations was to reduce risk to patients, find potential cases, and assure adequate treatment.

Active case finding was conducted both prospectively and retrospectively. A retrospective analysis of all nosocomial pneumonia cases diagnosed in the previous 6 months was completed by the hospital ICP and the Director of Medical Records. Charts were then reviewed to identify possible nosocomial pneumonias and to review if any testing was completed and found positive for *Legionella*. Prospectively, the hospital laboratory staff took the lead role. For every respiratory specimen culture ordered in the hospital, they sent a sample to their outside clinical laboratory for Legionella culturing, and performed urine antigen testing as well. Because this was very labor and resource intensive, and the primary interest was to identify nosocomial legionellosis, this level of surveillance was changed on June 19. The hospital then began requesting urine specimens from a patient hospitalized greater than or equal to 48 hours from whom respiratory specimens had been sent to the laboratory. Both legionella urinary antigen testing and cultures

were done for these patients (the urinary antigen testing at the hospital laboratory and the cultures at their outside clinical laboratory).*

Between late March 29 and early April, the CDC EIS Officer collected 53 environmental specimens: 29 swab samples, 22 water samples, and 2 ice samples. The swabs were collected by vigorously swabbing water fixtures (and in the case of showers, into the tubing of the shower hose). On June 10, three additional water specimens were collected from the cooling tower, the operating room air humidifier, and cold water at the point where city water enters the hospital. All specimens were collected in sterile containers and under conditions and specifications recommended by the PHL. All specimens were transported on the day of collection to the PHL and results were reported out as available. Additionally, temperature and pH levels were measured at the time of collection. On June 6, a representative from the LAC Environmental Health Division (EH) visited the hospital with ACDC to test chlorine levels in the water supply.

Hospital building plans were reviewed with the hospital Director of Engineering, ACDC, and EH to look for potential sources of water pooling which would allow *Legionella* to propagate. Repair records were reviewed to determine if any work had been done which may have altered the hospital water supply. A walk-through of hospital wards, operating rooms, and the power plant was done.

A floor map was used to visualize the rooms of patients who were housed primarily on the 4th floor. The distal rooms were defined as the last four rooms at the end of each hall on the ward—a total of 24 rooms met this definition. The 5th floor patient census data was also reviewed. These patients (hematology/oncology and pulmonary patients) were presumed to be at an increased risk for developing LD. ACDC staff reviewed respiratory therapy and ventilation techniques with the hospital's Director of Respiratory Therapy Services.

A case-control study was undertaken. A confirmed case of legionellosis was defined as having a compatible clinical history and one of the following laboratory criteria: 1) isolation of *Legionella* species from lung tissue, respiratory secretions, pleural fluid, blood, or other sterile site, 2) demonstration of Legionella species in lung tissue, respiratory secretions, or pleural fluid by direct fluorescent antibody testing, 3) fourfold or greater rise in immunoflourescent antibody titer to Legionella species (to 128 or greater), and 4) detection *of L. pneumophila* serogroup 1 antigen in urine.

A *community-acquired case* was defined as a patient admitted with symptoms compatible with legionellosis or who developed such symptoms within 48 hours of admission. A *probable case* was defined as a patient admitted for a portion of the incubation period prior to onset of illness, including patients who were discharged and re-admitted within the incubation period. A *definite case* was defined as a patient admitted for at least 10 days prior to onset of illness.

* The diagnosis of legionellosis can be made using a number of laboratory tests, each of which has advantages and disadvantages. A detailed description of all testing methods is available in the review article by Fields, Benson, and Besser, *Legionella* and Legionnaires' disease: 25 Years of Investigation, Clinical Microbiology Reviews, July 2002, p 506-526. In summary:

1. Culture remains the "gold standard" for diagnosis. Legionellae can be isolated from a number of specimens, though respiratory secretions (sputum, bronchial alveolar lavage, and bronchial aspirate) are considered the specimens of choice. The sensitivity of culture can be affected by many factors such as laboratory experience, inadequate samples, and delay of testing.
2. Microscopic examination of specimens using direct fluorescent antibody (DFA) staining provides a rapid method of identifying *Legionella*; immunofluorescent microscopy is technically demanding and should be performed by experienced laboratory personnel.
3. Serologic tests to detect antibodies to *Legionella* have important limitations. Indirect immunofluorescent assay (IFA) is the most common test used to detect antibodies. Even in cases of culture-confirmed Legionnaires' disease, a fourfold rise in antibody by IFA can be documented for only 70 to 80% of patients, and seroconversion following legionellosis may not occur for up to 2 months after illness onset.

Urinary antigen testing uses an antibody specific for *L. pneumophila* serogroup 1, and therefore may miss cases of legionellosis caused by other serogroups and species. Most patients will test positive for 4 to 14 days after exposure, though positive results have been shown to persist for up to 300 days. This test works best when combined with culture.

A chart abstraction form was developed. Three controls were chosen per case and were matched on +/- 2 days of the date of admission, were greater than 50 years old, and were admitted with a cardiac diagnosis. Data were analyzed using Epi Info 2000, Epi Info 6.0, and SAS. Matched analysis was performed on bivariate variables only.

RESULTS

Environmental Findings: Review of hospital plumbing indicated that city water enters the hospital pump room via two sources. It then divides into a supply for the fire control system and for potable water. The potable water passes through a water softening process, which uses a constant flow system. It then divides into cold and hot water supplies, one which serves the basement through 3rd floor (loop 1) and one which serves floors 4 through 8 (loop 2). There are two flash steam hot water heaters, one for each loop. Hot water is constantly recirculated through the system. The only potential for a "dead leg" in the system is if the distal areas do not utilize hot water. There were no indications of differences between floors or loops, and no obvious physical plant abnormalities which would allow *Legionella* to propagate were noted on the walk-through of the facility.

No recent plumbing repairs were noted in the hospital logs or DWP's review of records for the area around the hospital.

The environmental testing performed by the hospital's own clinical laboratory was reported as 1/3 (33%) positive for *Legionella pneumophila* serotype 1. These results were the first indication that the hospital water supply was contaminated with *Legionella*. Once these results were available, hospital administration decided to replace all spa-type showers with shower heads that prevent pooling of water behind the faucet. The only exception was some spa-type showers kept in the labor and delivery unit to facilitate bathing of an extremely low risk patient group.

The second set of environmental tests collected by the hospital's privately contracted environmental testing company was negative for *Legionella*.

In contrast, 25 of 56 (45%) hospital plumbing sites tested by the PHL were positive for *Legionella pneumophila* serotype 1, including one ice sample. Based on these results, the hospital water supply was super-heated by increasing the water temperature to ≥140º F and flushing the distal faucets for 15 minutes. Patients and staff were notified to prevent scalding and staff were posted at sites while the flushing was being done. One staff member suffered a mild burn injury during this procedure.

Ice machines were disassembled and disinfected and were not to be re-installed until the water supply was determined to be safe.

Follow-up environmental testing was performed by a different outside laboratory contracted by the hospital and the results of this testing showed all sites (15 of 15, 100%) positive for *Legionella* species (Table 1).

Table 1: Laboratory Final Report Following Super-Heating, 06/24/02

Sample	CFU*	Legionella Species/Serogroup
1	20	*L. pneumophila* serogroup 1, *L. bozemanii*
2	1	*L. pneumophila* serogroup 1
3	5	*L. pneumophila* serogroup 1, *L. bozemanii*
4	1	*L. pneumophila* serogroup 1
5	<1	*L. pneumophila* serogroup 1, *L. bozemanii*
6	<1	*L. pneumophila* serogroup 1
7	10	*L. pneumophila* serogroup 1
8	1	*L. pneumophila* serogroup 1
9	20	*L. pneumophila* serogroup 1
10	2	*L. pneumophila* serogroup 1
11	2	*L. pneumophila* serogroup 1, *L. bozemanii*
12	2	*L. pneumophila* serogroup 1
13	<1	*L. pneumophila* serogroup 1
14	10	*L. pneumophila* serogroup 1, *L. bozemanii*
15	60	*L. pneumophila* serogroup 1

* Colony forming units of *Legionella* per milliliter sample.

DWP indicated that the area in which the hospital is located is in a part of the city that does not draw any water from a monochloraminated source. DWP collected samples on June 10, from a site near the hospital input. Results of DWP testing of municipal water are summarized in Table 2.

Table 2: DWP Laboratory Results of Municipal Water

Analysis	Result
Temperature	22º C (71.6º F)
pH	7.17
Chlorine, free	1.22 mg/L
Chlorine, total	1.52 mg/L
Coliform, total	<1 NUM/100 ml
E. coli	<1 NUM/100 ml
Legionella pneumophila culture	0 CFU/ml

The hospital then discussed further decontamination procedures with its environmental hygiene consultant and based on his recommendations (consistent with CDC guidelines), decided to super-chlorinate the water supply (July 9–July 10). The second set of follow-up testing, collected on July 15, showed 7 of 12 (58%) sites positive for *Legionella pneumophila* serogroup 1 or *L. bozemanii* (Table 3).

Table 3: Laboratory Final Results Following Hyper-Chlorination,

Sample	Concentration*	Legionella Species/Serogroup
1	<1	*L. pneumophila* serogroup 1
2	1	*L. pneumophila* serogroup 1, *L. bozemanii*
3	1	*L. pneumophila* serogroup 1, *L. bozemanii*
4	Not detected	
5	Not detected	
6	Not detected	
7	Not detected	
8	Not detected	
9	<1	*L. bozemanii*
10	<1	*L. bozemanii*
11	<1	*L. pneumophila* serogroup 1, *L. bozemanii*
12	<1	*L. bozemanii*

* Colony forming units of *Legionella* per milliliter sample.

Water temperature at 20 distal hot water sites (measured on May 30) showed a mean of 101.5º F (range 91.4–118.2º F). Because several temperature readings were lower than the recommended 105–120º F, overall hospital hot water temperature was increased and a daily temperature log was to be kept. Subsequent temperature ranges taken at 34 sites showed a mean of 113º F (range 105–120º F). Additionally, booster pumps were increased to re-circulate the hot water through the system faster.

Water pH levels at 22 distal sites ranged from 7.3–8.0. Free chlorine levels were recorded at 9 distal sites. Hot water free chlorinelevels were all 0.0–0.2 ppm; 4 cold water levels were 0.0–0.2 ppm, 2 were 1.2 ppm, 1 was 1.3 ppm, and 2 were 1.5 ppm. The 0.0– 0.2 ppm cold water levels were all found in the basement or power plant, closer to the city water supply than patient rooms, where other levels were measured.

A review of the 5th floor oncology ward for 5 days in May and June 2002, showed that the majority of patients admitted to the ward are general medicine patients and no patients were noted to be on high-dose chemotherapy, which would confer the greatest risk for developing legionellosis.

A thorough look at the pre-operative, intra-operative, and post-operative procedures indicated no commonalities between those patients who had different procedures.

All respiratory therapy (including ventilators) utilizes sterile water, as well as self-humidifying systems when possible. No breaches in this system were identified.

On August 1, water samples from 10 sites throughout the hospital were tested again; all samples were negative for *Legionella*.

Retrospective Case Findings: The retrospective examination conducted by the hospital ICP revealed that between October 07, 2001 to March 18, 2002, 9 patients had been tested for Legionella infection. All were negative.

Case-Control Findings: Between January and July 2002, the hospital reported 13 LD cases. Of these, 4 cases were determined to be community-acquired cases, 6 were probable cases, and 3 definite cases. The case-control study considered all nine probable and definite LD cases. All case-patients were admit-

ted to the hospital with a cardiac diagnosis. All case-patients had fever and roentgenographic changes and were diagnosed with legionella urinary antigen testing. *Legionella*species were not recovered by culture from any case-patient isolates.

The mean length of stay of case-patients was 29 days (range 6–69 days), as compared to the controls, who stayed a mean of 6 days (range 1–35) (p = 0.0003). 8/9 case-patients spent time on the 4th floor prior to becoming ill; 7 were housed in distal rooms. Case-patients spent a mean of 3.9 days (range 0–9 days) in distal rooms and controls spent a mean of 1.4 days (range 0–8 days) in distal rooms (p = 0.02). It is common practice on the 4th floor to place (and move) patients to the rooms closest to the nurses' station (i.e., proximal rooms). The mean days that a distal room was open before a patient was placed there was 4.1 days for case-patients and 0.67 days for controls (p = 0.004).

The mean age of case-patients was 69 years (range 53–81 years), compared with the mean age of controls, 71 years (range 54–87 years, p = 0.61); 78% (7/9) of case-patients and 48% (13/27) of controls were male (p = 0.12). While hospitalized, 89% (8/9) of case-patients had at least one cardiac procedure (2 had two procedures), defined as coronary artery bypass graft, pacemaker placement, automatic internal cardiac defibrillator, or cardiac catheterization. Case-patients were more likely than controls to have a cardiac procedure (OR = 5.3, CI = 1.1–433, p = 0.02).

The American Society of Anesthesiologists (ASA) Physical Status Classification System provides a rating based on a patient's pre-operative underlying health status as a range where 1 is less ill and 5 is very ill. The ASA rating was available for 7/9 case-patients, but only 2/27 controls. The mean ASA for case-patients was 4 and for controls it was 3, with no significant difference between the two (p = 0.23). Left ventricular ejection fraction (LVEF) on admission was available for 9/9 case-patients and for 15/27 controls. The mean LVEF of cases was 33% and 49% for controls (p = 0.017).

Table 4 summarizes the evaluation of co-morbid diseases for significance as a risk factor for developing legionellosis. The co-morbid diseases that were statistically significant include congestive heart failure (CHF), diabetes mellitus (DM), chronic renal insufficiency (CRI), and acute renal failure during hospitalization (ARF). Other co-morbid conditions not found to be significant included chronic obstructive pulmonary disease (COPD), chronic renal failure (CRF), hemodialysis, HIV/AIDS, and malignancy.

Table 4: Co-morbid Diseases

Disease	Cases (n = 9)	Controls (n = 27)	OR	CI
COPD	3/9 (33%)	4/27 (15%)	3	0.5–17
DM	5/9 (56%)	4/27 (15%)	7	1.3–39
CHF	6/9 (67%)	5/27 (19%)	9	1.6–48
CRI	3/9 (33%)	1/27 (4%)	13	1.1–148
ARF	3/7 (43%)*	1/26 (4%)*	19	1.5 –228
CRF	1/9 (11%)	0/27 (0%)	Undefined**	
Hemodialysis	2/9 (22%)	1/27 (4%)	7	0.6–94
HIV/AIDS	0/2 (0%)*	1/3 (33%)*	Undefined**	
Malignancy	1/7 (14%)*	2/26 (8%)*	2	0.15–26

* missing data
** because of lack of data (p=>0.25)

When all co-morbid diseases were combined, case-patients were more likely than controls to have at least one co-morbid condition (OR undefined; p = 0.002), though this significance was lost once matched analysis was done (OR = 1.5, CI = 0.21–18, p = 0.67). Additionally, when controlling for each disease, CHF and DM remained significant, but CRI did not.

Other risk factors evaluated (Table 5) included ever having smoked tobacco and alcoholism. Alcoholism did not confer a significant risk; however, case-patients were 3.5 times more likely to have ever having smoked tobacco than controls (CI = 0.69–23, p = 0.07). Table 6 includes data collected on pre-operative Hibiclenz showers, days spent "nothing by mouth" (NPO), days with oxygen supplementation (O2), and number of nebulizer treatments (Nebs) also did not contribute significant risk. Mean days with a nasogastric tube (NGT) was significant (p = 0.0004), however only 5/9 case-patients and 1/27 controls had an NGT for any time.

Table 5: Risk Factors, Tests of Significance

Risk Factor	Case (Any Exposure)	Control (Any Exposure)	OR	CI	P value
Alcoholism	0/9	0/24	Undefined	n/a	0.41
Ever Smoke	6/9	6/23	3.5	0.69–4.4	0.07

Table 6: Risk Factors, Mean Days Exposed

Risk Factor	Case Any Exposure	Mean	Control Any Exposure	Mean	P value
Pre-op Shower	3/9	0.7	3/25	0.2	0.13
NPO	7/9	2.2	17/25	0.7	0.06
O2	6/9	5.6	14/27	1.9	1.07
Nebs	3/9	2.6	6/27	1.4	0.42
NGT	5/9	3.7	1/27	0.3	<0.05

Use of chemotherapy in the month prior to admission did not prove to be a risk factor, nor did corticosteroid use in the month prior to admission. However, a large intravenous corticosteroid dose during CABG and cardiac catheterization is standard procedure and six case-patients received corticosteroids in this manner; the OR for corticosteroid use after admission was 7 (CI = 1.3–37, p = 0.02). The mean number of days between steroid dose and disease onset for case-patients was 6 days (range 2–9 days).

Long Term Decontamination Solutions: In conjunction with the hospital's environmental hygienist, efforts continued to maintain the levels of *Legionella* in the hospital's water supply at "not detected". Environmental surveillance will continue per the CDC protocol. Currently, supplemental chlorine is being added to the plumbing system to maintain the free chlorine levels at the distal sites at 0.3–0.5 mg/L. The equipment to supplement the system was purchased and put into place in order to conduct the hyper-chlorination effort. A regulator which keeps the chlorine levels from rising too high, which can be detrimental to the plumbing system, was installed. Additional efforts (e.g., another hyper-chlorination flush) will be conducted as needed. DWP will complete plans to add monochloramine to the water supplying the hospital area. At that time the hospital will reconsider their plans.

Once *Legionella* was no longer detected in the water samples, potable water restrictions were removed. Clinical surveillance remained in place at a high level of intensity until the hospital Infection Control Committee determined it was appropriate to be less aggressive.

Communication Efforts: In addition to many informal meetings, formal presentations by ACDC staff were an important part of maintaining good communication with the hospital. On June 7 and June 27, hospital grand rounds were given by ACDC staff. Meetings with hospital public relations staff occurred with ACDC staff and with the LAC media offices. Additionally, ACDC staff met with the hospital Infection Control Committee, the Medical Executive Committee, and the Hospital Board of Directors.

On July 2, news of this outbreak was picked up by the local media. Subsequently, the hospital began providing a letter about Legionnaires' disease to all patients and guests entering the hospital. The hospital

was then directed by ACDC to inform both current and past patients of the potential risk for contracting Legionnaires' disease at the hospital. Once potable water levels of *Legionella* were negative, these letters were determined to no longer be necessary.

DISCUSSION

In summary, we determined that 9 patients who spent time at the same hospital prior to respiratory illness became ill with pneumonia-like symptoms and had positive urinary antigen tests for *Legionella. Legionella* species were detected throughout the hospital water supply. Decontamination of the hospital water supply was undertaken with the assistance of a privately contracted environmental hygienist. No patient isolates existed to confirm the link between water cultures and clinical cases. No specific exposure was identified and no clear risk-factors were identified secondary to small numbers compromising statistical analysis.

The delay in identification of *Legionella* in the hospital water supply allowed for a false sense of security after the initial cases were identified. The determination of nosocomial legionellosis is complicated and many factors were considered when deciding to initiate the outbreak investigation. However, the strength of this outbreak investigation was that once *Legionella* was identified in the water system, despite the inability to link the species to patient disease, the public health message was clear: decontaminate the water system and reduce risk to patients while this was being done. Once this was determined, the hospital moved quickly to respond with patient prevention and decontamination efforts.

Active clinical surveillance of nosocomial pneumonias for legionellosis was conducted in a thorough manner by the hospital laboratory, who took the initiative to train staff and obtain materials to perform on-site urine antigen testing for *Legionella* in order to improve turn-around time for test results.

No patients admitted after potable water restrictions were in place became ill with nosocomial legionellosis.

The difficulty in eliminating *Legionella* from a plumbing system was evident in the positive results found after super-heating. However, because the PHL only reports "detected/not detected" we were unable to determine if the follow-up testing perhaps represented a decline in *Legionella* levels found in the water supply. The goal of the second private environmental laboratory contracted by the hospital was to detect any *Legionella* in the environmental samples, rather than in the clinical samples at a later date (i.e., prevent disease); therefore, its laboratory is considered one of the most sensitive in the country. The usefulness of tracking levels of CFU in a water system is for determining if levels have decreased and perhaps identify areas which need more stringent decontamination.

The hot water temperature within the hospital was found to be lower than recommended and this problem was corrected. The pH levels detected in the hospital were with in the appropriate range. City chlorine levels appeared to be normal, but once water entered into the hospital, there were varying levels of free chlorine. DWP could not explain this and the hospital water is now being supplemented within the hospital system and levels are more than adequate to treat the water supply.

The identification of *Legionella bozemanii* in numerous water samples indicates that contamination persisted, however since all of the case-patients were diagnosed by urinary antigen testing, which does not detect *L. bozemanii*, it was unlikely to have been a source of disease.

The practice of keeping patients closer to the nursing station (i.e., out of distal rooms) may create "dead leg" space in the plumbing system, allowing *Legionella* to propagate. However, there is no evidence that the risk or quantity of bacteria was any greater on the 4th floor than anywhere else in the hospital. The hospital developed a protocol for flushing the pipes in end rooms when not used for a period of time.

The case-control study showed that case-patients were more ill than controls, based on having poorheart function, co-morbid conditions, and the length of stay. However, with so little data, more sophisticated analyses could not be performed.

Cardiac disease is not a common risk factor for contracting Legionnaires' disease. However, individuals with cardiac disease often have known risk factors such as a history of tobacco use, COPD, and DM. In this outbreak, it appears that the cardiac patients were actually the sickest (and thereby the most immunocompromised) patients at the hospital. The hospital reported high turnover for cardiac patients and is a referral hospital, seeing the sickest patients who could not be managed at a smaller hospital.

Limitations: The primary limitation of this study is the unavailability of patient isolates to compare to environmental cultures. Also, chart abstraction about important potential risk factors such as showering, tap water consumption, and use of ice, was difficult because such factors are not routinely documented in the chart. Case-patients were queried when possible.

Without laboratory isolates of Legionella species cultured from patients, it is impossible to definitively implicate the hospital water supply in case-patient illness. This issue was further complicated by the difficulty in clinical diagnosis of legionellosis. Because the urinary antigen test for *Legionella* can be positive for a long time following exposure, patients may have been exposed prior to entering the hospital. For example, the attending physicians of one case-patient determined by bronchoscopy that the patient did not have pneumonia; however this case-patient was included in the case-control study because the case-definition was met.

Finally, the small number of cases limits our ability to conduct advanced statistical analysis.

METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA) OUTBREAK IN THE LOS ANGELES COUNTY JAIL SYSTEM

BACKGROUND

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a well-characterized nosocomial pathogen that for many years was thought to affect only individuals residing in healthcare facilities [1]. Reports of community-acquired infections began in the 1980's with infections seen among intravenous drug users in Massachusetts and children in Missouri [2,3]. Most community-acquired infections manifest as moderate to severe skin infections and can lead to more serious conditions such as osteomyelitis, endocarditis and even death if not treated appropriately [4]. To date, only one published study has examined the impact of bacterial skin infections in an incarcerated population [5]. The lack of information concerning bacterial skin infections among incarcerated populations has serious implications for the treatment and control of MRSA infections among persons residing in correctional facilities.

The Los Angeles County Department of Health Services (LAC DHS) received a report of an increase in MRSA skin lesions in the Los Angeles County Jail (LACJ) system in June 2002. The lesions included boils, abscesses and "spider bites" in inmates beginning in February 2002. The LACJ is the largest jail system in the United States with an average of 20,000 individuals sleeping in its facilities each night. An outbreak of MRSA in a population of this size had not previously been documented. ACDC began an investigation to determine the extent of the outbreak and to develop prevention and control measures for the LACJ.

METHODS

Using multiple sources of data provided by the LACJ and Quest Diagnostics Laboratory (the clinical microbiology laboratory for the LACJ), inmates with a positive culture for MRSA from a wound site or blood specimen from January 2002 through December 2002 were identified. Inmates with more than one positive MRSA culture between January and December 2002 were counted as an incident case in the first month a positive culture was recorded. Variables chosen for analysis included age, sex, facility of residence at the time of positive culture, time from admission to the LACJ (booking date) to date of positive culture, site of the MRSA positive wound infection and percentage of all wound cultures testing positive for MRSA. Antibiotic resistance patterns among isolates from incident cases were analyzed using antibiotic sensitivity data extracted from laboratory culture reports. All inmates requiring hospitalization are sent to one DHS hospital. Hospital infection control line lists were gathered from 1998 through 2002 in order to analyze inmates MRSA hospitalization trends over time. Hospitalized inmates with pus and wound or blood infections were included in the analysis.

RESULTS

A total of 921 MRSA cases were identified in the LACJ system between January and December 2002 (Figure 1); 792 cases (87.3%) were male, and the median age was 36 years (range 18–73). The median time from booking date to the first MRSA positive wound culture was 44 days—the same median time that an average inmate is housed in the jail system. Eighty-three cases (9%) developed their MRSA infection within 5 days of being in the jail system. A total of 973 separate wound infections with MRSA were identified from the 921 cases as some inmates had multiple wounds that tested positive for MRSA. Wounds on the lower body were more common, accounting for 52.9% of all MRSA infection sites.

A total of 1247 wounds were cultured between January and November 2002. Of the wounds cultured each month, 53%–76% (mean 62%) were positive for MRSA (Figure 2).

Laboratory reports for 556 of the tested MRSA isolates were available for review. All of the tested isolates were susceptible to vancomycin and rifampin and most were susceptible to trimethoprim/sulfamethoxazole (TMP/SMX) (98.4%) and clindamycin (97.3%). Isolates showed partial resistance to fluoroquinolone antibiotics (31.2–86.5%) as well as erythromycin (94.2%) and tetracycline (34.7%). All isolates exhibited resistance to the beta-lactam antibiotics.

From 1998 through 2002, 132 inmates were hospitalized in the jail ward with a confirmed MRSA infection. The number of inmates hospitalized with an MRSA infection increased every year since 1998 (Figure 3). A steep rise in hospitalized cases was noted between 2000 and 2001, increasing from 13 to 45. The trend continued in 2002 with 67 MRSA hospitalizations recorded.

DISCUSSION

ACDC investigated an MRSA outbreak in the LACJ that was presumed to have begun sometime in 2001 after discovering a large spike in the number of MRSA hospitalizations that year. In 2002, a total of 921 cases were identified from multiple sources of data. While the number of cases fluctuated monthly, since January 2002, more than 50 new MRSA cases have been documented in the jail system each month.

Anecdotal reports at the start of the outbreak suggested spider bites as the causative agents for the wounds. However, after a thorough search for spiders in the inmate living quarters uncovered only non-biting spiders, it was concluded that the wounds must not have been caused by spider bites. The lack of spiders combined with the large number of wounds located on the lower body point to lack of hygiene as the primary factor in the development of MRSA infections in this population. New linens and laundry were provided once and twice a week respectively and showers were given at most every other day in some facilities. In addition, the provision of shower and phone privileges during the same time frame or inmates missing shower time due to facility transfers lead to inmates showering on a decreasingly frequent basis while in the jail. Inmates are given a cup of detergent once a month with which to clean their cells, though this cleaning rarely occurred. Living conditions such as these promote improper hygiene, which can lead to an increase in disease in general and MRSA infections specifically.

While the above analysis describes the MRSA situation in the LACJ system during 2002, there are limitations in the data. Only infections that were cultured in the medical clinic or in the hospital jail ward were included in this descriptive analysis. Any inmate with an MRSA infection, but not presenting to the medical clinic for evaluation or not having a culture performed on the lesion could not have been included in the MRSA case total. It is likely then that incident MRSA cases were underestimated during the course of the investigation due to self-selection bias or medical oversight.

Alternatively, an overestimation of incident cases may have occurred by counting prevalent cases as incident cases in 2002. Since complete medical histories were not available for any of the cases included in the study, inmates with a positive culture for MRSA in 2002 were counted as incident cases regardless of prior MRSA infection. This method of case counting could lead to severe misclassification bias, especially if a large portion of the identified cases had MRSA infections diagnosed prior to 2002.

Since cases and descriptive data were collected from multiple different sources, the information gathered for each individual case varies, which limits the conclusions that can be drawn from the data. Basic descriptive characteristics of cases such as race, ethnicity, co-morbidities and course of treatment for MRSA infection could not be evaluated due to the sparse amount of information collected for these factors. However, these characteristics are important in describing the basic parameters that define an outbreak. Without sufficient knowledge of these characteristics it is difficult to present a complete picture of the MRSA outbreak in the LACJ system.

RECOMMENDATIONS

Based on the findings, a set of recommendations was provided to the LACJ system in August of 2002 outlining specific actions that should be taken to control the spread of MRSA in their facilities. Recommendations included increasing surveillance for MRSA infections, educating for staff and inmates on MRSA infections, increasing opportunities for inmate personal hygiene including the removal of disincentives for maintaining personal hygiene, immediate cell cleaning for inmates with suspect MRSA infections, increasing laundry changes for all inmates and limiting facility transfers for inmates with open wounds. Additionally, a plan was developed for the treatment of soft tissue infections. The plan stressed wound drainage and subsequent wound care as the first line of treatment for a soft tissue infection. If drainage did not cure the infection or if drainage was not possible, appropriate antibiotics should be provided to the inmate. Since the investigation revealed more than 50% of all wounds cultured grew MRSA, an antibiotic regime that would appropriately treat an MRSA infection was recommended. TMP/SMX with rifampin or clindamycin with rifampin were suggested based on the antibiotic sensitivities of the previously tested MRSA isolates.

Using the median time from booking date to culture date and comparing this to the median stay in the LACJ system, the longer a person is in the jail system, the greater their risk is of developing an MRSA wound infection. Nine percent of the cases had developed their infection within five days of entering the jail system, which would indicate that they had acquired the infection outside of the jail system. This has implications for controlling the MRSA outbreak. MRSA is unlikely to be eradicated from the LACJ given the constant reintroduction of the bacterium from outside the LACJ.

Due to the severity of MRSA skin infections and the difficulty in eliminating the spread of this disease in large incarcerated populations, it is important for jail and prison medical staff to be vigilant in monitoring MRSA infections in their institutions. Increases in MRSA infections should be identified as early as possible to not only limit the spread of disease, but also to increase the chance of eliminating the pathogen from the facility.

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OUTBREAK OF COMMUNITY-ASSOCIATED METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* SKIN INFECTIONS AMONG ATHLETES

BACKGROUND

On September 12, 2002, ACDC was notified of three hospitalizations for cellulitis occurring within a 30-day period among players of the same sports team. On August 15, 2002, the first team member (Player #1) was hospitalized for cellulitis resulting from infection of stitches for a non-sports-related accident that occurred 6 days earlier. Wound culture in this case grew methicillin-sensitive *Staphylococcus aureus* (MSSA). On September 10, 2002, another player (Player #2) was hospitalized for superinfection of a cleat wound of the right anterior tibia sustained a week earlier. One day later, a third player (Player #3) was hospitalized for necrotizing fasciitis of the right elbow, which eventually required two surgical debridements and a skin graft. This wound was originally and erroneously believed to be due to a bug bite. The latter two cases had methicillin-resistant *S. aureus* (MRSA) confirmed on wound culture.

METHODS

On September 17, 2002, investigators from ACDC met with the team, conducted a site inspection and made preliminary recommendations—this included the use of chlorhexidine soap in locker room showers. A survey identified players with potential skin infections. Recommendations for treatment, prevention, and surveillance of suspicious skin conditions were provided. In addition ACDC completed chart reviews and interviews of the hospitalized cases. A week later, a site inspection and second player survey using the same instrument was repeated. In a letter to the head trainer and sports team physicians, results and recommendations from our investigation were summarized (available on page 40). Ongoing surveillance included a weekly patient log sent to ACDC until the end of the team's season. Laboratory investigation included pulsed-field gel electrophoretic analysis of the two MRSA isolates from Players #2 and #3 and nasal swab bacterial culture of Player #1.

RESULTS

Site inspections revealed clean and well-maintained facilities. Soap dispensers of pHisoHex® (hexachlorophene) were installed in the locker room showers. Areas of concern included bulk containers of sports massage lubricants and analgesic balm and the lack of soap and paper towel dispensers outside of locker room toilets.

Both self-administered surveys documented good player hygiene; a proportion of players used their own soap, rather than the bactericidal soap provided in the locker room showers. Both surveys identified players who reported suspicious skin lesions or recent antibiotic use; 11 players identified from the first survey and 10 from the second. As expected, players received a high frequency of cuts and abrasions. Players covered these wounds only about half of the time. Players also reported noticing teammates with boils or insect bites. Surveillance and communication with trainers and team physicians did not identify further cases of cellulitis or hospitalizations.

The laboratory investigation found that the MRSA isolates obtained from players #2 and #3 had identical antibiograms and PFGE patterns. These did not match isolates from a previous community-associated outbreak that occurred in 1997 [1], but did match MRSA isolates from a nosocomial outbreak among infants in an intensive care unit in 2002. Nasal swab culture from Player #1 (taken 1½ months after hospitalization and full recovery) did not identify *S. aureus.*

Interviews of the hospitalized players did not identify any epidemiologic links between players. All of these players played similar positions on the team but did not admit to any activities that would place them at higher risk than other players. These players also did not note any associations with hospitals, jail in-

mates, or other sick contacts. Players #2 and #3 were initially treated with oral cephalexin, prior to hospitalization.

Recommendations to control and prevent the spread of community-associated methicillin-resistant *Staphylococcus aureus* (MRSA) skin infections among athletes

Environmental control:

1. Continue to maintain excellent hygiene of facilities using appropriate disinfectant solutions according to manufacturer instructions.
2. Ensure that uniforms are washed in hot water at temperatures at or above 160° F and that dryers operate at 190° F or higher.

Player hygiene:

1. The use of pHisoHex® (hexachlorophene) is appropriate since no new hospitalizations for cellulitis have occurred. Other outbreaks of MRSA have been controlled with the use of chlorhexidine, which is what is typically recommended. If new cases arise, you may consider switching shower and hand dispenser soap to a chlorhexidine-based soap.
2. Immediately install dispensers of antibacterial soap (i.e., hexachlorophene or chlorhexidine) at the sinks outside toilet stalls in the locker room. Paper towel dispensers, trash receptacles, and appropriate maintenance are also necessary to ensure proper hygiene in this location.
3. Continue using antibacterial soap (i.e., hexachlorophene or chlorhexidine) in the locker room showers, as you are presently doing.
4. Continue providing antibacterial soap at all locations for at least four weeks after installation of hand soap dispensers to reduce or eliminate possible carriage of MRSA among players. Players should not use their own soap during this period, unless the player reports a significant skin reaction to the school soap.
5. Players should be educated on first aid management of wounds, which includes immediate washing of wounds with soap and warm water. All boils, abrasions, cuts and insect bites should be covered until completely healed. Players who do not cover their wounds should be prohibited from practice or play.

Surveillance:

1. Surveillance for skin lesions, as described below, should extend to players from all teams that share use of gym equipment, training and rehabilitation facilities, showers and locker rooms.
2. At least weekly, remind players to report skin changes that suggest underlying infection (such as redness, warmth, swelling, tenderness, or drainage), especially when associated with cuts, boils, insect bites, or sites of skin irritation.
3. Team physicians should maintain a daily log of patients evaluated for skin lesions at the team clinic. This log should include a detailed description of the lesions, the microbiologic cultures taken, the results of the cultures, as well as the treatment regimen and outcome. This should be maintained until the end of the season and sent weekly to ACDC.
4. MRSA suspected skin lesions should be cultured to assess the presence of MRSA. Results and isolates should be forwarded to the county DHS.

Treatment:

1. Physicians that care for players should not prescribe antibiotics unless there is an indication of acute infection. Adequate drainage of pustular lesions should be the primary treatment. Minocycline or trimethoprim/sulfamethoxazole should be considered as first-line antibiotics for skin infections when necessary, due to possible pre-existing antibiotic resistance to cephalosporins and fluoroquinolones.

CONCLUSIONS

Limitations: Interpretation of the findings in this investigation are subject to several limitations. Asymptomatic carriage of MRSA and the limited number of identified MRSA cases in this investigation might have prevented identification of the source of the outbreak and risk factors for infection [2]. Obtaining information was complicated, which could have prevented full disclosure of information by players and the physicians contacted. In addition, investigation into exposures and implementation of control measures took place simultaneously; thus, it is difficult to assess whether this outbreak resolved by the natural course of disease or by any specific intervention.

This investigation of hospitalized cases of MRSA cellulitis among players of the same sports team resulted in two isolates indistinguishable by PFGE from a nosocomial NICU outbreak in Spring 2002. However, the source of MRSA in this outbreak was never identified. Since these players participate in a con-

tact sport resulting in frequent cuts and abrasions, they might represent a population at higher risk for skin infections. The lack of soap dispensers in locker room bathrooms and use of topical sports treatments from bulk containers are environmental factors that may have played a role in this outbreak. Recent evidence suggests that some community-associated MRSA exhibit increased virulence [1,3–5]. Similar outbreaks of MRSA among athletes have resulted in significant morbidity [6–9]. Prompt investigation, enhanced surveillance, and the implementation of control measures may have prevented widespread infection among other players in this sports team.

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THE EFFECTIVENESS OF INTERIM RESTRICTIONS OF PNEUMOCOCCAL CONJUGATE VACCINE (PCV-7) DURING ITS NATIONWIDE SHORTAGE

BACKGROUND

In February of 2000, a pneumococcal conjugate vaccine (PCV-7) was licensed for infants and children. This vaccine contains the seven serotypes responsible for more than 80% of invasive pneumococcal disease in US children less than 4 years of age. In June of 2000, PCV-7 was added to the National Vaccines for Children Program. The California Department of Health Services (DHS) Immunization Branch made the vaccine available to California local health departments in September of 2000, and by the end of that month, the Los Angeles County DHS Immunization Program (LAC DHS IP) had developed and distributed guidelines and initiated a training program for LAC DHS clinics. By June of 2001, the clinics had integrated PCV-7 into their routine vaccination efforts.

In July of 2001, the manufacturer of PCV-7 first announced delays in the production and shipment of the vaccine. In September of the same year, the CDC first developed interim recommendations on vaccine usage in an attempt to prioritize the vaccine to all children less than 2 years of age, especially infants, and medically high-risk children 2 to 5 years of age [1]. In December of the same year, the CDC promulgated revised interim guidelines which allowed the regular number of vaccine doses to all high risk infants and children up to 5 years of age, but deferred all doses to low risk children 2 to 5 years of age and decreased the number of doses to low risk children under 2 years of age [2]. This revised interim schedule also included a more rigorous dose reduction for the severest shortage situations. As a result of the complexity of both the original and revised interim schedules as well as the routine schedule for this vaccine, there was much concern that vaccine usage would not be limited to the highest priority groups during the shortage of this vaccine.

The following analysis was undertaken to determine the effectiveness of the CDC interim guidelines in restricting vaccine usage to the medically high-risk patients in the LAC DHS community clinics.

METHODS

Monthly usage data for PCV-7 in LAC DHS clinics by age category were analyzed for the period April 2001 through August 2002 to identify differences in utilization of this vaccine before and after implementation of each of the interim guidelines. The Kruskal-Wallis test was used to assess the existence of differences among the different age groups of children, broken down by the period of time during which each of the interim guidelines was implemented. The Dunn test was used to identify the specific groups that differed and the strength of the differences.

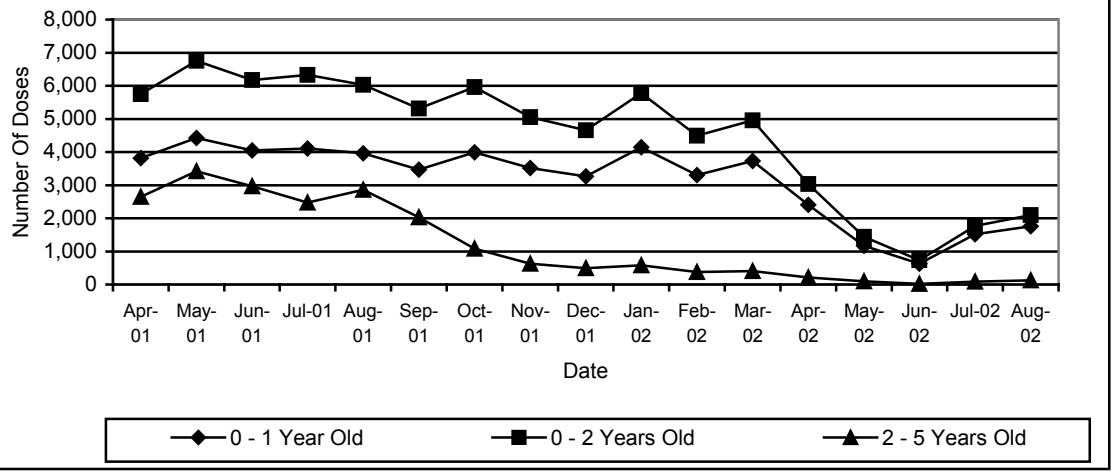
RESULTS

The number of doses rendered to children younger than 2 years of age began to decrease after the first interim guideline (released in September 2001) but decreased more sharply after the second interim guideline which was released in December 2001 (Figure 1). The doses given to infants (children aged under 1 year) did not change appreciably until after the second interim guideline was announced. A marked decrease in doses rendered to children 2–5 years of age was noted and sustained after announcement of the first interim guideline.

In order to rule out the possibility that the decreased doses resulted from either a decrease in availability of vaccine or a decrease in the number of children seen in the clinics during the study period, the proportion of doses administered to the various age groups during the periods covered by each of the guidelines was also determined (Figure 2). Results indicate that the percentage of vaccine rendered to children less

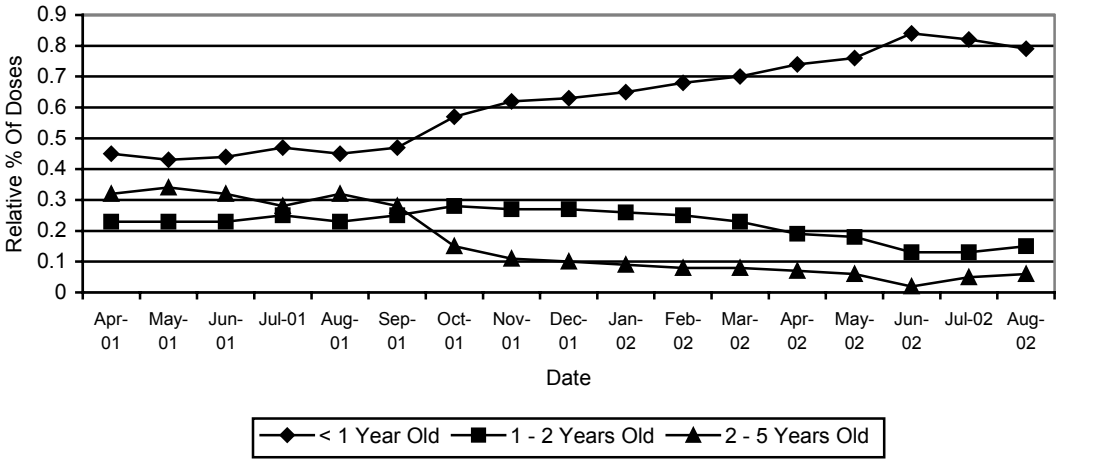
than 1 year of age increased significantly ($p < 0.0001$) after implementation of the first interim guidelines and that this increase was further enhanced after the second interim guidelines ($p = 0.0056$). The percentage of vaccine doses rendered to children 1 and older but less than 2 years of age increased after the first interim guidelines ($p < 0.0003$) but subsequently decreased with implementation of the second interim guidelines ($p = 0.0153$).

Figure 1: Monthly usage data for PCV-7 in LAC DHS clinics, by age category, for the period April 2001 through August 2002



The percentage of doses of PCV-7 rendered to children 2 to 5 years of age decreased significantly after the first interim guidelines ($p = 0.0007$) but did not change significantly after the second interim guidelines.

Figure 2: Monthly usage data for PCV-7 in DHS clinics, by age category as a proportion of total PCV-7 doses administered, LAC, April 2001 - August 2002



DISCUSSION

Freed, Davis, and Clark studied public and private medical practices in 2001 and found that few practices changed their vaccine administration patterns in response to the first interim guidelines for PCV-7 [3]. The analysis of LAC DHS clinic vaccine usage data showed opposite results.

The changes that occurred in the proportion of vaccine doses received by each age group during the time periods studied for LAC DHS clinics appear to be what would have been expected with implementation of each of the interim guidelines for PCV-7. Both the September 2001 and December 2002 guidelines allowed for vaccinating children 2 to 5 years of age only if they had a medical condition which placed them at high risk for invasive pneumococcal disease. This age group accounted for the biggest proportionate decrease in vaccine doses and most of the decrease occurred with implementation of the first interim guideline.

A significant increase in the proportion of vaccine doses given to children under age 1 accompanied the implementation of the first interim guideline and was enhanced further by the second interim guideline. Finally, the slight increase in the proportion of doses rendered to children 1 year of age and up to but not including 2 years of age which accompanied the first interim guideline, and the decrease in proportion of doses to this same age group with implementation of the second interim guideline, are both consistent with the fact that only the “severe shortage” schedule of the second guideline mandated fewer doses for this age group.

Special circumstances that could have led to greater impact of the interim guidelines on LAC DHS clinic vaccine administration practices, compared to other clinics are:

1. LAC DHS IP has a long history of monitoring immunization practices and managing vaccine supply to these clinics. This facilitated the ability of LAC DHS IP to quickly implement the interim guidelines in the LAC DHS clinics.
2. LAC DHS IP took responsibility for removing any discretionary aspects from the guidelines. For example, LAC DHS providers were told to implement the severe shortage schedule of the second interim guidelines, which prevented them from having to decide whether they were in a moderate or severe shortage.

CONCLUSION

For LAC DHS community clinics, both CDC interim guidelines had the desired effect of reducing total vaccine usage and prioritizing vaccine usage to the age groups most at risk for invasive pneumococcal disease. The role of LAC DHS IP in communicating the guidelines to providers in a clear and unequivocal manner that eliminated the need for providers to choose between the different levels of prioritization allowed by CDC, probably contributed to the guidelines’ effectiveness in these clinic settings.

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REASSESSMENT OF THE EPIDEMIOLOGY OF PERTUSSIS IN LOS ANGELES COUNTY DUE TO AN ATYPICAL SEASONAL INCREASE IN CASES

ABSTRACT

Because of an unusual increase in the number of reported cases of pertussis in the winter of 2001, the epidemiology of pertussis in Los Angeles County (LAC) over the last ten years was reexamined—specifically looking for trends in certain age groups and seasons. Key findings showed that all age groups are not of equal importance in the current epidemiology of LAC pertussis incidence. Specifically, the 5–14 age group appears to be emerging as an age group disproportionately affected by pertussis morbidity. In addition because of specific seasonal peaks in cases, this age group may also be contributing to the pertussis incidence among the most severely affected age groups as well as the 3–4 year cyclical rise in cases evidenced in LAC since 1997.

BACKGROUND

Since the early 1980s, the natural history of pertussis in LAC, much like the rest of the nation, became characterized by non-uniform temporal and age-specific patterns different from other infections transmitted by the respiratory route [1,2].

According to the findings from the 2001 National Immunization Survey, 80.2% (95% CI: 75.4%, 85%) of children 19–35 months of age in LAC (born February 1998 through May 2000) had been vaccinated with the recommended 4 or more doses of pertussis-containing vaccine. However, protection with vaccine decreases over time, with little or no protection 5–10 years following administration of the last dose (recommended at 4–6 years of age). With a secondary attack rate of 80%, adolescents and adults have become the primary reservoir of continued transmission of the infection and challenge the current concept of pertussis herd immunity [3]. During 1997–2000, a total of 29,134 pertussis cases were reported nationwide, with 29% of the persons with pertussis aged <1 year and 49% aged 10 and older [4].

LAC has historically evidenced a yearly seasonal summer peak in cases among infants less than 1 year of age. However, in the winter of 2001, an unusual increase in the number of reported cases spurred a reexamination of the epidemiology of pertussis in LAC compared to the entire state of California during the past 12 years—with a special focus on the seasonal morbidity differentials among age groups across time.

METHODS

Suspect pertussis reports received by the LAC Department of Health Services are classified as confirmed or probable cases if they meet the state of California's case definition. Reported pertussis cases from 1991–2003 that met the case definition were analyzed by age group and season of disease onset by the following categories:

- Age group: <1; 1–4; 5–14; 15–24; 25+
- Seasonal group: October-January (winter season); February-May (spring season); June-September (summer season)

Using data collected during case investigations, a temporal association was measured utilizing the following case factors with chi-square as the test of independence:

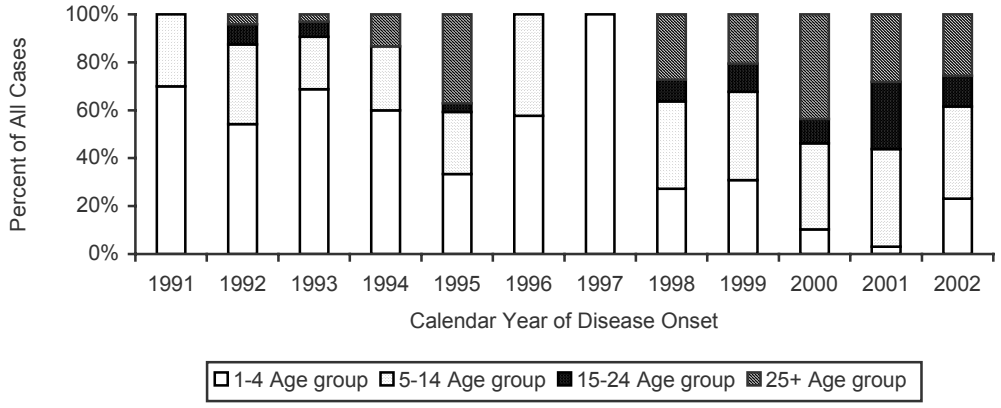
- Ethnicity (Hispanic vs. non-Hispanic)
- Gender
- Immunization history (<4 DTP doses versus ≥4 DTP doses)
- Case severity (developed complications or was hospitalized due to illness)

- Epidemiological linked status (contact to person with cough or a diagnosed pertussis case)
- Case status (probable versus confirmed)

RESULTS

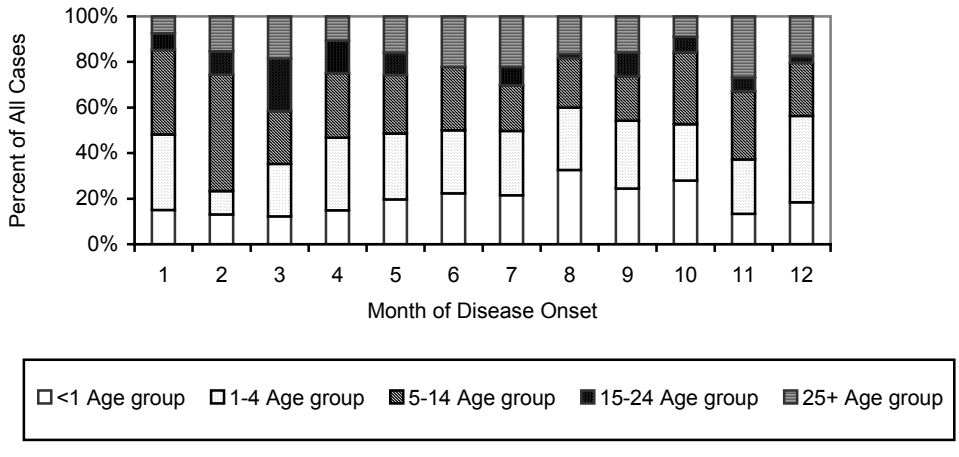
The first analysis in the reassessment evaluated the reported cases of pertussis each calendar year by age group during 1991–2002 (Figure 1). The majority of the cases (75%) were <1 year of age, and in comparison, all the other age groups appear as if they contributed similar proportions. However, after analyzing these age groups with a smaller scale, the proportion of cases among the 1–4 age group has been decreasing while the proportion of cases in the 5–14 and 25+ age groups has been steadily increasing. After the year 2000, the proportion of cases contributed by each of the older age groups surpassed the contribution of the 1–4 age group.

Figure 1. Reported cases of pertussis by age group,
LAC calendar year 1991-2002



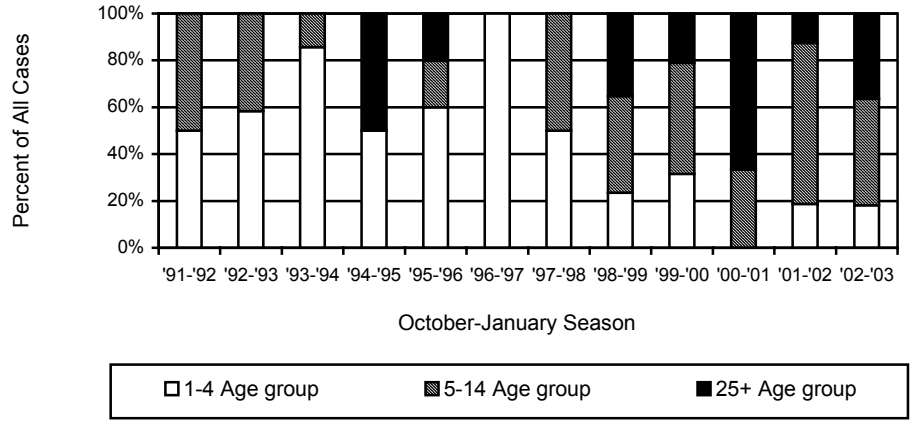
Investigating the seasonal correlation among these age groups indicated an interesting pattern (Figure 2). The average yearly number of cases in the <1 age group starts to rise in February, peaking in August-September, following a high proportion of cases in the 5–14 year olds in the winter season and the 25+ age group during April–July.

Figure 2. Reported cases of pertussis by age group and month of
disease onset, LAC 1991-2002



Because the calendar year disease onset analysis appeared to be masking an unusual epidemiological pattern in the cases reported by age group throughout the year, case totals among three age groups (1–4, 5–14, 25+) were analyzed during the last 12 winter seasons from October through January (Figure 3). The 5–14 age group has accounted for the highest proportion of all ≥1-year old cases reported during every winter season since the 1996–1997 winter season. Particularly in the 2001–2002 winter season, the 5–14 age group accounted for 20% (*n* = 11) of all reported cases, up from the average contribution of 7.2% during the same time periods in 1991–2001. In the 5–14 age group, three select winter seasons also showed evidence of higher than baseline case totals and would require further analysis: 1992–1993, 1998–1999, 2001–2002.

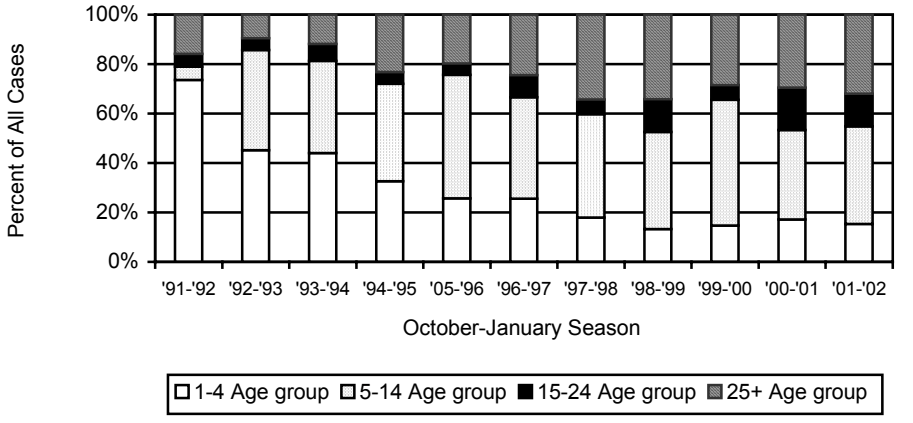
Figure 3. Reported cases of pertussis by age group, October-January, LAC 1991-2003

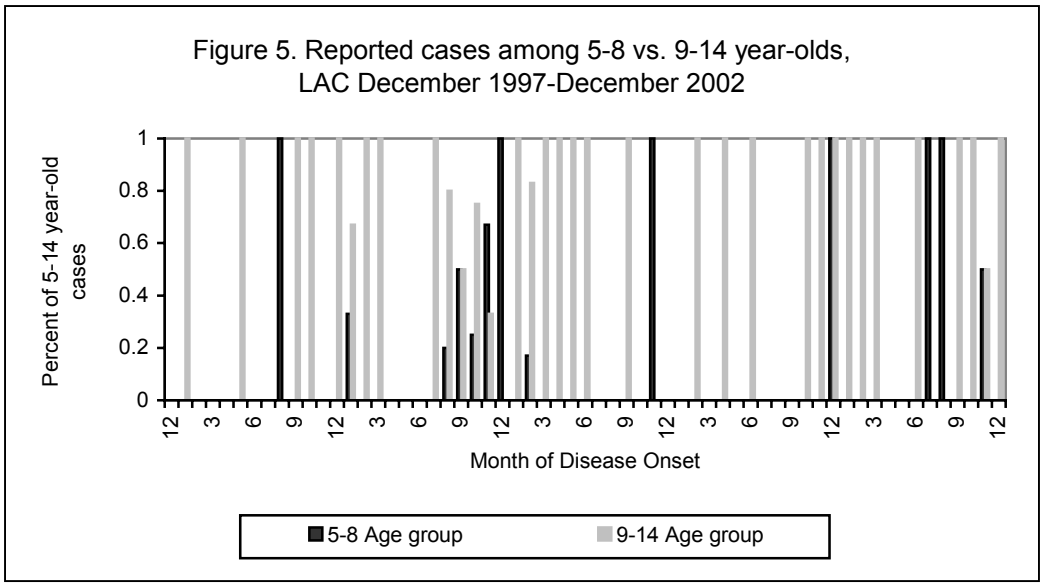


To examine whether a similar pattern was evidenced throughout the state, the proportion of reported cases of pertussis in California by the same age groups during the winter seasons 1991–2002 was analyzed (Figure 4). Similar to LAC, the proportion of cases in the 5-14 age group has surpassed each of the other age groups since 1992—with the 25+ age group following in close second.

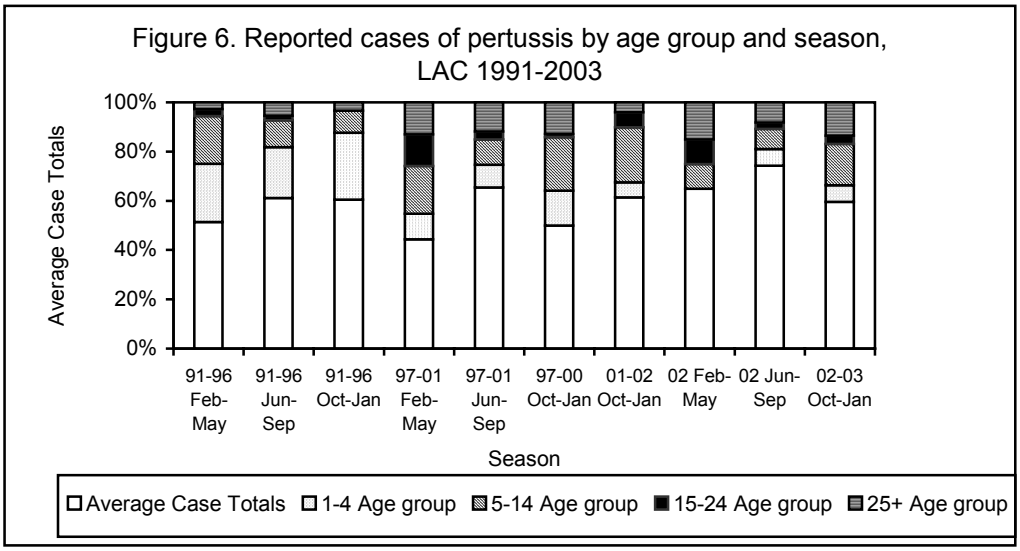
To further understand the phenomenon occurring in the 5–14 age group, closer examination was given to the specific ages within this group by month of disease onset from December 1997 to December 2002

Figure 4. Reported cases of pertussis by age group, October-January, California1991-2002





(Figure 5). The 5–14 age group case totals appear to rise primarily during the winter months, with the 9–14 age group accounting for the majority of the 5–14 year old cases, consistent with the expected age range of waning immunity.



Since the 5–14 age group did not account for cases uniformly in a calendar year, the proportion of reported cases of pertussis by age group and season was analyzed (Figure 6). Because the proportion of cases in 5–14 year olds increased dramatically after the 1996–1997 winter season (Figure 3), the seasons of February–May, June–September, and October–January in 1991–2002 were aggregated according to whether the season occurred before or after the 1996–1997 winter season. The number of cases reported in October–January 2001–2002 (*n* = 55) was up 77% from the same seasonal average in 1991–2000. Barring the inclusion of the <1 age group, the 5–14 age group has contributed the highest proportion of cases in nearly every season since the end of the 1996–1997 winter season.

Possible explanations for this observed temporal and age association needed to be examined. Two winter seasons with high case numbers (October–January 1992–1993, 1999–2000) were compared to the 2001–2002 winter season. Compared to 25% of 1999–2000 and 1992–1993 cases, only 3% of 2001–

2002 cases had contact to a pertussis case, thus indicating that parents, siblings, and other household contacts were not the cause of the increase in cases in 2001–2002.

During the 2002 calendar year, 170 cases were reported, up 66% from the calendar year average in 1991–2001. The proportion of cases with disease onset in specific seasons in 2002 was compared. The majority of cases with onset in February–May and June–September were linked to pertussis cases (none of whom were the 5–14 year old winter cases in 2001–2002) and/or in contact with someone with a cough (95% and 100%, respectively). This association was not evidenced in the winter season 2001–2002.

CONCLUSIONS

The 5–14 year-olds (in particular 9–14 year-olds) appear to be emerging as an age group disproportionately affected by pertussis morbidity, with no reported evidence of epidemiological links. More information will be needed about the epidemiological link or social networking of this age group of cases with other age groups in order to firmly support the hypothesis that the 5–14 age group could be driving the summer seasonal increase in cases in the <1 year-olds due to a high contribution of cases during the winter seasons. Furthermore, this age group contributed to a large proportion of cases in the winter season of 1998–1999, preceding a 30-year record high of 238 cases that was reported during calendar year 1999. It appears that the contribution of cases by this age group could be influencing the 3–4 year cyclical rise in cases evidenced in LAC since 1997.

In addition, all older age groups are not of equal importance in the current epidemiology of LAC pertussis. The 25+ and 5–14 age group seasonal increases may be driving pertussis incidence among the most severely affected age groups, as has been reported in previous studies. This finding can't be explained as parents and siblings transmitting the infection to infants since there is no reported evidence. Vaccinating adults and teenagers in order to maintain herd immunity in the community could be a cost-effective approach; an adult vaccine is currently being investigated for selective use in the United States.

Several factors were ruled out that could have artificially elevated the number of reported cases in the 2001–2002 winter season and into 2002. First, no changes in testing or the vaccination schedule were adopted and no intervention activities were performed during one year prior to and during this period. In addition, vaccine shortages were experienced nationally from the last quarter of 2000 through the second quarter of 2002. However, the interim schedule would not have put any children at risk of contracting pertussis, and the majority of providers in LAC did not have to adopt the schedule. Other than the 1995 institution of the epidemiological linked case, which could possibly have contributed to the misclassification of pertussis cases ever since, there have been no changes in the case definition prior to the 2001–2002 winter season.

More research is needed in order to identify etiologic factors for the proportion of cases in the 5–14 age group. Information is needed on the social network patterns of age groups by incorporating active surveillance activities (e.g., active screening projects during the winter season at specific sites/schools looking for contacts to pertussis cases outside of the household). The most important finding that this study addresses is that this complicated epidemiology of pertussis in LAC would not have been discovered if surveillance data had only been analyzed by calendar year, which is the standardized time measure public health epidemiologists employ to identify trends in surveillance data.

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SHIGELLOSIS OUTBREAK IN A JEWISH COMMUNITY

BACKGROUND

On September 3, 2002, a physician alerted ACDC of a possible outbreak of shigellosis in the traditionally observant Jewish community in Los Angeles County (LAC). ACDC initiated an investigation to determine if there was an outbreak and if so, to look for a source of infection and decide whether control measures were indicated. Initial investigation revealed cases of *Shigella sonnei*, several of which were previously unreported.

METHODS

Case Definition: A case of outbreak-associated shigellosis was defined as: 1) a person with culture-confirmed *Shigella sonnei* living in specific census tracts with a high population of traditionally observant Jews, with onset between June 15, 2002 and August 4, 2002; or 2) a household contact to a confirmed case living in the above described census tracts with symptoms clinically compatible with shigellosis (a presumptive case).

ACDC requested a list of the children seen for shigellosis in the reporting physician's office. Cases were referred to district nursing staff for investigation and identification of contacts. ACDC requested that isolates from the physician's laboratory be sent to the PHL for strain typing by pulsed field gel electrophoresis (PFGE). Routine surveillance of shigellosis cases identified additional cases. Databases from 2000 and 2001 were reviewed for a baseline of shigellosis in the local traditionally observant Jewish community. District personnel managed confirmed cases and presumptive cases for additional follow up according to the Communicable Disease Manual (B-73).

RESULTS

The traditionally observant Jewish community resides mainly in certain census tracts of Service Planning Areas (SPA) 4 and 5. In 2000, there was one case reported in these census tracks. In 2001, there were three such unlinked cases.

Between June 15, 2002, and August 4, 2002, there were 13 cases with culture confirmed *Shigella sonnei* and 9 cases with presumptive shigellosis. These 22 cases were reported among 8 households in the traditionally observant Jewish community. All cases identified within the examined census tracks were members of the traditionally observant Jewish community. There was an average of 5.4 individuals in each household investigated. Of these cases, 55% were less than 5 years and 91% were less than 17 years of age; 68% were female. Fever, diarrhea and cramps were reported by all cases, leading 17 to seek medical care; 6 reported bloody diarrhea.

A total of 10 *S. sonnei* isolates were analyzed for PFGE patterns; 5 isolates had an indistinguishable pattern, 1 had a three-band difference, and 3 had a two-band difference. Patterns with two or three band differences were found within single households. The earliest cases occurred in a family with history of an uncle visiting from the Chicago area who had recently recovered from shigellosis prior to his visit. The isolates from this family were not available for PFGE.

DISCUSSION

Shigella sonnei is the most common serotype in community shigellosis outbreaks [1]. Younger children are at higher risk of becoming infected and contributing to transmission in day-care, preschool, family settings and the community. There have been previous outbreaks of shigellosis and hepatitis A in Jewish

communities in New York City; investigations of these outbreaks indicated many opportunities for person-to-person transmission. Visiting between communities also contributed to spread of disease [2,3].

Earlier outbreaks in other traditionally observant Jewish communities had *Shigella* isolates with PFGE patterns that differed by less than or equal to three bands. This meets the definition of a single Shigella type [3].

Interaction with a confirmed case by an individual or family members and attendance at a boys' summer day camp linked cases in this outbreak. PFGE results show that these cases were part of a single outbreak. A visit by a shigellosis case from another community may have initiated this outbreak.

Although one physician's office treated the majority of the cases, his office did not report the cases individually in a timely manner, which led to a delayed ACDC investigation. This may have contributed to further spread of shigellosis in this community.

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PERINATALGROUP B STREPTOCOCCUS SURVEILLANCE

Group B Streptococcal (GBS) disease is the most common cause of sepsis and meningitis in newborns in the US and has been identified as a national public health priority by both the CDC and Healthy People 2010. Eighty percent of cases occur within the first week of life, known as early-onset disease. The remaining 20% are referred to as late-onset disease and carry similar associated morbidity and mortality. In 1996, recommendations by the CDC, the American Academy of Pediatrics (AAP), and the American College of Obstetricians and Gynecologists (ACOG) called for screening pregnant women and subsequently giving those women identified as colonized antibiotics during labor and delivery. Since the introduction of screening and chemoprophylaxis guidelines in 1996, national rates of early-onset GBS have declined by 70% to 0.5 cases per 1,000 live births in 1999 [1].

However, because GBS is not a required reportable disease, the burden of disease was unknown in Los Angeles County (LAC). Active surveillance in 1986 found an incidence in infants <1 day old of 0.53 cases per 1,000 live births, with a case fatality of 25%. It was previously unknown what the current incidence of this preventable disease is in LAC.

METHOD

A temporary active surveillance project was initiated September 1, 2001 to establish the incidence of early onset GBS disease in LAC. Seventy delivery hospitals in LAC were sent an introductory packet of information, including a form requesting their participation. Laboratories were asked to report all GBS results in babies born at participating hospitals who were 0-6 days old, and who had a positive culture for GBS from a usually sterile site. Laboratories faxed reports to the Acute Communicable Disease Control Program (ACDC) when cases were identified. Laboratories were randomly selected to be contacted by ACDC on a monthly basis as a reminder to report all neonatal GBS cases. Laboratory directors were asked to review bacteriology logs to confirm all cases had been reported. Live birth data was provided by the LAC office of vital statistics.

RESULTS – CONCLUSION

Sixty-five (93%) of 70 LAC delivery hospital laboratories agreed to participate in this study. Between September 30, 2001 and April 04, 2003, 68 cases were reported to ACDC: 13 in 2001, 49 in 2002, and 6 in 2003. These cases were reported from 27 laboratories.

The remainder of this report focuses on the 49 cases reported in 2002. These cases were reported from 23 different laboratories. Twenty-five (51%) were females. The mean age of cases was 0.69 days (range, 0–6; median 0). Nineteen (39%) were Hispanic, 3 (6%) were African American, 3 (6%) were Asian/Pacific Islander, 7 (14%) were white, and 17 (35%) had unknown race/ethnicity. 40 (82%) specimens were isolated from blood; 9 (18%) from another sterile site.

There were 139,059 live births occurring at the 65 participating hospitals. The rate of neonatal GBS disease among these participating hospitals was 0.35 per 1,000 live births. 12 (18%) reporting sites GBS had disease rates >0.5/1000 live births.

In order to compare this study with the active surveillance project among infants under 1 day of age done in 1986, we calculated a similar rate for the 2002 cohort. There were 31 infants <1 day old with GBS, for a rate of 0.48 per 1,000 live births. This indicates a minimal decline in the number of cases, though the interpretation of this finding is complicated by changes in the definition of early-onset GBS.

The infection control practitioner at each of the 70 delivery hospitals received a letter summarizing the findings of this surveillance project, along with information on the newly published Prevention of Perinatal Group B Streptococcal Disease [1] from the CDC, requesting that it be distributed to the obstetrical department and to the microbiology laboratory director.

Although this incorporates only one year of data, it is a reassuring view of the rate of GBS in LAC. Continued vigilance in maternal screening and treatment to prevent neonatal GBS is crucial.

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ELEMENTARY SCHOOL VARICELLA OUTBREAK: IT'S NOT JUST ABOUT KIDS

BACKGROUND

Varicella vaccine, licensed in 1995, is recommended for routine vaccination of children aged 12–18 months and for vaccination of susceptible older children, adolescents, and adults. In California, vaccination was mandated for school entry in 2001 [1]. Since vaccine licensure, the number of varicella cases nationwide has declined among all age groups [2]. However, cases and outbreaks will continue to occur as a result of breakthrough disease and gaps in immunity with unvaccinated persons. In September 2001, a school nurse at a Los Angeles County (LAC) elementary school reported multiple cases of varicella to the LAC Department of Health Services. There was concern among parents and staff of the elementary school because cases were occurring in children previously vaccinated for varicella. The investigation of this varicella outbreak identified 51 cases in a highly immune population and provided critical lessons regarding missed opportunities to screen, educate, and vaccinate adults for varicella.

METHODS

Case Finding: Cases were reported by school nurses, who initiated active surveillance for cases based on attendance records. Susceptible adults and adult cases were determined by self-reporting to the school nurse and through interviews with case-patients.

Case Definitions: A natural case of varicella was defined as an acute maculopapulovesicular rash with no other diagnosis occurring during September 1, 2001 through January 12, 2002, in a child attending the affected school who had not received the varicella vaccine or who had been vaccinated <14 days before disease onset. Breakthrough disease was defined as a case of varicella in a child vaccinated >42 days before disease onset. A susceptible child had no history of either vaccination or natural disease. The exposure group was children sharing a classroom with a case-patient. An adult secondary case was defined as having an acute maculopapulovesicular rash with no other diagnosis occurring during September 1, 2001 through January 12, 2002, in a person aged ≥18 years, living with a child who attended the affected school. Disease was classified as mild (<50 lesions without complications), moderate (51–500 lesions without complications), and severe (>500 lesions or any serious complications).

Questionnaires: To conduct a cohort study, a self-administered questionnaire was distributed by teachers to the parents of all exposed children. An additional telephone questionnaire was administered by investigators to the parents of case-patients to gather information related to the severity of the child's varicella illness, exposure history, contact with an HCP, and days missed from school because of illness. School immunization records (maintained by the school nurse) were reviewed and vaccination dates confirmed with the pediatrician when necessary. A modified questionnaire was administered by investigators to adult cases to assess previous varicella illness and vaccination, chronic health problems, potential exposure to varicella disease, and days missed from work as a result of illness.

Laboratory Investigation: Polymerase-chain-reaction analysis and restriction-fragment-length polymorphism analysis was offered to children and adults with a current varicella rash to determine varicella zoster virus presence and to distinguish wild-type virus from the vaccine strain. We offered children without a history of varicella disease or vaccination enzyme-linked immunosorbent assay testing for antibody against whole-cell varicella zoster virus.

Statistical Analysis: Data were analyzed in Epi Info 2000 (Centers for Disease Control and Prevention, Atlanta GA) and SPSS version 8 (SPSS Inc., Chicago, IL). All *p*-values are two-sided, with a significance level of $p \leq 0.05$. Differences between proportions were tested by Fisher's exact test; differences between means were tested by using a t-test. Vaccine effectiveness and 95% confidence intervals (CI) were calcu-

lated by using the cohort method [3]. Data regarding children who had an unknown vaccination status or varicella history were excluded from analysis.

RESULTS

The outbreak occurred in an elementary school (grades K–6) in which more than 900 children were enrolled. Twenty-one (47.7%) of 44 classrooms had at least one child with varicella. Outbreak control was facilitated by the school nurse and included sending a letter home with all children at the affected school. This letter advised parents to have susceptible children vaccinated, but did not recommend screening for varicella among the children's adult household contacts.

Questionnaires were returned from 387 (93%) of the 417 children in the exposed group. Although the overall vaccine coverage among the exposed group at the start of the outbreak was only 62%, a total of 341 of 387 (88%) children were immune, on the basis of either disease or vaccination history; 25 (7%) were susceptible; and 21 (5%) had an unknown immune status (Table 1).

Fifty-one cases of varicella were reported with disease onset during September 21, 2001 to December 21, 2001; of these, 48 (94%) were interviewed. Twenty-six (54%) were determined to be immune because of a history of varicella vaccination or past disease; 19 (40%) were susceptible; and three (6%) had an unknown immune status (Table 1). Among the 48 case-patients interviewed, the mean age was 6.9 years (range: 5–10 years), and 33 (69%) were male. Forty-one (85%) case-patients were in grades K–2.

The attack rate was 12% (51/417) for all students in the exposed group, 10% (24/240) for vaccinated children, and 76% (19/25) for the unvaccinated susceptible group. Vaccine effectiveness was 87% (95% CI = 80%–92%) against disease of any severity and 95% (95% CI = 43%–99%) against severe disease (Table 1).

Table 1. Immune Status and Disease Attack Rates of Varicella Case-patients and Exposed Children During Varicella Outbreak, Los Angeles County, September 2001—January 2002

	Varicella Case Patients (*n* = 48)		Exposed Children (*n* = 387)		Attack Rate	
Characteristic	No.	(%)	No.	(%)	No. of Cases/ No. Exposed	(%)
Immune	26	(54)	341	(88)	26/341	(8)
- Vaccinated	24	(50)	240	(62)	24/240	(10)
- History of varicella disease	2	(4)	101	(26)	2/101	(2)
Not vaccinated, susceptible	19	(40)	25	(7)	19/25	(76)
Unknown immunity	3	(6)	21	(5)	3/21	(14)

No case-patients were hospitalized, although susceptible children were more likely than vaccinated children to have had moderate-to-severe disease, to have reported fever, and to have vesicles. Susceptible children spent more days sick and more days with a rash, compared with vaccinated children. The mean number of school days missed by case-patients was 5.2 (range: 2–13 days) (Table 2). Thirty-three (68.8%) case-patients had contact with an HCP regarding their illness.

Five known susceptible adults were household contacts of children in the exposed group. Four (80%) were women, and the mean age was 33 years (range: 18–45 years). Of these, two persons (one with documented negative serology for varicella virus and one with no known history of varicella vaccination or disease) did not become ill despite living in the same house as unvaccinated case-patients. Three adults developed varicella; two were mothers of non-ill vaccinated children, and one was the mother of an unvaccinated case-patient. None of the adults had any known recent exposure to varicella other than at their children's school. All three adults were born in the US and had siblings distant in age. In the past,

one incorrectly received only one dose of varicella vaccine, and one received varicella immunoglobulin during pregnancy but did not later receive the vaccine (Table 3). One adult had mild disease; one had moderate disease; and one had severe disease with a subsequent diagnosis of viral meningitis. All adult case-patients were employed and each missed 5 days of work because of illness. One susceptible adult, who was not ill and was serologically negative, was incorrectly told by her HCP that she could not be vaccinated until the outbreak was over.

Table 2. Characteristics of Illness Among Children with Varicella by Previous Vaccination Status During Varicella Outbreak, Los Angeles County, September 2001—January

Characteristic	Vaccinated Children (*n* = 24)	Unvaccinated Children (*n* = 19)	*p*-value*
Severity of illness			
- Mild	19 (79%)	4 (21%)	0.02
- Moderate or severe	5 (21%)	15 (79%)	
Presence of fever			
- Yes	8 (33%)	13 (68%)	0.02
- No	16 (67%)	6 (32%)	
Presence of vesicles			
- Yes	16 (67%)	18 (95%)	0.02
- No	8 (33%)	1 (5%)	
No. of days sick			
- Mean	0.52	1.4	0.01
- Median	0	2	
- Range	0–4	0–5	
No. of days until rash fully crusted			
- Mean	4.8	6.7	0.005
- Median	4.5	7.0	
- Range	2–10	3–11	
No. of days missed school			
- Mean	5.1	5.3	0.67
- Median	5	5	
- Range	2–13	2–9	

* *p*-value significant at ≤0.05

Table 3. Description of Susceptible Adults Associated with Varicella Outbreak, Los Angeles County, September 2001–January 2002

				Child Contact	
Gender	**Age**	**Illness?**	**Vaccinated?**	**Illness?**	**Comments**
Female	28	Yes	Yes	No	One dose varicella vaccine
Female	45	Yes	Yes	No	
Female	39	Yes	No	Yes	Prior varicella-zoster immune globulin
Male	18	No	No	Yes	
Female	unk	No	No*	Yes	Negative varicella serology

* Two children.

Laboratory specimens were obtained from one case-patient and one adult patient with current rash to test for presence and type of varicella virus; both were wild-type varicella virus. Four children in the exposure group remained susceptible after the outbreak period. One consented to testing for presence of antibodies against varicella virus and was antibody-negative. The health department recommended vaccination for all susceptible persons.

DISCUSSION

We investigated a varicella outbreak involving 51 cases in an elementary school where the majority of children were immune. This outbreak resembled others occurring in LAC and elsewhere during this post-vaccination era. Varicella vaccine effectiveness was within the expected range, vaccinated children had milder illness than susceptible children, and the outbreak was caused by wild-type varicella virus [4,5]. However, multiple missed opportunities occurred for prevention of potential morbidity among adults through screening, education, and vaccination of adults for varicella.

All of the susceptible adults associated with this outbreak had previous interactions with their HCPs. However, HCPs missed multiple opportunities to advise susceptible adults regarding varicella vaccination recommendations: the outbreak notice from the school nurse, when contacted regarding a current case of varicella, at the time of their child's routine childhood varicella vaccination, and during routine medical care. Additionally, two adults were given erroneous medical information from their HCP, underscoring the need for education regarding adult varicella vaccination. Eighty percent of the known susceptible adults were women with children, indicating that prenatal screening for postpregnancy vaccination of susceptible women might be a critical intervention.

Possibly, the number of susceptible adults associated with this outbreak was underestimated as a result of self-reporting. Two ill adults were parents of non-ill vaccinated children, and their only exposure was visiting a school where a varicella outbreak was occurring, again emphasizing the need for the school nurse to advise all parents to have susceptible household members screened for varicella during outbreak situations. HCPs should screen children, adolescents, and adults for previous varicella disease during routine visits, and household contacts of reported varicella case-patients should be referred for appropriate care. Considering the increased risk for complications associated with adult cases of varicella, all susceptible persons without contraindications should be encouraged to receive varicella vaccination, irrespective of age.[3] Because of inherent difficulties in vaccinating adults, emphasizing routine childhood varicella vaccination is critical. Additionally, different methods can be used to improve vaccine coverage among both children and adults (e.g., client and HCP reminders) [6,7].

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VARICELLA ACTIVE SURVEILLANCE PROJECT AND EPIDEMIOLOGIC STUDIES—SUMMARY 2002

In September 1994, the LAC Department of Health Services entered into a cooperative agreement with the CDC to establish active surveillance for varicella in Antelope Valley, California. Baseline information on disease incidence and varicella vaccine coverage levels by age group, and the impact of increasing vaccine coverage have been collected. Surveillance for herpes zoster was added on January 1, 2000.

The current objectives of the Varicella Active Surveillance Project (VASP) in Antelope Valley are to: 1) maintain active surveillance for varicella disease, 2) maintain active surveillance for herpes zoster, 3) continue to monitor varicella vaccine coverage by age group, 4) measure the impact of varicella vaccine on varicella disease, and 5) conduct other applied epidemiological research related to varicella disease and varicella vaccine.

Nearly 100% of all identified reporting sites participate in this surveillance project, including public and private schools and day care centers with enrollments of 12 or more children; public health clinics, hospitals, private practice physicians and health maintenance organizations; employers with 500 or more employees; correctional facilities; and miscellaneous others likely to identify and report cases of varicella and zoster. All sites submit the varicella and zoster surveillance log to the VASP on a biweekly basis. A case of varicella is defined as illness with acute onset of a diffuse papulovesicular rash without other known cause; for herpes zoster, a case is defined as a macular-papular or vesicular rash that is diagnosed by a licensed healthcare provider, unilateral and involving at least one dermatome. A structured telephone interview is conducted with each case (under the age of 20 years for zoster) or their parent/guardian to collect detailed demographic, clinical, and health impact data and to determine if there are additional cases or susceptible contacts within the household. Susceptible household contacts are re-interviewed four to six weeks after the initial contact to identify additional cases. All providers currently administering the vaccine submit the Varivax Immunization Report on a monthly basis. From 1995 to 2002, varicella data were entered into a Turbo Pascal based database designed by project staff; however beginning in 2003, all data entry for varicella and zoster is via Access and data analysis is performed with SAS. Completeness of reporting is estimated using two-source capture-recapture methods.

The number and types of varicella reporting sites have remained stable since 1995. Varicella cases have decreased 86% over the project period, from 2,934 varicella cases in 1995 to 412 cases in 2002. Varicella incidence decreased by almost half, from 2.1/1,000 population in 2001 to 1.2/1,000 population in 2002. Peak incidence in 2002 occurred among children aged five to nine years (5.7/1,000 population), followed by preschoolers age one to four years (3.7/1,000 population) and children 10–14 years (2.8/1,000 population). Distribution of reported varicella cases by race/ethnicity has been relatively stable since 1995. The percentage of breakthrough cases (cases occurring >42 days after vaccination) has increased from 1% of verified cases in 1996 to 30.4% in 2002. The proportion of cases reporting fewer than 50 lesions has increased from 35.3% (1,305 of 2,934 cases) in 1995 to 49.5% (204 of 412 cases) in 2002. Of the 412 verified cases in 2002, 17 (3.4%) reported 21 complications. This compares to: 13% (in 1995), 8% (1996), 10% (1997), 11% (1998), 10% (1999), 6% (2000), and 5.5% (2001). The most common complication in 2002 was infected lesions (33.3%, 7 of 21 cases), whereas otitis media was the most common complication in 2001 (33.3%; 14 of 42 cases). There was one hospitalization due to varicella disease reported in 2002. Varicella completeness of reporting remained steady, estimated at 61.4% in 2002 for children aged 2–18 years of age.

Zoster cases among children <20 years old decreased by 23% from 73 cases in 2000 to 56 cases in 2002. The rate of zoster in children 1–9 years of age significantly decreased by more than half, from 74/100,000 population in 2000 to 34/100,000 population in 2002. Considering cumulative cases from 2000 to 2002, more cases reported a history of varicella disease (n = 153) than a history of receiving varicella vaccine (n = 15). In the vaccinated, the mean age of HZ was 4.77 years; whereas, in those with

previous varicella infection, the mean age of HZ was 11.2 years. When vaccinated and unvaccinated individuals between 1–4 years were compared, the mean ages were comparable, 2.39 and 1.92 years for natural and vaccinated cases respectively. There was one herpes zoster hospitalization in 2002.

Highlights of project activities have been summarized in two previous publications available on-line [1,2]. In addition, a workshop on "Varicella Susceptibility Among Adolescents in an Active Surveillance Site" was presented at the 2002 National Immunization Conference. The Antenatal Varicella Susceptibility Study started in March of 2002. It is anticipated that information from this project will continue to impact varicella surveillance and control strategies nationwide.

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WEST NILE VIRUS:
FIRST LOCALLY ACQUIRED CASE IN LOS ANGELES COUNTY

BACKGROUND

West Nile virus (WNV) was first isolated the in West Nile district of Uganda in 1937. WNV was first recognized in North America when an arboviral encephalitis outbreak was investigated by the New York City Department of Health and Mental Hygiene in Queens in August 1999. Since that time, WNV has spread to 46 states in the US with human cases reported from 45 states in 2003. The basic transmission cycle involves mosquitoes feeding on wild birds infected with the West Nile virus, then spreading the virus to other birds during subsequent feeding. Infected female mosquitoes incidentally transmit West Nile virus to humans and other animals when taking a blood meal.
Human-to-human transmission of WNV generally does not occur. However, human WNV infection was associated with WNV-infected blood transfusion and organ transplants in 2002. Beginning in June 2003, blood and organ donations are screened for WNV infection.

The incubation period for WNV infection is accepted to be between 3–14 days. Most individuals, about 80%, who are infected with WNV will have asymptomatic infection. In about 20% of those humans infected with WNV will develop "West Nile fever", a mild dengue-like illness of sudden onset, with a duration of 3–6 days. The signs and symptoms include fever, muscle pain, lymph node swelling, headache, abdominal pain, vomiting, rash, eye pain and anorexia. About 1 in 150 infected persons develop meningitis or encephalitis, which may be accompanied by an acute flaccid paralysis syndrome in rare instances. Advanced age is the primary risk factor for severe neurological disease and death.
Case History: In the summer of 2002, the first locally acquired of WNV infection was reported in a healthy 31-year old female resident of Los Angeles County (LAC). In early August, she developed severe headache, fevers, stiff neck, nausea, and muscle weakness. She made two visits to a local hospital emergency room. On the second visit, she was admitted to the hospital for treatment of bacterial meningitis and observation with the diagnosis of viral versus bacterial meningitis. Her physician completed a thorough medical evaluation for both viral and bacterial meningitis including cerebral spinal fluid (CSF) testing for WNV infection. Her clinical course and laboratory results supported the diagnosis of viral meningitis and she was released from the hospital after 2 days.

The infectious disease consultant in this case had seen the article in *The Public's Health*[*] on arboviral and WNV testing and requested testing from the LAC Public Health Laboratory (PHL). The patient's CSF specimen was sent to the LAC PHL and the Centers for Disease Control and Prevention (CDC) EIA IgM antibody was positive for WNV. Acute and convalescent serum specimens were subsequently obtained and were also IgM positive by the CDC EIA methodology for WNV infection. These laboratory results were duplicated at the State of California Department of Health Services Viral and Rickettsial Disease Laboratory. Further confirmatory WNV testing of the serum, using the Plaque Reduction Neutralization Testing, performed at the University of California at Davis, supported the diagnosis of WNV.

Interviews conducted by a medical epidemiologist at ACDC did not reveal any known risk factors for acquiring WNV infection. The case lived in southwestern LAC and reported no recent travel outside of California or LAC. She denied travel outside of the US. She lived near a park and cemetery and had no pets or ill household members. She reported no mosquito bites or seeing mosquitoes within 2 weeks prior to symptom onset. The case visited a local park 4 days prior to onset during the afternoon, and no mosquitoes were noticed. She worked in downtown Los Angeles delivering packages part-time during the day and reported no mosquito exposure during working hours. The patient denied ever having a blood transfusion, receiving any blood products, or having used IV drugs.

[*] Acute Communicable Disease Control. West Nile virus heading for California. The Public's Health 2002;2(6):1,5. Available at: www.lapublichealth.org/wwwfiles/ph/ph/ph/TPHJune_2002.pdf

Local WNV surveillance in mosquito pools, sentinel chicken flocks, dead birds and sick equines revealed no evidence of WNV in Southern California during the summer of 2002. In response to this first WNV case, additional sentinel chicken flocks and mosquito traps were placed in the case's urban work routes and residential and recreational areas. Additionally, the local vector control district fogged the downtown Los Angeles area, which has *Culex quinquefasciatus* mosquitoes in the storm sewer system. Despite intensified mosquito and sentinel flock WNV surveillance in these areas, no additional local evidence for endemic WNV infection was noted.

In summary, the origin of the first case of WNV in LAC is not known—possible etiologies included exposure to WNV infected mosquitoes transported through airline or trucking from states endemic for WNV in 2002.

Public Health and Vector Control Districts Responses: Public information was provided on the DHS LAC Public Health web site and printed educational material were distributed to the media. Medical provider information was distributed to selected infectious disease specialists, neurologists, emergency room physicians, hospital administration including infection control practioners and laboratory directors including clinical information as well as how to report cases of meningitis/encephalitis and submit clinical specimens to the PHL.

Surveillance was increased by the vector control districts, with increased testing of sentinel flocks and chickens through 2002. Dead bird testing was coordinated through LAC DHS Veterinary Public Health and the CA DHS.

PREVENTION

Mosquito Control: The most effective prevention consists of residential mosquito habitat elimination: emptying buckets, birdbaths and other containers of stagnant water, maintaining ponds and swimming pools, and not over watering residential and recreational lawns. It is essential to ensure screens are in place on doors and windows and in good repair. Complaints of mosquito problems should be made to local vector control districts so that they can evaluate and initiate control measures.

Personal Protection: Avoidance of mosquito bites is essential to prevent WNV infection. This includes avoiding mosquito-prone areas (especially at dawn and dusk), use of protective clothing such has long sleeves and pants, and use of DEET based mosquito repellants when outdoor.