



## ACTIVE VARICELLA SURVEILLANCE AND EPIDEMIOLOGIC STUDIES JANUARY 1 - DECEMBER 31, 1995

### BACKGROUND

Before approval of varicella vaccine in the United States, varicella-zoster virus infection resulted in an estimated four million cases of chickenpox, 364,000 physician office visits, 9,000 hospitalizations, and 90 deaths each year. The combined direct and indirect annual cost of varicella has been estimated at over \$400 million.

A live, attenuated varicella vaccine was licensed in the United States in March 1995. Some authorities expressed concern that the vaccine might result in a shift in incidence to older age groups where the risk of complications is known to be greater. Accurate surveillance of varicella as vaccine utilization increased was considered essential in order to monitor the effects of the vaccine.

In September 1994, the Los Angeles County Department of Health Services was funded by the Centers for Disease Control and Prevention (CDC) for Active Varicella Surveillance and Epidemiologic Studies, also referred to as the Varicella Surveillance Project (VSP). The objectives were:

1. To establish a reporting system to accurately define the baseline incidence and epidemiological profile of varicella disease prior to licensure and wide use of varicella vaccine;
2. to measure school and work days lost as indicators of the personal and economic costs of varicella disease;
3. to maintain the reporting system to obtain demographic and epidemiological data after vaccine licensure in order to identify changes occurring in the epidemiology of varicella as a result of vaccine usage.

### METHODS

**Study Population:** The study population consisted of the approximately 290,000 residents of the Antelope Valley Health Cluster. The Antelope Valley is located in northern Los Angeles County, covers nearly 2,000 square miles, and contains 35 communities.

**Data Collection:** Potential surveillance units included all (1) public and private elementary, middle and high schools with an enrollment of 12 or more; (2) licensed day-care centers/preschools with an enrollment of 12 or more; (3) hospitals; (4) public and private health clinics; (5) family medicine, pediatric, and internal medicine physicians; (6) health maintenance organizations; (7) correctional facilities; and (8) employers with more than 500 employees. Of 293 potential surveillance units identified, 289 agreed to participate. At two-week intervals, surveillance units completed and submitted a Varicella Case Log by fax, telephone, or mail. Telephone interviews were conducted with case-patients or adult caretakers of case-patients less than 18 years old to obtain demographic, clinical and other



epidemiologic variables. Frequently, telephone case interviews resulted in the identification of additional household cases that had not been reported by other surveillance units. Chart reviews were conducted and interview data confirmed for hospitalized cases only. For each case, the severity of varicella rash was graded as mild, moderate, or severe according to the estimated number of lesions, and an overall severity of disease index (SDI) was assigned, ranging from 1 for mild disease to 5 for severe life-threatening illness (detailed description of severity of disease indices available upon request).

## RESULTS

Between January 1 and December 31, 1995, 3,306 persons with varicella were reported by surveillance units; 106 (3%) were excluded as not meeting the case definition. Of the remaining 3,200 presumptive cases, 3,109 were verified by telephone interview and collection of clinical data completed; 181 (5%) declined or were unable to be located and were considered probable cases.

**Demographics:** The peak incidence occurred among 5- to 9-year-olds, followed in decreasing order by 1- to 4-year-olds, infants less than one year of age, adolescents, and adults (Table 1). Incidence did not differ by race/ethnicity. Males and females were affected equally for all age groups except for cases 20 years and older, where the male-to-female rate ratio was 1:1.5. A distinct seasonal trend was noted with nearly 80% of cases occurring during January through June.

**Disease Severity:** Varicella rash lesion severity was graded as Amild@ for 35%, Amoderate@ for 46%, and Asevere@ for 19% of cases. Infants less than one year old and adolescents and adults fifteen years of age and older were significantly more likely to have a Asevere@ grading of lesions than were case-patients in other age groups ( $\kappa^2 = 31.5$ ,  $p < 0.001$ ). Most cases of varicella were relatively mild overall, as estimated by an SDI of 1 for 86% of cases; fewer than 1% of all cases were assigned an SDI of 3 or higher and there were no cases with an SDI of 5.

Temperature during varicella correlated with age and lesion severity. Infants less than one year of age and adults 20 years of age and older were more likely than cases in other age groups to have maximum recorded temperatures equal to or greater than  $38.5^{\circ}\text{C}$  ( $\kappa^2 = 6.9$ ,  $p < 0.01$ ). Forty-five percent of case-patients whose maximum recorded temperature exceeded  $38.5^{\circ}\text{C}$  had a grading of lesions of Asevere@ compared with 19% of case-patients with maximum temperatures less than  $38.5^{\circ}\text{C}$  ( $\kappa^2 = 99$ ,  $p < 0.001$ ).

The household was cited as the most likely source of exposure for 41% of cases and school for 34%. There were 983 households with one or more secondary cases of varicella. These households involved 2,300 cases, with an average of 2.3 cases per household. Skin involvement tended to be more extensive in secondary household cases; 28% of secondary household cases had a lesion grading of Asevere@ compared with 11% of index cases ( $\kappa^2 = 80$ ,  $p < 0.001$ ).



***Varicella-Associated Complications or Conditions:*** Three hundred forty-two (13%) case-patients were treated for a variety of varicella-associated conditions. One hundred sixty-five (6.3%) received antibiotics for otitis media, 68 (2.6%) for pharyngitis, and 60 (2.3%) for skin or soft tissue bacterial infections. Fourteen non-hospitalized case-patients reported having been diagnosed with pneumonia and one with encephalitis. Other less commonly diagnosed conditions included exacerbation of pre-existing respiratory disease, severe vomiting, urinary tract infection, and hallucinations.

Six case-patients required hospitalization: two for dehydration, one for thrombocytopenia, two immunocompromised case-patients for parenteral antiviral therapy, and one pregnant patient was admitted in labor. None experienced long-term sequelae.

***Medications During Varicella:*** Twelve percent of case-patients received antibiotics during varicella and 4.7% received acyclovir. Acyclovir use was more common in adults over 20 years of age, while antibiotic use was independent of age.

***School or Work Days Lost by Cases and Caretakers:*** Cases missed 12,141 days of school and 774 days of work, and caretakers missed 205 days of school and 2,229 days of work for a combined total of 15,349 days of school or work lost as a result of varicella.

***Vaccinated Cases:*** Thirteen (0.4%) cases occurred in patients who reported having received varicella vaccine. Of these, eight had onset within 21 days of vaccination and may have been incubating wild varicella-zoster virus infection at the time of vaccination. Of the remaining five cases with onset more than one incubation period after vaccination, one had "severe" grading of lesions, two moderate, and two mild.

## DISCUSSION

While it is difficult to draw conclusions from one year of surveillance data for a disease whose incidence may fluctuate from year to year, many of our results validate findings from previous studies. The peak incidence of 1995 VSP cases occurred among 5- to 9-year-olds and 95% of cases occurred in persons under the age of 20. The age distribution closely approximated the age distribution of expected cases in the study population, based on the National Health Interview Survey (NHIS) age-specific incidence rates for varicella. Other consistent findings include a seasonal increase in incidence in late winter/early spring, increased disease severity in infants and adults, correlation between severity of varicella rash and presence of fever, and absence of differences based on gender or race/ethnicity.

We also found that 13% of cases experienced varicella-associated complications, and 12% of cases received antibiotics. The risk of hospitalization in the study population was 1 in 503 cases, and a substantial number (15,349) of days of school and work were lost by cases and caretakers as a result of varicella.

Population-based active surveillance for varicella, similar to LAC=s VSP, is labor-intensive and probably only feasible in sentinel sites on a national scale. Lessons learned from VSP



will be valuable when designing future varicella surveillance systems. For example, since more than 80% of VSP cases were reported from schools, preschools, or household interviews and only 17% of cases were identified by health care providers, surveillance systems focusing on health care providers will likely result in underreporting. Incorporation of varicella vaccine in the infant immunization schedule will likely result in dramatic decreases in varicella incidence in the relatively near future. Surveillance for varicella must be able to accommodate changes in varicella incidence in order to assess long-range effects of the vaccine on varicella epidemiology.

**Table 1. Varicella Cases and Rates by Age, Antelope Valley Varicella Surveillance Project (VSP), 1995, and NHIS, 1980-1990**

Age (Years)	No. of Cases	%	VSP Rate per 1,000	NHIS Rate per 1,000
<1	129	(4)	20.0	25.0
1-4	1,145	(38)	44.2	82.8
5-9	1,284	(43)	48.0	91.1
10-14	238	(8)	10.5	25.4
15-19	69	(2)	3.9	6.7
≥20	154	(5)	1.0	2.3
Total	3,019	(100.0)	11.0	16.0