Acute Communicable Disease Control

Special Studies Report

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Los Angeles County
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CLINICAL STAFF TRAININGS TO PROMOTE APPROPRIATE USE OF ANTIBIOTICS AMONG PATIENTS: A PROJECT BY THE LOS ANGELES COUNTY DEPARTMENT OF HEALTH SERVICES, LOS ANGELES ANTIBIOTIC RESISTANCE EDUCATION ADVOCATES (LAC DHS LA AREA)*

BACKGROUND

Antibiotics are becoming less effective and in some cases ineffective against bacterial infections (referred to as "antibiotic resistance"). The combination of overuse and misuse of antibiotics is a significant cause for concern as a contributor to the problem of antibiotic resistance in the community and in healthcare settings. Effective interventions to promote appropriate antibiotic use should include involvement of healthcare providers and the public.

In an effort to encourage patient education about appropriate antibiotic use among parents and children, free, 1-hour in-service trainings were offered in 2003 by the Los Angeles County Department of Health Services, Los Angeles Antibiotic Resistance Education Advocates (LACDHS LA AREA) project to clinical staff (e.g., physicians, nurses, medical assistants, and managers) of the Comprehensive Perinatal Services Program (CPSP). CPSP is a Medicaid fee-for-service program that integrates nutrition, psychosocial, and health education assessments, interventions, and perinatal education with basic obstetrical care for low-income pregnant women. Based on initial reviews, reports and feedback from similar training offered to CPSP sites in 2001, the presentation was revised to include additional topics regarding patient demand for antibiotics and risks in consumer use of illegal prescription antibiotics. Other additions included a follow-up survey to assess continuing patient education and a materials order form for requesting more antibiotic resistance education materials. Complementary to these improvements, clinical staff trainings were initiated in 2003 in response to unfulfilled training requests from CPSP providers in 2001.

Behaviors That Promote Antibiotic Resistance

Antibiotic Overuse: Antibiotics are unnecessarily taken to treat upper respiratory viral illnesses such as the cold and flu. Antibiotics should be used solely for the purpose of treating bacterial infections. The widespread misconception that antibiotics treat all types of illnesses stresses the need for public education.

Antibiotic Misuse: Incomplete courses of antibiotic prescriptions are consumed and the leftover prescriptions are taken for a later use or shared with others. Patients often take antibiotics and stop because they feel better —not knowing that taking the entire prescription is necessary to maximize treatment of eradicating bacterial infections.

METHODS

Announcement Mailings: Letters were sent to advertise the trainings to CPSP clinical staff in LAC. Training registration forms were also sent. Completed forms were processed by scheduling a 1-hour training session at the participant's facility.

Training: A 1-hour training session was developed by LA AREA that included the following topics: 1) introduction to the problem of antibiotic resistance, 2) consequences of antibiotic resistance, 3) public knowledge, attitudes, and practices concerning antibiotic use, 4) behavior change messages in addressing overuse and misuse of antibiotics, 5) addressing patient demand for antibiotics, 6) risks in consumer use of illegal prescription strength medications including antibiotics, and 7) promoting disease prevention. All training sessions were conducted with a PowerPoint™ presentation with slide handouts provided. All participants wrote their names on a sign-in sheet.

* Many thanks to Harold Sterker, Joanne Roberts, Aurora Arellano, and Dr. Robert Settlage for their help in making the antibiotic education training possible for the community of CPSP participants serving Los Angeles County. For additional information and samples of health education materials used in this project, please contact the Acute Communicable Disease Control Program.

Pretest, Posttest and Evaluation: The pretest, posttest, and training evaluations were developed to assess any changes in knowledge of participants and evaluate the effectiveness of the intervention. Tests and evaluations were anonymous. Incomplete and/or illegible tests and evaluations were omitted from data analysis. The test consisted of 10 true-false questions in the areas of: 1) viruses vs. bacteria, 2) antibiotic use misconceptions, 3) common misuse practices, and 4) health and safety tips. Questions from the pretest were the same for the posttest.

Evaluations that were administered immediately after the trainings consisted of closed-ended questions that assessed participant attitudes about the clarity, content and usefulness of the information. Attitudes were measured on a 5-point Likert scale to ask participants whether they "strongly agree, agree, are neutral, disagree, or strongly disagree" with the statements. Open-ended questions assessed participant attitudes about the strengths and weaknesses of the training.

Supplemental Resources: Participants were given technical articles about antibiotic resistance, prescription pad forms for treating viral infections, formatted letters to day care providers and clinical practice guidelines. A train-the-trainer set of computer disks were provided to each participating site. These disks included the training presentation, speaker notes, tests and evaluation forms. Patient education materials on antibiotic resistance were also given to participants. These materials included brochures, posters and videotapes.

Follow-up Survey: Following completion of the trainings, a follow-up survey was mailed to participants to assess the extent of continuing education efforts about appropriate antibiotic use, the interest in future trainings for clinical staff and the usefulness of the distributed materials. Only staff who participated in the training were asked to complete the survey and a copy of each site's sign-in sheet was sent to help identify those individuals. Thus, more than one completed survey can be returned from a single site.

Materials Order Form: Included with the survey were forms to request additional free antibiotic resistance education materials.

RESULTS

Announcement Mailings: In March and April 2003, letters were sent to 496 CPSP sites. A total of 54 (10%) sites returned a training registration form.

Training: Thirty-two sites received in-service trainings between May and December 2003. The remaining 22 sites did not receive training due to loss to follow-up, non-response after repeated attempts of contact, the provider indicating loss of interest, or continuous postponement by the provider of scheduled in-service trainings. Included in the training were 222 health professionals; the majority were nurses and medical assistants.

Pretest and Posttest: There were 127 pretests and 184 posttests administered among the 32 participating sites. Among the pretests, 5 were incomplete and/or illegible and were omitted from data analysis. Among 9 sites, 53 pretests were not administered in order to save time at the request of the participants. Test comparisons showed an improvement in knowledge from pretest (35%) to posttest (83%) in getting all ten answers correct. An indeterminable number of participants who came late to the trainings and were only able to complete the posttest scored well despite receiving partial training (Figures 1 and 2).

Evaluation of Closed Ended Questions: Among 190 evaluations that were administered and collected, 10 were incomplete and/or illegible and were omitted from data analysis. The majority of participants felt that the training was beneficial to them and their patients (Table 1). This includes the clarity of the presentation and materials.

Figure 1
Overall Pre-Test Performance
(N=122)

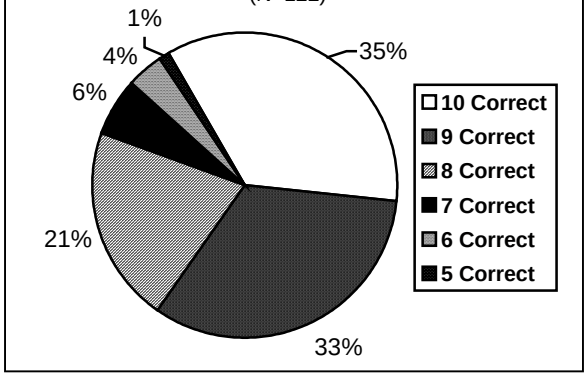


Figure 2
Overall Posttest Performance
(N=184)

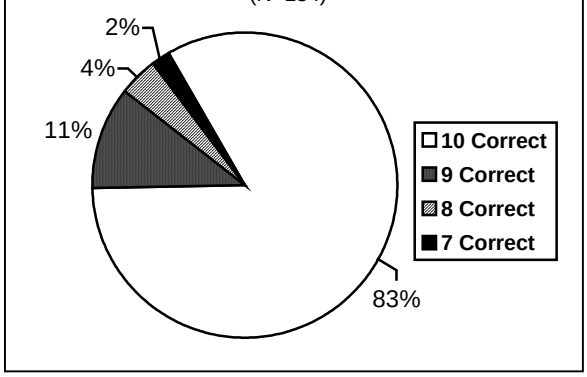


Table 1. Evaluation of Trainings

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I learned something new.	3%	1%	10%	44%	42%
I will share today's information with my patients/recipients of my service.	3%	0%	2%	35%	60%
Speaker was clear.	3%	1%	3%	40%	53%
Handouts were clear.	3%	0%	2%	38%	57%
Information was helpful.	2%	1%	3%	35%	59%

Evaluation—Open-Ended Questions: When participants were asked what they liked about the training, the majority of them felt that it was clear and informative. This was especially true for those who felt that they learned something new. When participants were asked what they would improve in the training, the majority of them did not have any suggestions. A few expressed considerations of making the presentation more technical for advanced audiences. For example, one participant wanted to hear about specific antibiotics. It was unclear as to whether or not this type of presentation would be about clinical practice guidelines and judicious prescribing. Under the open comments section, a few participants did express the need for antibiotic resistance education out in the community. Some expressed satisfaction with now having Spanish materials to share with their patients. Some participants who were neutral or didn't feel that they learned something new commented that as trained medical professionals, they were already aware of the problems of antibiotic resistance.

Supplemental Resources: Over 16,000 patient education materials on antibiotic resistance were disseminated to the 32 participating CPSP sites throughout the training period.

Follow-up Survey: Surveys were mailed to 32 sites that participated in the training; 10 (31%) sites returned forms. A total of 35 surveys were received from the 10 sites (range 1–5 per site) One survey was incomplete and omitted from data analysis. In assessing the extent of continuing education efforts about appropriate antibiotic use, the majority of participants reported sometimes to always discussing the issue with their patients (Table 2).

When participants were asked about the methods of education they used to discuss antibiotics and antibiotic resistance with their patients, 55% (n=18) only conducted face-to-face discussion, 11% (n=4) left materials in the waiting room only, 31% (n=11) did both, and 3% (n=1) did not conduct patient education. A few of the sites (3 of 11) reported using the training materials to train other staff (resulting in

11 additional people trained) and many (7 of 11) reported interest in receiving another training session for any other current or future employees of their clinical staff. Provider attitudes towards the utility of the English and Spanish antibiotic resistance education materials were largely ranked as somewhat useful to very useful in their practice.

Table 2. Discussion of Antibiotics—Responses to Follow-up Survey

	Always	Most of time	Sometimes	Never
How often do you talk to your patients about antibiotics? (n=34)	24%	29%	44%	3%
How often do you talk to your patients about antibiotic resistance and the proper uses of antibiotics? (n=34)	29%	39%	29%	3%

Materials Order Form: Requests for over 5,000 patient education materials were delivered amongst 6 sites that returned order forms.

DISCUSSION

In the efforts to outreach to an accessible population of participants through CPSP, it was unfortunate that only 10% of CPSP participants registered for the trainings and only 60% of these participants received the trainings. It is unknown why there was such a low response; CPSP offices may be too busy to incorporate training opportunities into their work schedules or the topic of antibiotic resistance may not be a topic of interest in this population. In the future, we will make targeted follow-up to those sites that did not respond.

The difficulties experienced in trying to conduct the trainings among those interested were primarily due to the busy schedule and limited time offered by CPSP participants. Scheduled meetings were often postponed by participants with some declining offered trainings or were lost-to-follow-up afterwards. Upon arrival to some participating CPSP sites, trainings had to be delayed due to excess and/or unexpected patient visits. Consequently, pre-tests weren't conducted in order to save time at the request of the participants. Additionally, a few participants came late to the trainings and did not take the pre-test.

Performance comparisons showed a large improvement from pretest (35%) to posttest (83%) in answering all questions correctly. Additionally, the majority of participants (66%) felt that they learned something new.

The majority of participants felt that the test was easy. Whether or not this reflected the pre-test and/or post-test (which both had the same test questions) cannot be determined. Since the majority of the questions tested knowledge on antibiotic use and practices, future questions should be added regarding effective patient-provider communication and tools for education about appropriate antibiotic use. Such questions would appropriately address the main focus of the training—to promote increased efforts among participants to educate patients about antibiotic resistance and appropriate use.

In addition to the low response rate to the training registration, the follow-up surveys had a low response rate. Only 34% of participating sites returned follow-up surveys. In the future, a second mailing of training registration and follow-up survey announcements will be conducted.

The follow-up survey may not have accurately assessed post-training effects of patient education. For example, the question, "Since the training, how often do you talk to your patients about antibiotic resistance and the proper uses of antibiotics?" could be interpreted by the respondent in terms of all total patient visits. Since not every patient visit would result in prescribed antibiotic treatment, the question should have been clarified to indicate only "when appropriate" (i.e., when a patient insists on receiving an antibiotic, when the patient is prescribed an antibiotic, etc.).

The participants' positive feedback about the presentation indicated the need to educate patients about antibiotic resistance. Participants felt that this subject was relevant to their everyday practice and they were candid to discuss their experiences with patients who use antibiotics inappropriately. Participants' accounts included patients who come into their clinics asking for antibiotics to treat their cold or flu.

Participants discussed cases where patients used specific antibiotics in the absence of any illness. Some of these cases involved parental decision to treat their child with antibiotics. Participants also discussed cases in which patients would share antibiotics and other medications with family members. However, some participants reported having patients who would proactively seek their advice regarding the right medications to take for their specific illness. Expecting mothers were reported to be more often reluctant about taking any type of medication (unless directed by the doctor) for concern over their baby's health.

Participants were appreciative of receiving patient education materials especially when they did not have any materials on the subject of appropriate antibiotic use before the training. Additionally, the materials would complement patient education efforts especially when participants receive requests for antibiotics from patients with the cold or flu. In addition to the request for Spanish language materials by participants, there were two sites that each requested materials for their patients in Chinese and Korean respectively. Fortunately, a high volume of health education materials (over 21,000) was successfully distributed amongst 32 participating sites.

Based on discussion and evaluations from CPSP participants in the training, antibiotic resistance and appropriate antibiotic use are important issues to discuss with patients especially when some participants reported overuse and misuse of antibiotics among their patients. Efforts to improve and continue these trainings in addition to supporting participants with education materials will be conducted in the near future.

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

BACKGROUND

The anthrax attacks of 2001 and the recent outbreaks of severe acute respiratory syndrome (SARS) and influenza strikingly demonstrate the continuing threat from illnesses resulting from bioterrorism and emerging infectious diseases [1,2]. In particular, these outbreaks have highlighted that an essential component of preparations for illnesses and syndromes potentially related to bioterrorism includes the deployment of surveillance systems that can rapidly detect and monitor the course of an outbreak with the goal to minimize associated morbidity and mortality. Prior to these events, 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 to track emerging diseases. Unfortunately, this information often comes in sporadically or is sufficiently delayed such that response efforts can be severely hindered. In order to respond more effectively to suspect illness and potential disease outbreaks, better methods for timely detection must be developed [3].

Driven by the threat of additional outbreaks resulting from bioterrorism and the increasing availability of data available for surveillance, surveillance systems have proliferated. Many health departments across the nation have begun diverse surveillance systems. For instance, Connecticut monitors admissions to all its acute hospital and visits to emergency departments to detect bioterrorism events [4], Massachusetts utilizes ambulatory-care encounters [5], and New York City analyzes data from fifteen sentinel emergency departments [6]. 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 [7], nurse hot line call [8], and nursing homes [9].

The ACDC began an infectious disease surveillance project in the fall of 2001. This system relied principally upon chief complaint data, from patient records of selected emergency departments (ED), organized into syndromes of interest. The syndromes were chosen to represent the chief complaints that would be expected in outbreaks of infectious diseases (respiratory symptoms, fever, rash, gastrointestinal symptoms) Use of chief complaint data, which is patient-derived and recorded as soon as the patient presents to the ED, was appropriate because it has been shown to have good agreement with final diagnosis, which is physician-generated—and therefore often takes considerably longer to be recorded and received by the surveillance system [10]. 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.

We collected ED chief complaint information from three hospitals in Los Angeles County (LAC) to provide early recognition of an increase or clustering of disease syndromes that might be indicative of a disease outbreak, whether natural or intentional. The following describes the LAC emergency department-based surveillance system for the period January 1, 2003 through December 31, 2003.

METHODS

Data Sources and Syndrome Categories: Staff from ACDC receive emergency department logs daily from three large metropolitan hospitals in the City of Los Angeles (Hospital 1, Hospital 2, and Hospital 3). For each daily log received, the patient's identification number, age, sex, chief complaint, and final diagnosis

* 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*).

are entered into a database. Patient chief complaints are then classified into one of four categories: gastrointestinal (GI), respiratory, rash or neurological. 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. For data processing, syndrome coding and data management SAS software is utilized. The syndrome-coding algorithm is designed to capture the wide variety of misspellings and abbreviations in the chief complaint field.

Data Analysis: A 30-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 30-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 (SD) beyond the previous 30-day average, a "signal" will be generated. The signal generated from the 30-day average plus 3 SDs results in a more conservative alarm system than the 30-day average plus 2 SDs. 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 days] **<** [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(s). 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.

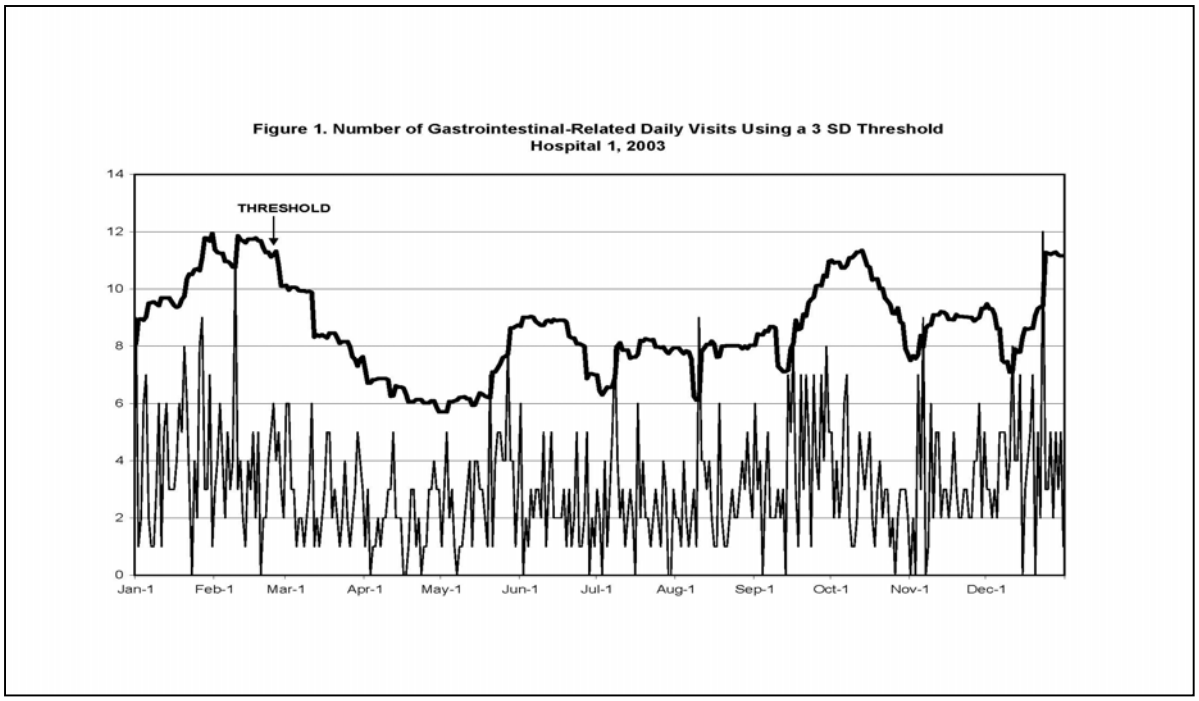
RESULTS

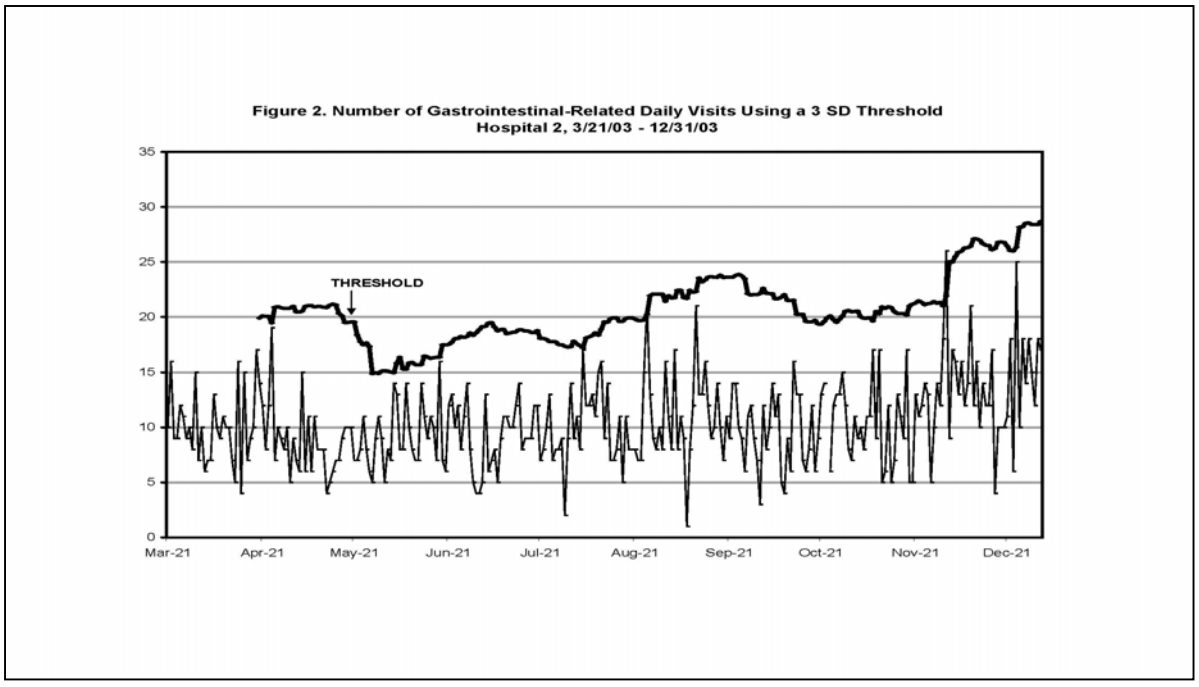
For 2003, Hospital 1 had a total of 33 signals utilizing the more conservative method (3 SDs) and 78 utilizing the less conservative method (2 SDs) across the syndromic categories (Table 1). Hospital 2 had 15 signals using the more conservative method and 64 using the less conservative method across the syndromic categories (Table 1). Hospital 3 had 50 signals using the more conservative method and 20 using the less conservative method across the syndromic categories (Table 1). Gastrointestinal visits fluctuated throughout the year, while 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, 2003

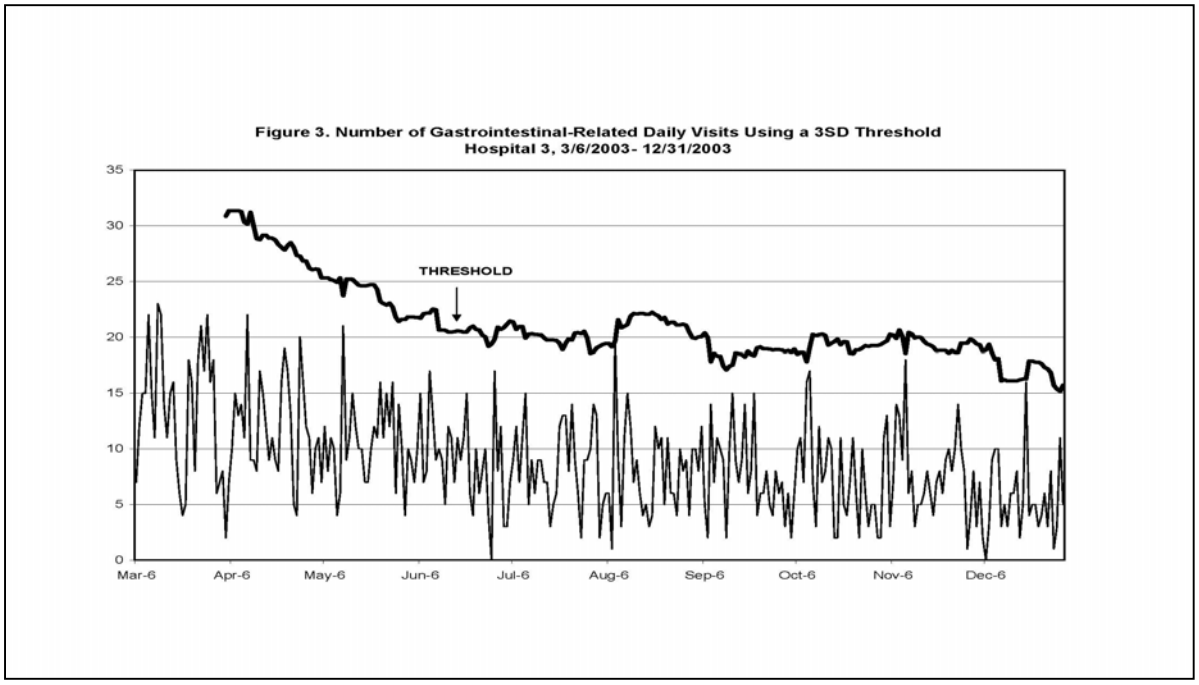
	Hospital 1		Hospital 2		Hospital 3	
Syndrome	**2 SD**	**3 SD**	**2 SD**	**3 SD**	**2 SD**	**3 SD**
Gastrointestinal	21	9	14	2	9	1
Neurological	11	10	19	5	5	5
Rash	20	7	17	3	18	9
Respiratory	26	7	14	5	18	5
TOTAL	**78**	**33**	**64**	**15**	**50**	**20**

Gastrointestinal-Related Visits: There were a total of 1,664 gastrointestinal-related visits in 2003 from Hospital 1, 3,050 from Hospital 2, and 3,197 from Hospital 3. Hospital 1 had 21 signals using a 2 SD method and nine signals using a 3 SD method (Figure 1). Hospital 2 had 14 signals using a 2 SD method and two signals using a 3 SD method (Figure 2). Hospital 3 had nine signals using a 2 SD method and one signal using a 3 SD method (Figure 3). The following figures display findings based on a 3 SD cut-off.

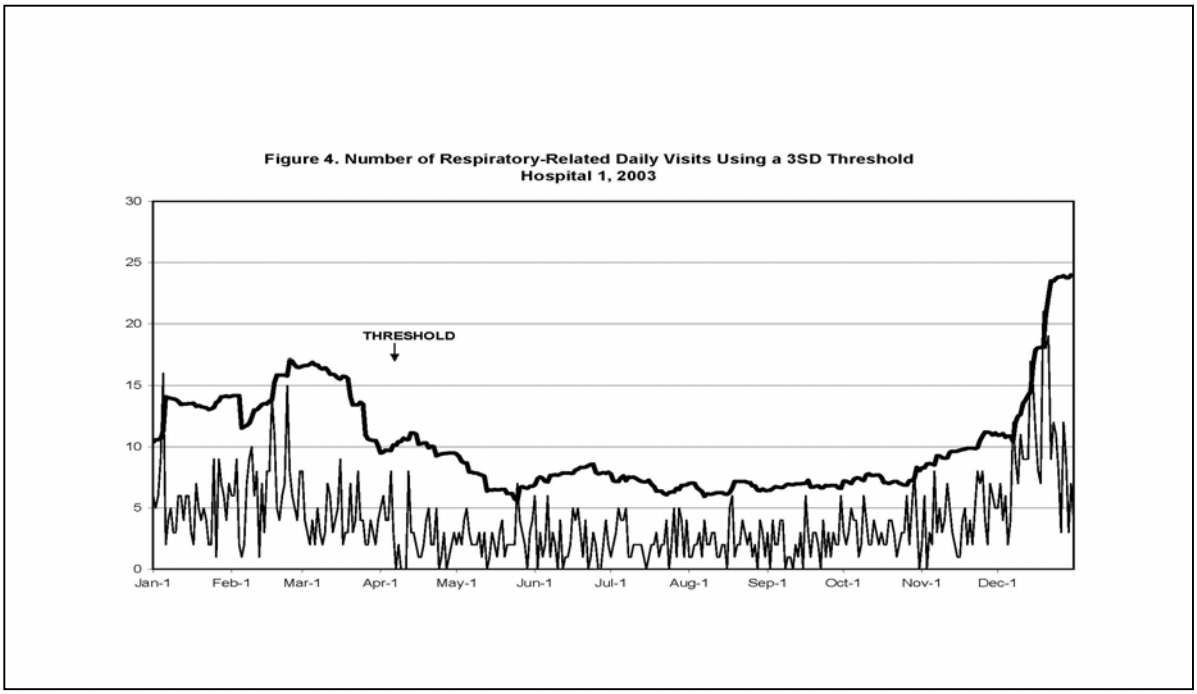


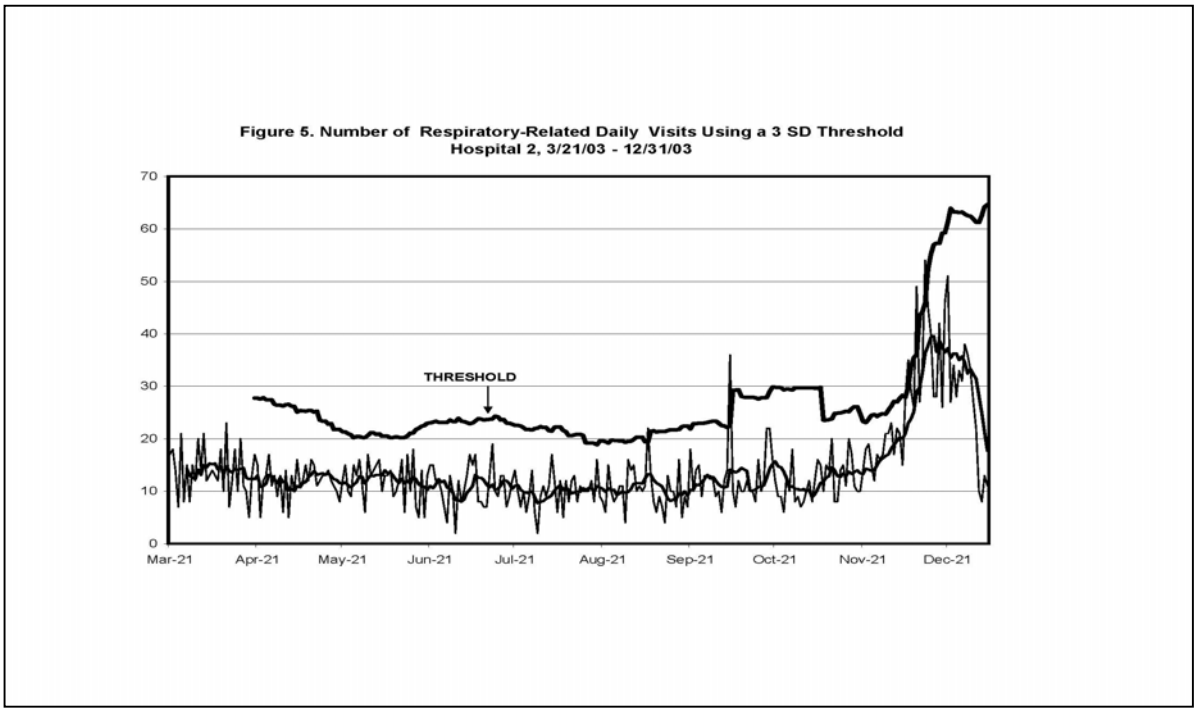


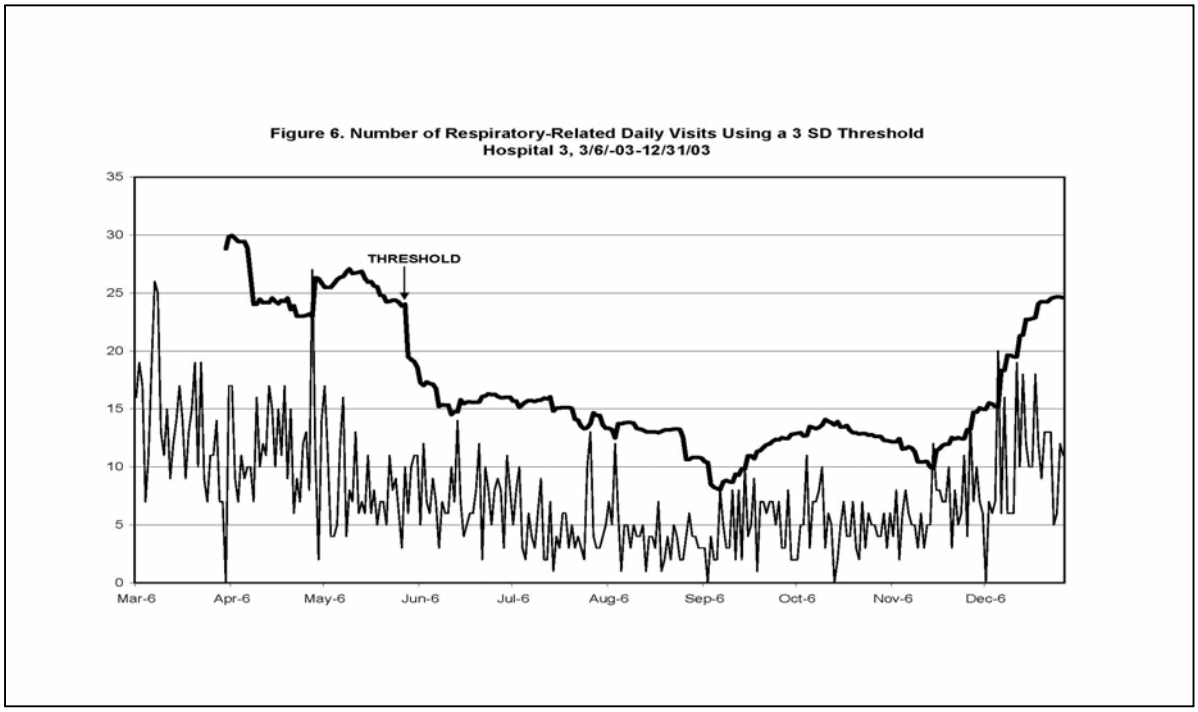
Hospital 3 had nine signals using a 2 SD method and one signal using a 3 SD method (Figure 3). The following figures display findings based on a 3 SD cut-off.



Respiratory-Related Visits: There were a total of 1,824 respiratory-related visits in 2003 from Hospital 1, 2,266 from Hospital 2, and 2,730 from Hospital 3. Hospital 1 had 26 signals using a 2 SD method and 7 signals using a 3 SD method (Figure 4). Hospital 2 had 14 signals using a 2 SD method and five signals using a 3 SD method (Figure 5). Hospital 3 had 18 signals using a 2 SD method and five signals using a 3 SD method (Figure 6).







Neurologic-Related Visits: There were total of 36 neurologic-related visits in 2003 from Hospital 1, 76 from Hospital 2, and 18 from Hospital 3. There were 11 signals using a 2 SD method and 10 signals using a 3

SD method for Hospital 1. Hospital 2 had 19 using a 2 SD method and five signals using a 3 SD method. Hospital 3 had five signals using a 2 SD and five signals using a 3 SD method.

Rash-Related Visits: There were a total of 346 rash-related visits in 2001 from Hospital 1, 804 from Hospital 2, and 85 from Hospital 3. There were 20 signals using a 2 SD method and 7 signals using a 3 SD method for Hospital 1. Hospital 2 had 17 using a 2 SD method and three using a 3 SD method. Hospital 3 had 18 signals using a 2 SD method and nine signals using a 3 SD method.

DISCUSSION

Our syndromic surveillance system has proven to be a useful tool in the detection of emerging infectious disease outbreaks. All three hospitals exhibited an increase in respiratory cases in the beginning of November 2003, heralding the start of flu season in LAC. In addition, our system was able to detect an increase in GI cases among children in Hospital 2. Further investigation revealed an outbreak of rotavirus in the community. The fundamental goal of syndromic surveillance is early detection of potential bioterrorist events or emerging infectious disease outbreaks, not to diagnose individual cases or to find cases of reportable disease; however, as demonstrated by our system, it can also be used to detect community outbreaks. The timely use of automated chief complaint data, especially with detection algorithms, may be a valuable resource for supplementing current infectious disease surveillance systems.12 Further refinement of the system, such as expanded analysis and increased coverage, will further enhance the capabilities of our syndromic surveillance system.

Syndromic surveillance has the potential to become a useful tool. 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, but to detect emergent disease situations as rapidly as possible. Advantages include circumventing the need for providers to initiate reporting and easy manipulation of the system for data analysis [11]. Finally, syndromic surveillance has been shown to detect patterns and outbreaks that were not detected by traditional surveillance systems [13].

One important limitation is that syndromic surveillance 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 30 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 gastrointestinal syndromes, including anthrax, plague or tularemia, only if they affect a wide geographic range and affect many individuals who seek care in an ED.

Therefore, 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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LOS ANGELES COUNTY SMAPOX VACCINATION PROGRAM

BACKGROUND

In January of 2002, the Los Angeles County Immunization Program (LACIP) of the Los Angeles County Department of Health Services was given the responsibility for developing a plan to vaccinate persons in Los Angeles County (LAC) against smallpox in the event of a smallpox emergency. This smallpox vaccination plan, henceforth to be referred to as the "post event" vaccination plan, was heavily based on guidance provided by the Centers for Disease and Control and Prevention (CDC) through the "Interim Smallpox Response Plan and Guidelines," first released in November of 2001 [1]. The LAC post event vaccination plan provided for the vaccination of the following groups of individuals in priority order:

1. Non-ill persons exposed to the initial release of the smallpox virus.
2. Persons who had face-to-face, household, or close proximity contact with a confirmed or suspected smallpox case while the confirmed or suspected case was communicable.
3. Personnel selected for the direct medical or public health evaluation, care, or transportation of confirmed, probable, or suspected smallpox cases, and other persons with likelihood of contact with infectious material from a smallpox case or suspect such as laundry or medical waste handlers at a facility where a smallpox case or suspect is receiving care.
4. Family members of close contacts to cases or suspect cases.
5. Other groups whose unhindered function is deemed essential to the support of response activities such as selected law enforcement personnel, emergency response workers, or military personnel.
6. Larger segments of the community if mass vaccination campaigns are authorized by CDC.

As national and local efforts continued towards planning for a smallpox emergency, the need for vaccinating select personnel prior to a smallpox emergency (pre-event vaccination) achieved a higher level of priority. On November 22, 2002, CDC requested states, some larger cities, and other localities such as Los Angeles County, to develop plans for vaccinating key public health personnel and select hospital health care workers as part of the first phase of a three phase pre-event vaccination program. The urgency in completing such a plan was compounded by the build-up to the Iraq war in March 2003. The LAC Pre-Event Vaccination Plan was submitted to CDC for approval on December 1, 2002.

Organization, Management, and Implementation of the LAC Pre-Event Vaccination Plan: The Medical Director of the LACIP was given the responsibility for coordinating the pre-event vaccination program, with support form other LACIP management staff. The efforts of seven full time equivalent LACIP positions was required during a two month start up phase prior to the first vaccinations being offered.

Activities, which were required during the start up phase, were:

1. Educating LAC Public Health Personnel about the vaccination program.
2. Recruiting and screening public health response team members to be vaccinated.
3. Notifying hospitals about the program and working with them to develop procedures to: a) insure adequate vaccination site care, b) documentation of proper vaccination site cover dressing while at work, and c) recruiting and screening potential vaccinees.
4. Selecting fixed clinic vaccination sites and developing mobile sub-teams.
5. Identifying, ordering, and procuring appropriate supplies.
6. Implementing the pre-event vaccination system (PVS) data management system.
7. Developing a curriculum to train vaccination operations staff.
8. Conducting multi-venue training sessions for vaccination operations staff.
9. Developing a system to monitor for, report, and treat adverse events to vaccination.
10. Developing and implementing appropriate vaccine handling, storage, and distribution procedures.

Public health personnel stationed in the eight Service Planning Areas (SPAs) throughout LAC were given the responsibility for staffing the fixed clinics and mobile vaccinating sub-teams, once vaccination operations began. These persons were tasked with screening, educating, vaccinating and providing follow-up (document vaccine take, and monitor for adverse events) of the vaccinees. The public health personnel targeted for voluntary vaccination as public health response team members were: physicians, epidemiologists, public health nurses, disease investigators, laboratorians, environmental health staff, translators, and public health communication staff. The public health response team members are the persons who would be expected to initiate the containment activities around the first smallpox confirmed or suspect cases. Emergency transport staff and select security or force protection personnel were also targeted for vaccinations.

All of the 81, "911" paramedic receiving hospitals and veterans administration medical centers were encouraged to develop hospital smallpox health care teams and offer vaccination to the team members. In total, the LAC pre-event vaccination program was prepared to vaccinate 9,165 persons once vaccinations operation commenced.

RESULTS

The first smallpox vaccination clinic in LAC was held on January 29, 2003, five days after the Secretary of Health and Human Services made the declaration, required by law, that smallpox countermeasures were being implemented [2]. During the first clinic session in LAC, 27 public health staff were vaccinated against smallpox. A total of 52 vaccination clinic sessions were held over a period of 21 weeks resulting in a total of 243 persons receiving vaccinations. In addition, 240 public health staff received intensive training on smallpox vaccine operations. Also, 150 hospitals infection control, employee health, and hospital management staff received training on how to implement smallpox vaccination operations in the hospital environment. Most significantly, the capacity to safely vaccinate persons against smallpox was established at select health centers in each of the eight

SPAs. It should be noted that no major adverse events where attributed to the LAC pre-event vaccination program.

DISCUSSION

Ours was the first health department in California to initiate a pre-event vaccination program after the Secretary of Health and Human Services' Declaration that smallpox countermeasures were being initiated. In general, the number of persons vaccinated in LAC was significantly less than what was anticipated, based on estimates from our emergency medical services department regarding hospital interest and based on a survey of public health nursing staff which had been conducted in the fall of 2002 [3]. That survey suggested that almost 50% of public health nursing staff would accept the vaccine if it was offered to them. The lower than expected numbers of vaccinees that participated may have resulted from a combination of the following factors. Firstly, the CDC mandated screening criteria for this voluntary program excluded vaccinees both on the bases of their individual health (presence of a risk factor for an adverse response to vaccination) as well as the health status of family members and close contacts. There were individuals who wanted to be vaccinated but who could not, due to strict adherence to the CDC guidelines. Secondly, the lack of a no-fault compensation program in the first several months of the program for vaccinees who might experience an adverse event was stated by some potential vaccinees to be a disincentive for vaccination. Thirdly, the publicity around the cardiac events, including two deaths, which were reported in other parts of the country during the third operational month of the national program, affected interest in vaccination. On resumption of our local vaccination program after an approximately two week hiatus required by CDC to implement new cardiac related screening criteria, the "broken" appointment rate significantly increased, exceeding 50% for many of the scheduled clinic sessions.

Despite the above circumstances and the low numbers of persons vaccinated, it is noteworthy that the infrastructure to administer this unique vaccine was developed and established in LAC. Additionally, a

critical core of persons recently vaccinated against smallpox has been established in LAC. Both of these accomplishments have increased LAC's level of preparedness to respond to a smallpox emergency.

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SUMMARY OF ADVERSE EVENTS FOLLOWING CIVILIAN AND MILITARY SMALLPOX VACCINATION—LOS ANGELES COUNTY, 2003

BACKGROUND

The US discontinued routine childhood smallpox immunization in 1971 and routine immunization of health care workers in 1976 with the last reported smallpox case reported in Somalia in 1977. In 1980, the World Health Organization (WHO) Global Commission for the Certification of Smallpox Eradication officially declared that smallpox eradication had been achieved. Since 1977, there have been no indigenous cases of smallpox despite extensive surveillance [1]. In the fall of 2002, the Los Angeles County (LAC) Department of Health Services Immunization Program prepared a smallpox vaccination plan for selected health care workers, public health workers and first responders in response to renewed concerns that the smallpox virus might be used as a biological weapon against military or civilian targets. In February 2003, LAC Immunization Program initiated Phase I of the smallpox vaccination plan with the vaccination of selected public health workers, hospital based teams, and first responders. The military initiated their smallpox vaccination program earlier that year, January of 2003. This renewed direction to initiate a smallpox immunization program within the US raised concerns many health care workers would be confronted with smallpox vaccination reactions for the first time in their professional careers.

Smallpox vaccine is made from live vaccinia virus and protects against the disease smallpox caused by the variola virus. It does not contain variola virus, the causative agent of smallpox [1]. Because viral replication and shedding occurs at the vaccination site (beginning 2-5 days post-vaccination), unintended transmission is possible from the time immediately after vaccination until the scab separates from the skin, approximately 2-3 weeks [2]. Although virus exists in the scab, it is bound in the fibrinous matrix, and the scab is not believed to be highly infectious. During the smallpox eradiation era, transmission usually required close interaction and occurred most often in the home [3]. Adverse events following vaccination can occur following individual smallpox vaccination or as a result of unintended transmission of vaccinia virus from recently vaccinated immunized persons. Adverse reactions following smallpox vaccination have been well documented during the years of universal vaccination in the US. Most adverse reactions are diagnosed on the basis of clinical examination and history. Most reactions can be managed by observation and supportive care; they are usually self-limited include fever, headache, fatigue, myalgias, chills, local skin reactions, nonspecific rashes, erythema multiforme, lymphadenopathy, and pain at the vaccination site [3]. Other reactions are most often diagnosed through a completed history and physical and might require additional therapy. Adverse reaction that might require further evaluation or therapy include: inadvertent inoculation, generalized vaccinia, eczema vaccinatum, progressive vaccinia, postvaccinia central nervous system disease, and fetal vaccinia. An in depth discussion of the diagnosis, treatment, prevention of the above noted adverse events is provided by the CDC [2]. This report summarizes the smallpox vaccination adverse events reported to the ACDC from February 26 to May 9, 2003.

METHODS

Smallpox vaccination adverse events reports were obtained through passive surveillance. Adverse events were reported to ACDC by both medical providers and by infection control practitioners from hospital facilities that suspect smallpox adverse events.

Case definition: A smallpox vaccination adverse event was defined as a reaction following the vaccination that did not meet the criteria of a normal vaccination response or unintended or “inadvertent” vaccinia transmission to an unvaccinated person due to close contact with a recently vaccinated person.

In preparation for the start of a limited smallpox vaccination program (Phase I) involving volunteer public health and medical workers and selected first responders, LAC medical providers were made aware of

potential adverse events following smallpox vaccination that they might encounter in their clinical setting through a mass mailing. The mass mailing was sent to all LAC medical providers and included: recommendations from the CDC [2], a memorandum from the health officer mandating reporting of smallpox adverse events within one day, description of the treatment available for smallpox adverse events, and directions for clinicians needing clinical consultation and treatment for adverse events through our program (ACDC). Once a report was called to an ACDC physician, a standardized Vaccine Adverse Event Reporting System (VAERS) report form was completed by the clinician and submitted to ACDC. This report was then faxed to the LAC Immunization Program, State of California Immunization Program and the CDC Immunization Program. All serious adverse events that required treatment consideration with vaccinia immune globulin (VIG) or antiviral therapy with cidovifir were made with in collaboration with the ACDC, the treating physician, and the CDC smallpox adverse event expert consultation line. Clinicians were requested to submit clinical specimens to the LAC Public Health Laboratory for testing for the presence of vaccinia virus. All clinical specimens submitted for vaccinia testing had nucleic acid polymerase chain reaction (PCR) testing, direct fluorescent antibody testing (DFA) to assess the presence of vaccinia virus in addition to other viral testing that could clinically mimic an adverse event which included herpes simplex virus (PCR) and varicella virus (DFA).

RESULTS

From February 26 through May 9, 2003, seven adverse events related to smallpox vaccination were reported to the ACDC. These seven included, 4 were female and 3 were male, median age=28 (range 19 to 53 years). There were no deaths reported.

Of the seven individuals, four (three female and one male) had adverse events secondary inadvertent vaccinia transmission from close physical contact with military contacts that had recently been vaccinated with the smallpox vaccination, and three cases were civilian smallpox vaccinees.

Three civilian smallpox adverse reactions were reported from vaccines. The first report was a 23 year-old male health care worker reported pleuritic chest pain 7 days following vaccination. Medical evaluation did not reveal evidence of myocardial or pulmonary damage. His symptoms resolved in 7 days. The second was a 53 year-old male physician who presented with a radicular pain syndrome involving the neck. His medical workup did not show spinal cord damage and his symptoms resolved in 2 days. The third report was in a 38 year-old public health worker who was diagnosed with generalized vaccinia 12 days following smallpox immunization. None of these individuals required hospitalization, treatment with VIG or cidofovir, and all recovered uneventfully.

Four adverse events were documented due to inadvertent transmission from their military close contacts. The first documented and most serious adverse event occurred in a female contact to military contact developed ocular vaccinia with conjunctivitis. She presented to multiple emergency rooms with presumed bacterial conjunctivitis until she was eventually hospitalized and the correct diagnosis was made. Her diagnosis was confirmed by the LAC Public Health Laboratory when her conjunctival specimen revealed vaccinia by DFA and PCR testing. This person received specific treatment with VIG and made an uneventful recovery after 3 days [4]. The remaining three individuals with inadvertent inoculation of the vaccinia virus from their intimate military contacts were not hospitalized, did not require specialized therapy, and recovered uneventfully. Vaccinia lesions due to close contact were described on these individuals' forearm, digit and mid-thorax, and one person had pustular lesions on her scalp and forearm. In two of the four cases, vaccinia was demonstrated in the lesions by DFA and PCR technology. In one of the four cases, no specimen could be obtained and in the other cases the specimen did not reveal vaccinia and the diagnosis were made by clinical examination and medical history. Following May 9, 2003, no further adverse events were reported to ACDC.

DISCUSSION

On March 28, 2003, the CDC reported cases of cardiac adverse events among vaccinated recently with smallpox vaccine [5]. This included 10 cases of myopericarditis among approximately 240,000 primary

vaccines in the military vaccination program, and two such cases (one with myocarditis and one of pericarditis) had been reported among civilian vaccinees. Additionally, the CDC received reports of five civilian patients with cardiac ischemic events after smallpox vaccination, including three patients with myocardial infarctions and two patients with angina. Two of the five individuals died due to myocardial infarction. With the documentation of cardiac adverse events following smallpox vaccination in both the military and civilian population, the Advisory Committee on Immunization Practices (ACIP) issued new emergency recommendations that persons be excluded from pre-event smallpox vaccination program who have known underlying heart disease, with or without symptoms, or who have three of more known major cardiac risk factors [6]. With these noted cardiac adverse event reports, smallpox vaccination requests severely dropped off in LAC. In total, 243 non-military persons received smallpox vaccination in 2003 in LAC. The drop off in civilian smallpox vaccine doses and possibly stricter guidance to military smallpox vaccines regarding transmission to their close contacts following vaccination may have contributed to the sharp cut-off of reported adverse events following smallpox vaccination.

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LABORATORY EXPOSURE TO *BURKHOLDERIA PSEUDOMALLEI* LOS ANGELES, CALIFORNIA—2003*

BACKGROND

On July 26, 2003, the ACDC received a report that a local clinical laboratory had isolated from specimens *Burkholderia pseudomallei*, a category B biologic terrorism agent and the causative organism for melioidosis, which is endemic to certain tropical areas. Because laboratory workers had manipulated cultures of the organism, CDC was asked to assist in the subsequent investigation. This report summarizes the results of that investigation, which included assessment of laboratory exposures, postexposure chemoprophylaxis, and serologic testing of exposed laboratory workers. The findings underscore the need to reinforce proper laboratory practices and the potential benefits of chemoprophylaxis after laboratory exposures.

METHODS

The specimens were taken from a man aged 47 years with diabetes mellitus who had been evaluated at a local emergency department (ED) for fever, chills, and chest and leg pain. He had traveled to El Salvador 3 weeks earlier and returned 3 days before visiting the ED. During the preceding 2 weeks, the man had intermittent fever and night sweats. In the ED, a chest radiograph revealed bilateral and multifocal infiltrates, and he was admitted to the hospital; a computed tomography imaging scan indicated the presence of pulmonary abscesses. During the next 2 days, his condition deteriorated, requiring intubation and mechanical ventilation for respiratory failure; he died from fulminant sepsis and multiorgan system failure. An autopsy revealed acute necrotizing pneumonia, multiple renal abscesses, and cirrhosis.

During the patient's hospitalization, seven specimens of blood, urine, sputum, and bodily fluid were obtained; 2 days after the patient's death, bacterial isolates from all specimens were presumptively identified as *B. pseudomallei* by the laboratory's automated identification system and subsequently confirmed by polymerase chain reaction at the LACDHS Public Health Laboratory. A total of 17 laboratory workers had manipulated cultures from these specimens. These workers were considered exposed and were offered antibiotic chemoprophylaxis within 48 hours of their exposures.

An onsite investigation was conducted on August 7. Laboratory procedures were reviewed and work activities classified into high and low risk. High-risk activities were defined as those that might result in organism-containing aerosol or droplet formation. High-risk activities included sniffing open culture plates to detect characteristic odors emitted by certain bacteria and preparing suspensions from culture plates using a vortex machine. High-risk activities also included routine laboratory procedures when not performed in a biological safety cabinet (BSC), such as picking colonies, subculturing, inoculating biochemical tests, centrifuging, and preparing slides. Manipulations of cultures inside a BSC were classified as low-risk exposures. On August 11, exposed workers completed a questionnaire regarding demographics, medical and travel histories, and work activities performed on the *B. pseudomallei* cultures. Active surveillance was conducted for symptoms consistent with melioidosis among exposed workers. Finally, serum specimens were obtained for anti-*B. pseudomallei* antibody testing from all exposed workers at 1, 2, 4, and 6 weeks after exposure. Serologic testing was performed by using an indirect hemagglutination test at PathCentre (Nedlands, Australia), with a positive result defined as a titer $\geq$40 [1].

* Reprinted from: CDC. Laboratory Exposure to *Burkholderia Pseudomallei*—Los Angeles, California, 2003. MMWR 2004; 53(42):988-990. Available at: www.cdc.gov/mmwr/PDF/wk/mm5342.pdf.

RESULTS

All 17 exposed workers completed the questionnaire. The median age was 48 years (range: 36-59 years). All reported ≥10 years of laboratory work experience (Table 1). Five persons (29%) reported an underlying condition, such as diabetes, that might put them at risk for severe disease. Eight (47%) reported having traveled to Southeast Asia during their lifetimes. Thirteen (77%) reported high-risk activities, including four (24%) who reported sniffing an open *B. pseudomallei* culture plate because of the distinctive "earthy" odor.

Sixteen workers completed a 3-week regimen of trimethoprim-sulfamethoxazole, and one completed a 3-week regimen of doxycycline. Antibiotics were begun at a median of 2 days' postexposure (range: 0–4 days). None of the exposed laboratory workers had symptoms consistent with melioidosis during 5 months after exposure. Two laboratory workers had titers of ≤20 for *B. pseudomallei* on the first serum drawn. Both workers were born in the United States, and neither demonstrated an increase in titer 6 weeks after exposure. The first (no. 17) reported sniffing a *B. pseudomallei* culture plate. The worker recalled previous travel to Hawaii, Europe, Mexico, and Jamaica but reported no previous illnesses consistent with melioidosis. The second worker (no. 1) reported low-risk activities. The worker reported previous travel to the Philippines and Singapore and was hospitalized in 2001 for pneumonia with pleural effusions requiring thoracenteses; no pathogen was identified.

Table 1. Characteristics of laboratory workers exposed to *Burkholderia pseudomallei* (*B. ps*) culture isolates—Los Angeles, California, 2003

Worker	Years of laboratory experience	Underlying medical condition	Any lifetime travel to areas where melioidosis is endemic?	Performed high-risk laboratory activities*	Sniffed open *B. ps* plate?	Detected anti-*B. ps* titer (date of blood draw)
1	20	—	Y	—	—	20 (9/24/03)
2	22	—	Y	Y	—	—
3	11	Diabetes mellitus	Y	—	—	—
4	25	—	—	Y	—	—
5	20	—	—	Y	Y	—
6	17	Thalassemia	—	Y	Y	—
7	12	Rheumatoid arthritis	—	Y	—	—
8	22	—	Y	—	—	—
9	10	—	Y	Y	—	—
10	20	—	—	Y	—	—
11	24	Ulcerative colitis	—	Y	—	—
12	15	—	Y	Y	Y	—
13	19	—	Y	Y	—	—
14	17	—	Y	—	—	—
15	25	—	—	Y	—	—
16	21	—	—	Y	—	—
17	28	Diabetes mellitus	—	Y	Y	20 (9/26/03)

* Activities that might result in aerosol/droplet formation, procedures not performed in a biosafety cabinet, or the sniffing of open culture plates.

Although the occurrence of potentially high-risk work activities performed outside a BSC were documented, no laboratory workers in this investigation were infected with *B. pseudomallei.* In response to this incident, laboratory safety recommendations for *B. pseudomallei* were reviewed; the laboratory had existing policies against sniffing all culture plates and continued to prohibit this and other unsafe laboratory practices.

Editorial Note: This report describes the investigation into the exposure of 17 laboratory workers to the gram-negative bacillus *B. pseudomallei,* which causes melioidosis infection. The majority of infections with *B. pseudomallei* are asymptomatic [1]. Symptomatic disease can be in localized or septicemic forms. Foci of infection include lung, skin, and genitourinary tract. Although infection can occur in healthy persons, *B. pseudomallei* is an opportunistic pathogen. Underlying immunosuppressing conditions,

including diabetes mellitus, chronic renal failure, and alcohol abuse, are risk factors for septicemic melioidosis. Hypotension, absence of fever, leucopenia, and abnormal renal and hepatic function are poor prognostic features [2].

DISCUSSION

B. pseudomallei is endemic to Southeast Asia and northern Australia, but sporadic cases have been reported from other tropical and subtropical areas between 20^0 north and south latitudes, including El Salvador [3]. The primary route of infection is thought to be inoculations; however, infection meight occur through inhalation, aspiration, and ingestion. The environmental reservoirs for *B. Pseudomallei* are surface water and soil [4]. The median incubation period of melioidosis is 9 days (range: 1–21 days), although reactivation of previously asymptomatic disease can occur after months or years [5].

Two laboratory-acquired infections have been reported previously [6,7]. A case of pneumonia, epididymo-orchitis, and a leg abscess occurred in a previously healthy laboratory worker. These conditions were associated with open-flask sonication of a suspension of organisms outside of a BSC, presumably resulting in inhalational exposure. In addition, a previously healthy bacteriologist had tender right axillary lymphadenopathy and pneumonia after cleaning a leaking centrifuge tube without wearing gloves. The worker reported having an ulcerative lesion on one finger at the time of the incident, suggesting that infection occurred via inoculation. After appropriate treatment, both patients recovered without adverse sequelae.

Biosafety level (BSL) 2 practices, equipment, and containment are recommended for working with known or potentially infectious body fluids, tissue specimens, or cultures. However, a review of work in a clinical laboratory in an area in which melioidosis is endemic indicated low risk to laboratory workers [8]. The laboratory described in that report followed BSL-2 precautions, with aerosol-generating procedures performed in a Class II or higher BSC, whereas new or ongoing cultures were examined on the open bench; sniff testing of opened culture plates was prohibited. Serologic follow-up of 60 laboratory workers over 15 years identified three workers with titers suggestive of subclinical infection, consistent with the background seroprevalence in the local community. These data suggest that infection is not easily acquired from routine, open-bench laboratory work with *B. pseudomallei.* In the current investigation,the low titers of workers no. 1 and 17 are not considered evidence of infection with *B. pseudomallei* among persons residing in areas where disease is not endemic (B. Currie, M.D., Royal Darwin Hospital and Menzies School of Health Research, personal communication, 2004).

Recommendations for postexposure prophylaxis (PEP) with trimethoprim-sulfamethoxazole or doxycycline for 3 weeks were based on in vitro and animal data; no published data for humans are available. As shown in Table 2, current treatment recommendations for melioidosis comprise an initial, intensive phase followed by eradication therapy [4].

Table 2. Treatment Recommendations for Meliodosis

Initial intensive therapy (lasting >14 days)		
Ceftazidime	50 mg/kg up to 2 g	Every 6 hours
	or	
Meropenem	25 mg/kg up to 1 g	Every 8 hours
	or	
Imipenem	25 mg/kg up to 1 g	Every 6 hours
	and (optional)	
Trimethoprim-sulfamethoxazole	8 + 40 mg/kg up to 320 + 1600 mg	Every 12 hours
Eradication therapy (lasting >3 months)		
Trimethoprim-Sulfamethoxazole	320 + 1600 mg and (optional)	Every 12 hours
Doxycycline	2 mg/kg up to 100 mg	Every 12 hours

As the findings in this report indicate, potentially unsafe laboratory practices such as sniffing opened culture plates can occur before isolates are identified. Such practices should be prohibited, especially given that *B. psuedomallei* can be misidentified by biochemical substrate utilization tests [9]. Because infection with *B. pseudomallei* can be severe, PEP with doxycycline (2 mg/kg up to 100 mg orally, twice daily) or trimethoprim-sulfamethoxazole (8 + 40 mg/kg up to 320 + 1,600 mg orally, twice daily) can be considered if cultures of the organism are inadvertently manipulated outside of BSL-2 conditions. Animal data suggest that 5 days of PEP might be insufficient to prevent infection [10]. Because the incubation period of melioidosis can last up to 21 days, 3 weeks of PEP might be necessary. PEP should be recommended for laboratory manipulations or incidents that result in exposure to aerosols or dropets or contact with nonintact skin and for persons with risk factors for septicemic disease. CDC requests that incidents involving unsafe laboratory exposure to *B. pseudomallei* be reported to the Meningitis and Special Pathogens Branch, National Center for Infectious Diseases, telephone 404-639-3158.

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CORONER PROJECT 2003:
LOS ANGELES COUNTY UNUSUAL DEATH SURVEILLANCE

BACKGROUND

The Unusual Death Surveillance System began in 2001 as a joint project between the ACDC and the Los Angeles County Department of Coroner (DC). This project was developed in order to identify deaths possibly related to bioterrorism or emerging infectious diseases (e.g., SARS, West Nile virus, avian influenza, etc.) and is funded by the Centers for Disease Control (CDC) Bioterrorism Preparedness and Response Cooperative Agreement. Early detection of deaths due to bioterrorist or emerging infectious diseases may lead to earlier enactment of treatment and prevention strategies, which may in turn limit the number of residents negatively impacted by the situation. This report provides a detailed overview of the system and a descriptive summary and analysis of the death records in 2003.

METHODS

Data files are sent daily to ACDC from the DC encompassing more than 40 variables including demographic information and a brief synopsis of events prior to death. Of the more than 60,000 deaths that occur each year in LAC, approximately 18,000 become coroner cases (Table 1). ACDC receives data on all coroner deaths except those from automobile accidents, homicide and suicide due to the non-infectious disposition of these cases. Records are searched electronically for key words that might indicate that the death was due to an infectious disease. Deaths which are unexplainable by the ACDC investigator are subject to follow-up by gathering additional information from the medical examiner in charge of the case. Additional action may result from the investigation depending on the information gathered from the DC.

Table 1. Coroner Case Definition

The jurisdiction of the coroners in California is described in the California *Government Code* (Section 27491). The coroner is responsible for the following cases:

1. **Any homicide, suicide or accidental death, or any case in which the cause or mode of death cannot be determined.** An injury causing death may be either old or new.
2. **Therapeutic misadventures.** A patient who dies within 24 hours of surgery or anesthesia should be reported to the coroner because of the possibility of therapeutic misadventure. Patients who die as a consequence of therapy, such as those with drug reactions, or patients who die unexpectedly during minor procedures, should also be reported.
3. **Sudden or unusual death.** If the attending physician can certify the cause of death as natural disease, the case need not be reported. However, all cases of sudden unexpected death in infants (under 1 year of age) are coroner's cases.
4. **Any death related to self-induced or criminal abortion.**
5. **Deaths related to drug addiction or drug overdose.** A death from consequences of drug use, such as acquired immunodeficiency syndrome or endocarditis in an intravenous drug user, is a coroner's case. Death from acute alcohol poisoning is a coroner's case, but death from consequences of chronic alcoholism is not.
6. **Aspiration.** Deaths from terminal aspiration of gastric contents or aspiration pneumonia may be coroner's cases, depending on the underlying cause of the aspiration. Deaths from choking on food are coroner's cases.
7. **Deaths while in custody or under sentence.** Any person who dies in jail or while under arrest is a coroner's case; this includes deaths during involuntary 72 hour or 14 day psychiatric hospitalization.
8. **Deaths due to a possible undiagnosed contagious disease constituting a public health hazard.** Contagious diseases constituting a public health hazard are those diseases which are required to be reported to the health department. Cases where the contagious disease has been diagnosed need **not** be reported to the coroner.
9. **Deaths from occupational disease or occupational hazard.** Deaths which occur while at work should generally be reported to the coroner. A death due to consequences of an occupational disease, such as asbestosis, is an accidental death and should be reported.
10. **Deaths in state hospitals.** Any death which occurs in a hospital operated by the State Department of Mental Health or the State Department of Developmental Services is a coroner's case.
11. **Deaths due to criminal acts of another.** When there are reasonable grounds to suspect the death was due to the criminal acts of another person, the case should be reported.
12. **Deaths involving rape or sodomy.**
13. **Unattended fetal deaths.**
14. **Human remains discovered outside a dedicated cemetery.**

Death records with a date of death in 2003 were aggregated and included in the analysis. Basic demographic variables (e.g., age, race, sex, place of death, mode of death) were tallied and examined for trends.

Two methods were used to identify death records potentially due to a bioterrorist agent or an emerging infectious disease—a computer key-word search with occasional clinician review versus identification solely by clinician. In the computer-assisted method, an algorithm was designed to signal deaths records containing key words in the investigator notes that might indicate the death was due to an infectious agent. Reports containing specified key words were then coded into one of five "syndrome" categories: Fever, Gastrointestinal, Respiratory, Neurological and Rash (Table 2).

Table 2. Syndrome Categories and Associated Key Words Used to Electronically Identify Suspicious Coroner Deaths Based on Death Investigator Notes (2003)

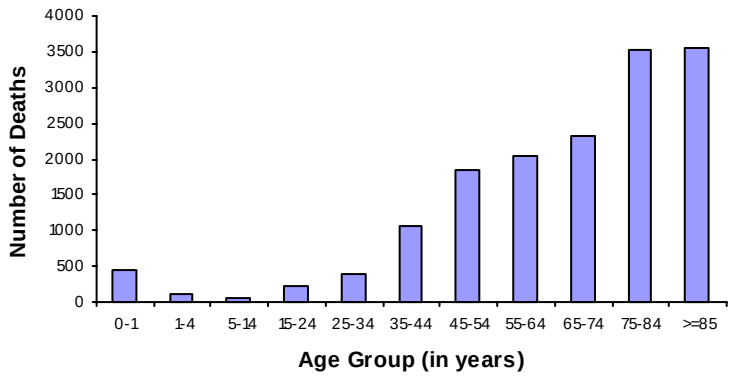
Fever Syndrome	Gastrointestinal Syndrome	Neurological Syndrome	Rash Syndrome	Respiratory Syndrome	
fever	nausea	seizure	rash	respiratory	pharyngitis
high fever	vomit	paralysis	skin	flu	laryngitis
	diarrhea	facial paralysis	varicella	pneumonia	SARS
	gastritis	encephalitis	chicken pox	cough	
	gastroenteritis			difficulty breathing	
	abdomen pain			tightness chest	
	abdominal pain			asthma	
	food poisoning			bronchitis	

If cases fit more than one category, the syndrome most representative of the case description was used. Death records that were coded into one of the five syndrome categories were then reviewed by a clinician (a nurse or a physician). Suspicious deaths not explainable after the clinician's review of the DC investigator notes were then followed-up with the DC. The second method utilized a clinician visual review of all death records sent to ACDC with suspicious cases being selected for follow-up with the DC. Death records selected by the clinician visual review, but not coded into one of the five syndrome categories by the computer program were listed as "Other" syndrome. Both methods were employed simultaneously in order to perfect the computer algorithm so that future cases identified by a clinician review would also be flagged using the electronic key word search.

RESULTS

Demographics—All Coroner Cases: ACDC received a total of 15,585 death records from DC with a date of death in 2003; Table 3 provides a summary of the demographic characteristics of these death records. Over half of the cases were male (53%), 44% were female and 3% of cases did not have a gender specified. Almost 60% of the cases were White, while Black and Hispanic cases made up 15% and 13% of the case total respectively. Approximately 5% of cases did not have a race or ethnicity specified.

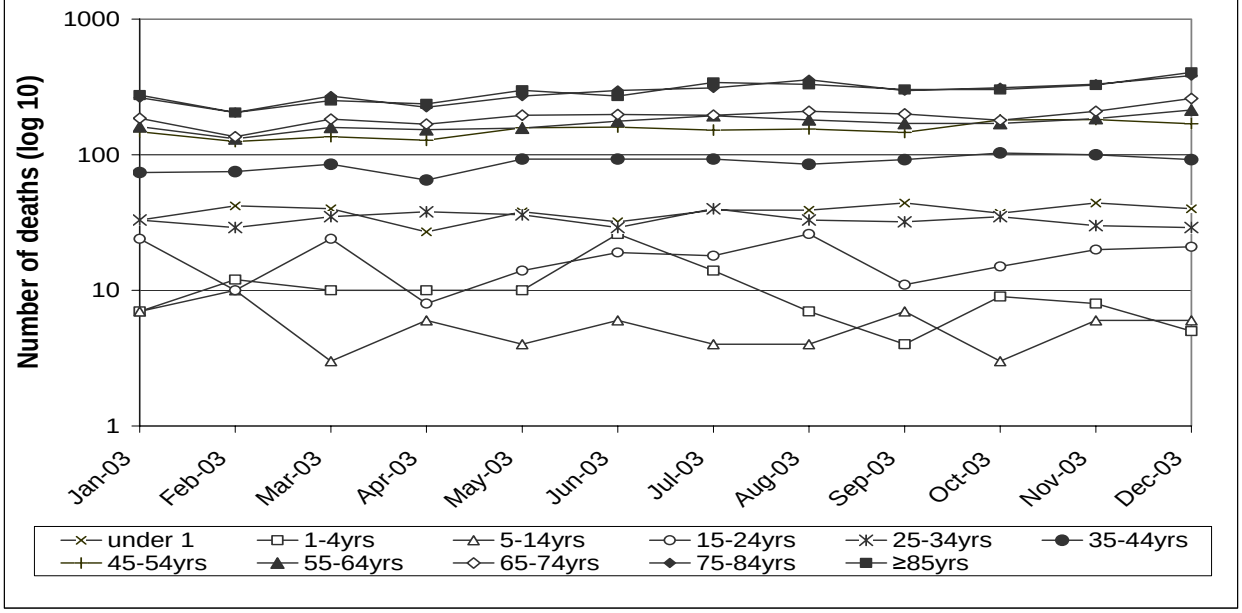
Figure 1. Number of coroner deaths reported to ACDC, by age group, 2003



Cases aged 14 years and under made up only 4% (643 deaths) of the death records received from DC. An increasing number of death records were received for each 10-year age group beginning at the 15-24 years category (Figure 1). The lowest number of death records received was for the 5–14 year age group (66 deaths). Within the

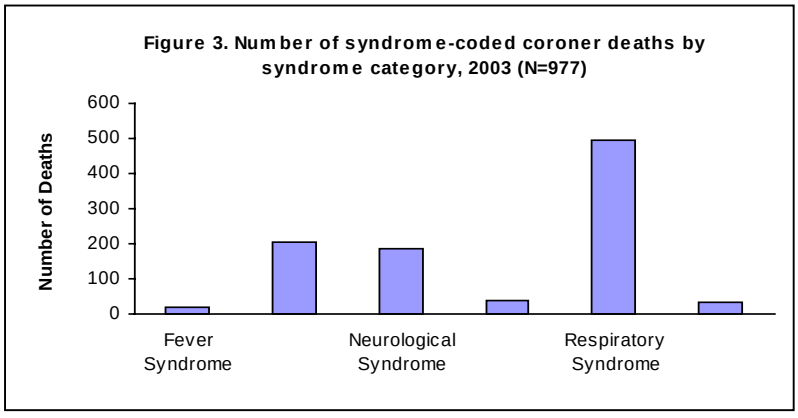
individual age categories, the number of deaths occurring each month appeared to remain consistent throughout the year with several exceptions (Figure 2). First, an artificial peak in deaths was seen in 1–4 year age group during June 2003 due to fetuses and embryos being sent to the coroner from a school science laboratory. Second, the two oldest age groups showed a large increase in deaths in November and December. This corresponds to a commonly observed increase in respiratory disease that occurs in the fall and winter months.

Figure 2. Log number of coroner deaths reported to ACDC, by month of death and age group, 2003



By definition, most of the death records received were described as death due to natural causes (84%) with an additional 14% of deaths due to a non-vehicular accident or a combination of accidental and natural causes. The cause of death was undetermined for 0.5% (n=77) of the cases. An autopsy was performed on less than half (43%) of the deaths reported to ACDC.

Syndrome-Coded Cases: A total of 977 death records (6%) were coded into one of the six syndrome categories (syndrome-coded cases) by either the computer key word search or the clinician review (Figure 3). Respiratory, gastrointestinal and fever syndromes captured the greatest number of cases (493, 205 and 186 cases respectively) while rash, neurological and other syndromes had very few cases (39, 33 and 21 cases respectively). Figure 4 shows the number of syndrome-coded death records for each syndrome by the month of death. Respiratory syndrome cases significantly increased at the end of 2003, starting in October. While gastrointestinal and neurological syndrome cases fluctuated throughout the year, no significant seasonal trends were found.



Several interesting trends were noted for syndrome-coded death records. Approximately 95% had an autopsy performed compared to only 43% of the total cases reviewed (Table 3). In addition, the number of syndrome-coded cases in each age group varied considerably from the overall age distribution of cases (Table 3). The greatest proportion of syndrome-coded cases was seen in the 5–14 year age group with a decreasing proportion of deaths seen for both younger and older age groups. Within each age category, cases were most often respiratory syndrome except in the 15–24 and the 24–35 age groups (Figure 5). In these groups, cases most often had neurological syndrome, however, the percent of respiratory syndrome cases remained high.

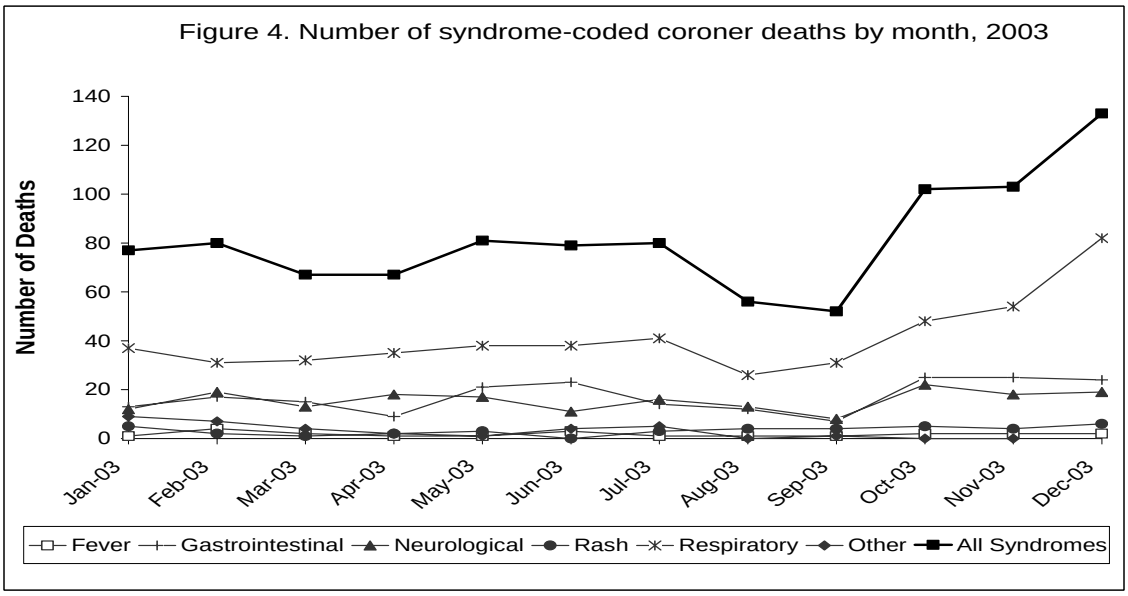
Table 3. Summary of Demographic Variables for Coroner Deaths* Reported to ACDC, 2003

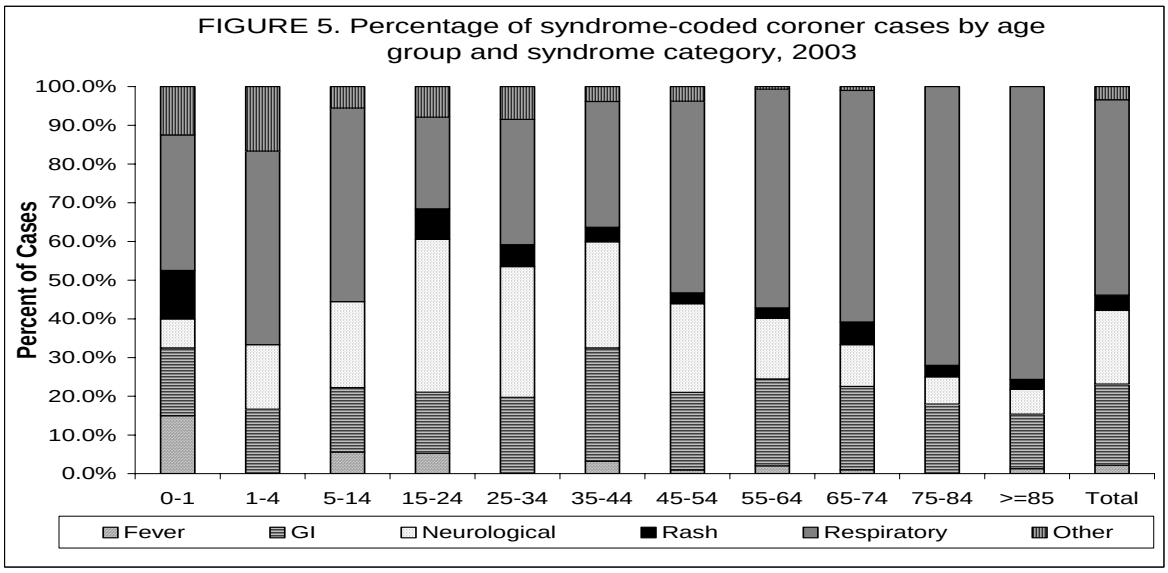
	Coroner Deaths Reported to ACDC		Syndrome-coded Cases		Cases Requiring Follow-up	
	n	**%**	**n**	**%**	**n**	**%**
Total Number of Deaths	**15,585**	100.0	977	6.3	96	0.6
Gender						
Male	8,263	53.0	577	59.1	57	59.4
Female	6,859	44.0	397	40.6	39	40.6
Unknown	463	3.0	3	0.3	0	0.0
Race/Ethnicity						
White	9,281	59.5	432	44.2	32	33.3
Black	2,385	15.3	241	24.7	16	16.7
Hispanic	2,104	13.5	216	22.1	37	38.5
Asian/Pacific Islander	935	6.0	62	6.3	10	10.4
American Indian	43	0.3	3	0.3	1	1.0
Not stated/Unknown	837	5.4	23	2.4	0	0.0
Age Group						
Under 1 year	455	2.9	40	8.8**	15	37.5***
1-4 years	122	0.8	12	9.8	5	41.7
5-14 years	66	0.4	18	27.3	8	44.4
15-24 years	210	1.3	38	18.1	6	15.8
25-34 years	399	2.6	71	17.8	11	15.5
35-44 years	1,050	6.7	157	14.9	18	11.5
45-54 years	1,840	11.8	214	11.6	19	8.9
55-64 years	2,052	13.2	147	7.2	7	4.8
65-74 years	2,321	14.9	102	4.4	5	4.9
75-84 years	3,525	22.6	100	2.8	2	2.0
≥ 85 years	3,545	22.7	78	2.2	0	0.0
Autopsy Performed						
Yes	6,460	43.4	931	95.3	93	96.9
No	8,825	56.6	46	4.7	3	3.1
Mode of Death						
Natural	13,075	83.9	628	64.3	75	78.1
Accident	1,301	8.4	148	15.1	3	3.1
Accident/Natural	952	6.1	174	17.8	14	14.6
Natural/Homicide & Natural/Suicide	101	0.6	18	1.8	1	1.0
Accident/Suicide	79	0.5	5	0.1	0	0.0
Undetermined/Missing	77	0.5	4	0.4	3	3.1

* ACDC receives death records for all coroner cases *except* automobile accidents, suicides and homicides. The above summary of demographic data for coroner deaths excludes those records not reported to ACDC.

** Proportion based on the total number of cases in each age group (column 1).

*** Proportion based on the total number of syndrome-coded cases in each age group (column 3).





ACDC Follow-up Cases: Among the 977 syndrome-coded cases, additional follow-up with the DC was undertaken for 96 (9.8%) death records (follow-up cases). The majority of the follow-up cases were flagged by electronic coding into a syndrome category (63 cases, 66%). Of these cases, respiratory and gastrointestinal syndromes each accounted for one-third of those receiving follow-up review (22 cases each) with the remaining 19 cases coming from the other three syndrome categories. The remaining 33 follow-up cases were selected by manual review of the data (Table 4).

Approximately 97% of the follow-up cases had an autopsy performed, similar to the percentage of syndrome-coded cases receiving an autopsy. The trend in the distribution of follow-up cases by age group was similar to that seen with the syndrome-coded cases. The greatest proportion of follow-up cases was again in the 5–14 year age group with a decreasing proportion of deaths for younger and older age groups. The majority of deaths records selected for follow-up were under 55 years of age.

DISCUSSION

In 2003, ACDC reviewed 15,585 death records for signs of possible bioterrorism or new emerging infectious diseases. Only 6.3% were coded by algorithm into one of five constructed syndrome categories. This is in part due to the low percentage of cases that undergo an autopsy. Cases that do not undergo an autopsy often have very little descriptive information in the "Event Description" and "Synopsis" fields of the medical examiners' reports. Since this information is used to decide whether or not the death is suspicious, a death will not be followed-up without adequate descriptive information in these fields.

Table 4. Summary of Syndrome-Coded Coroner Cases, 2003

	Syndrome-coded Cases (N=977)		Cases Requiring Follow-up (N=96)	
Syndrome	**n**	**%**	**n**	**%**
Fever	21	2.1	8	8.3
Gastrointestinal	205	21.0	22	22.9
Neurological	186	19.0	9	9.4
Rash	39	4.0	2	2.1
Respiratory	493	50.5	22	22.9
Other*	33	3.4	33	34.4

* Five syndrome categories were used to code cases, however, 33 cases investigated in 2003 did not fall into one of these categories. These cases were investigated based on clinical judgment alone, as they were not flagged during the electronic key word search.

The 96 death reports chosen for additional follow-up with the DC had a very different age distribution than the total 15,585 death records. Approximately 85% of the follow-up cases were less than 55 years of age, compared to only 25% of the total received death reports. It is expected to see an increasing number of deaths in older age categories as persons 50 years and older are more likely to have chronic conditions that could lead to death. However, it is less likely that persons under 50 years old would have underlying medical conditions that could explain a sudden death. Thus, when searching for suspicious deaths possibly due to bioterrorism or emerging infectious disease, cases among those less than 54 years are more likely to become follow-up cases than older cases.

None of the deaths reported to ACDC appeared to be due to an intentional bioterrorist event. In addition to accomplishing its primary objective of bioterrorism and emerging infectious disease surveillance, this project was also useful in fulfilling other state and nationwide disease surveillance activities. Several previously undetected cases of reportable public health conditions were identified from the coroner data files in 2003. While the total number of reportable disease cases identified in 2003 was not recorded, ACDC has developed a system for tracking such cases of reportable disease identified from the coroner data for 2004.

In late-2003 the CDC asked state and local health departments to report severe complications and deaths associated with influenza A in persons less than 18 years of age. Nine pediatric death reports received in ACDC had sufficient descriptive information to suggest possible influenza disease at the time of death and the DC was asked to perform influenza testing. Two of the nine cases (22%) were found to be positive for influenza A. Both cases were reported to the CDC for inclusion in their nationwide surveillance of pediatric influenza-associated complications and deaths.

Overall, this unusual death surveillance project is best used as a complimentary surveillance system in conjunction with other established forms of disease surveillance. While this project is still being tested and edited as needed, it has been helpful in identifying suspicious deaths that could be of public health concern. Additionally, the coroner project has been instrumental in increasing the communication and collaboration between Public Health and the DC, which will likely prove vital in the case of a real bioterrorism event.

PREDICTORS FOR RESTAURANT INSPECTION SCORE: RESULTS FROM A STUDY ON FOOD SAFETY KNOWLEDGE, ATTITUDES, AND BEHAVIORS AMONG RESTAURANT WORKERS IN LOS ANGELES COUNTY, 2003

BACKGROUND

The inspection grades posted in most Los Angeles County (LAC) commercial food establishments have their beginnings in 1996 when the National Advisory Committee on Microbiological Criteria for Foods finalized the Hazard Analysis Critical Control Points (HAACP) standards for food safety. The focus on food safety led to the LAC Board of Supervisors adopting Ordinance #97-0071 on January 16, 1998—which required the posting of inspection grades for all commercial establishments that prepare and serve food [1,2]. The intention of this ordinance was to disclose results of retail food establishment inspections to the public (i.e., compliance with HAACP and other safety standards). Although cities within LAC had final say to instituting this ordinance, most cities did because of the public demand.
LAC Environmental Health (EH) performs the inspections of and provides the grades to commercial food establishments in LAC. Inspectors search for physical evidence of unsafe food handling practices and increased risks for foodborne illness. Violations against food and work safety standards reduce inspection scores, which are translated into grades posted on 8x10 inch cards. Grades range from A (90–100 points), B (80–89 points), and C (70–79 points) to numerical scores when the grade is less than C [2]. For most food establishments, routine inspections are unannounced and occur one to three times per year. Follow-up inspections are conducted for establishments with serious violations. When desiring a better grade, owners of establishments can request a non-routine inspection for a fee. Surveys have shown that people who dine out use restaurant grades in choosing their dining facilities [3,4,5].

The ACDC conducts surveillance of communicable disease in LAC and often collaborates with EH in investigating foodborne illnesses and outbreaks and in performing food safety projects. The California State Department of Health Services obtained funding from the United States Department of Agriculture (USDA) and recruited LAC EH and ACDC to identify food safety training needs of workers of small, non-franchise food establishments in LAC and measure differences between small restaurants in low-poverty areas and small restaurants in high-poverty areas with regards to food safety knowledge, attitudes, and behaviors. From this project, the following study developed to identify predictors of restaurant inspection scores. The following are preliminary results that were presented at the American Public Health Association Conference in San Francisco, CA in November 2003.

METHODS

Using 2000 U.S. Census data, ACDC defined two areas of contiguous LAC census tracts, one of high-poverty and one of low-poverty. Census tracts of the cities of Long Beach and Pasadena were excluded. The high-poverty area consisted of 201 census tracts with 0–32% of the population making 200% of the 2000 Federal Poverty Level or more. The low-poverty area consisted of 71 census tracts with 77–100% of the population making 200% of the Federal Poverty Level or more. The authors used this 200% criterion because of LAC's high standard of living compared to the rest of the US. Geographically, the high-poverty area included South, South Central, and East Los Angeles, while the low-poverty area included West Los Angeles, Santa Monica, and Malibu.

Using their database of licensed food establishments, EH listed all retail food establishments within the two study areas that had a maximum capacity of seating ≤ 60 patrons at one time, were not part of a franchise or had less than three restaurants in LAC, and prepared most of their food onsite. There were 1904 establishments in the high-poverty area and 477 establishments in the low-poverty area meeting these criteria. ACDC randomized these two lists of restaurants to order the sequence of calls for requesting participation in the study.

The materials and designing of the study involved recruitment of Spanish-English-speaking interviewers, development of the study questionnaire, and testing of participation incentives and food safety handling education materials. The study questionnaire measured: 1) demographics, 2) food safety knowledge (based on correct answers to 10 food safety questions), 3) attitudes, and behaviors (KAB), 4) work history, 5) managers' and supervisors' KAB and training of workers, and 6) restaurant characteristics such as type of cuisine and average cost of menu items. ACDC and EH used three sets of focus groups outside the two study areas to test and refine the study questionnaire, and then recruited and trained staff for data collection and entry. In addition, ACDC and EH pilot tested the recruitment of study participants. Between two pilot tests, participation increased from 4% to nearly 100% when $5 grocery vouchers were added to recruitment protocol. After selecting educational materials from the FightBAC® program (which produces food safety educational items for the home), designing a food safety magnet, and adding Hepatitis A pamphlets from ACDC health educators, ACDC and EH proceeded to have the study interviewers call food establishments to confirm study eligibility and request participation. Interviews occurred between July 2002 and February 2003. Restaurant managers often designated which workers could be available for interview. With the study budget ACDC and EH determined a recruitment goal of 80 restaurants and 280 workers from each study area.

Measurements of certain variables need some description. Rank categories were defined as upscale when most entrées cost over $15, reasonable priced when most entrées cost more than $5 but less than $15, and economical when most entrées cost less than $5. In calculating the average cost of menu items, all food items were included to reflect the variety of types of food establishments surveyed.

The study investigators used Microsoft Access for data management and SAS version 8.0 for data analysis. Data from the study interviews and the licensed food establishment database of EH were merged to develop a mathematical linear regression model to predict the most recent routine restaurant inspection score. As the unit of analysis was the restaurant, study investigators summarized worker data per restaurant. For example, "gender" became the percent of males working in an establishment; and "knowledge question 1" became the percent of workers in a restaurant who correctly answered food safety knowledge question 1. Restaurant characteristics and worker characteristics were included in this analysis; however, variables measuring attitudes and behaviors were not included but will be in a future analysis. Univariate analyses provided tests for normality, an inherent assumption in linear regression. Model fitting techniques to find optimal model fits to the data included considerations of confounding and multicollinearity (i.e., minimal variance between variables). To select a parsimonious model, eigenvalue analyses were performed to check for multicollinearity, in addition variable transformations such as power and log transformations, dummy coding, influence diagnostics to remove influential outliers, and calculations of adjusted R^2 (R=correlation coefficient) were conducted. Statistics from linear regression (coefficients with $p \leq 0.10$) and assumptions of confounding helped determine the selection of variables for inclusion in mathematical models. As this was a preliminary analysis performed during the study, data collection and entry were not complete for the multiple regression analyses. The methods of this study were submitted to and approved by the LAC Department of Health Services Institutional Review Board.

RESULTS

A total of 148 restaurants and 403 workers were surveyed. This analysis is based upon 98 restaurants and 262 workers. Overall, the majority of establishments served American cuisine and had full serve or fast food service (Table 1). The median restaurant inspection score was 91 (Table 2). Workers were usually female (63%), Hispanic (55%), foreign-born (91%), and read little to no English (53%, Table 3). A majority (56%) of the workers were in the food industry for three or more years.

Starting with 44 variables (Table 4) to find a parsimonious predictive model for inspection score, analyses progressed from a 22- to a 10-predictor model (Table 5). The 22-predictor model, based on all 98 restaurants, had eight statistically significant predictors, included all confounders considered important, omitted three influential outliers, and contained no multicollinear or transformed variables. Interaction between age and sex was tested but not found to be statistically significant. The 10-predictor model had all statistically significant variables ($p \leq 0.05$), but assumed a full data set of 57 restaurants rather than 98

as it was based on the 22-predictor model. Thus, the p-values of the 10-predictor model were expected to be smaller. The variables of the 22- and 10-predictor models are listed in Table 6. Comparison of the coefficients between these two models shows a dilution of effects caused by the removal of the confounders in the 10-predictor model (Table 7).

Table 1. Characteristics of Food Establishments (N=98; high-poverty=29, low-poverty=69)*

Characteristic	Number	Percent*
Cuisine		
American	30	36.6
Mexican	9	11.0
Mexican-American	5	6.1
Chinese-Asian	14	17.1
Japanese	11	13.4
Other**	14	17.1
Rank		
Upscale	4	5.1
Reasonably Priced	36	45.6
Economical	39	49.4
Services		
Fast Food	43	48.3
Take-out	44	49.4
Deliver	9	10.1
Self-serve	2	2.3
Full-serve	44	49.4
Other**	33	37.1

* Missing data varies among variables; range 5–26 restaurants (5.1–26.5%).
** Includes coffee shops, bakeries, mini-markets, and meat markets.

Table 2. Median Characteristics of Food Establishments (N=98; high-poverty=29, low-poverty=69)

Characteristic	Median	Range*
Cost of menu items (average = $5.00)	$6.18	$0.35–$23.00
Inspection score	91.0	74–100
Number of customers served per week*	400	75–2,500
Number of employees interviewed	2.5	1–7
Number of days since last inspection	72.5	0–1,461
Number of seats available*	30	0–60

* Missing data varies among variables; range 5–26 restaurants (5.1–26.5%).
** Includes coffee shops, bakeries, mini-markets, and meat markets.

Table 3. Worker Characteristics (N=262; high-poverty=82, low-poverty=180)*

Characteristic	Number	Percent*
Gender		
Males : Females	97 : 163	37.3 : 62.7
Race		
Hispanic	144	55.0
Asian	69	26.3
Black	0	0.0
White	30	11.5
Other	19	7.3
Citizenship		
Born outside US	238	90.8
Highest Level of Education		
College and Above	48	18.5
Some College	52	20.1
High School	64	24.7
Some High School	47	18.2
Elementary School	48	18.5
Training		
Certified food handler	97	37.3
Time in Food-Industry		
Less than 6 months	26	10.0
6 months to <1 year	21	6.9
1 to <3 years	70	26.9
3 or more years	145	55.8
English Proficiency		
Speak little or none	128	49.0
Read little or none	137	52.5
		Range
Age (years)	35 (median)	15–95
Knowledge**	6 (mean)	1–10

* Missing data varies among variables; range 1–8 workers (0.4–3.1%).
**Knowledge is a summary variable measuring the number of correct responses to 10 food safety questions.

Table 4. Predictors Considered in Multiple-Linear Regression Models

1. Poverty area	16. Time in current restaurant	31. Mexican-American Cuisine**
2. Gender	17. Correct knowledge answers	32. Other cuisine**
3. Age	18. Refrigeration question	33. Total seats
4. White race/ethnicity*	19. Holding food question	34. Avg. customers per week
5. Asian race/ethnicity*	20. Cooling foods question	35. Average cost
6. Other race/ethnicity*	21. Cooling, storage question	36. Rank restaurant
7. Born outside U.S.	22. Batch prep question	37. Self service
8. How well speak Spanish	23. Food poisoning question	38. Delivery
9. How well read Spanish	24. Sanitizer question	39. Take out
10. How well speak English	25. Wounds & handling question	40. Full service
11. How well read English	26. Raw meat question	41. Fast food
12. Highest education level	27. Hepatitis A question	42. Other service
13. Certified food handler class	28. Japanese cuisine**	43. Time from interview to inspection
14. Pass certification	29. Chinese cuisine**	44. Employees interviewed
15. Time in food industry	30. Mexican cuisine**	

* Hispanic race/ethnicity is reference to which White, Asian, and Other are compared.
** American cuisine is reference for cuisine type in 44-predictor model, but American, Mexican-American, Chinese, and Other cuisine together is reference for cuisine type in more parsimonious models.

Table 5. Progression Towards More Parsimonious Models

Number of Predictors	Adjusted R2*	Mean Square Error (MSE)**	*F*-statistic,± *p*-value	Restaurants with Complete Data (N=98)	Number of Significant Predictors (p≤ 0.05)
44	0.69	9.18	3.48, 0.115	49 (50%)	0
22	0.48	10.65	3.38, <0.001	57 (58%)	8
10†	0.55	9.33	7.79, <0.001	57 (58%)	10

* Statistic adjusted for number of variables in model; describes correlations (R), e.g., perfect positive or negative correlation has R2=1.
** Describes variance of the model's fit to the data: before removing three influential outliers, the MSE of the 22-predictor model was 15.63.
± *F*-statistic measures model's fit to the data: the higher the *F*-statistic, the better the fit; p-value ≤0.05 is arbitrary standard for a good fit to the data; before removing outliers, the 22-predictor model had an F-statistic=2.84 and p=0.003.
† Based on 57 restaurants.

Table 6. Variables in 22-Predictor and 10-Predictor Models

1. Poverty area	9. How well read English	17. Self Service*
2. Gender*	10. Highest education level	18. Delivery*
3. Age*	11. Certified food handler class	19. Take out
4. White race/ethnicity	12. Time in food industry*	20. Full service
5. Asian race/ethnicity*±	13. Correct knowledge answers	21. Fast food*
6. Other race/ethnicity	14. Japanese cuisine	22. Employees interviewed*
7. Born outside US	15. Mexican cuisine	
8. How well read Spanish*	16. Average cost*	

* Variables included in the 10-predictor model.
± Reference to which Asian race/ethnicity was compared for 10-predictor model is all non-Asian races/ethnicities.

Table 7. Statistically Significant Effects (p≤ 0.05) on Inspection Score: Comparison of 22-Predictor and 10-Predictor Models

		22-Predictor Model		10-Predictor Model	
Predictor	Compared By	Score Change	p -value	Score Change	p -value
Gender	Percent	6.79	0.001	5.32	<0.001
Age	Median years	0.27	0.003	0.21	0.004
Asian race/ethnicity*	1 percent	-7.26	0.020	-4.26	0.006
How well read Spanish	1 percent	-2.69	0.012	-2.24	0.001
Time in food industry	Average years	-0.17	0.196	-0.21	0.026
Average cost	1 dollar	0.69	0.003	0.65	<0.001
Self service	Yes vs. No	-7.63	0.009	-6.99	0.005
Delivery	Yes vs. No	-4.46	0.117	-5.86	0.012
Fast food	Yes vs. No	5.55	<0.001	5.77	<0.001
Employees interviewed	Person	0.79	0.076	1.12	0.002

* Different reference groups included: 22-predictor model compares percent Asian workers to percent Hispanic workers; 10-predictor model compares percent Asian workers to percent non-Asian workers.

The 10-variable linear regression model using data from 57 restaurants was the most parsimonious of our analysis. Accounting for only the other variables in this model, this model indicates that food establishments with self-service will have inspection scores seven points lower than food establishments

without self-service (Table 7). Also, it indicates that: 1) establishments that serve fast food will have scores 6 points higher than those that do not serve fast food, 2) establishments that deliver food will have 5.86 less points on inspection scores than those that do not deliver food, 3) a food establishment with a greater percentage of male workers will have a higher inspection score by 5.32 points compared to establishments with the same percentage of female workers, 4) an establishment with at least 1% more Asian workers will have 4.26 less points on inspection score, 5) as the percentage of workers with better Spanish literacy increases, inspection score will drop 2.24 points, 6) an establishment with workers averaging 1-year more in food service experience than workers in other food establishments will have a lower inspection score by 0.21 points, 7) a $10-increase in average cost of menu items increases inspection score by 6.5 points, 8) an establishment with worker median age 1-year greater than those of other establishments will have an inspection score higher by 0.21 points, and 9) an establishment having one more worker interviewed than other food establishments will have a higher inspection score by 1.12 points.

DISCUSSION

While this study presents interpretable results, some limitations exist, a few of which may be inherent to the system of performing restaurant inspections in LAC. First, the results presented are preliminary and based on an incomplete data set. Effect estimates may differ after calculations with the complete data of 148 (74 high-poverty, 74 low-poverty) food establishments and 403 (209 high-poverty, 194 low-poverty) workers. Second, this analysis assumes inspections scores are reliable and valid measures of food safety practices. With 91 as the median score of routine inspections, systematic biases may exist. For instance, influences from the establishment owner or manager and from LAC may affect scoring by the inspectors. Unfortunately, such influences are hard to measure and therefore hard to control in effect estimation. Third, although the food establishments were randomly selected, managers often designated which employees were available for interview. Any general bias by managers to select more or less knowledgeable employees for interview might affect survey results. Fourth, interviewers were not able to validate responses to survey questions. If a worker answered that he read Spanish well, the interviewer did not test the validity of this answer.

The analysis of this study portrays several points regarding food safety knowledge and restaurant inspection scores in LAC. As none of the knowledge questions appeared in the 10-predictor model, any differences in food safety knowledge between areas of high-poverty and low-poverty did not affect restaurant inspection score. Establishments that serve fast food, or have higher percentages of male workers, percentages of older workers, or average costs of menu items tend to have higher restaurant inspection scores. On the other hand, food establishments that have self-service, delivery, or greater percentages of Asian workers, workers highly literate in Spanish, or workers who have been in the food industry longer tend to have more violations found during inspections. Possible explanations include males may be more likely to be managers, chefs, or food handlers sent to certified food handler classes, or more successful in disputing violations. Fast food establishments most likely have easier food safety protocols to follow than establishments that serve food that requires more preparation and food handling. Establishments with higher menu prices may have more money to spend towards food safety training. In food establishments with self-service, like buffets, customers perform food handling and significant reductions in inspection scores will occur when sneeze guards are lacking. Future studies are necessary to determine the reasons for the positive and negative effects of these inspection score predictors.

The study findings illustrate public health and environmental health needs and indicate future considerations. For example, self-service restaurants need the development of protocols to make them less prone to violations. Younger food service workers need to learn and practice food safety perhaps through a LAC DHS public health and environmental health targeted education campaign. Moreover, more studies are needed to determine why male gender can effect restaurant inspection scores, why restaurants with higher proportions of Asian workers score lower on inspections, whether food service workers with longer experience need reinforcement of food safety training, if Spanish literacy is a proxy measure for culture, why a greater percentage of workers with higher Spanish literacy lowers inspection

score, and what causes self-service and delivery restaurants to have more violations than fast-food restaurants.

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UNIVERSITY INFLUENZA SURVEILLANCE PROJECT: 2003–2004

BACKGROUND

Each year, respiratory illnesses such as influenza cause considerable morbidity and mortality. From 1990–1999, epidemics of influenza across the US have been responsible for an average of 36,000 deaths annually [1]. Since complications from influenza are especially detrimental to the elderly, the mortality rate due this disease is expected to continue to rise as our population ages [1]. Across all ages, influenza is believed to affect 10–20% of the population each year [2]. Thus, in a county as large as Los Angeles with an estimated population of almost 10 million [3], even a minor influenza season can account for over 1 million ill residents. In light of our already beleaguered healthcare system, this level of illness can debilitate hospitals and emergency rooms [4].

Influenza surveillance presents a unique challenge since most people affected by influenza do not seek medical care. Influenza cases that are properly diagnosed are not reportable to most local health departments and thus go uncounted each season. As such, there is no gold standard for influenza surveillance in the world today. For that reason, many health departments worldwide are looking for new methods of surveillance for respiratory illness as a proxy for influenza.

University settings may provide a unique opportunity for routine influenza surveillance due to the defining characteristics of college students. College students are a population that is particularly vulnerable to infection with unique respiratory illnesses since they frequently travel to or have arrived from areas that would likely expose them to novel viral strains (e.g., China, Southeast Asia). In addition, students typically live in close contact with numerous other students (i.e., in dormitories, sororities, fraternities, and apartments), conditions that can facilitate the spread of respiratory illness. Lastly, unlike the broader community, university students often seek medical care at a single health center located at their university. Accordingly, universities are often considering methods of enhancing their surveillance of respiratory illnesses in order to mitigate the effects of respiratory disease on their student population.

In order to assess the usefulness of universities as potential sites for influenza surveillance, a pilot program was developed by the ACDC. The objectives of the study were to: 1) describe the characteristics of respiratory illness in university students, 2) evaluate the feasibility of university student health centers as sentinel sites for influenza surveillance, 3) facilitate the identification of common and novel respiratory viruses in circulation, and 4) compare student viral surveillance with other respiratory illness surveillance systems.

METHODS

University student health centers in Los Angeles County (LAC) were contacted and asked to participate in the project. The project underwent review and approval by the LAC Department of Health Services (DHS) Institutional Review Board (IRB). Universities that expressed interest in participating in the project obtained additional IRB approval from their respective university IRB committees.

Participating health centers received influenza test supplies to perform nasopharyngeal (NP) swabs on students presenting to their facility with a respiratory illness meeting the project case definition. An in-service was provided to the medical staff of participating health centers to review the biology and pathology of the influenza virus, explain the project background and protocol, and provide refresher training on how to perform an NP swab test.

On one day each week, participating sites were asked to identify students presenting to their health center with a respiratory illness meeting the project case definition. For inclusion in the study, the test subject needed to: 1) be ≥18 years of age, 2) be a student at the university where the testing was being performed, 3) have a fever >100.1 at the time of the office visit, 4) have an illness onset day <4 days

before the office visit, 5) have at least one other respiratory symptom (e.g., cough), and 6) be able to provide informed consent. Students that met the project inclusion criteria were asked to read and sign a project consent form and complete a symptom survey. The symptom survey asked for basic demographic and symptom as well as other relevant illness information (e.g., recent travel and vaccination status). The signed consent form remained at the testing site and the symptom survey was faxed to ACDC for data entry and analysis. An NP swab culture was performed on the student and sent to the LAC Public Health Laboratory (PHL) for testing. Health centers were asked to submit no more than three specimens per week for testing.

In order to maintain student anonymity, the symptom survey and NP swab were coded with the last four digits of the student identification number. The primary project liaison at each health center maintained a list of the participant code numbers and corresponding student names. This allowed the health center liaison to add the test results to the student's permanent medical record and contact the student for additional treatment if necessary.

In addition to specimen testing, each site was asked to report the number of upper respiratory infection (URI) and influenza visits and the total number of primary care visits recorded at their facility each week. The data was collected from each facility's coded billing records and included URI, Influenza/Flu and ENT diagnosis codes. These numbers were used to calculate the percentage of primary care visits due to acute respiratory complaints by week for each health center. The mean number of acute respiratory and primary care visits reported from each university during the project was used to calculate the average weekly percentage of respiratory visits at each site. The university data was compared to state- and nationwide influenza-like illness (ILI) data for the 2003–04 influenza season. For these surveillance systems, an ILI visit is defined as fever >100 °F and either cough or sore throat.

Weekly reports were sent via email to each health center liaison summarizing the specimens submitted from their site and the current status of each specimen. Monthly reports provided an overview of data collected from each health center individually and aggregate data for all project sites combined.

A rapid enzyme immunoassay (EIA) test* and a complete viral culture** were performed on each NP secretion specimen. In January 2004, the rapid EIA test was replaced with the more sensitive rapid culture test (Diagnostics Hybrid Inc.'s Mixed FreshCells™: R-Mix). The test identifies the same viruses as the complete viral culture, but results are available much sooner. Positive results for the rapid tests were communicated from ACDC immediately back to the student health center via phone. Final viral culture results were faxed to the student health centers as they became available.

Descriptive analysis was performed on data collected from the symptom survey and the NP swab specimens. Facility-specific trends in the percentage of respiratory visits were compared between schools and against sentinel physician data reported state- and nation-wide.

RESULTS

Five universities in LAC were asked to participate in the project for the 2003–04 influenza season. Of these, four were able to complete the necessary paperwork in time to participate in the project. Three sites began the project in November 2003 and the fourth site began in early-December 2003 with all sites participating through March 2004 (Table 1). Participating universities varied on geographic location, student body size, and student characteristics.

A total of 19 specimens were submitted during the project. Of these, 11 (58%) were positive for influenza A (H3N2), 1 (5%) was positive for parainfluenza Type 1 and 7 (37%) specimens tested negative for those respiratory viruses identifiable via a complete viral culture test. Table 2 shows the breakdown of specimen results by university. Overall, 63% of the submitted specimens were positive for a respiratory virus. The

* EIA test: BD Directigen™ Flu A + B
** Viral Culture: RhMK and MRC-5 cells, identifies Flu A, Flu B, Parainfluenza Types 1-3 and Adenovirus

student health centers had a range of 40%-100% in the percent of submitted specimens testing positive for a respiratory virus.

Table 1. University Demographics*

	University A	University B	University C	University D
Student body size	> 30,000	5,000–10,000	> 30,000	< 5,000
Undergraduate	77%	71%	52%	44%
Male	40%	45%	52%	71%
International Students	5.4%	5.8%	17.4%	26.1%
Avg. # primary care visits/year	40,000	12,000	36,000	7,000
Flu vaccination	Nominal Fee	Nominal Fee	Nominal Fee	Free
Project Start Date	11/5/03	11/5/03	11/18/03	12/10/03

* Data collected from university registrars/websites and student health center self-reports.

Table 2. Summary of Collected Specimens by University

	Project Start Date	# of Weeks Participated	# Specimens Submitted	# Positive	# Negative	Percent Positive
University A	11/5/03	21	2	2	0	100%
University B	11/5/03	21	5	3	2	60%
University C	11/18/03	19	7	5	2	71%
University D	12/10/03	16	5	2	3	40%
Total			**19**	**12**	**7**	**63%**

Table 3 provides a summary of the basic demographics of the project participants. Over 90% of the students reported living in either a dorm or apartment and almost 50% reported travel outside of the university within 1 week of illness onset. Only 42% of the participants reported ever having a flu shot and only 16% reported having a flu shot for the 2003–04 influenza season.

Table 3. Participant Demographics

Gender	58% male (n=11)
Age (mean)	22 years (range: 18-31)
Place of residence	58% Dorm (n=11) 37% Apartment (n=7) 5% Home (n=1)
Temperature (mean)	101.2 °F
Days from symptom onset to clinic visit (mean)	1.7 days
Travel	47% (n=9)
Flu Shot (ever)	42% (n=8)
Flu Shot (2003-04 season)	16% (n=3)

The percent of symptoms reported by participants testing positive for influenza A versus participants testing negative are shown in Table 4. Typical influenza-associated symptoms (e.g., fever, cough, fatigue, headache, body aches, etc.) were reported by most of the participants who were positive for influenza A. In addition, runny nose and vomiting, which are not characteristic of influenza infection, were reported by 82% and 27% respectively of those testing positive for influenza A. Large differences in the percent of participants reporting cough, runny nose and vomiting were seen between those students testing positive versus negative for influenza.

Table 4. Summary of Symptoms Reported by Patients Testing Positive vs. Negative for Influenza (n=18)

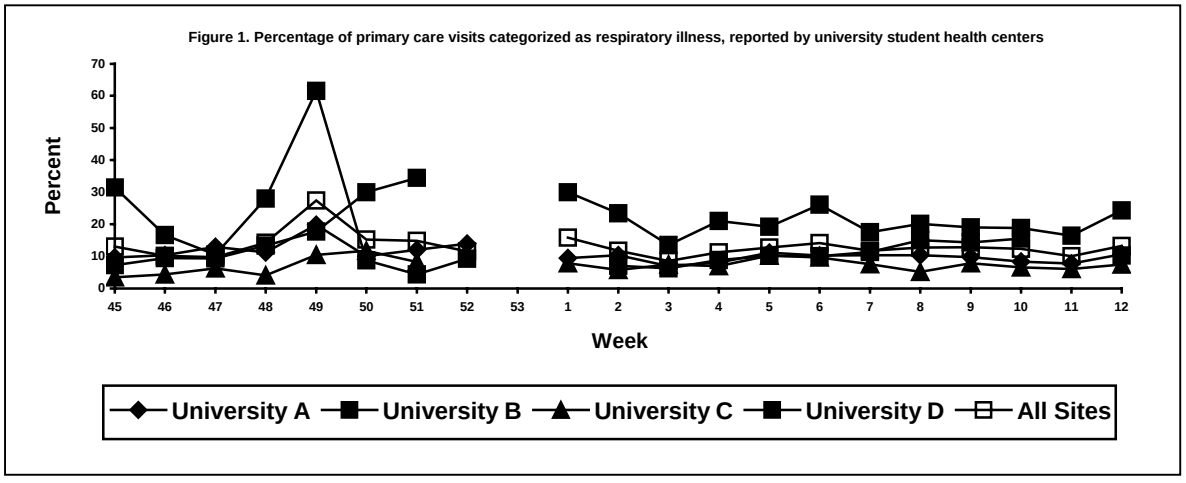
	Positive Specimens (n=11)		Negative Specimens (n=7)	
Symptoms	**n**	**Percent**	**n**	**Percent**
Cough	11	95%	3	43%
Fatigue	11	95%	6	86%
Fever	10	84%	7	100%
Headache	10	79%	6	86%
Body ache	10	79%	5	71%
Runny Nose	9	74%	3	43%
Chills	8	74%	6	86%
Congestion	8	74%	5	71%
Weakness	8	68%	6	86%
Sore Throat	7	68%	5	71%
Nausea	4	37%	3	43%
Vomiting	3	16%	0	0%

All participating sites submitted weekly data on total visits and respiratory illness visits from November 2003 through March 2004; limited data was collected in December due to winter break. The percent of respiratory visits varied from an average of 7.2% per week to 20.7% per week (Table 5, Figure 1). Larger average percentages for respiratory visits were seen for University B and D, whose student bodies consist of fewer than 10,000 students. The mean number of respiratory visits reported weekly from each university was similar to the median number of visits in this category for all participating sites, however, differences were noted between the mean and median number of primary care visits per week from a few of the universities.

Table 5. Number and Proportion of Visits for Respiratory Illness

	Peak Week	Peak %	Average % / week	Range (%)	Respiratory Visits/Week (mean)	Primary Care Visits/Week (mean/median)
University A*	49	19.8	10.7	7.0 – 19.8	83	769/872
University B	51	34.4	13.6	6.3 – 34.4	47	342/372
University C*	50	11.7	7.2	3.5 – 11.7	66	956/904
University D	49	61.5	20.7	4.4 – 61.5	34	163/152
All Sites	**49**	**27.4**	**13.1**	**8.6 – 27.4**	**58**	**558/410**

* Student Body >30,000 students.



All participating student health centers had a peak in respiratory visits between weeks 49 and 51 with the peak percent ranging from 11.7% to 61.5%. The university respiratory data was consistent with the peaks in ILI visits reported by both California (peak in week 49) and the US (peak in week 51).

DISCUSSION

The University Influenza Surveillance Project was implemented to evaluate the feasibility of university student health centers to serve as sentinel sites for influenza surveillance. As this was a pilot project, the most important outcome of this year's project was whether this type of surveillance is feasible, which was found to be true.

The university health centers were excited about the project and eager to participate. Their excitement stemmed from the high incentives for project participation as well as simple project requirements. The health centers were able to work within the project parameters and effectively identify eligible students for participation in the project while maintaining the anonymity of all student participants. Lastly, data transmission (patient surveys, respiratory data, weekly and monthly reports, etc.) between the university health centers and ACDC was completed easily and efficiently.

Another important aspect to this project was providing refresher training to university health center medical staff on how to perform an NP swab—a test with which many clinicians may be unfamiliar. As novel respiratory viruses continue to emerge, clinicians will be asked to perform viral testing more frequently to distinguish common respiratory pathogens from emerging viral respiratory illness. Many clinicians are inexperienced performing NP swabs and thus may be hesitant to perform testing when treating a patient with a respiratory illness. Through this project, university health center medical staff members were able to perform NP swabs on participants and increase their repertoire of diagnostic tests to be used during the influenza season.

Due to the strict inclusion criteria, only 19 NP specimens were submitted for testing, which severely limited the statistical analyses that could be performed. Thus, while the information collected from the individual participants is interesting, firm conclusions cannot be drawn from this data.

All participating sites submitted weekly respiratory data from November 2003 through March 2004. The peaks in the percent of respiratory visits seen weekly matched the peaks in the percent of ILI visits reported in state- and nation-wide data even though the data collected by this study were not restricted to the national case definition for ILI. Using routinely collected medical billing data may prove to be useful in the future not only for influenza surveillance, but for other disease surveillance systems as well.

This project is ongoing for the 2004–05 influenza season—though changes will be implemented to expand the project and address problems from last year. Eight university student health centers will be asked to participate in the project in the hopes of expanding the geographic area covered by the project sites. To increase the number of submitted specimens, participants will not be required to have a fever at the time of the office visit. Instead, a documented fever *or* a self-report of fever within 4 days of illness onset will make a student eligible for project assuming the other inclusion criteria is met. Additionally, each site will be allowed to test up to 5 students on their chosen testing day. Data will also be collected on the number of eligible students on the chosen testing day that decline to participate in the project. If a large number of eligible students are found to decline participating in the study, additional changes may be implemented in the future that attempt to increase student incentives for participating in the project.

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AN 11-YEAR RETROSPECTIVE STUDY ON LISTERIOSIS IN LOS ANGELES COUNTY, 1992–2002

BACKGROUND

Listeria monocytogenes is a ubiquitous bacterium in the environment but rarely causes human disease. However, in addition to flu-like symptoms (e.g., fever, muscle aches, headache, nausea, diarrhea, and neck stiffness), human cases can experience septicemia, meningoencephalitis, and sometimes death. When sporadic and epidemic cases occur, transmission is by the fecal-oral route and cases are usually characterized by advanced age, compromised immune systems, and pregnancy. As *L. monocytogenes* is a cold-loving bacterium that can proliferate in refrigerators, foods that have been associated with listeriosis outbreaks include raw milk, raw milk products, Mexican style fresh cheese and other soft cheeses, raw vegetables, deli salads, bagged salads, raw or undercooked seafood, and ready-to-eat meats like pâtés and deli meats [1–8].

CDC estimates that *L. monocytogenes* causes 2,500 illnesses, 2,300 hospitalizations, and 500 deaths per year in US [9]. Relative to other foodborne disease agents, *L. monocytogenes* has a case-fatality rate of 20%, second only to *Vibrio vulnificus* (39%), and causes 27.6% of all foodborne disease related deaths, second only to nontyphoidal *Salmonella* (30.6%) [9]. A multi-site study conducted by CDC between 1989 and 1993 found that Los Angeles County (LAC) had the highest incidence of perinatal listeriosis[10]. With other selected California counties, LAC had the highest incidence rate of listeriosis among nine surveillance sites in 2001 [11]. Since 1985, *L. monocytogenes* has been a reportable disease in LAC. To describe the epidemiology of listeriosis in LAC, we performed a retrospective study using surveillance data from 1992 to 2002. The following results from this study were presented at the 2003 Infectious Disease Society of America Conference in San Diego, California.

METHODS

A listeriosis case was defined by culturing *L. monocytogenes* from a normally sterile body site. A single perinatal case was defined as a mother-fetus pair with at least one positive specimen between the two. A non-pregnant person over 42 days of age with a positive specimen defined a nonperinatal case. Consistent with traditional ACDC criteria for listeriosis case investigation, study cases were residents of LAC (excluding the cities of Long Beach and Pasadena), were confirmed by the LAC Public Health Laboratory, and had disease onsets between 1992 and 2002.

Data were collected as hospitals and laboratories reported cases. Infection control practitioners (ICP), public health nurses (PHN), and ACDC staff investigated risk factors for listeriosis including predisposing medical conditions, and ACDC epidemiologists reviewed case documents for consistency to enter case data into the ACDC surveillance database and report to the California State Department of Health Services. During case interviews or review of documents such as medical charts and death certificates, ICPs, PHNs, and ACDC epidemiologists defined presence of kidney disease, steroid use, and other risk factors. The authors reviewed surveillance data since 1985 and because of data consistency issues made the first study year 1992. Missing data and data discrepancies in the surveillance database were cross-referenced to archived case documents and corrected. Otherwise missing responses to risk factor questions were regarded as “no” answers.

Univariate and stratified analyses were performed using SAS and Microsoft Excel. These programs were employed to calculate frequencies, risk ratios, 95% confidence intervals (95% CI), and p-values as well as to described disease trends. Incidence rates were calculated from population data obtained from LAC Vital Records.

RESULTS

Of 367 cases, 114 (31%) were perinatal and 253 (69%) nonperinatal (NP). Among the NPs, 175 (69%) had *L. monocytogenes* cultured from blood only, 29 (11%) from cerebrospinal fluid (CSF) only, 23 (9%) from both blood and CSF, and 26 (10%) from focal sites (Table 1). Among the perinatal cases, 75% (n=85) had positive cultures from the mother and of these positive cultures 20% (n=17) of fetal/infant cultures were negative (Table 1).

Table 1. Summary of Listeriosis Cases LAC, 1992–2002

	Number	Percent
Case Type		
Nonperinatal	253	69%
Perinatal	114	31%
Culture Site		
Blood only	175	69%
CSF only	29	11%
Blood and CSF	23	9%
Focal site	26	10%
Results of Mother		
Positive	85	75%
Missing	29	25%
Results of Child from Positive Mother		
Positive	25	22%
Negative	17	15%
Missing	38	33%
Unborn	5	4%
Results of Child from Negative Mother		
Positive	28	25%
Negative	1*	<1%

* Twin was positive.

During 1992–2002, the number of annual cases generally decreased from 43 cases to 21 cases (Figure 1), and incidence rates declined from 2.7 to 1.5 NP cases per million LAC residents and 11 to 5 perinatal cases per 100,000 live births (Figure 2).

Figure 1. Listeriosis Cases (N=367)
LAC, 1992-2002

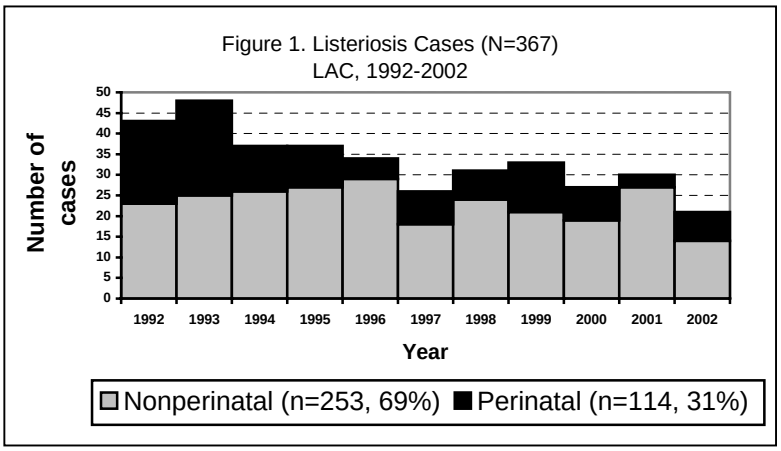
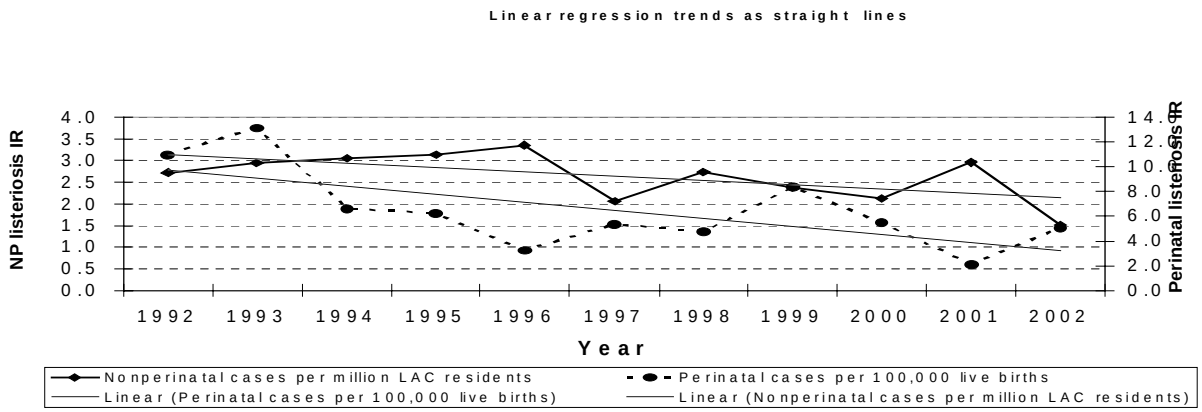


Figure 2. Listeriosis Incidence Rates (IR), LAC, 1992-2002



The average annual incidence rates were 2.6 NPs per million residents and 6.5 perinatal cases per 100,000 live births (Tables 2 and 3). Among NPs, case-fatality was 19.0% (47 died, 200 alive, 6 unknown outcome) and 138 (55%) of NPs were ≥65 years old (mean age=60.7 years). In addition, incidence rate increased with age, case-fatality was greatest at age ≥ 65years and 45-54 years, and males (n=139, 55%) had greater risk of disease (2.93 cases per million residents) and fatality (20%) than females. Among perinatal cases, case-fatality was 30% (birth outcomes: 27 stillborn, 7 died, 7 alive-sick, 67 alive-healthy, 6 unknown) and decreased with higher gestational age. Furthermore, mean maternal age was 28 years, and female infants (n=49, 53%) had greater risk of disease (5.7 cases per 100,000 live births) and death (33%).

Table 2. Nonperinatal Listeriosis Cases (n=253)
LAC, 1992–2002

Characteristics	No.	Percent	IR*	Deaths No.	Deaths CF†
Gender					
Male	139	54.9	2.93	27	20.0
Female	114	45.1	2.35	20	17.9
Age					
1-4	2	0.8	0.32	0	0.0
5-14	6	2.3	0.40	0	0.0
15-34	26	10.3	0.83	3	11.5
35-44	20	7.9	1.34	1	5.0
45-54	39	11.5	2.72	5	17.2
55-64	32	12.7	4.46	5	15.6
≥ 65	138	54.5	14.82	33	25.0

* Average incidence rate per one million LAC residents.
† Case fatality.

**Table 3. Perinatal Listeriosis Cases (n=114)
LAC, 1992–2002**

Characteristics	No.	Percent	IR*	Deaths No.	Deaths CF**
Gender†					
Male	46	48.4	5.1	5	11.1
Female	49	52.6	5.7	6	33.3
Gestation at Admission±					
Very immature (≤ 27 weeks)	39	39.8	–	25	69.4
Preterm (28–36 weeks)	47	48.0	–	7	15.9
Full-term (37–40 weeks)	12	12.2	–	1	8.3

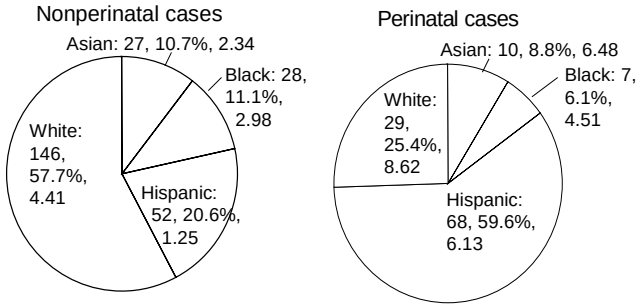
* Average incidence rate per one million LAC residents.
** Case fatality.
† Child's gender unknown for 19 cases.
± Gestational age unknown for 16 infant cases.

By race/ethnicity, among NPs, Whites had the most cases (146, 58%) and the highest average annual incidence rate (4.4 NPs per million LAC residents); among perinatal cases, Hispanics had the most cases (68, 60%) but Whites had the highest average annual incidence rate (8.6 perinatal cases per 100,000 live births, Figure 3).

Most of the NP and perinatal cases occurred in the spring and summer months (Figure 4). NP incidence increased in March, peaked in June and continued with higher numbers through October. Incidence of perinatal disease peaked in January, June, and September, and was higher from April to October.

Compared to NPs, perinatal cases were more likely to report consumption of Mexican cheese (RR=4.8, 95% CI: 2.9–7.9) and soft cheeses (RR=1.7, 95% CI: 1.1–2.6, Table 4). The most commonly reported risk food for NPs and perinatal cases were raw fruits and raw vegetables.

Figure 3. Number, Percent, and Average Annual Incidence* of Listeriosis by Race/Ethnicity
LAC, 1992-2002



*Nonperinatal incidence per million LAC residents, perinatal incidence per 100,000 live births

Figure 4. Listeriosis by Month of Onset,
LAC, 1992-2002

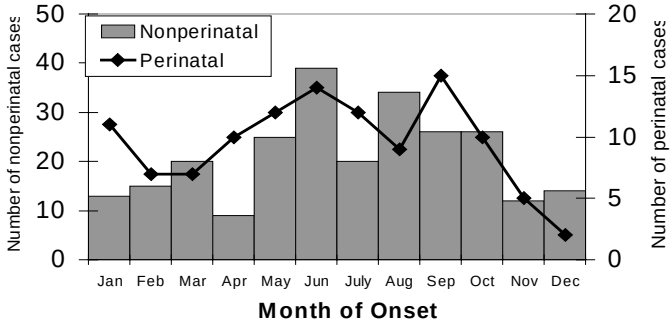


Table 4. Reported Consumption of Risk Foods Among Listeriosis Cases (n=253) LAC, 1992–2002

	Perinatal (n=114)		Nonperinatal (n=253)	
Risk Food	**No.**	**Percent**	**No.**	**Percent**
Raw milk	2	1.8	3	1.2
Other raw milk product	2	1.8	2	0.8
Mexican-style cheese	41	36.0	19	7.5
Soft cheese	31	27.2	40	15.8
Other cheese	33	29.0	69	27.3
Raw beef	2	1.8	8	3.2
Raw pork	0	0.0	2	0.8
Raw poultry	0	0.0	1	0.4
Raw eggs	3	2.6	5	2.0
Raw fish	5	4.4	14	5.5
Cold cuts	6	5.3	18	7.1
Raw fruits	69	60.5	124	49.0
Raw vegetables	63	55.3	118	46.6

Univariate analysis of risk factors found that among NPs risk of death increased with kidney disease (RR=2.1, 95% CI: 1.3–3.), being ≥65 years (RR=2.1, 95% CI: 1.2–3.6), and having cancer (RR=1.8, 95% CI: 1.1–2.9, Table 5). Risk factors of higher prevalence among NPs included age ≥65 years (55%), male gender (55%), steroid medication (33%), cancer (32%), antibiotic medication (28%), diabetes (23%), and kidney disease (19%).

Stratified analyses on NP data revealed evidence of confounding (Table 6). Stratification by steroid use found increased risk of death among non-steroid users with kidney disease (RR=2.7, 95% CI: 1.4–5.3) or with cancer (RR=2.4, 95% CI: 1.3–4.7), and among steroid users ≥ 65 years (4.1, 95% CI: 1.5–11.4) or with diabetes (RR=2.4, 95% CI: 1.1–5.1).

Table 5. Risk Factors for Death Among Nonperinatal Cases LAC, 1992–2002

Risk Factor	No.	Percent	Risk Ratio*	95% CI**
Kidney disease	47	18.6	2.10	1.25 – 3.54
≥ 65 years	138	54.5	2.05	1.16 – 3.64
Radiation	14	5.5	1.98	0.93 – 4.21
Liver disease	30	11.9	1.78	0.96 – 3.29
Cancer	82	32.4	1.75	1.05 – 2.91
Lung disease	5	2.0	1.72	0.79 – 3.74
Alcohol abuse	23	9.1	1.70	0.86 – 3.36
Diabetes	57	22.5	1.52	0.88 – 2.62
Steroids	83	32.8	1.37	0.81 – 2.29
Antibiotics	70	27.7	1.33	0.78 – 2.27
Asthma	8	3.2	1.33	0.39 – 4.54
Chemotherapy	39	15.4	1.30	0.69 – 2.47
Chemo-radiation	9	3.6	1.18	0.34 – 4.10
Male gender	139	54.9	1.12	0.67 – 1.89

* Risk of death: case deaths vs. case survivors, N=247, outcome missing for 6 cases.
** 95% confidence interval.

Table 6. Risk Factors Among Nonperinatal Cases by Steroid Use LAC, 1992–2002

	Steroid Use		No Steroid Use	
Risk Factor	**RR**	**95% CI**	**RR**	**95% CI**
Kidney disease	1.37	0.57–3.26	2.71	1.41–5.25
Cancer	1.01	0.45–2.29	2.44	1.26–4.72
Alcohol abuse	0.86*	0.14–5.17	2.23	1.04–4.76
$65 years	4.13**	1.50–11.40	1.39	0.69–2.83
Diabetes	2.14	1.13–5.12	1.11	0.51–2.42
Male gender	1.80	0.79–4.11	0.85	0.43–1.67
Antibiotics	1.49	0.68–3.28	1.05	0.46–2.39
Radiation	1.92**	0.79–4.64	1.49*	0.26–8.42
Chemotherapy	1.02**	0.39–2.68	1.49	0.64–349
Asthma	3.10*	1.25–7.65	— †	— †

* One cell size <5 cases.
** Two cells have size <5 cases.
† No deaths.

DISCUSSION

Limitations of this study include possible misclassification of exposure data, small numbers for extensive mathematical modeling to more accurately measure risk of fatality among NPs, and possible reporting bias. Even though all available case documents were reviewed by ACDC epidemiologists conducting listeriosis surveillance, because different ICPs and PHNs over time helped define presence of exposures there is a small possibility of exposure misclassification that can affect risk estimates when prevalence exposures are very small. While the decline of listeriosis is a sign of improving health in the population, the smaller numbers impede accurate estimation of risks per exposure classification. Thus, with this study data building a mathematical model that includes several risk factors and possible confounders would result in low power as some strata may have counts of two or less. To limit reporting bias and be conservative, the authors considered blank responses and unknowns as “No” answers to presence of risk factors; otherwise, many risk ratios would be higher and significant at the $p \leq 0.05$ level.

The results of this study show that in general listeriosis is declining and that public health can target certain risk groups and effect interventions to prevent disease and fatality in LAC. For instance, public health education in early spring that targets adults who are ≥ 65 years of age, have kidney disease, or have cancer might reduce NP incidence. Health care providers should teach food safety to their elderly patients who use steroid medication or have chronic illness. Also, through consultation by pharmacists or warning labels, individuals at risk of listeriosis who need prescriptions for steroid medication or medication for a predisposing medical condition can be made aware of high-risk foods or situations. Furthermore, food safety education campaigns targeting pregnant women, especially recently pregnant women of Hispanic or White race/ethnicity might further reduce perinatal listeriosis. The results from this study show that 15% of perinatal cases would not be reported if only the infant is cultured for *L. monocytogenes*. Hence, public health should encourage obstetricians to culture febrile pregnant women to improve case detection. While the reported incidence of listeriosis is small compared to other foodborne diseases, the risk of hospitalization and death is relatively large and preventive efforts should be developed and initiated with this in mind.

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RECENT INCREASE IN NOROVIRUS OUTBREAKS, SPECIFICALLY IN SKILLED NURSING FACILITIES

BACKGROUND

Noroviruses (formerly known as Norwalk-like viruses or NLV) are small round structured RNA viruses in the Caliciviridae family. Symptoms of norovirus infection often appear suddenly and may include nausea, vomiting, diarrhea, abdominal cramps, low-grade fever, body aches, headache and fatigue. The incubation period is usually 24 to 48 hours and the duration is relatively short—usually 1 to 2 days. Norovirus is very contagious and is found in the stool and the vomitus of an infected person. Humans are the only known reservoir [1]. A person becomes infected when the virus gets into the mouth, which can happen several ways: 1) fecal-oral contact, 2) ingestion of aerosolized vomitus, 3) eating food that has been contaminated with the virus, or 4) touching surfaces/fomites that have been contaminated with the virus. The “norovirus season” mainly occurs during the winter season—usually October to March.

During the 2002 to 2003 winter season, an increase in the number of norovirus outbreaks in skilled nursing facilities (SNF) was noted. Due to the large number of outbreaks reported in SNFs in early 2003 and after observing the numbers begin to rise again in November, ACDC sent out a letter to all SNFs in Los Angeles County (LAC) in early December 2003. The letter contained general information about noroviruses, guidelines for outbreak control in facilities, as well as a reminder that all outbreaks must be reported to LAC Department of Health Services.

Norovirus outbreaks can occur in any setting; however, there are multiple reasons that noroviruses can spread quickly in SNFs. SNFs are relatively closed environments, with close living quarters which have common areas that are shared by many people such as dining areas and recreation rooms. It only takes a small dose of the virus to become infected, possibly as little as 100 virions [2]. Noroviruses can spread easily by staff, from room to room, if proper infection control is not practiced. Some of the practices that staff should be sure to perform include: changing gloves between patients, frequently washing hands, and cleaning up vomit or fecal accidents with a bleach solution. Most SNFs are made up of an elderly population that may have multiple medical conditions, leaving them more susceptible to infection. Norovirus does not cause any severe sequelae; however the virus can cause dehydration, especially in an older population. There is currently no treatment for norovirus infection other than supportive care.

The recent increase of norovirus outbreaks in LAC, especially in SNFs, continued into the 2003 winter season. This marked increase led to a more in depth review of the outbreaks in 2002 and 2003.

METHODS

All norovirus outbreaks were reviewed from 2002 to March 2004. Data included the outbreak setting, whether the outbreak was confirmed by the Public Health Lab (PHL), and the number of cases.

Norovirus outbreaks are detected through passive surveillance. Both public callers and health care professionals report gastrointestinal outbreaks to ACDC. These outbreaks are divided into three categories of settings: 1) community outbreaks (schools, retirement homes), 2) foodborne outbreaks (restaurants, caterers), and 3) hospital/healthcare outbreaks (SNFs).

A confirmed norovirus outbreak is one that has had two or more stool specimens test positive for the virus by the PHL. A probable norovirus outbreak is one that has symptoms, duration and incubation that are consistent with the etiology of the virus but does not have two positive stool specimens.

The PHL uses RT-PCR to detect norovirus in stool. The virus can sometimes be detected up to a week or more after onset. The test is not FDA approved and is used only to diagnose the outbreak as a whole—not individuals. Testing for norovirus has been conducted by PHL since 1999. The G1 and G2 primers

were used until April of 2000 when a new primer, Region B, was introduced. This allows for the detection more strains. The PHL does not identify specific strains but tests for the presence of norovirus in stool. The RT-PCR test can have a false negative result if the stool was collected too late after onset or if the specimen was not properly refrigerated.

When a norovirus outbreak occurs at SNF, a Public Health Nurse (PHN) from the corresponding district visits the facility and consults with the administrators and directors to insure proper control measures are taken in order to stop the spread of the virus. They also collect epidemiologic information (e.g., onset date and time, symptoms, room numbers, etc.) in order to look for clusters and to determine whether illness originated from a point source or a propagated outbreak. The PHN also collects stool specimens in order to test for norovirus and bacterial agents. Norovirus outbreaks in other settings are investigated similarly; however, foodborne outbreaks are usually investigated by ACDC's Food and Water Safety Unit rather than by district PHNs.

RESULTS

In 2003, the number of norovirus outbreaks increased by 18% from the previous year. Outbreaks occurring in SNFs helped contribute to this increase. In 2002 there were 21 outbreaks in SNFs compared to 37 in 2003 (a 76% increase). In both years, outbreaks occurring in SNFs made up the greatest proportion of all norovirus outbreaks (Table 1). However in 2003, the proportion of reported outbreaks in SNFs increased from 42% to 63%, which was offset by a decrease in the non-SNF settings.

Table 1. Norovirus Outbreaks by Setting and Year

Year	SNF		Community		Foodborne		TOTAL
	n	%	n	%	n	%	N
2002	21	42	17	34	12	24	50
2003	37	63	13	22	9	15	59

In 2002, 50% of all norovirus outbreaks were confirmed which increased to 61% in 2003 (Figure 1). The percentage of confirmed outbreaks in SNFs increased from 57% in 2002 to 76% in 2003 (Table 2). In 2003, the average number of cases per outbreak at SNFs increased to 24 cases, from 18 cases in 2002.

Table 2. Suspected Norovirus Outbreaks—Percent Confirmed and Average Number of Cases by Setting and Year

Setting	Outbreaks in 2002		Outbreaks in 2003	
	% Confirmed	Avg. number of Cases per Outbreak	% Confirmed	Avg. number of Cases per Outbreak
SNF	57	18	76	24
Community	29	20	54	21
Foodborne	67	25	11	21

Analyzing the outbreaks by the seasonal pattern (October to March), the 2002–2003 season had 46 outbreaks—over half were in SNFs (n=26, 56%). The 2003–2004 season had 50 outbreaks, with 36 (72%) occurring in SNFs. Both seasons had their peaks in January (Figure 2). Among the SNF outbreaks, the 2002–2003 season had an average of 21 cases per outbreak, which increased to an average of 26 cases in the 2003–2004 season.

Figure 1
Norovirus Outbreaks in SNFs
2002 and 2003

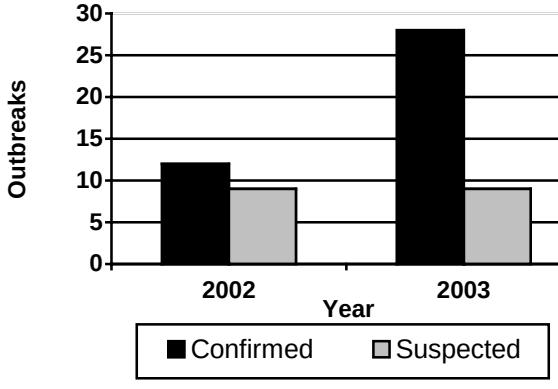
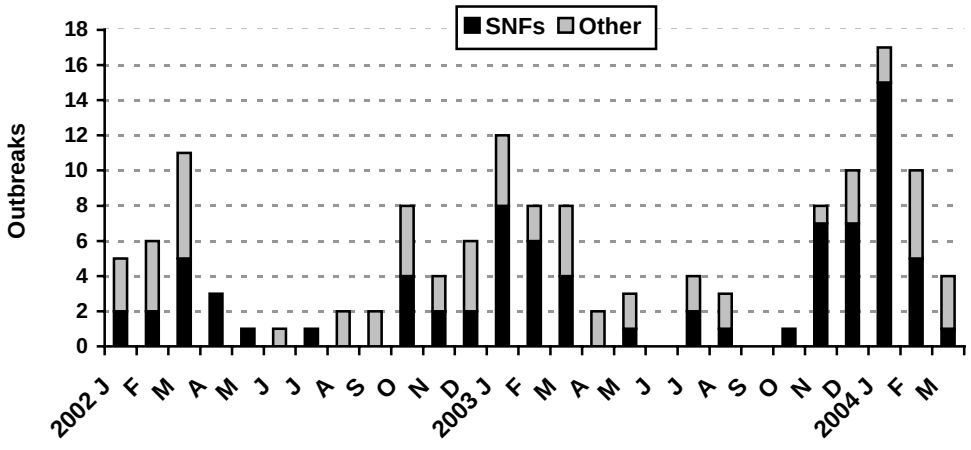


Figure 2
Norovirus Outbreaks (Confirmed & Suspected)
by Month of Onset, Jan 2002 to Mar 2004



DISCUSSION

The numbers used for this analysis are based on outbreaks that were reported to ACDC. It is possible that the letter mailed out to all the SNFs in early December 2003 caused an increase in reporting, which could account for the high peak in January of 2004. Although the percent of reported outbreaks in SNFs increased by 76% in 2003, it is likely that more outbreaks occurred than what was actually reported.

The recent increase in norovirus outbreaks in SNFs in LAC is similar to the unprecedented number of outbreaks that occurred in 2002 in the United Kingdom. In January of 2002, there were 45 norovirus outbreaks reported, of which 21 were in hospital or nursing homes [3]. The reason for this recent increase in healthcare setting outbreaks could be due to new variant strains of norovirus circulating in the community [4].

Norovirus is present throughout the community, and therefore, it is hard to prevent it from entering a SNF environment—especially with many staff and visitors coming and going. However, it is possible to reduce the numbers and magnitude of these outbreaks, especially through routine infection control measures, such as regular handwashing. Because SNFs are a great environment for norovirus to thrive, it is important for the staff and administrators to identify early signs of a possible outbreak. Implementing control measures immediately may be the only way to contain an outbreak of norovirus from spreading throughout the entire facility. Such control measures can be found in the December, 2002 publication by the California Department of Health Services [5], “Control of Viral Gastroenteritis Outbreaks in California Long-Term Care Facilities”.

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COMMUNITY-ASSOCIATED METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* SKIN INFECTIONS IN ATHLETES—2003

BACKGROUND

During 2003, ACDC received reports of skin or soft tissue infections (SSTI) with methicillin-resistant *Staphylococcus aureus* (MRSA) among participants of competitive sports team in Los Angeles County (LAC). Two outbreaks of MRSA SSTIs were investigated by ACDC involving players on: 1) a university football team, and 2) a soccer team from a different university. Objectives of the investigations were to describe the outbreaks, determine risk factors for disease acquisition, and implement preventive measures.

Outbreak 1: Football Team A

In August 2003, ACDC was notified that four players on football Team A were hospitalized for SSTIs with positive wound cultures for MRSA. A year prior, this team had three different players hospitalized for SSTIs—two were due to MRSA. Recognizing the potential for additional infections among these players, we initiated a public health investigation.

METHODS

A case was defined as a player on Team A with an SSTI, either culture-confirmed as MRSA or clinically diagnosed, occurring during the outbreak period August 5 to September 5, 2003. Cases were found by reviewing the trainer's treatment log, receiving reports of SSTIs from players and trainers as well as reports of hospitalized players from clinicians. Student health service was queried to determine if these infections were prevalent on campus. MRSA isolates were characterized by pulsed-field gel electrophoresis (PFGE). An unmatched case-control study was conducted to determine potential risk factors for infection. A carrier was defined as an asymptomatic teammate with a positive nasal culture for MRSA during the same period. Controls were randomly selected from asymptomatic, non-carrier teammates. A nasal carriage study was conducted to determine the nasal carriage rate of MRSA, and a carrier-control study to determine risk factors for MRSA nasal carriage. In addition, ACDC inspected the facilities with an Environmental Health specialist and recommended infection control measures.

RESULTS

A total of 11 players (seven culture-confirmed) were identified that met the case definition yielding an attack rate of 10% (11 out of 107 players on the team). All were diagnosed with SSTIs during or within two weeks of training camp (August 5–18, 2003). All were healthy males without any underlying chronic illnesses. Boils were the predominant presenting sign of infection. Two players had their initial lesions diagnosed as "insect bites." The upper extremities (forearm and elbows) were the sites most commonly infected. Nine required surgical incision and drainage, and four were hospitalized. All infections resolved after appropriate treatment were given. Infections were identified by PFGE to be due to a community-associated strain of MRSA prevalent in LAC (USA 300). Linemen appeared to be at highest risk for infections. Ultimately, 10 case-patients and 32 controls were enrolled into the case-control study. Case-patients were found to have 15 times the odds of sharing bars of soap with teammates and statistically significant higher odds (undefined) of having pre-existing cuts or abrasions than controls. Nasal cultures showed that the MRSA nasal carriage rate on this team was 8% (8 out of 99 players cultured). A total of 4 carriers were enrolled into the carrier-control study. Carriers were found to have had 45 times the odds of having a locker adjacent to or across from a case-patient than controls.

The site inspection occurred on September 3, 2003 during which time we observed many potential causes of infection: 1) wound care was delayed on the practice field, 2) towels were shared among players, 3) players were sleeping in the locker room, 4) whirlpool tubs were not properly maintained, and

5) laundry procedures might have been inadequate. Recommendations were made to address those issues. Several infection control measures were implemented by the team including increasing the frequency of cleaning of the facilities and equipment, educating players on proper hygiene, and initiating daily hexachlorophene showers (on August 25, 2003). No new SSTIs were reported for four weeks after the discontinuation of hexachlorophene showers on September 19, 2003. During October 20 to November 9, 2003, four new players were diagnosed with MRSA SSTIs. ACDC conducted another site visit—this time to observe a game held on November 22, 2003. During the game we noted that the student trainers were re-using towels between treating players and that players were sharing towels among themselves. Subsequently, the team switched to single-use towels and re-emphasized proper hygiene practices. No new infections were reported for the remainder of the season.

Outbreak 2: Soccer Team B

In September 2003, ACDC was notified of two players on a university soccer team admitted to the hospital for treatment of SSTIs. One had been culture-confirmed as MRSA. Based on ACDC's experiences with MRSA outbreaks in athletic teams, we were invited by a staff physician to conduct an investigation and make recommendations for disease control and prevention.

METHODS

Active surveillance was instituted for suspicious skin lesions throughout the season. Players with infections were reported to ACDC by a staff physician. MRSA isolates were characterized using PFGE. A cohort study was conducted by interviewing team members on September 29, 2003 using a standardized questionnaire developed from the outbreak on football team A (described above). Nasal cultures were taken from the entire team on that date to ascertain the point prevalence of nasal carriage of MRSA. A site visit was conducted to assess infection control standards and recommendations were made to improve infection control to decrease the risk of transmission of MRSA.

RESULTS

ACDC received reports from the team of seven players diagnosed with SSTIs during September–November, 2003. The overall attack rate was 25% (7 out of 28 on the team). The lesions of all the cases were erythematous and had induration about the size of a quarter with a central pustule. Six had abrasions within 1–2 cm from site of infection. However, no infections were at known skin trauma sites. The majority (86%) of infections occurred in juniors or seniors, whereas they account for 46% of the players on the team. Forwards had the highest position-specific attack rate (40%), followed by midfielders (36%). PFGE characterization of three available MRSA isolates from players with infections identified the predominant community-associated MRSA strain in LAC (USA 300).

All team members (n=28) were interviewed. All reported having shared bars of soap with teammates in the locker room, 86% having shared the whirlpool tubs with teammates, and 31% having shared the tubs with uncovered cuts or abrasions. The majority (79%) reported having cuts or abrasions and most (66%) had wounds not usually covered until >2 hours post-injury. However, the cohort study yielded no statistically significant associations. The nasal carriage rate of MRSA on the team was 4% (1 out of 28 players cultured). This nasal carrier subsequently developed an SSTI. ACDC inspected the locker room on September, 29 2003 during which we noted that players were sharing towels and only one bar of soap was available for use in the shower room. ACDC recommended to install liquid soap dispensers, provide more towels provided, and prohibit the sharing of towels and other personal items. No other SSTIs were reported to ACDC after November 2003.

DISCUSSION

Both of these outbreaks were caused by a community-associated strain of MRSA—the same strain responsible for other outbreaks in LAC, including in the County Jail, amongst men who have sex with men, and in hospital newborns. Lapses in proper hygiene practices such as delayed wound care or the

sharing of personal items might have contributed to disease transmission. In the football outbreak, use of a liquid antibacterial soap and increased health education might have prevented new infections. These investigations were limited by the small number of cases. Plus, not all case-patients were cultured and not all MRSA isolates were available for PFGE analysis. Access to players for interviews was also difficult. As such, under-reporting of infections might have occurred.

As the prevalence of community-associated MRSA increases in the public, other similar outbreaks might occur. Athletes at all levels, high-school to professional, appear to be at increased risk for MRSA SSTIs because of close conditions in the locker room, shared personal items, and shared equipment. Health care providers are encouraged to consider MRSA in the differential diagnosis of SSTIs in this population. Infections with these community-associated MRSA strains might mimic common lesions such as pimples, pustules, or “insect bites.” Particular attention should be noted should clusters of these SSTIs occur signaling a potential outbreak. In LAC, these clusters should be reported to ACDC. Additional information about community-associated MRSA can be found online at www.lapublichealth.org/acd/MRSA.htm.

INVESTIGATION OF COMMUNITY-ASSOCIATED METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* SKIN INFECTIONS AMONG HIV-POSITIVE MEN WHO HAVE SEX WITH MEN

BACKGROUND

In November 2002, several physicians notified the Los Angeles County Department of Health Services (LACDHS) of approximately 30 cases of skin infections with methicillin-resistant *Staphyloccus aureus* (MRSA) among predominantly HIV-positive men who have sex with men (MSM) in their practices. The physicians noted that the infections were recurrent and difficult to treat, with several patients requiring hospitalization. Most did not have traditional risk factors for nosocomial MRSA—which include history of hospitalization, surgery, dialysis, stay in a skilled nursing home, or presence of an indwelling medical device in the past year. The Cedars-Sinai Medical Center (CSMC) laboratory tested a convenience sample of 10 isolates from the index clinic and found that eight (80%) isolates matched the same pulsed-field gel electrophoresis (PFGE) pattern and that one (10%) isolate differed by only one band, indicating a predominant clonal MRSA strain. The predominant PFGE strain did not match any nosocomial MRSA strains. The number of patients reported by this clinic, anecdotal reports from other local clinics, evidence for a clonal MRSA strain, and lack of nosocomial associations indicated a possible outbreak of community-associated MRSA (CAMRSA) skin infections among HIV-positive MSM. This was the first time this group had been reported with CAMRSA skin infections and it was important to determine if this group had specific outbreak risk factors that could be identified and addressed.

METHODS

Risk Factor Investigation: A matched case-control study was performed to determine risk factors for CAMRSA skin infection among HIV-positive MSM.

Questionnaire Design: The questionnaire included items regarding demographics, close contacts, visits to public places (e.g., fitness gyms), hygiene practices, history of skin lesions, health care and jail exposures, and past medical history including antibiotic use, substance abuse, sex behaviors, and visits to commercial sex venues and group sex (circuit) parties. The chart abstraction form included items regarding clinical presentation, diagnosis, and treatment of MRSA skin lesions, past medical history, immune status, and history of opportunistic infections. Also collected were CD4 and viral load counts dated closest to (either before or after) the initial clinic visit for the case-patient.

Case Definition: For purposes of the case-control study, a case was identified as a person with a community-onset (identified in the outpatient setting or within the first 72 hours of hospital admission) culture-positive MRSA skin infection during September 2002 to May 2003 in an HIV-positive MSM enrolled in continuity care at one of the three participating clinics in LAC.

Case and Control Selection: Healthcare providers from the clinics of three local organizations agreed to participate in the investigation. Recruitment into the study was restricted to HIV-infected patients because recruitment of adequate numbers of HIV-negative cases and controls from these clinics would delay the investigation—the continuity patients in these clinics were predominantly HIV-positive—and because HIV status might confound risk factors of CAMRSA infection. For each case identified, three HIV-positive MSM controls were selected from daily manifests, matched on the same physician, clinic, and day (or week) that the case patient presented with a skin infection subsequently diagnosed as CAMRSA.

Questionnaire Administration and Chart Abstraction: Experienced interviewers from LACDHS were trained to administer the survey. The investigators reviewed medical charts on interviewed patients for additional information. Investigators received consent from the cases and controls before reviewing medical charts.

Data Entry and Analysis: Bivariate analysis on matched cases and controls and logistic regression of multivariate models were employed. Analyses were performed with the SAS statistical software package (version 8.2, SAS Institute, NC). For multivariate analyses, the final model included history of hospitalization, race/ethnicity, and number of sex partners as a categorical variable.

Laboratory Investigation: One isolate taken from a patient included in the case-control analysis was selected to represent the predominant CAMRSA strain among isolates from the index clinic. The representative isolate was sent to the LACDHS Public Health Laboratory and the CDC laboratory and analyzed with PFGE by using *Sma*I for comparison with collected outbreak CAMRSA strains.

Molecular and Inducible Resistance Analysis: The CDC laboratory used polymerase chain reaction methods to determine the staphylococcal cassette chromosome methicillin resistance complex (SCC*mec*) and to test for the presence of genes for Panton-Valentine leukocidin (PVL), toxic shock toxin, and staphylococcal enterotoxins (SE) A–E and H. The isolate was evaluated for inducible clindamycin resistance by using the standard disk induction ("D-zone") test.

RESULTS

Case-Control Study Demographic Characteristics: A total of 35 case-patients and 76 controls completed interviews. Case-patients and controls had similar demographic characteristics, except that case-patients were significantly more likely than controls to be white (cases n=24, 68.6% versus controls n=34, 44.7%, p=.01). Among case-patients compared with controls, median CD4 counts were lower (cases=338 copies/ml versus controls=410 copies/ml) and median viral loads were higher (cases =8,154/mm3 versus controls=594.5), but the differences were not statistically significant.

Clinical Characteristics and Treatment of Cases: Skin lesions were most often diagnosed as abscesses and most often involved the legs, buttocks, and arms. All case isolates with antibiotic sensitivity data available from chart review were resistant to the beta-lactam antibiotics evaluated. Most isolates were resistant to ciprofloxacin and erythromycin; one isolate was intermediately resistant to trimethoprim/sulfamethoxazole. No isolates were reported as resistant to vancomycin, rifampin, or gentamicin. Antibiotics to which the isolates were commonly resistant (i.e., amoxicillin, amoxicillin/clavulanate, cephalexin, ciprofloxacin, clarithromycin, and dicloxacillin) were used as initial treatment among 13 of the 31 patients (42%) for which we have initial treatment information.

Matched Case-Control Analysis: Exposures that remained significant in multivariate analysis included public hot tub or sauna use and methamphetamine use (Table 1). Exposures with significant negative associations to infection included always using a condom during sex and prophylaxis for opportunistic infections. Exposures that were significant in multivariate but not bivariate analysis included having a sex partner with a skin infection. When hospitalized patients were excluded in the multivariate analysis, similar results were found.

Table 1. Results of multivariate analysis in a case-control study of CAMRSA skin infections among HIV-positive MSM

Exposures During the Past 3 Months	Adjusted Matched OR*	(95% CI)	χ^2 p-value
Sex partner with skin infection	9.2	(1.4–61.5)	.022
Methamphetamine use	8.5	(1.6–45.1)	.012
Routinely used a public hot tub or sauna	3.9	(1.2–12.6)	.023
History of antibiotic prophylaxis for opportunistic infection, self-reported or on medical record	0.3	(0.1–1.0)	.042
Always used a condom during sex (among sexually active)	0.1	(0.0–0.6)	.019

* Controlling for history of hospitalization during the past 12 months, race/ethnicity, and number of sex partners (as a categorical variable during the past 3 months).

Laboratory Investigation: The LACDHS Public Health Laboratory determined that an isolate representing the predominant strain from the index clinic matched the PFGE pattern of previously collected outbreak strains of CAMRSA in LAC. The PFGE pattern of the isolates also matched a predominant CAMRSA strain, USA300, which has been identified in several outbreaks nationwide. The CDC laboratory identified genes for PVL and SCC*mec* complex, type IVa. The isolate was clindamycin-susceptible and erythromycin-resistant and did not exhibit inducible clindamycin resistance.

DISCUSSION

We found that close contact, such as intimate sexual contact, with a person infected with an MRSA skin infection might be a risk factor for MRSA skin infection. Drainage from MRSA skin lesions can be very infectious. MSM with high-risk sex and drug use behaviors might be more likely to have unprotected skin-to-skin contact with persons with MRSA skin lesions. Our identification of an association between MRSA skin infection and use of steam baths or saunas further supports the possibility of contact transmission of MRSA, either by direct skin-to-skin contact or via an environmental source, further facilitated by skin macerated during prolonged exposure to moisture and heat. Other researchers have found that a wood sauna bench was a likely source of *S. aureus* transmission in an outbreak of boils in an Alaskan village (*West J Med*, 2000; 172(4):2359).

The findings of our investigation indicate that CAMRSA is an important causative organism of soft tissue infections among HIV-positive MSM, sometimes resulting in hospitalizations and surgical interventions. In addition, a large proportion of the case-patients in this study were initially treated with antibiotics that CAMRSA has been predominantly resistant to, highlighting the need for a high index of suspicion among high-risk patients in order to facilitate early and appropriate diagnosis. Furthermore, the laboratory investigation identified a predominant clonal strain of CA-MRSA, USA300, which is common to outbreaks in LAC and elsewhere in the US.

Our risk factor investigation is subject to following limitations. First, our case-control study did not have the power to implicate specific behaviors or a point source of infection. However, surveillance from both County and national sources suggest an increase in MRSA infections in the overall population that is not likely to be explained by a point source. Second, the analysis relied on recall of exposures from patients and medical charts. Case-patients might be more likely to recall certain exposures, especially in the setting of media reports and increased community awareness of MRSA skin infections. Third, we did not collect specific data on income or education from persons interviewed. Cases and controls were similar in the proportion of age, racial/ethnic group, and health insurance status. However, persons with high-risk sex behaviors or drug use might represent a more marginalized population at higher risk of MRSA skin infections due to exposures not accounted for in this study.

Control Measures: In parallel with our investigation, we instituted measures to help prevent and control CAMRSA skin infections, as well as to inform healthcare providers and the public. The following are some of the measures taken. First, we developed patient and healthcare provider guidelines on CAMRSA skin infections, links to relevant internet sites and posted them on a dedicated web page on the LACDHS website (www.lapublichealth.org/acd/MRSA.htm) and made them available on the LACDHS website. Healthcare provider fact sheets were faxed to healthcare providers, HIV community-based organizations, clinics, and hospitals throughout LAC.

We also notified the local and national medical community about CAMRSA in MSM by posting articles in *The Public's Health* (an LAC Department of Health Services publication), Epi-X (a national public health web site), the National Association of County and City Health Officers, and the Infectious Diseases Association of California Listserv. We made local presentations about CAMRSA to healthcare provider groups, especially those concerned with HIV/AIDS, and made regional and national presentations on risk factors for CAMRSA in MSM. We provided an oral presentation and health education materials to managers of commercial sex venues regarding hygiene measures to control MRSA in the environment. With assistance from CDC, we have developed guidelines for preventing the spread of MRSA in public venues—these can be found on the LACDHS website at: www.lapublichealth.org/acd/MRSA.htm.

Final Recommendations: MRSA in the community is an emerging disease in both the MSM and general population, and at both the local and national levels; control and improved understanding of this disease will require continued local participation in the national response. The findings of this investigation support the initial recommendations and advice outlined in our original patient and healthcare provider fact sheets. These recommendations are summarized below.

First, clinicians must recognize CAMRSA as a cause of skin and soft tissue infections. Incision, drainage, and local care remain first-line treatments for soft tissue infections, when appropriate. Wound culture can guide the selection of appropriate antibiotics when necessary. Patients should be encouraged to complete prescribed courses of antibiotics, or return to the healthcare provider if the infection does not resolve as expected. Patients with MRSA should be educated in proper hygiene and wound care to prevent transmission to close contacts. Additionally, healthcare providers can take measures to prevent the spread of MRSA in the healthcare setting.

Managers and owners of public venues such as fitness gyms, sex clubs, and bathhouses should be aware of measures to prevent the spread of MRSA among patrons by direct and indirect contact. For example, steam bath users should be directed not to share towels and to place a clean towel between their skin and steam bath surfaces. Patrons should be directed to carefully cover any skin lesions and dispose of used dressings properly.

Individuals can help protect themselves by maintaining personal hygiene and handwashing with soap, especially before and after going to places where bare skin can contact public surfaces or other people. Use of a barrier, such as a towel, over public surfaces might be useful. Also, we encourage individuals to be aware of other people that they have close contact with. Persons should seek the advice of a healthcare provider immediately for any suspicious lesions.

POPULATION SURVEILLANCE FOR PEDIATRIC COMMUNITY-ASSOCIATED METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* IN LOS ANGELES COUNTY

BACKGROUND

Community-associated methicillin-resistant *Staphylococcus aureus* (CAMRSA) has emerged as a significant cause of skin and soft tissue infections. In a recent study, over 50% of wound infections seen in an emergency room in northern California were due to CAMRSA. CAMRSA is distinguished from healthcare-associated MRSA (HAMRSA) clinically and genetically. CAMRSA strains are characterized by the presence of genes for the Panton-Valentine leukocidin (PVL) and the presence of the staphylococcal chromosomal cassette (SCC) *mec* type IV (HAMRSA typically has SCC*mec* types I, II, and III and does not contain genes for PVL). The majority of infections caused by CAMRSA are skin and soft tissue infections—though some deaths and invasive disease have been reported—and often occur in children. HAMRSA is associated with invasive disease and is seen in older patients with a history of hospitalization or nosocomial exposure.

With increasing reports of CAMRSA outbreaks in Los Angeles County (LAC) in jail inmates, men who have sex with men, athletes, and in newborn nurseries, the Los Angeles County Department of Health Services (LACDHS) declared MRSA in hospitalized children less than 18 years to be a reportable disease for 6 months in 2003. The goal of making MRSA reportable was to understand the incidence, diagnosis, treatment, and risk factors for MRSA. We chose to make it only reportable in children because of increasing anecdotal reports of CAMRSA in children in LAC, widespread reports of CAMRSA in children in other jurisdictions, and because of limited resources in LACDHS to follow-up adult patients.

METHODS

The reporting requirement included all LAC residents younger than 18 years of age who were hospitalized with an invasive or skin or soft-tissue infections caused by MRSA between May 5 and November 7, 2003. Nosocomial MRSA infections, as determined by the reporting healthcare professional, were exempt from the reporting requirement. Infection control practitioners and physicians were notified about the reporting requirement through the internet and the mail.

Medical charts of cases were reviewed for the following information: demographics (race/ethnicity, age), address, primary diagnosis, length of stay in the hospital, isolate source, treatment, and outcome. One research nurse reviewed all the charts.

Telephone interviews were attempted with a parent or guardian of each child. Information collected on the telephone interviews included: 1) race/ethnicity, 2) household size, 3) history of nosocomial exposure (hospitalization, dialysis, or surgery in the prior year; family member who is a healthcare worker or family member with a chronic disease that required frequent hospitalization), 4) history of chronic disease, 5) presence of skin infections in the household before and after hospitalization, 6) exposure to antibiotics in the previous six months, and 7) exposure to recently incarcerated persons and men who have sex with men in the 30 days before onset of symptoms.

Population data were abstracted from the 2000 US Census Data and the 2002–2003 LAC Health Survey. Cases were assigned a household income based on the 2000 US census median income for their zip code of residence. The median household income of the cases was calculated and compared by paired t-test to LAC overall median income.

Data were entered into MS Access and analyzed with SAS version 8 (Cary, NC). Race and ethnicity were coded separately in the survey.

Laboratory Investigation: Isolates were sent to a research laboratory at the University of California San Francisco (UCSF) for analysis. MRSA isolates were compared to strains seen in the United States and they were analyzed for the presence of SCC*mec* IV and genes for PVL.

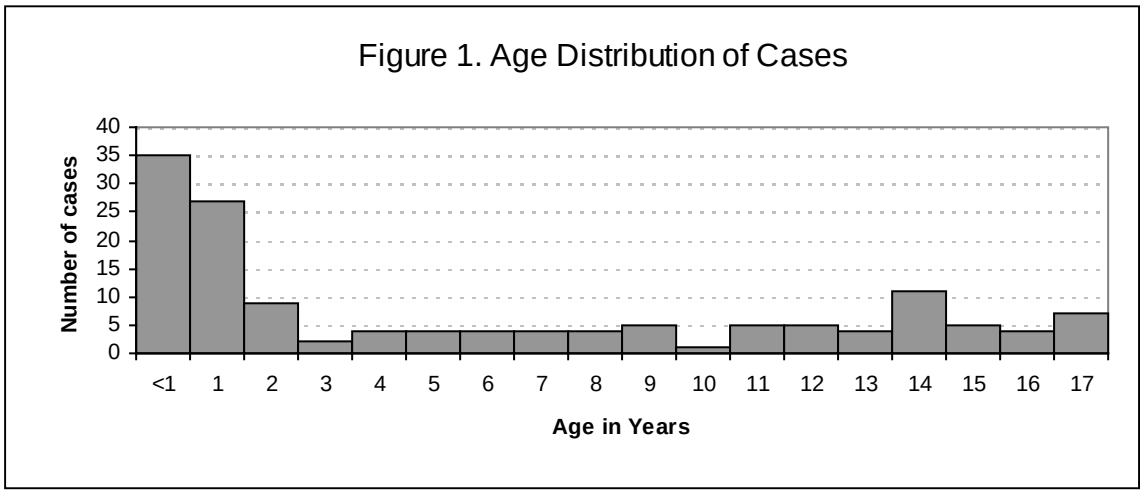
RESULTS

A total of 140 cases of MRSA were reported from 31 hospitals (range 1–17 cases/hospital). The mean age of the cases was 6.25 years and the median was 2.68 years (Table 1); the largest number of cases (n=35, 25%) were in children <1 year of age (Figure 1). The majority of cases were of Latino origin (66%). For age, gender, and race/ethnicity, there were no statistically significant differences between the reported cases and LAC residents under 18 years of age (Table 1). However, 75% (105 of 140) of cases lived in zip codes with a lower median income than the median income of LAC and the median surrogate household income for cases ($35,744) was less than the median annual income ($42,189) for LAC overall (p=0.0023).

Table 1. Demographic Characteristics of Cases

Characteristics	Case Population* (N=140) no.	(%)	LAC Population* (N=2,667,976) no.	(%)
Gender				
Male	69	(49%)	1,366,921	(51)
Female	71	(51%)	1,301055	(49)
Race/Ethnicity**				
Latino	78	(66%)	1,636,000	(60%)
White	19	(16%)	552,000	(20%)
Black	18	(15%)	279,000	(10%)
Asian/PI	3	(3%)	281,000	(10%)
Other	1	(1%)	–	–

* Age younger than 18 years.
** Information for 21 LAC cases missing.



The most common diagnoses were cellulitis (43%), abscess (36%), and abscess/cellulitis (11%). A few (n=10, 7%) were diagnosed with invasive disease including (some overlapping diagnoses) which included: bacteremia (n=4), meningitis (n=2), osteomyelitis (n=3), bursitis (n=2), and renal abscess (n=1). Three (3%) were other/unknown. Many of the charts (n=32, 23%) indicated a possible insect or spider bite as the cause of the lesion. There were no deaths.

The average number of days hospitalized was 5.15, median 4, and the range was 1–30 days. Almost all cases (99%) were treated with antibiotics including 91% with oral antibiotics and 98% with IV antibiotics. Initially, 75% of cases received ß-lactam antibiotics; although many received these antibiotics in conjunction with a second antibiotic to which the isolate was sensitive (clindamycin, vancomycin, or TMP-SMX). The majority (n=89, 70%) underwent incision and drainage procedures for their skin lesions.

A parent or guardian of 82 (58%) cases was interviewed. More than a third of the cases (35%, n=29) had risk factors for nosocomial MRSA (Table 2) including hospitalization in the previous year (not including hospitalization at birth). Almost one-half (43%, n=35) had other risk factors for MRSA (Table 3).

One fifth of patients (20%, n=16) had a household contact with a self-diagnosed skin infection in the month before onset of infection and 10% (n=8) had a household contact who developed a skin infection in the month after the case was hospitalized (median follow-up 24.5 days after onset of cases' symptoms, range 8–137 days).

The rate of hospitalization with MRSA was 10.3/100,000 person-year in those younger than 18 years old. This rate is considerably higher than the corresponding rates of hospitalization for the most commonly reported infectious diseases of public health significance (Table 4) in LAC.

Table 2. Risk Factors for Nosocomial MRSA

Exposure	Interviewed Cases (N=82)	
	no.	(%)
Healthcare worker in household	10	(12%)
Household contact with underlying illness	8	(10%)
Hospitalization in prior year	18	(22%)
TOTAL	29	(35%)

Table 3. Other Risk Factors for MRSA

Exposure	Interviewed Cases (N=82)	
	no.	(%)
Antibiotic use in prior 6 months	29	(35%)
Contact with recently incarcerated individual*	9	(11%)
TOTAL	35	(43%)

* Contact in the 30 days prior to onset of symptoms of MRSA.

Table 4. Rates of Hospitalization for Infectious Diseases in Persons <18 Years—Los Angeles County, 2003

Organism	Number Reported	Rate of Hospitalization*
MRSA	140**	10.30
Salmonella	99	3.71
Invasive *Streptococcus pneumoniae*	84	3.15
Shigella	65	2.44
Campylobacter	30	1.12

* Cases per 100,000 population <18 years old.
** Only reported May 5 to November 7, 2003.

Laboratory Results: Over half of MRSA isolates (n=83, 58%) were collected and analyzed; 79 (96%) were consistent with the USA 300 CAMRSA strain. Almost all (n=82, 99%) carried SCC*mec* IVa and 100% of the isolates possessed genes for PVL.

DISCUSSION

This is the first population based report of children hospitalized with MRSA and there are several notable findings. First, there was a high rate of morbidity associated with MRSA and the rate of hospitalization with MRSA was higher than any of the other reportable infectious diseases in LAC. Furthermore, laboratory findings identified that almost all the cases were caused by CAMRSA strains despite risk factors for HAMRSA in more than one-third of the cases. The majority of the cases in this report were skin and soft tissue (90%) infections and only 7% were invasive which is consistent with other reports of CAMRSA.

The majority (75%) of initial treatment regimens included ß-lactam antibiotics which are not effective against MRSA. Almost one-quarter were initially misdiagnosed as insect or spider bites which may have delayed proper treatment. Twenty-two percent of household contacts developed a self-reported skin infection in the month prior to or after the onset of symptoms of the index case suggesting that this organism is easily transmitted to close contacts. These findings demonstrate the need for healthcare provider education about the correct diagnosis and treatment of CAMRSA and the need to inquire about household and close contacts with skin infections to prevent recurrent exposures to the organism.

Of note, almost half (46%) of the cases were younger than 2 years—this may represent hospitalization bias. Pediatricians may have been more likely to hospitalize very young patients with MRSA. More needs to be understood about physicians' decisions about hospitalization for CAMRSA SSTI since several investigators have shown that these lesions may be treated with wound care and may not require either antibiotics or hospitalization.

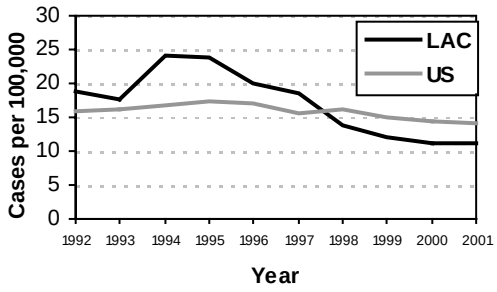
This study, in conjunction with other studies in California, point to the increasing incidence of CAMRSA, the high morbidity associated with CAMRSA, and the need for increased clinician and patient education. Research is needed on prevention, treatment, and outcomes of CAMRSA.

THE CHANGING EPIDEMIOLOGY OF SALMONELLOSIS IN LOS ANGELES COUNTY 1992–2001

BACKGROUND

Nontyphoidal *Salmonella* species are one of the most frequent bacterial causes of foodborne illness in the US—and there are an estimated 4 million persons ill with nontyphoidal salmonellosis each year. Foodborne transmission causes more than 95% of human salmonellosis cases, with foods of animal origin being the most common source. While generally causing self-limited illness, for the very young, the very old and those with lowered immunity, salmonellosis can cause serious sequelae and death. Trends in *Salmonella* incidence, hospitalization rates and outbreak etiologies in Los Angeles County (LAC) from 1992–2001 are described.

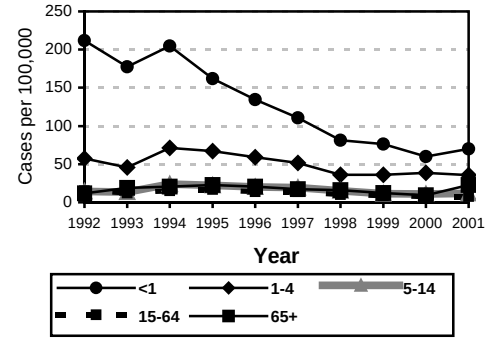
Figure 1
Salmonellosis Incidence
1992-2001



METHODS

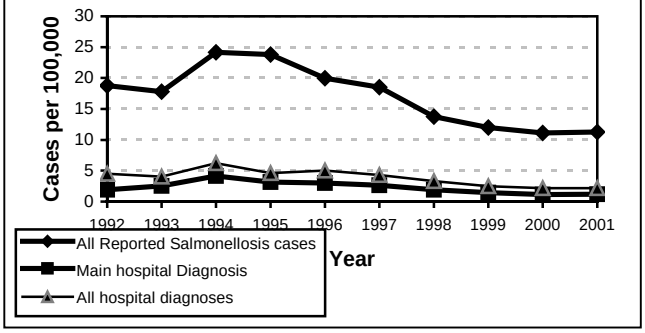
All persons diagnosed with salmonellosis and residing in LAC are required by California state law to be reported to the LAC Department of Health Services. A confirmed case is defined as an individual who had a culture-confirmed *Salmonella* isolate from stool, blood, urine, wound, CSF or other site. A presumptive case is defined as an individual who is epidemiologically linked to a culture-confirmed case, and has diarrhea (>2 loose stools/24 hours) and fever, or diarrhea and at least two other symptoms such as cramps, vomiting, or aches with negative or unknown culture results. Age, race, ethnicity, gender, hospitalization and outcome are all collected from routine salmonellosis case history forms used for interviews conducted on each reported case of salmonellosis.

Figure 2
Salmonellosis
Incidence Rates by Age Groups
LAC, 1992–2001



Hospital discharge data (version A) was obtained from the California Office of Statewide Health Planning and Development for 1992 through 2001. Discharge records containing the ICD9 code for nontyphoidal *Salmonella* infection (003, 003.0, 003.1, 003.2, 003.20, 003.21, 003.22, 003.23, 003.24, 003.29, 003.8, and 003.9) as principal or additional diagnosis were included as hospitalized cases. LAC Vital Records data were used to calculate rates.

Figure 3
Salmonellosis
Reported and Hospital Diagnosis by Year
LAC, 1992–2001



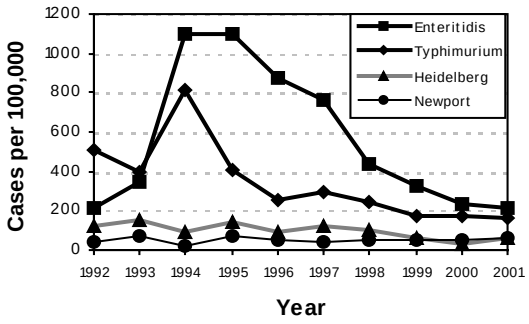
In addition, LAC laboratories are required by state law to submit all *Salmonella* isolates to the local health department. Locally, these isolates are then confirmed, grouped and serotyped by the LAC Public Health Laboratory. In addition, pulsed-field gel electrophoresis (PFGE) has been

regularly performed on selected serotypes since 1999, and has been performed for outbreaks and special investigations on *Salmonella* isolates since 1995.

RESULTS

There were 15,174 cases reported and 1% resulted in death during the study period. Rates of salmonellosis have declined steadily from a high of 24/100,000 in 1994 to 10/100,000 for 2001 (Figure 1). LAC rates peaked in the mid-1990's, but have now fallen below the national rate.

Figure 4
Salmonella
Serotypes by Year
LAC, 1992–2001

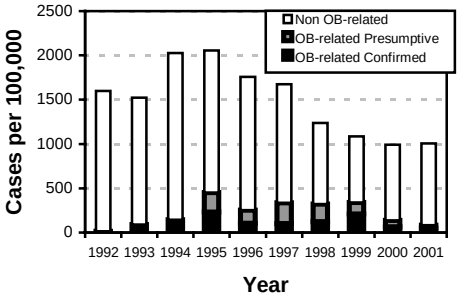


The highest average rates for the ten year period were in those under age one year (100/100,000), followed by 1-4 year olds (45/100,000), and those over 65 years (18/100,000, Figure 2). Extremely high rates in infants have fallen steadily during the study period. One percent of cases (152) resulted in death and 49% of deaths were in persons >65 years old. The majority of these deaths occurred in persons with underlying medical conditions that decrease immunity.

There were 3160 hospitalizations for the study period; highest age group rates among those hospitalized were 19.0/100,000 for <1 year old and 9.8/100,000 for 65 years and older (Figure 3). The age group rates were based on the salmonellosis as any diagnosis on the hospital discharge data set.

The diamond line refers to all reported salmonellosis cases, whether hospitalized or not. The squares are those hospitalized persons with salmonellosis as the main diagnosis and the triangle line is those cases with salmonellosis as any hospital diagnosis.

Figure 5
Salmonellosis
by Year and Outbreak Status*
LAC, 1992–2001



From 1992–2001, *Salmonella* Enteritidis (SE) was the most frequent serotype isolated, followed by *S*. Typhimurium, *S*. Heidelberg and *S*. Newport, respectively (Figure 4). In LAC, the incidence of SE cases spiked in 1994, then dropped from 11.7/100,000 in 1994 to 2.6/100,000 in 2001, with a concurrent decrease in SE outbreaks. In addition, a lesser decrease was seen in the second most frequently isolated serotype, *S*. Typhimurium during this time. Investigations were conducted for 132 salmonellosis outbreaks; the etiology for 66 (50%) outbreaks was *Salmonella* Enteritidis (SE) and in 41% of SE outbreaks, shell eggs were implicated as the source. The proportion of cases that are due to outbreaks varies by year, depending on the size and nature of the outbreak (Figure 5). Beginning in 1997, 17 outbreaks of various serotypes associated with fresh produce occurred (Table 1). Sources were canteloupe (n=4), alfalfa sprouts (n=4), cilantro (n=4), unpasteurized orange juice (n=2), pre-cut melons (n=1), green grapes (n=1) and mango (n=1). Many of these outbreaks consisted of apparently sporadic cases in multiple jurisdictions and detection coincided with the initiation of PFGE in public health laboratories and the PulseNet surveillance system.

Table 1. Suspected Sources Of Outbreaks by Year						
Year	Number of Outbreaks	Number of Outbreaks by Suspected Source of Infection				
		Eggs	Poultry	Carrier	Produce	Unknown
1992	3	0	0	2	0	1
1993	11	2	1	2	0	6
1994	13	3	2	3	0	5
1995	17	3	8	3	0	3
1996	10	4	2	1	0	3
1997	17	4	3	0	1	9
1998	22	8	5	1	2	6
1999	21	3	3	2	6	7
2000	8	0	1	2	2	3
2001	10	0	0	0	6	4
TOTAL	**132**	**27**	**25**	**16**	**17**	**47**
%	**100%**	**20%**	**19%**	**12%**	**13%**	**36%**

DISCUSSION

Rates of *Salmonella* infections have fallen by half since 1995. This reduction is mostly due to a decrease in *S*. Enteritidis and to a lesser degree to a decrease in *S*. Typhimurium. *S*. Enteritidis rates have been falling since an dramatic increase in SE associated with eggs was recognized in 1994. Local and state public health and agriculture agencies worked with the egg industry to develop a prevention strategy, and as of 2002, more than 99% of the eggs produced in California are from farms that participate in the California Egg Quality Assurance Program. It is possible that these measures also impacted other serotypes of *Salmonella* found in poultry, including *S*. Typhimurium.

Demographic trends in salmonellosis are similar to those found in the rest of the US. The very young and old are at risk for hospitalization and the elderly have greater mortality. Most of these deaths are in persons with underlying medical conditions such as cancer, cardiovascular disease, or immunocompromising conditions. In the very young, increased food safety knowledge by parents may be responsible for the decrease in salmonellosis in those under one year of age.

While most outbreaks of salmonellosis of proven etiology are foodborne, there has been a shift from long-established sources such as meat, poultry, eggs and dairy products toward fresh produce as the source vehicle for transmission. As *S*. Enteritidis due to eggs has fallen, so have outbreaks due to *S*. Enteritidis. As better control of meat and dairy products decreases salmonellosis from these sources, new sources have been discovered, such as imported produce from areas that do not have the same standard of living and hygiene that we have in the US. Demand for fresh fruits and vegetables year-round have led to increasing imports of fresh produce from around the world. These widely-distributed products, if contaminated, can lead to sporadic cases occurring over a large geographic area, in different health jurisdictions. In the past, these sporadic cases would have been investigated as individual cases, but now, because of various Web boards, such as PulseNet and listservs, such as FoodNet, these sporadic cases can be linked together by serotype and PFGE pattern type and investigated together as an outbreak.

Our definition of outbreaks is changing from classic point source events to include sporadic cases of the same strain type. Many of these outbreaks involved widely-distributed products such as imported produce, processed meat or spices. Case-control studies are then conducted to attempt to find the associated food source. These studies are more difficult than the classic point source investigation, and may involve several lengthy interviews of each case. Because of the increase in produce-related outbreaks, public education regarding uncooked produce as an additional source of foodborne illness

should be expanded. Health care providers should educate elderly patients and those who use steroid medication or have chronic illness regarding food safety. Local, state and federal regulators from farm to table need to enforce food safety regulations to ensure that foods produced in the US and those imported are free of pathogenic bacteria.

ADDITIONAL RESOURCES

For frequently asked question about salmonellosis:
www.admin.lapublichealth.org/wwwfiles/ph/PH/PHN/Salmonellosis.PDF

General information about salmonellosis:
www.cdc.gov/ncidod/diseases/submenus/sub_salmonella.htm

General information about foodborne illness and reporting information in LAC:
www.lapublichealth.org/acd/food.htm

Information on salmonellosis and reptiles: www.lapublichealth.org/acd/docs/PetReptile%20Brochu.pdf

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THE IMPACT OF LOS ANGELES COUNTY IMMUNIZATION CLINIC CLOSURES ON VACCINE USAGE IN THE COMMUNITY

BACKGROUND

The Los Angeles County Immunization Program (LACIP) of the Los Angeles County Department of Health Services (LACDHS) distributes publicly-funded/Vaccines For Children (VFC) vaccines to LACDHS and select non-profit clinics (i.e., community and free clinics) in order to reach populations most at need. Community and free clinics are community-based, owned by a non-profit public benefit organization, exempt from taxation under Section 501 (c)(3) of the Internal Revenue Service Code, exempt from state franchise or income tax by the Franchise Tax Board, and licensed by the California Department of Health Services as a community clinic. LACDHS public health clinics are categorical communicable disease clinics. LACDHS personal health clinics function as a primary care setting providing complete medical services. LACDHS comprehensive health centers are primary care facilities that house specialty clinics (i.e., diabetes care) and can refer patients to LACDHS personal and public health clinics as necessary. All LACDHS clinics can see similar clients, regardless of insurance status.

Because 18 LACDHS personal health clinics that offer immunization services closed during March through September 2002, an examination of vaccine utilization data of providers receiving publicly-funded vaccines was conducted prior to and after the clinic closures in order to ascertain the impact of immunization clinic closures on vaccine utilization.

METHODS

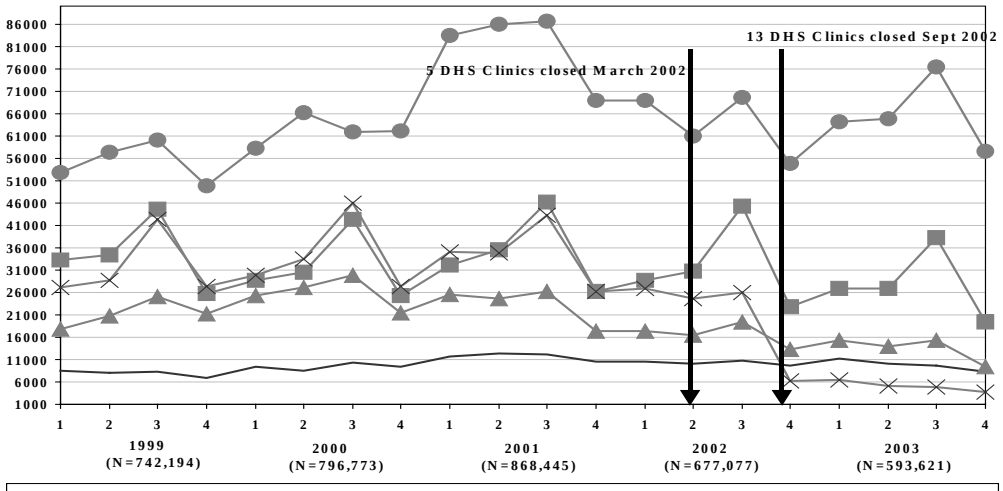
Clinics that receive publicly-funded vaccines submit weekly reports to LACIP documenting the numbers of doses of each vaccine that were administered to specific age groups. Since vaccine utilization in our county has historically displayed cyclical patterns by calendar quarter-year, the data were analyzed by quarter-year before and after the clinic closures and further stratified by age group of vaccine recipient, clinic type, and vaccine type by the following categories:

- Quarter-Years Before the Clinic Closures: Quarter 1, 2000 (Q1-2000); Quarter 2, 2000 (Q2-2000); Quarter 3, 2000 (Q3-2000); Quarter 4, 2000 (Q4-2000).
- Quarter-Years Immediately After the Clinic Closures: Quarter 4, 2002 (Q4-2002); Quarter 1, 2003 (Q1-2003).
- Quarter-Years 3 to 6 Months After the Clinic Closures: Quarter 2, 2003 (Q2-2003); Quarter 3, 2003 (Q3-2003); Quarter 4, 2003 (Q4-2003).
- Age Group of Vaccine Recipient: 2 years and younger (#2 years); 3–5 years; 6–9 years; 10 years and older (10+).
- Clinic Type: Community/free clinics; LACDHS public health clinics; LACDHS personal health clinics; LACDHS comprehensive health clinics; LACDHS hospitals.
- Vaccine Type: Diphtheria/Tetanus/Acellular Pertussis (DTaP); Haemophilus influenzae, Type B (HiB); Hepatitis A (Hep A); Hepatitis B (Hep B); Intravenous Polio Vaccine (IPV); Measles/Mumps/Rubella (MMR); Varicella, Hep B/HiB combination vaccine.

RESULTS

Public and non-profit clinics administered a yearly median estimate of 759,649 total vaccine doses during 1996–2000. The yearly doses administered from 1999 through 2003 ranged from the lowest doses administered in 2003 of 593,621 to the highest doses administered in 2001 of 868,445 (Figure 1).Before the clinic closures, 60 LACDHS clinics accounted for 51.2% of these doses, compared to 42 clinics administering 39% of doses in January–October 2003. The closures were projected to account for 11.6% of total yearly vaccine doses administered and 22.7% in LACDHS facilities alone.

Figure 1. Vaccine Doses Administered by Quarter-Year, 1999–2003



Quarter-Year Comparison Before and After the Clinic Closures, by Age of Vaccine Recipient: As exhibited in Figures 2 and 3, doses administered in all age groups decreased, when comparing the time periods before and after the clinic closures. The #2 age group experienced the smallest decrease in doses administered in select quarters.

The 3–5 age group historically has demonstrated a cyclical pattern of vaccine administration, with peaks in doses administered during the back-to-school quarter (Q3) and the lowest doses administered in the first and fourth quarters. The same trend is evidenced after the clinic closures; however, the overall doses administered decreased.

Figure 2. Vaccine Doses Administered by Age of Recipient Before and After the Clinic Closures, by Quarter-Year

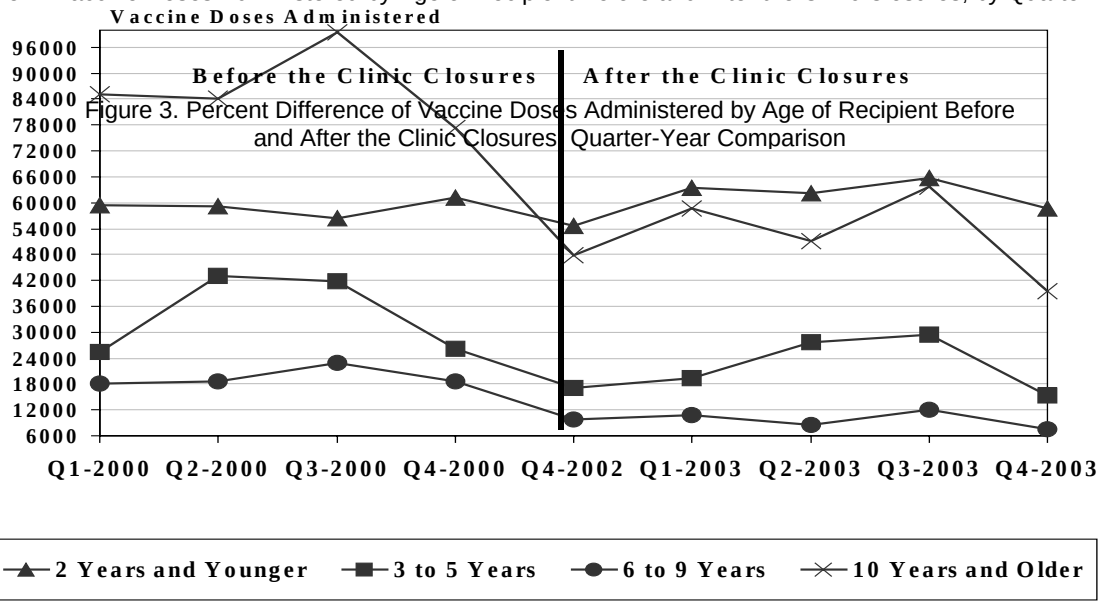
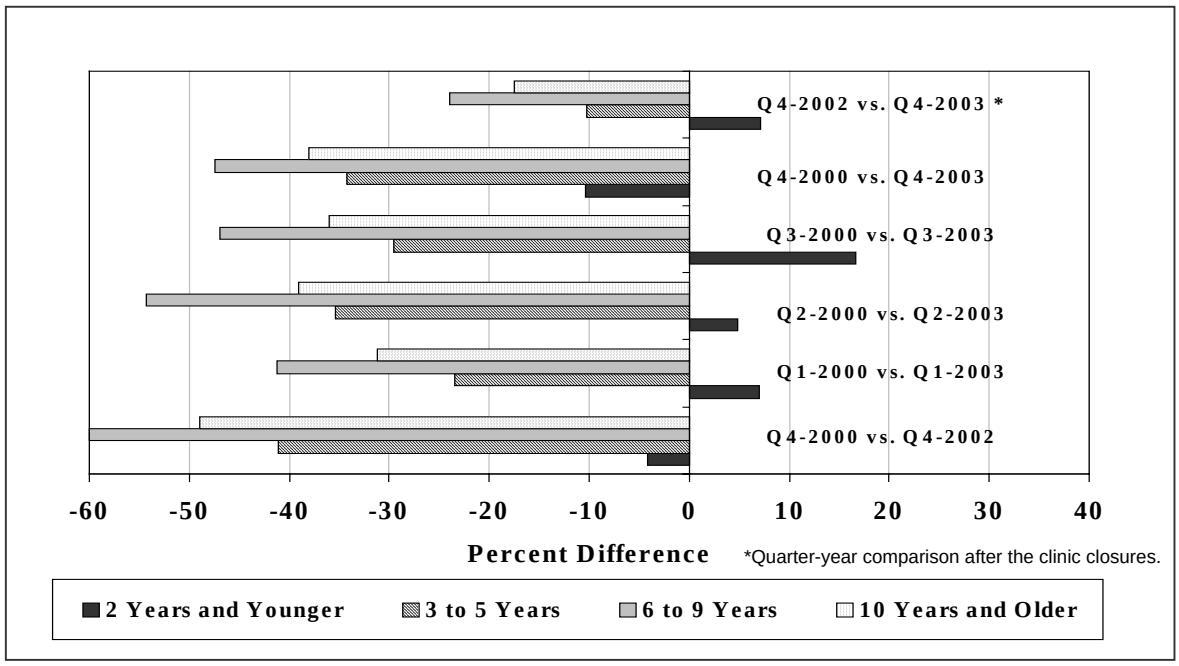


Figure 3. Percent Difference of Vaccine Doses Administered by Age of Recipient Before and After the Clinic Closures, Quarter-Year Comparison

The 6–9 and 10+ age groups experienced the largest age-specific decreases in doses, when comparing the time periods before and after the clinic closures (Figure 3). However, the dramatic decrease in doses

administered in these age groups occurring since the closures appears to have slowed in recent quarters (Figure 3).



Quarter-Year Comparison Before and After the Clinic Closures, by Clinic Type and Age of Vaccine Recipient: After a decline in doses immediately after the LACDHS clinic closures in all ages, community/free clinics began to administer more doses, but only in the #2 age group (Quarter-year comparison range: 15.9%–54.6% increase).

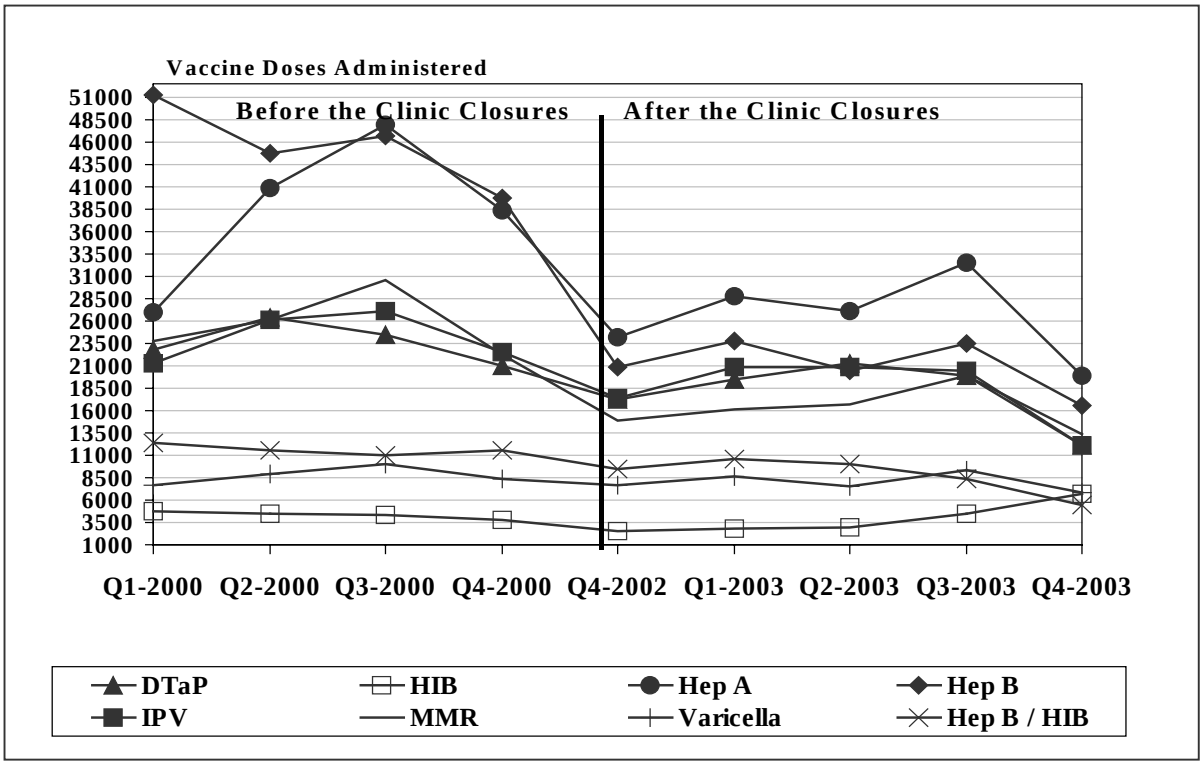
LACDHS comprehensive health clinics have administered fewer doses in all age groups since the clinic closures occurred, with the largest decrease in administered doses evidenced in the 6–9 age group (quarter-year comparison range: 51.0%–76.8% decrease).

The LACDHS hospitals administered more doses in the #2 age group; beginning immediately after the closures and continuing until Q4-2003 (quarter-year comparison range: 7.6%–30.5%). The largest decrease in doses at hospital clinics occurred in the 6–9 age group (quarter-year comparison range: 14.7%–69.5%).

Since LACDHS personal health clinics were the clinics primarily impacted by the closures, the largest overall decreases in doses administered were evidenced across all quarter-year comparisons in all age groups in these clinics. However, this decrease slowed in Q4-2003 (vs. Q4-2000 and Q4-2002) in all age groups. The 6–9 and 10+ age groups experienced the largest decrease in doses administered in these clinics since the closures.

LACDHS public health clinics increased the number of doses administered in the #2 age group since the clinic closures (quarter-year comparison range: 10.4%–29.0%), except when comparing Q4-2003 with Q4-2002. The 10+ age group received fewer doses at these clinics in recent years (Q4-2002 vs. Q4-2003: 34.3% decrease; Q4-2003 vs. Q4-2002: 21.9% decrease).

Quarter-Year Comparison Before and After the Clinic Closures, by Vaccine Type: Historically, most of the publicly-funded vaccines are administered in greater amounts during the back-to-school quarter (Q3) in



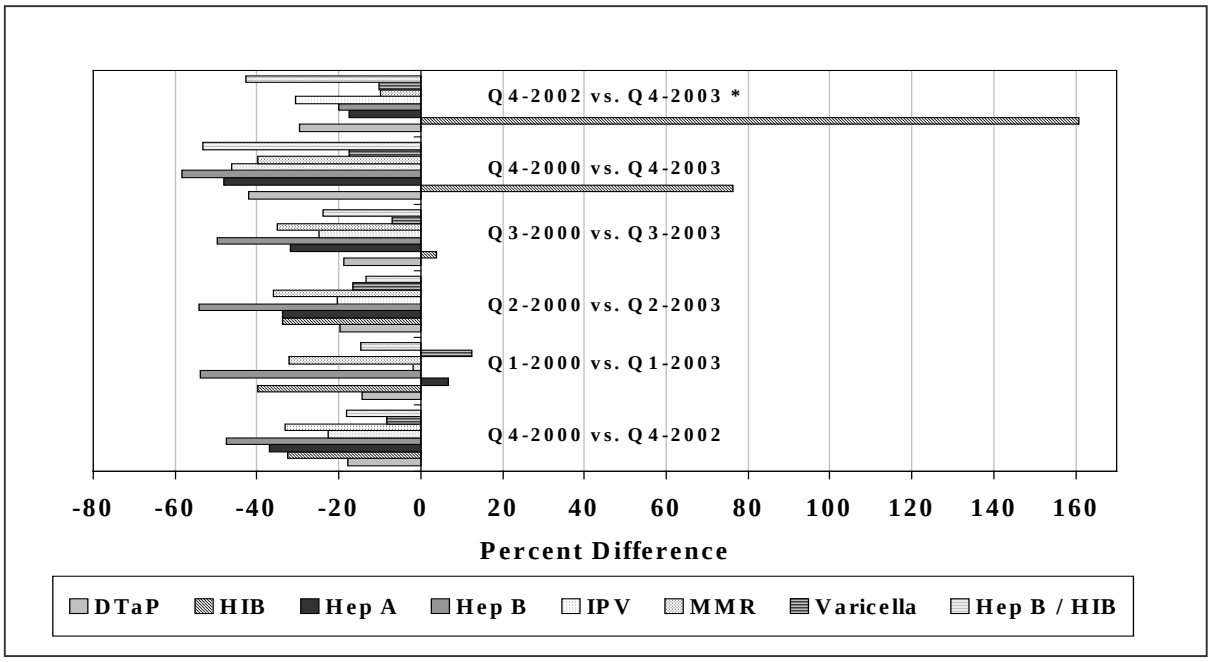
order to meet school entry requirements, and this was still the case after the clinic closures. However, as demonstrated in Figures 4 and 5, all the vaccines were administered in lower amounts after the clinic closures, when compared to the same time periods before the closures.

The vaccines with the smallest decrease in doses administered since the clinic closures were Varicella and HepB/HiB vaccines. HiB was the only vaccine that was administered in greater amounts in recent years (Figure 5).

Figure 5. Percent Difference of Vaccine Doses Administered by Vaccine Type Before and After the Clinic Closures, Quarter-Year Comparison

*Quarter-year comparison after the clinic closures.

Figure 4. Vaccine Doses Administered by Vaccine Type Before and After the Clinic Closures, by Quarter-Year



The vaccines with the largest decrease in doses administered since the clinic closures were DTaP, MMR, and Hep B. The quarter-year range of DTaP doses administered before the clinic closures was 21,035–26,447, compared to 12,169–21,206 after the clinic closures. With the MMR vaccine, the quarter-year range of doses administered before the clinic closures was 22,257– 30,566, compared to 13,417–19,832 after the clinic closures. With the HepB vaccine, the quarter-year range of doses administered before the clinic closures was 39,693–51,273, compared to 16,599 – 23,441 after the clinic closures.

Quarter-Year Comparison Before and After the Clinic Closures, by Vaccine and Clinic Type: Community/free clinics administered less doses of all vaccines immediately after the clinic closures, followed by a small increase in doses administered of most vaccines during Q1-2003 (10.2% increase from Q1-2000), culminating in the back-to-school vaccination surge in Q3-2003 (23.5% increase from Q3-2000). Since Q3-2003, all vaccines have been administered in lesser amounts at these clinics, with the exception of HiB (166.2% increase Q4-2003 vs. Q4-2002).

The vaccines with the largest decrease in administration at LACDHS comprehensive health clinics were Hep A (quarter-year comparison range: 35.1%–70.9% decrease) and Hep B (quarter-year comparison range: 35.8%–65.9%).

LACDHS hospitals were the only facility type that did not decrease its doses administered immediately after the closures in most vaccines (1.7% overall increase Q4-2002 vs. Q4-2000) and actually administered more doses until recent quarters (Q4-2003 vs. Q4-2000: 11.7% decrease; Q4-2003 vs. Q4-2002: 13.1% decrease) in all vaccines, excluding HiB.

Since LACDHS personal health centers were the clinics primarily impacted by the clinic closures, all vaccines were administered in much lower amounts after the closures, most notably HepB.

The amount of varicella doses administered at LACDHS public health clinics has increased since the closures (quarter-year comparison range: 2.6%–29.6%), except when comparing Q4-2002 versus Q4-2003 (12.1% decrease). The vaccines with the largest decrease in doses administered at these clinics since the closures were Hep B and MMR vaccines.

DISCUSSION

Despite the fact that community/free clinics are administering more vaccine in the 2 years and younger age group, many other individuals are not receiving integral vaccines in LACDHS and community/free clinics, prompting the questions as to where individuals are seeking immunization health services and whether immunization coverage levels in LAC have been impacted.

Data released from the National Immunization Survey for the survey period July 2002 through June 2003 show 82.4% of 19–35 month-old children in LAC are immunized with 4 doses of DTaP, 3 doses of Polio, 1 dose of MMR, 3 doses of HiB, and 3 doses of Hep B (4:3:1:3:3) [1]. A steady increase every year in the 4:3:1:3:3 immunization coverage level as well as single vaccine coverage has been evidenced for years. Although these data appear to indicate that there has been no overall impact on county immunization coverage levels in children due to the LACDHS clinic closures, evidence of an impact at a smaller community or population-specific level needs to be investigated. For example, race- or geographic-specific differences in immunization coverage may be discovered since many minority populations in our county utilize LACDHS clinics that administer vaccine [2]. Currently, race and other socio-demographic variables are not collected during vaccine administration.

Longitudinal vaccine utilization, as analyzed in this report, needs to continue to be monitored. In addition, race-specific assessments investigating immunization health seeking behavior need to be conducted in order to better understand the finer changes in immunization coverage levels and other immunization knowledge, attitudes, beliefs, and practices that may have been impacted by a number of clinic closures.

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2. Los Angeles County Immunization Program. Characteristics of Patients Seeking Care from Los Angeles County Public Immunization Clinics, April–May 2003 vs. August–September 1999.

USING CLUSTER SURVEY METHODOLOGY TO ASSESS CURRENT IMMUNIZATION COVERAGE LEVELS AMONG AFRICAN AMERICAN CHILDREN 2–3 YEARS OLD AND FACTORS INFLUENCING COMPLETION

BACKGROUND

Little information exists regarding immunization coverage rates of African American (AA) children in Los Angeles County (LAC). The sample size of AA children participating in the National Immunization Survey (NIS) in LAC is too small to estimate coverage rates [1]. The best source of data is the California Kindergarten Retrospective Survey (CA KRS) [2], but the data is retrospective and does not reflect current coverage levels. CA KRS data show that immunization coverage levels among LAC AA toddlers for the 4:3:1 vaccination series* at 24 months and 3 years of age are lower than all other ethnic groups. The 2001 CA KRS data show that 4:3:1 series completion at 24 months of age was lowest among LAC AA toddlers (52%), compared to Whites (71%), Hispanics (72%), and Asians (80%).

A door-to-door survey using "cluster survey" methodology was conducted to estimate current immunization coverage levels. The objectives of this survey were to determine the immunization coverage for AA children 2–3 years old residing in 5 predominantly AA LAC zip codes; to identify factors influencing the completion of childhood immunizations; to assess parent's/guardian's knowledge, attitudes, and practices related to childhood immunization; and to identify culturally appropriate methods to encourage timely childhood immunizations among the surveyed population.

METHODS

Study Population: All parent/guardians of AA children between the ages of 24 and 47 months during the survey period and living in zip codes 90008, 90043, 90047, 90056, and 90305 were eligible to participate in the survey. According to demographic data collected from the 2000 US Census, these zip codes had a high percentage (>70%) of AA residents and had demographic characteristics comparable to AA residents in other zip codes of LAC. Data was collected on marital status, household income, education, WIC status, and healthcare status.

Enumeration: The survey area was divided into 170 clusters (i.e., groups of blocks), each with at least 20 eligible children according to the 2000 US Census. Fifty clusters were then randomly selected based on probability proportionate to the estimated size of the eligible children. From July to November 2002 LAC Immunization Program and Great Beginning for Black Babies staff visited all addresses in each block to determine the number of eligible AA children age 2–3 years old per cluster. Each household respondent was asked if an AA child 2–3 (24–47months) years old lived at the residence and to provide the child's birth date. All eligible children were entered into a database to be selected for their parent/guardian to be interviewed.

Interview: After a cluster was completely enumerated, 10 eligible children were randomly selected from that cluster. Each selected child's parent/guardian was surveyed and the child's immunization record was reviewed. Vaccine doses and the dates when the vaccinations were given were copied from the child's immunization card. If the immunization card was absent at the time of the interview, staff obtained parent's permission to contact the child's health care provider(s). Interviewers also asked questions about the parent's knowledge and perceptions about immunizations; barriers to immunizations; and healthcare access and utilization.

RESULTS

From the 48 clusters, approximately 450 blocks (>35,000 households) were enumerated. Two clusters were dropped. Approximately 700 eligible children were identified, but 134 parents/guardians refused to

* 4:3:1 combination series includes 4 DTaP/DTP (diphtheria, pertussis, tetanus), 3 Polio, and 1 MMR (measles, mumps, rubella).

disclose information about their children and only 565 children were eligible to be selected for interview (about one eligible child per block).

Out of the remaining 533 eligible parents/guardians, 362 (68%) completed the survey, 75 (14%) refused, 35 (7%) had moved after enumeration, 23 (4%) subsequently responded as not having children, 15 (3%) had children whose birth dates were recorded incorrectly at enumeration and were not eligible to be interviewed, 18 (3%) did not respond to our attempts to be interviewed, and 5 (1%) were classified as "other" (i.e., did not speak English, were not AA, or not a permanent resident).

Demographics: More than half of the children were 2 years old (57.7%) and the remaining children were 3 years old (42.3%). The age of parents/guardians who were interviewed was evenly distributed across all age groups, almost half were never married (48.8%); most had low incomes (36.0% with a household income below $20,000 and 24.9% between $20,000–$40,000); and some (29.3%) had graduated high school, or had some college education or an associates degree (36.7%, Table 1).

Table 1. Demographic Characteristics of Children and Their Parents/Guardians

Demographic Variables	Number	Percent
Age of child in years (n=362)		
2 years old	209	57.7
3 years old	153	42.3
Sex of child (n=362)		
Male	183	50.6
Female	179	49.4
Age of parent/guardian in years (n=362)		
Under 24	63	17.4
25-29	72	19.9
30-34	72	19.9
35-39	78	21.5
40 and older	73	20.2
Refuse to answer	4	1.1
Marital status of parent/guardian (n=361)		
Never married	176	48.8
Married	122	33.8
Separated/divorced	28	7.8
Living with a partner	21	5.8
Other	9	2.5
Refuse to answer	5	1.3
Estimated household income (n=361)		
Below $20,000	130	36.0
$20,000-$40,000	90	24.9
$40,000-$60,000	43	11.9
More than $60,000	40	11.1
Refused to answer	58	16.1
Highest grade parent/guardian completed in school (n=362)		
Some high school	43	11.9
High school graduate/general ed. diploma	106	29.3
Some college/associates degree	133	36.7
College graduate	57	15.7
Post-graduate	20	5.5
Refuse to answer	3	0.8

Health Care Coverage and WIC Enrollment: The survey also evaluated health care coverage and utilization of WIC (Women, Infant and Children program) services as possible factors that influence immunization completion rates. Among our study population, most of the children had been to the same health care provider since birth (70.2%) and few children (13.8%) had been uninsured. More than half of the children had private insurance or Medi-Cal since birth. Many of the children (81.5%) had also been enrolled in the WIC program (Table 2).

Table 2. Health Care Coverage and WIC Program Enrollment

Variables	Number	Percent
Child been to same doctor/clinic since birth (n=359)		
Yes	252	70.2
No	107	29.8
Type of medical or health insurance for the child* (n=361)		
Private/HMO	198	54.9
Medi-Cal	200	55.4
Emergency Medi-Cal	16	4.4
Healthy Families or California Kids	28	7.8
No insurance/never had insurance	9	2.6
Child ever been uninsured (n=356)		
Yes	49	13.8
No	307	86.2
Child ever enrolled in WIC (n=362)		
Yes	295	81.5
No	67	18.5

* Multiple responses allowed.

Table 3. Comparison of Vaccine Coverage Levels Between Study Population and US National Immunization Survey, 2002

Vaccine Doses Received	Cluster Survey 2002 (24-47mos)	Percent NIS 2002 African American (19-35 mos)	NIS 2002 LAC (19-35 mos)	NIS 2002 LAC (24 mos)
Single Antigen Vaccine				
3 DTaP/DT	88.7± 4.0	93.5 ± 1.8	93.1 ± 4.2	91.8 ± 5.9
4 DTaP/DT	76.8 ± 4.3	75.8 ± 2.9	83.7 ± 5.3	82.6 ± 7.3
3 Poliovirus	85.6 ± 3.7	87.4 ± 2.1	88.3 ± 4.8	85.4 ± 6.6
1 MMR	88.4 ± 3.7	90.3 ± 1.9	91.1 ± 4.0	92.8 ± 4.9
3 Hib	81.8 ± 4.6	91.6 ± 1.9	89.7 ± 4.7	88.2 ± 6.3
3 Hepatitis B	81.8 ± 4.0	88.0 ± 2.1	90.4 ± 3.9	86.3 ± 6.4
1 Varicella	84.3 ± 4.0	82.7 ± 2.5	88.1 ± 4.3	85.0 ± 6.7
1 Hepatitis A	61.3 ± 7.8	N/A	N/A	N/A
2 Hepatitis A	17.7 ± 3.7	N/A	N/A	N/A
3 PCV 7	21.3 ± 4.2	33.9 ± 3.1	34.4 ± 6.4	25.6 ± 7.5
Combined Vaccination Series				
4 DTP, 3 Polio, 1 MMR	73.5 ± 4.0	71.6 ± 3.0	79.6 ± 5.6	79.1 ± 7.5
4 DTP, 3 Polio, 1 MMR, 3 Hib	70.4 ± 4.3	70.7 ± 3.0	77.1 ± 5.8	75.9 ± 7.7
4 DTP, 3 Polio, 1 MMR, 3 Hib, 3 Hep B	67.4 ± 4.3	67.7 ± 3.1	76.0 ± 5.9	74.0 ± 7.8

Immunization Coverage Levels: The primary objective of the survey was to assess immunization coverage levels for single vaccination series and for combined vaccination series.* The immunization coverage levels for most single vaccine series and combined vaccination series were comparable to the

* Combined vaccination series defined as 4:3:1 (4 DTaP/DTP, 3 Polio, 1 MMR), 4:3:1:3 (4 DTaP/DTP, 3 Polio, 1 MMR, 3 Hib), and 4:3:1:3:3 (4 DTaP/DTP, 3 Polio, 1 MMR, 3 Hib, 3 Hepatitis B).

2002 NIS coverage levels* for US AA children 19–35 months and all LAC children 19–35 months. Coverage levels for *Haemophilus influenzae* type b (Hib), hepatitis B (Hep B), and pneumococcal conjugate vaccine (PCV 7) were lower than NIS levels. Completion rates were also low for vaccines not required for daycare/school entry such as hepatitis B and PCV 7(Table 3).

Immunization Related Behaviors: Although most children had been immunized (98.9%), less than 75% of parents/guardians had the child's immunization card available at home. Pediatricians were the main immunization providers (88.6%), while the health department was the least common source of immunizations (13.9%). Most parents/guardians (83.5%) made an appointment when it was time for their child to get immunized and a significant proportion of parents (41.6%) had to wait eight or more days to get one. Among the parents/guardians who made appointments, most (73.5%) never missed an appointment. Among those who did miss an appointment most (88.8%) rescheduled, but less than half (47.2%) received a reminder from their provider to reschedule the appointment. However, most (55.6%) parents/guardians relied on their doctor to tell them when their child's next immunization was due. The most common reasons parents/guardians missed an immunization appointment were: 1) they were busy or had a conflict with work (31.0%), 2) they forgot (23.0%), and 3) the child was sick (16.1%, Table 4).

Table 4. Parents'/Guardians' Immunization Related Behaviors

Variables	Number	Percent
Child ever been immunized (n=362)		
Yes	358	98.9
No	4	1.1
Immunization card available during interview (n=362)		
Yes	267	73.8
No	95	26.2
Usual immunization provider (n=358)		
No immunization of child	7	2.0
Pediatrician	318	88.8
Family practitioner	64	17.9
Neighborhood clinic	64	17.9
Health department	50	14.0
Emergency room	9	2.5
Schools	2	0.6
Mobile clinic	8	2.2
Immunization cost (n=358)		
$0 (Free)	259	72.3
$1–$20	95	26.5
More than $20	4	1.1
Type of immunization appointment (n=358)		
Make appointment only	299	83.5
Walk-in only	20	5.6
Both (appointment and walk-in)	37	10.3
Other	2	0.6
Wait time to get an appointment (n=321)		
None	9	2.9
1–3 days	108	35.7
4–7 days	66	21.2
8–14 days	56	17.9
15 days or more	73	22.3
Refuse to answer	9	2.9
Ever missed an appointment (n=336)		
Yes	89	26.5
No	247	73.5

* NIS immunization coverage level calculation is not directly comparable due to weighted calculations and therefore, statistical significances cannot be determined.

Table 4 (cont). Parents'/Guardians' Immunization Related Behaviors		
Variables	**Number**	**Percent**
Reasons for missing an appointment (n=87)		
Busy and working	27	31.0
Forgot	20	23.0
Child was sick	14	16.1
Other	26	29.9
Did doctor/clinic send reminder to reschedule (n=89)		
Yes	42	47.2
No	43	48.3
Don't know	4	4.5
Did parent reschedule appointment (n=89)		
Yes	79	88.8
No	9	10.1
Don't know	1	1.1
How does parent know when next immunization is due* (n=358)		
Doctor says when to come back	199	55.6
Look at the child's immunization record	67	18.7
Reminder sent by mail or phone	63	17.6
Nurse says when to come back	28	7.8
Office clerk says when to come back	15	4.2
Don't know when to return	2	0.6
Other	113	31.6

* Multiple responses allowed.

Potential Barriers: Parents/guardians identified lack of transportation (14.0%), a child being ill (11.9%), and work hours overlapped with doctor's hours (5.3%) as the most common barriers to keeping *their* child's immunizations up-to-date. In contrast, parents/guardians identified lack of medical coverage (20.7%), religious beliefs (11.0%), and lack of time (11.0%) as the most common reasons why *other* parents do not immunize their children.

Factors Associated with Better Immunization Coverage Levels: Children whose usual immunization provider was a pediatrician were more likely to have completed the 4:3:1 vaccination series than children whose usual source of immunizations was the health department (76.4% ± 4.6 and 58.0% ± 11.9 respectively). Children immunized by a family doctor were also more likely to be better immunized, but the differences were not statistically significant (Table 5). Cost of immunizations and making appointments were not significantly associated with better immunization coverage levels. Children whose parents/guardians had the child's immunization record at the time of interview had significantly better coverage levels than those who did not (Table 6).

Table 5. Combination Vaccine Series Coverage Levels by Provider, Cost of Immunization and Appointment Type

	Percent		
Provider Type	**4 DTP/DT, 3 Polio, 1 MMR**	**4 DTP/DT, 3 Polio, 1 MMR, 3 Hib**	**4 DTP/DT, 3 Polio, 1 MMR, 3 Hib, 3 Hep B**
Pediatrician (n=359)			
Yes (n = 318)	76.4 ± 4.6	73.0 ± 5.0	69.5 ± 4.9
No (n = 41)	56.1 ± 14.4	56.1 ± 14.4	56.1 ± 14.4
Family Doctor (n=358)			
Yes (n = 64)	76.6 ± 9.7	73.4 ± 10.4	70.3 ± 10.8
No (n = 294)	73.8 ± 4.4	70.7 ± 4.4	67.7 ± 4.5
Community Clinic (n=359)			
Yes (n = 64)	67.2 ± 12.7	67.2 ± 12.7	67.2 ± 12.7
No (n = 295)	75.6 ± 5.1	71.9 ± 5.5	68.1 ± 5.4
Health Department (n=355)			
Yes (n = 50)	58.0 ± 11.9	54.0 ± 12.4	54.0 ± 12.4
No (n = 305)	76.7 ± 4.4	73.8 ± 4.5	70.2 ± 4.7
Cost of Immunization (n=358)			
Free (n = 259)	72.6 ± 4.8	70.3 ± 5.3	67.6 ± 5.5
Not Free (n = 99)	78.8 ± 8.1	73.7 ± 8.3	69.7 ± 9.2
Appointment Type (n=356)			
Appointment (n = 299)	77.3 ± 3.8	74.2 ± 4.1	70.9 ± 4.1
Walk-in (n = 20)	65.0 ± 23.7	65.0 ± 23.7	60.0 ± 22.5
Both (n = 37)	56.6 ± 19.1	61.4 ± 30.1	51.4 ± 20.1

Table 6. Vaccine Coverage Level by Status of Immunization Card at Interview (n = 362)		
	Percent	
Vaccine Series	Immunization Card at Home at Time of Interview (n = 267)	Immunization Card Not at Home at Time of Interview (n = 95)
4 DTP/DT, 3 Polio, 1 MMR	79.4 ± 4.1	56.8 ± 12.8
4 DTP/DT, 3 Polio, 1 MMR, 3 Hib	76.8 ± 4.7	52.6 ± 12.1
4 DTP/DT, 3 Polio, 1 MMR, 3 Hib, 3 Hep B	73.0 ± 4.3	51.6 ± 12.2

Parent/Guardian Knowledge, Attitudes, and Beliefs: Most parents/guardians were able to name the several common vaccine preventable diseases (VPDs); 49.4% identified 1 to 3 diseases and 40.9% identified 4 to 7 diseases. The most commonly identified VPDs were chickenpox (62.7%), measles (54.1%), and polio (47.2%). However, few parents/guardians could identify diphtheria (15.5%), pertussis (9.1%), tetanus (6.9%), pneumococcus (5.8%), and Hib (4.1%) as VPDs, suggesting a need for more education about these diseases. Doctors, nurses, or health care professionals were the most common source of information about their child's health and immunizations (85.9% and 82.6% respectively). Print materials such as brochures and pamphlets were identified as a secondary source of information for both child's health and immunization (Table 7).

Table 7. Parents'/Guardians' Sources of Health Information (n = 362)				
	Child's Health		Immunizations	
Sources of Health/Immunization Information*	Number	Percent	Number	Percent
Doctor, nurse, health care professional	311	85.9	299	82.6
Brochures, pamphlets	60	16.6	53	14.6
Newspaper, magazine, print media	52	14.4	25	6.9
Family	23	6.4	11	3.0
Government, community agencies (WIC/DPSS)	19	5.2	23	6.4
Television	17	4.7	9	2.5
Friends, neighbors	13	3.6	5	1.4
Grocery stores, drugstore, mall	4	1.1	2	0.6
Health promoter/community health worker	2	0.6	2	0.6
Radio	1	0.3	2	0.6
Church/religious leader	1	0.3	0	0.0
Do not know	1	0.3	0	0.0
Other	84	23.2	55	15.2

* Multiple responses allowed.

Overall, parents/guardians had positive attitudes toward immunizations and trusted their child's health care provider. Most parents/guardians (89.8%) felt it was "very important" for their children's immunizations to be up-to-date and many (90.1%) felt that immunization kept their children from getting serious diseases. A strong perception of vulnerability was reflected in that 86.2% of parents/guardians believed children under 2 years old are at high risk for getting a VPD. However, parents/guardians had a slightly less positive attitude toward the efficacy and safety of the vaccines. Although nearly 99% of parents/guardians immunized their child, only 77.1% felt it was "OK for a child to get 3 or 4 immunizations at the same time." Only 64.2% of parent/guardians felt that immunizations prevented children from getting the diseases and 75.3% felt vaccines were safe and unlikely to cause health problems. Despite having positive attitudes, a little over 20% of parents/guardians were uncertain or felt that immunizations were for "disease that are not around anymore" (Table 8).

Table 8. Parents'/Guardians' Attitudes Towards Immunizations		
Variables	**Number**	**Percent**
How important is it for your child to be up-to-date on immunizations? (n=362)		
Not important	5	1.4
Somewhat important	5	1.4
Important	27	7.5
Very important	325	89.8
Immunizations keep children from getting serious diseases (n=362)		
True	326	90.1
False	30	8.3
Do not know	6	1.7
Immunizations do not really work and the child can still get the diseases (n=358)		
True	72	20.1
False	230	64.2
Do not know	56	15.6
Children under 2 years old are especially at risk for some of the diseases that are prevented by immunization (n=362)		
True	312	86.2
False	28	7.7
Do not know	22	6.1
Immunizations are for diseases that are not around anymore (n=362)		
True	54	14.9
False	281	77.6
Do not know	27	7.5
Immunizations are safe and unlikely to cause serious problems (n=361)		
True	272	75.3
False	62	17.2
Do not know	27	7.5
It is OK for a child to get 3 or 4 immunizations at the same time (n=362)		
True	279	77.1
False	59	16.3
Do not know	24	6.6
Immunizations are not safe and can cause other health problems (n=361)		
True	41	11.4
False	291	80.6
Do not know	29	8.0
Parents trust doctor/clinic that immunizes child (n=355)		
Yes	344	96.9
No	11	3.1
Parents feel respected by doctor/clinic that immunizes child (n=359)		
Yes	349	97.2
No	10	2.8

DISCUSSION

The cluster survey allowed us to capture population-based immunization data and to assess previously unknown parental knowledge, attitudes and behaviors related to childhood immunizations among the LAC AA community. Although the study was geographically limited and may not reflect immunization rates among all AA children in LAC, the study identified potential factors influencing immunization rates in LAC's AA community. The immunization coverage levels for the children from the study were better than AA children in the 2001 CA KRS and comparable to AA children and LAC children (age 19–35 months) in

the 2002 NIS. One possible explanation for the "higher" immunization coverage levels among our study population is that the children were probably more likely to have received their immunizations because they were between the ages of 24 and 47 months, which is older than the immunization coverage checkpoints of 19–35 months and of 24 months.

In this study, immunization coverage levels could only be obtained from those parents/guardians who were available to be interviewed in person during the hours of the survey and those who were willing to disclose their child's immunization information. As such, our results may reflect the behaviors of parents/guardians with more positive attitudes toward immunizations. In fact, most parents/guardians perceived immunizations to be important for their children, felt respected and trusted their child's physician, and had the child's yellow card available at the time of interview—a factor associated with better immunization coverage levels. Correspondingly, a large proportion of the children were enrolled in WIC, had some insurance, and had a pediatrician or family doctor as the usual immunization provider, factors also associated with higher immunization coverage levels.

While most AA children from the study had been immunized, had pediatricians as their usual immunization provider, had been enrolled in WIC, and their parents/guardians had positive attitudes, these factors alone do not explain why their immunization rates were lower compared to 2002 NIS data collected for all LAC children 19–35 months old. Based on the results from the survey, mainstream health care providers, such as doctors and nurses, should not be overlooked as a respected source of accurate and up-to-date immunization information in this community. Not only did parents/guardians identify health care providers as the major source of information about their child's health and immunizations, but many also relied on their child's health care providers to inform them of when their child's next immunization was due. While the need for community outreach in the AA community exists, providers play an important role in increasing immunization coverage levels in this community—especially if they are prepared to educate parents about the fundamentals of when different vaccines are due, the serious diseases that vaccines prevent, and their potential side effects. Also, because half of the parents/guardians who missed an appointment reported they did not receive a reminder to reschedule missed appointments, health care providers can help increase immunization coverage levels by implementing effective reminder-recall strategies or a computerized registry to remind parents of when their child's immunizations are due. Establishing the availability of taxi vouchers or bus tokens in provider offices through collaborative efforts with community based organizations that provide transportation assistance could also address the most common barrier mentioned for not keeping a child's immunizations up-to-date—lack of transportation.

Education and outreach efforts should focus on creating positive messages and dispelling myths regarding vaccine safety, adverse reactions, and efficacy. Although most of our parents had positive attitudes toward immunizations, some parents gave less confident responses to questions about the safety of simultaneous administration of multiple vaccines, the efficacy of vaccines over time, and side effects of immunizations. Furthermore, parents/guardians and providers both need to be reassured and reminded that immunizations can be given to a child with a mild illness. The second most common barrier parents/guardians faced in keeping their child's immunizations up-to-date, and a reason why they missed a child's appointment, was that the child was sick. The Advisory Committee on Immunization Practices (ACIP) and the American Academy of Family Physicians (AAFP) both recommend any persons with minor acute illness (e.g., diarrhea or mild upper-respiratory tract infection with or without fever) be immunized to prevent missed opportunities and delays in vaccination.

The population surveyed was relatively well informed and had positive attitudes toward immunizations, but they may not represent the knowledge, attitudes, and practices of all AA parents/guardians in LAC. Parents/guardians who refused to be interviewed or those who did not respond may have had different knowledge, attitudes, and immunization practices. The relative difficulty in convincing parents/guardians to participate in the survey reflects the challenges in reaching the AA community and supports the need for persistent and culturally sensitive outreach programs to overcome inhibitions and distrust. While no single strategy can eliminate immunization disparities among LAC's AA community, some important aspects should include increasing access to immunizations, having providers promote the importance of timely immunizations and dispel common misconceptions, and improving patient follow-up.

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1. CDC. National, State, and Urban Area Vaccination Coverage Levels Among Children Aged 19-35 Months—United States, 2002. Available at: www.cdc.gov/nip/coverage/NIS/02-03/toc-0203.htm
2. CA DHS Immunization Branch, 2001 Kindergarten Retrospective Survey Report.

ACTIVE VARICELLA SURVEILLANCE AND EPIDEMIOLOGIC STUDIES: SUMMARY 2003—ANTELOPE VALLEY, CALIFORNIA

BACKGROUND

Before introduction of the varicella vaccine, approximately 4 million cases of varicella occurred each year in the US, resulting in an annual average of 11,000 hospitalizations and 100 deaths. In 1995, the varicella vaccine was licensed for all susceptible people 12 months of age and older and was added to the Recommended Childhood Immunization Schedule in 1996.

Since varicella is not a nationally notifiable disease, a surveillance system to monitor the impact of the varicella vaccination was needed. Thus in September 1994, the Los Angeles County Department of Health Services entered into a cooperative agreement with the Centers for Disease Control and Prevention (CDC) to establish active surveillance for varicella ("chicken pox") in Antelope Valley, California. The Varicella Active Surveillance Project (VASP) collects baseline information on disease incidence and varicella vaccine coverage by age group. Surveillance for herpes zoster in children <20 years old was added in 2000.

After nine years of data collection, the objectives of VASP in Antelope Valley are: 1) to maintain active surveillance for monitoring varicella disease, 2) to maintain active surveillance for herpes zoster, 3) to continue to monitor varicella vaccine coverage by age group, 4) to measure the impact of varicella vaccine on varicella disease, and 5) to conduct other applied epidemiological research related to varicella disease and varicella vaccine.

METHODS

A verified 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, unilateral, involving at least one dermatome diagnosed by a licensed healthcare provider. Reporting sites that participate in this surveillance project include public and private schools, day care centers with enrollments of 12 or more children, public health clinics, hospitals, private practice physicians and health maintenance organization offices, employers with 500 or more employees, correctional facilities, and miscellaneous others likely to identify and report cases of varicella and zoster. The number of varicella/zoster reporting sites has increased from 284 in 1995 to 313 in 2003—primarily due to population growth. Nearly 100% of identified reporting sites participated in the project.

Reporting sites submit the Varicella/Zoster Surveillance Log to VASP on a biweekly basis. This log includes date of report, case name, age, race/ethnicity, address and telephone number. After obtaining informed consent, a structured telephone interview is conducted with each case or their parent/guardian by a member of VASP. Detailed demographic, clinical, and health impact data are collected, and additional cases or susceptible contacts within the household are identified. Susceptible household contacts to varicella cases are then re-interviewed four to six weeks after the initial contact to identify additional cases. All providers currently administering the varicella vaccine submit the Varivax Immunization Report on a monthly basis.

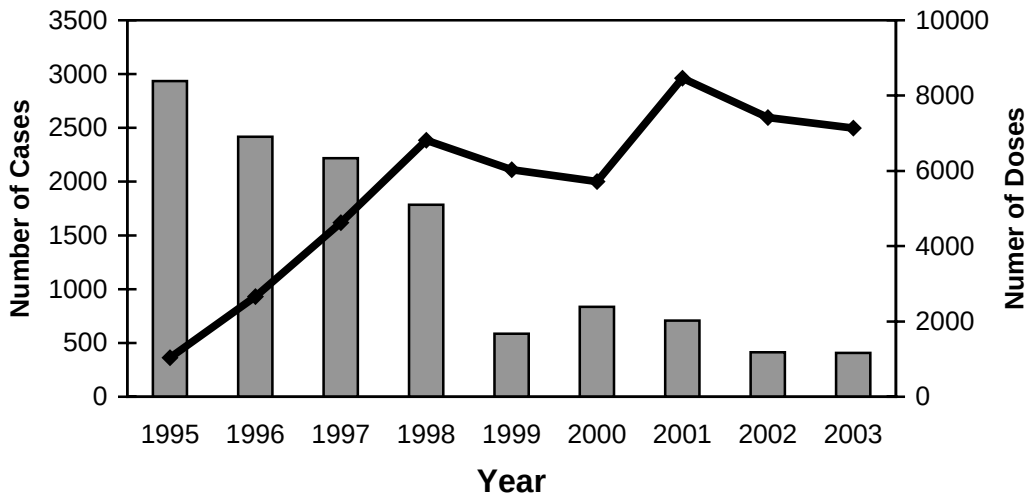
From 1995 to 2002, varicella data was entered into a Turbo Pascal based database designed by project staff; however, beginning in 2003, all data entry for varicella and zoster is entered into MS Access and data analysis is performed with SAS v. 8.2 (SAS Institute, Cary, NC). Trend analysis was utilized to examine of disease incidence with time. Completeness of reporting is estimated using two-source (schools and healthcare providers) capture-recapture methods.

RESULTS/DISCUSSION

Verified varicella cases, those with collection of clinical data, have decreased by 86% over the nine year project period—from 2,934 varicella cases in 1995 to 408 cases in 2003. Among 5–9 year-olds, varicella incidence decreased from 54.9 cases per 1,000 in 1995 to 5.2 per 1,000 in 2003. In 2003, children ages 5–9 years of age had the highest varicella incidence (5.2 per 1,000 population), followed by children 10–14 years of age (3.5 per 1,000) and preschoolers age 1–4 years of age (3.1 per 1,000).

The percentage of breakthrough cases (those occurring >42 days after vaccination) has increased from 1% of verified cases in 1996 to 39.2% in 2003. Cumulative breakthrough cases (1995–2003) as a percent of cumulative vaccine doses administered (1995–2003) ranged from 0.65% (24/3,686) in 1996 to 1.6% (783/49,829) in 2003 (Figure 1).

Figure 1. Antelope Valley VASP Cases and Administered Doses, 1995-2003



Most reported varicella disease continues to be mild. In 2003, 94.1% of cases had mild uncomplicated varicella disease and 5.9% had either a high fever or a bacterial infection treated with antibiotics. None reported lower respiratory tract infections. Of the 408 verified cases in 2003, 17 (4.1%) reported a complication; this compares to 13% in 1995. The most common complication in 2003 was infected lesions (47.0%, 8/17). There were no hospitalizations due to varicella complications in 2003.

Using two-source capture-recapture estimates, varicella completeness of reporting estimation has remained relatively steady over the 9 year study period, ranging from a low of 50.4% in 1995 to a high of 62% in 2002; in 2003 estimated completeness was 55.2% for children 2–18 years of age.

Fifty-five reporting sites provided varicella vaccine; persons one year of age received the majority (57%; 4,050/7,083 doses) of the administered doses in 2003, followed by two year olds (9.7%; 686/7,083 doses). The Antelope Valley birth cohort is approximately 5,000.

Herpes zoster (HZ) analysis was confined to individuals <20 years old. HZ cases decreased 26% from 73 in 2000 to 54 in 2003. Zoster incidence declined among children in all age groups from 2000 to 2003. In the 1–9 year-old age group, there was a statistically significant decline ($p<0.05$) in the incidence of HZ reported between 2000 and 2003 using trend analysis. Considering cumulative cases from 2000 to 2003, more HZ cases reported a history of varicella disease (n=191) than a history of receiving varicella vaccine

(n=25). There were no HZ cases with a history of varicella vaccine in those 10 to 19 years of age, a group with low vaccination coverage. In HZ cases with a history of varicella vaccination, the mean age of HZ was 4.9 years. In contrast among those with previous varicella infection, the mean age of HZ was 11.3 years. When vaccinated and unvaccinated individuals between 1–4 years were compared, the mean time to zoster was similar in those with disease history (2.39 years) and vaccination history (2.04 years). There were no HZ hospitalizations in 2003.

Project Highlights: Project activities include the following publications and presentations.

- Seward JF, Zhang JX, Maupin TJ, Mascola L, Jumaan AO. Contagiousness of varicella in vaccinated cases: A household contact study. JAMA 2004; 292:704-708. Abstract available at: www.jama.ama-assn.org/cgi/content/abstract/292/6/704
- Hall S, Maupin TJ, Seward J, Jumaan AO, Peterson C, Goldman G, Mascola L, Wharton M. Second varicella infections: Are they more common than previously thought? Pediatrics 2002; 109(6):1068–1073. Abstract available at: ww.pediatrics.aappublications.org/cgi/content/abstract/109/6/1068?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&author1=Maupin&fulltext=Varicella&searchid=1106594359715_12947&stored_search=&FIRSTINDEX=0&sortspec=relevance&journalcode=pediatrics
- Seward JF, Watson BM, Peterson CL, Mascola L, Pelosi JW, Zhang JX, Maupin TJ, Goldman GS, Tabony LJ, Brodovicz KG, Jumaan AO, Wharton M. Varicella disease after introduction of varicella vaccine in the United States, 1995–2000. JAMA 2002; 287:606–611. Abstract available at: www.jama.ama-assn.org/cgi/content/abstract/287/5/606
- Population-based study of herpes zoster in children and adolescents post varicella vaccine licensure, 2000–2002. Poster presentation. 41st Annual Meeting of IDSA 2003: San Diego, CA.

Ongoing Research Projects:

1. **Varicella Zoster Virus Susceptibility Among Women in Antenatal Clinic Population**: This study will describe susceptibility to varicella and identify geographical and racial/ethnic differences among pregnant females. There are 436 participants from the Antelope Valley enrolled in the study thus far.
2. **Laboratory Confirmation of Varicella Disease**: With declining varicella disease incidence and increasing proportion of breakthrough cases, the validity of clinical diagnosis has been raised. Free lesion (PCR) and serological (IGG & IGM) testing to confirm diagnosis is offered to Antelope Valley Healthcare Providers. Approximately 70 specimens have been collected thus far.
3. **Analysis of Antelope Valley Varicella Outbreaks, 1995–2003**: The number of outbreaks, the number of children affected per outbreak and the duration of the outbreaks declined steadily since introduction of the varicella vaccination program. No outbreaks occurred in daycare centers in 2002 or 2003 where vaccination coverage is expected to be the highest.
4. **Varicella Breakthrough Analysis 1995 to 2003**: Using Antelope Valley and West Philadelphia VASP data, the clinical picture of breakthrough disease is in the process of analysis.
5. **Varicella Hospitalizations, 1995–2002**: Using Antelope Valley, Texas and West Philadelphia VASP data, hospitalized varicella cases are being reviewed in depth to derive a clinical description and assess severity.
6. **Chickenpox or Smallpox—The Use of the Febrile Prodrome as a Distinguishing Characteristic**: Antelope Valley and West Philadelphia VASP data is being used to describe the prodrome characteristics of varicella cases.
7. **Determining Risk of a Second Varicella Infection, A Case Comparison Study, Antelope Valley VASP 1995–2003**: Current national varicella immunization policy assumes that a single natural infection with varicella-zoster virus or vaccine confers lifelong immunity. Antelope Valley is comparing second infections reported within the VASP database from 1995 to 2003 to a comparison group matched by gender and month of onset.

It is anticipated that information from this project will continue to impact varicella surveillance and control strategies nationwide.

WEST NILE VIRUS WITHIN LOS ANGELES COUNTY: FIRST AUTOCHTHONOUS HUMAN WEST NILE VIRUS INFECTION IN 2003

Since the introduction of West Nile virus (WNV) in the continental US in summer of 1999, WNV has become established in nearly all of the contiguous states causing nearly 10,000 cases and 262 deaths in 2003.

In 2002, the first locally acquired human case of WNV in California was identified in Los Angeles County (LAC). However, other forms of local WNV surveillance including dead birds, sentinel chickens, and mosquito pools did not reveal evidence of WNV. In 2003, one case of WNV fever acquired within LAC was documented and laboratory-confirmed.

The first case of locally acquired WNV fever in a LAC resident was laboratory-confirmed in late December 2003 by the California Department of Health Services Viral and Rickettsial Diseases Laboratory (VRDL). ACDC was notified by ARUP Laboratory of Utah of a positive WNV serum IgM test in late October 2003 in a LAC resident. The patient and his physician were contacted and interviewed by ACDC, and the patient provided another serum specimen in early December 2003 so that confirmatory testing could be completed at the LAC Public Health Laboratory.

The case, a 61 year-old Hispanic male, was admitted to an LAC hospital for complaints of fever, fatigue, nausea and diarrhea for 10 days in mid-October 2003. Serum WNV testing was ordered by the attending physician as part of a fever work-up during his hospital admission. The patient recovered uneventfully. He lived in Whittier and gave a history of mosquito bites two days prior to admission while sleeping in his living room with a broken screen door. He believes he was bitten in the early morning of the first week of October. He denied any travel outside of Whittier area 14 days before onset of symptoms. He received no blood products or organ donations within the month prior to symptom onset. In early December, the patient's serum tested weakly positive by CDC WNV ELISA testing in both the LAC Public Health Laboratory and the state VRDL. WNV confirmatory testing, plaque reduction neutralization test, performed at the VRDL confirmed the diagnosis of WNV fever in late December 2003.

Related environmental findings in the fall of 2003 include: 11 dead crows with WNV recovered in Whittier and 6 WNV-infected mosquito pools in two adjoining cities in late September to November 2003. In 2003, there were no sentinel chickens with WNV-positive blood tests from LAC. This is the third endemic case of WNV infection acquired in the state of California in 2003 with the first two human cases being reported from Imperial and San Bernardino counties respectively.