

---

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

---

**VARICELLA ACTIVE SURVEILLANCE PROJECT 2000**

**BACKGROUND**

The Varicella Active Surveillance and Epidemiologic Studies in Antelope Valley was funded by the Centers for Diseases Control and Prevention(CDC) in September 1994 to (1) develop a reporting system to accurately define the baseline incidence and epidemiological profile of varicella disease prior to licensure and widespread use of varicella vaccine, (2) identify changes in the epidemiology of varicella as a result of vaccine usage, (3) ascertain the immunization status of cases, and (4) evaluate the demographic and clinical profiles of vaccinated and unvaccinated cases of varicella.

The Antelope Valley is located in the northeastern part of Los Angeles County (LAC) and consists of approximately 35 communities, covering nearly 2,000 square miles. Sixty-three percent of Antelope Valley's population of approximately 300,000 reside in its two largest cities, Lancaster and Palmdale. The racial/ethnic composition of the population in 2000 was estimated to be 63% White, 24.3% Hispanic, 6.4% Black and 5.2% Asian/other. In 1998, there were approximately 5,000 live births in Antelope Valley. The area's relative isolation from other large urban centers encourages the use of local medical providers and facilities. Both the geographical location and relatively young age distribution of Antelope Valley residents has made it an ideal study site.

**METHODS**

The population-based varicella active surveillance project (VASP) collects reports of varicella from 305 surveillance units, which represent nearly all potential surveillance units identified; these include all public and private schools and day care centers with enrollments of 12 or more children; public health clinics, hospitals, private practice physicians, and health maintenance organization (HMO) offices; employers with 500 or more employees; correctional facilities; and miscellaneous others likely to identify and report cases of varicella. A case of varicella is defined as illness with an acute onset of a diffuse papulovesicular rash without other known cause. Case reports and data regarding vaccine administration are collected every two weeks. A structured telephone interview is conducted with each case or parent/guardian to collect detailed demographic, clinical, and health impact data and to determine if there are additional cases or susceptible contacts within the household. Susceptible household contacts are re-interviewed four to six weeks after the initial contact to identify additional cases. Only cases that are confirmed by case interview are counted as verified. Those that are unreachable by telephone or decline the interview are considered probable cases. Data collection began January 1, 1995.

In September 1995, the project began to monitor vaccine use in the study population. A varicella immunization report is submitted monthly by all 59 providers currently offering the vaccine. Herpes zoster was included in active surveillance beginning January 1, 2000. Case interviews are only conducted on reported cases of herpes zoster aged 19 and younger.

---

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

---

**REPORTING SOURCES**

A total of 281 reporting sites representing 305 surveillance units are currently participating (Table 1). Varicella cases also are identified through household interviews and occasionally from sources not specifically under active surveillance. Fluctuation in the number of surveillance units by type are primarily related to schools, day care centers and medical facilities opening, consolidating, or closing. No sites have refused further participation in the project. With prompting, reporting site compliance in submitting case logs every two weeks to the VASP office is 100%.

**Table 1. Participating Surveillance Units, Antelope Valley, VASP, 1995, 1999, and 2000**

Surveillance Unit by Type	Number and Distribution of Surveillance Units Participating		
	1995 N (%)	1999 N (%)	2000 N (%)
Elementary and High Schools	93 (32.7)	101 (32.7)	102 (33.9)
Preschool/Day Cares	49 (17.2)*	76 (24.6)	76 (24.9)
Private Practice MDs	89 (31.3)	81 (26.2)	73 (23.9)
HMO Offices	7 (2.5)	19 (6.1)	20 (6.6)
Hospitals	4 (1.4)	3 (1.0)	3 (1.0)
Public Health Clinics	12 (4.2)	11 (3.6)	13 (4.3)
Correctional Facilities	3 (1.0)	3 (1.0)	3 (1.0)
Large Employers	11 (3.9)	10 (3.2)	10 (3.3)
Miscellaneous	14 (4.9)	3 (1.0)	3 (1.0)
Households	1 (0.4)	1 (0.3)	1 (0.3)
Outside Normal Sampling	1 (0.4)	1 (0.3)	1 (0.3)
<b>TOTAL</b>	<b>284 (100)</b>	<b>309 (100)</b>	<b>305 (100)</b>

**VARICELLA SURVEILLANCE DATA**

Between January 1 and December 31, 2000, surveillance units reported 1,008 persons with varicella; 82 (8.1%) were excluded when case interviews revealed that illness or school absence

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

was not due to varicella, 837 (83.0%) were verified by telephone interview and collection of clinical data was completed, 89 (8.8%) were unreachable by telephone or declined to be interviewed and were considered probable cases, and none are pending collection of clinical data. In this report, analysis is limited to verified cases unless otherwise specified.

In 1995, unvaccinated first varicella cases comprised 95% of total verified varicella cases; however, in 2000 they now comprise 74% of cases. This decrease was largely influenced by breakthrough cases (varicella infection >42 days after vaccination) (Table 2).

**Table 2. Verified Varicella Case Type, Antelope Valley, VASP, 1995, 1999 and 2000**

Verified Varicella Case Type	1995 N=2,934 n (%)	1999 N =587 n (%)	2000 N=837 n (%)
Possible Breakthrough Cases (Onset >42 days after vaccination)	4 (0.1)	52 (8.9)	141 (16.8)
Reported Second Infections (Reinfections)	132 (4.5)	78 (13.3)	81 <sup>1</sup> (9.0)
First Infections, Unvaccinated ("Classic" Disease)	2,798 (95.4)	457 (77.8)	620 (74.0)

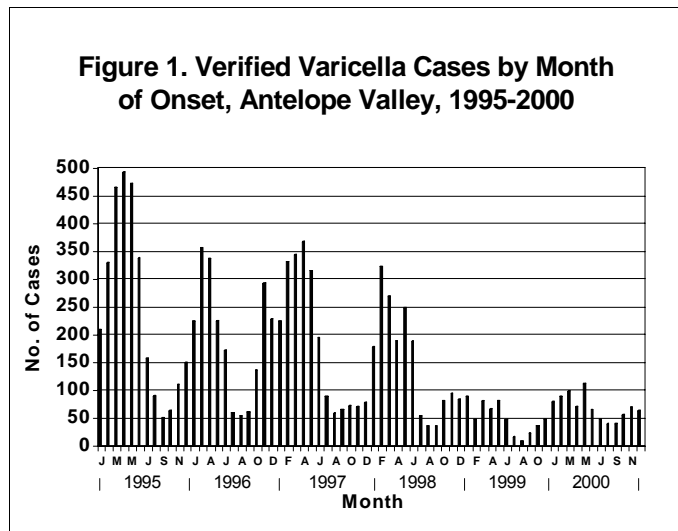
<sup>1</sup>Of the 81 cases, 5 cases experienced both a breakthrough and reported a previous history of varicella.

**Trends**

The number of verified varicella cases declined 80% between 1995 and 1999 (2,934 and 587 cases in 1995 and 1999, respectively), but increased 43% to 837 cases in 2000. A blunting of characteristic seasonality was noted in 1999 and, to a lesser extent, again in 2000 (Figure 1).

**Age**

Rates decreased in all age groups over the study period but the decline was most pronounced among children aged one to four years. In 2000, rates were highest among children aged five to nine years (20.5 per 1,000 population), followed by children aged one to four years (7.5 cases per 1,000), and children aged less than one year (4.8



**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

per 1,000) (Figure 2). The increase in 2000 compared to the previous year was largely explained by increases among children aged five to nine years (50% increase) and one to four years (50%).

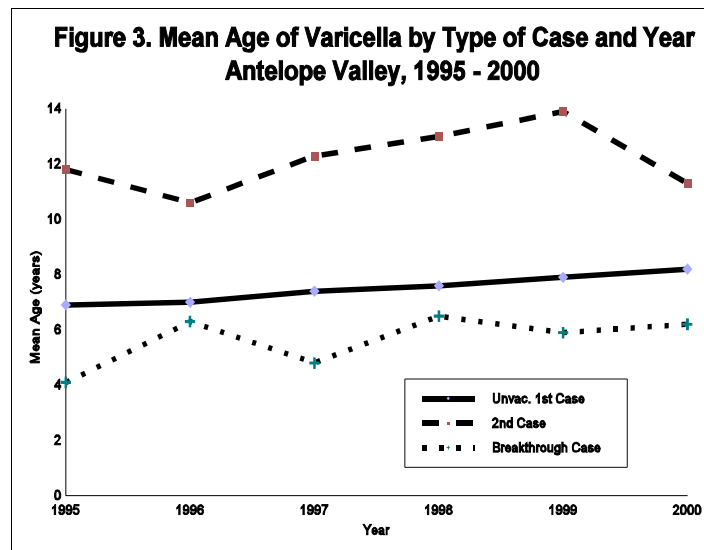
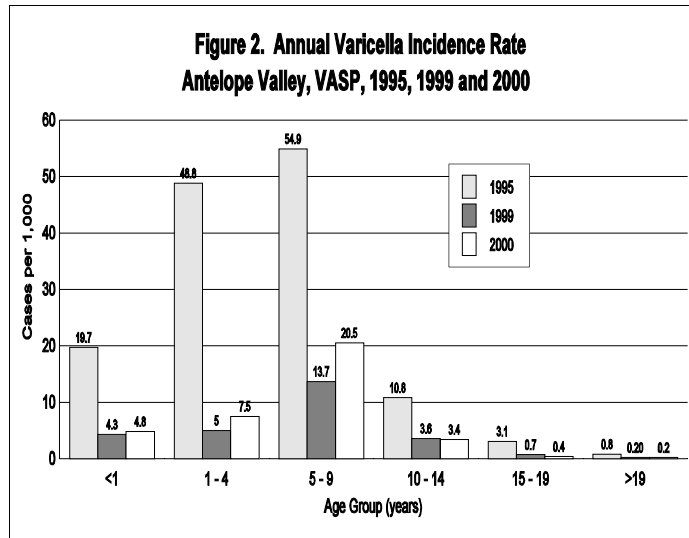
The overall mean age of verified cases was 7.1 years in 1995, 8.5 years in 1999 and 8.1 years in 2000. Limiting the analysis to unvaccinated first cases (excluding the breakthrough and reinfections), the mean age was 6.9 years in 1995 and 8.2 years in 2000 (Figure 3). The mean age of breakthrough cases and second infections in 2000 was 6.2 years and 11.3 years, respectively.

**Gender**

In 1995, there was considerable variation in the female:male case ratio by age group, with females aged 20 years and older outnumbering males of the same age group 1.6:1; in 2000, the female-to-male case ratio approximated 1:1 in all age groups.

**Race/Ethnicity**

As in previous years, age-adjusted incidence rates of varicella among Blacks were higher than among non-Hispanic Whites (Figure 4). In 2000, Black children aged five to nine years experienced the highest rates of any racial/ethnic group (26.7 cases per 1,000 population). This rate is higher than the 19.8 cases per 1,000 reported in 1999 (data not shown). Higher than anticipated rates of varicella among Blacks may be the result of underestimation of the number of Black residents in the Antelope Valley; data from the California Basic Educational Data System (CBEDS) suggest that the number of school-aged Black children in the Antelope Valley is substantially higher than the Antelope Valley



**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

population estimates compiled by County of Los Angeles Internal Services Urban Research Division.

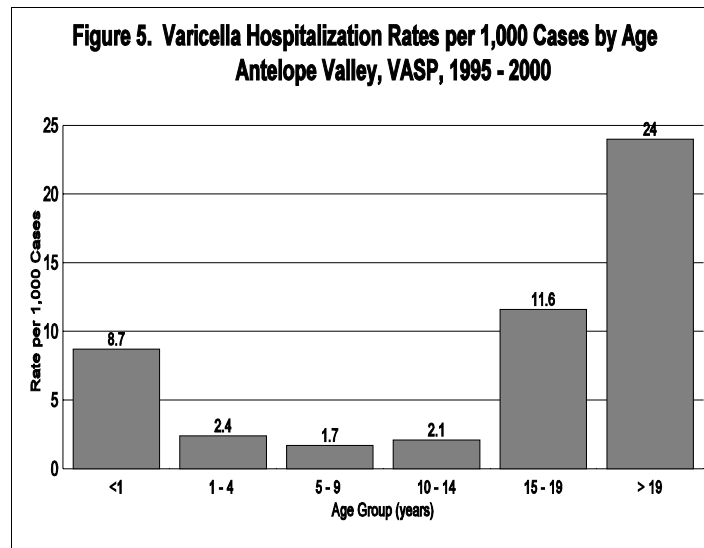
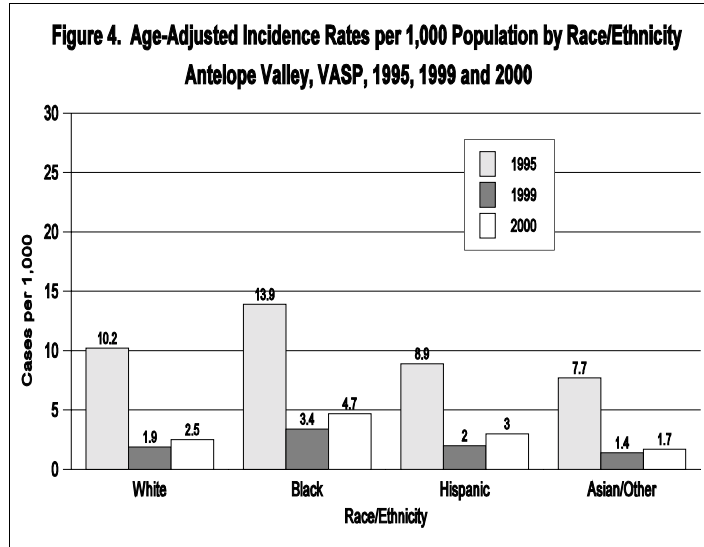
**Lesion Severity**

Beginning January 1, 1997, along with the two other project sites, we modified the definition of lesion grading from “mild” (<50), “moderate” (50-250) and “severe” (>250) to “less-than-average” (<50), “average” (50-500) and “more-than-average” (>500). The definition of <50 lesions for “mild” cases in 1995 and 1996 changed only in name to “less-than-average” in 1997. Thus, the mildest lesion grading definition remained consistent from 1995 to 2000.

The proportion of case patients with a “more-than-average” lesion grading decreased from 9.2% in 1997 to 6.2% in 2000 ( $\chi^2 = 6.85, p < 0.01$ ). In 1999 and 2000, the proportion of cases with “more-than-average” lesion grading was highest among 15- to 19-year-olds. Across all age groups, there was a trend towards milder lesion grading over the six-year study period. As in previous years, lesion severity in breakthrough cases in 2000 was significantly milder than in cases that were unvaccinated experiencing their first varicella infection ( $\chi^2 = 75.86, p < 0.005$ ): 78% of breakthrough cases reported “fewer-than-average” lesions, compared with 37.6% of unvaccinated first varicella cases.

**Severity of Disease Index**

In 2000, 92.4% of cases reported a Severity of Disease Index (SDI) of 1, indicating mild uncomplicated disease, compared with 84.1% in 1995 ( $\chi^2 = 38.7, p < 0.005$ ). Only 2 (0.2%) cases reported an SDI > than 2. In 2000, adults were more likely than other age groups to have complications (SDI 2), although this finding may be biased due to small numbers (Figure 6). Severity of Disease Index for breakthrough cases in 2000 did not differ significantly from unvaccinated first varicella cases. Beginning in January



---

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

---

2000, case-patients/parents were asked to subjectively assess their illness. Forty percent were described as “not appearing sick,” 45% were “moderately sick,” and 14% were “severely sick.” Adults were significantly more likely to be assessed as “severely sick” ( $\chi^2=35.9$ ,  $p<0.005$ ).

### **Complications**

We defined a complication as a self-reported condition or event for which the case-patient was evaluated and treated by a health care provider and which occurred within two weeks of the onset of varicella disease. Self-reports of complications were confirmed for hospitalized cases only. Of the 837 verified cases in 2000, 50 (6%) cases reported 59 complications. Fewer cases reported complications in 2000 than in any previous year (compared with 13% in 1995, 8% in 1996, 10% in 1997, 11% in 1998, and 10% in 1999).

There were only two varicella-related hospitalizations in 2000. One patient was a vaccinated four-year-old White male with onset of varicella on January 28, 2000, who was hospitalized for two days beginning January 30 with acute bronchospasm and associated dyspnea/hypoxia. The second was a five-year-old Hispanic male with onset of varicella on January 3, 2000, who was hospitalized on January 13 status post cardiopulmonary arrest due to an asthmatic attack. This child suffered permanent brain damage as a result of this episode. The rate of hospitalization due to varicella was lower (0.6/100,000 population) in year 2000 than in any previous year. Considering combined years 1995-2000, adults aged 19 years and older had the highest rate of hospitalizations (24 per 1,000 varicella cases), while children aged 5 to 9 years had the lowest rate (1.7 per 1,000 cases) (Figure 5).

### **Medications Received During Varicella**

Cases receiving antiviral medication increased from 4.7% of reported cases in 1995 to 8.6% in 2000 ( $\chi^2=18.8$ ,  $p<0.005$ ), ibuprofen use increased from 3.8% of cases in 1995 to 13.1% in 2000 ( $\chi^2=49.9$ ,  $p<0.005$ ), while antibiotic use decreased from 12% of cases in 1995 to 6.2% in 2000 ( $\chi^2=23.2$ ,  $p<0.005$ ).

### **Varicella Outbreaks**

An outbreak was defined as 5 or more cases reported from the same school or daycare within a 21-day period, continuing until such time as a 21-day period occurred without a reported case. While the number of outbreaks decreased 67% from 58 in 1995 to 19 in 2000, the number of outbreaks increased 2.7 fold from 7 in 1999 to 19 in 2000 (Table 3). Of the 62 cases comprising the 7 outbreaks in 1999, 3 (4.8%) cases were among vaccinated and 59 (95.2%) were among unvaccinated individuals. Of the 226 cases that comprised the 19 outbreaks in 2000, 47 (20.8%) cases were among vaccinated and 179 (79.2%) were among unvaccinated individuals.

---

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

---

**Table 3. Varicella Outbreaks, Antelope Valley, 1995, 1999, and 2000**

<b>Varicella Outbreaks</b>	<b>1995*</b>	<b>1999</b>	<b>2000</b>
Total No. of outbreaks	81	20	34
Total No. of cases in outbreaks	1,332	174	356
Average No. of cases/outbreaks	16.4	8.7	10.5

\*1995 data exclude cases ascertained from other reporting sites and thus represent an underestimate

### **Breakthrough Disease**

We defined breakthrough disease as a reported case of varicella that occurred in a person who had received varicella vaccine more than 42 days before rash onset. Varicella vaccination was confirmed in one of two ways: (1) interviewees checked the vaccine immunization record at the time of the telephone case interview, or (2) medical office staff (who reportedly administered the vaccine) checked the medical record. Of 837 verified cases of varicella in 2000, 164 (19.6%) cases occurred in persons who reported having received varicella vaccine. Of these, 141 (86%) developed varicella 42 or more days after vaccination and were considered possible breakthrough cases. Breakthrough cases as a proportion of total cases increased each year in all age groups. In 2000, 25.4% of cases in children aged 1 to 4 years, 18% of cases in children aged 5 to 9 years and 9.5% of cases in children aged 10 to 14 years were classified as breakthrough cases.

In 2000, most of the breakthrough cases had fewer than 50 lesions (78%) and the vast majority (94%) had no complications (severity of disease index 1). More than 76% of the breakthrough cases had a known source of exposure to varicella and nearly half (47.5%) were diagnosed by a healthcare provider (Table 4). The average interval between the date of vaccination and onset of breakthrough varicella in the 351 cumulative breakthrough cases (1995-2000) was 1.9 years. This interval increased from 2.1 years for the 52 cases in 1999 to 2.7 years for the 141 cases in 2000.

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

**Table 4. Breakthrough Varicella Cases (Occurring >42 days After Receipt of Varicella Vaccine), Antelope Valley, 1996, 1999 and 2000**

Age, Confirmation of Vaccination, Lesion Grading, Disease Severity, Illness Order, Source of Varicella Exposure and Source of Varicella Diagnosis	1996 N=24 n (% of cases)	1999 N=51 n (% of cases)	2000 N=141 n (% of cases)
Age: 1-4 Years	12 (1.6)	20 (16.0)	49 (25.4)
5-9 Years	10 (0.8)	27 (9.0)	82 (18.0)
10-14 Years	1 (0.5)	4 (4.6)	8 (9.5)
15 - 19 Years	0	0	0
> 20 Years	1 (0.8)	0	2 (4.0)
Confirmed Receipt by: Vaccine Record	N/A	10 (19.6)	42 (29.8)
Healthcare Provider	N/A	31 (60.8)	71 (50.4)
Recall only	24 (100)	8 (15.7)	14 (9.8)
Lesion Grading: <Average	17 (70.8)	39 (76.5)	110 (78.0)
Average	7 (29.2)	11 (22.6)	29 (20.6)
>Average	0	1 (2.0)	2 (1.4)
Disease Severity: Index 1	20 (83.3)	48 (94.1)	132 (93.6)
Index 2	4 (16.7)	3 (5.9)	8 (5.7)
Index 4	0	0	1 (0.7)
Illness Order: Primary or Co-Primary		45 (88.2)	129 (91.5)
Secondary		6 (11.8)	12 (8.5)
Sources of Varicella Diagnosis: Healthcare Prov.	8 (33.3)	26 (51.0)	67 (47.5)
Parent/Self	16 (66.7)	25 (49.0)	74 (52.5)
Other	0	0	0
Source of Varicella Exposure: Known Source <sup>1</sup>	21 (87.5)	28 (54.9)	108 (76.6)
Unknown	3 (12.5)	23 (45.0)	33 (23.4)
Receipt of other Vaccines on the Same Day as Varicella	2 (8.3)	22 (43.1)	Not ascertained



---

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

---

### Days of School and Work Missed Due to Varicella

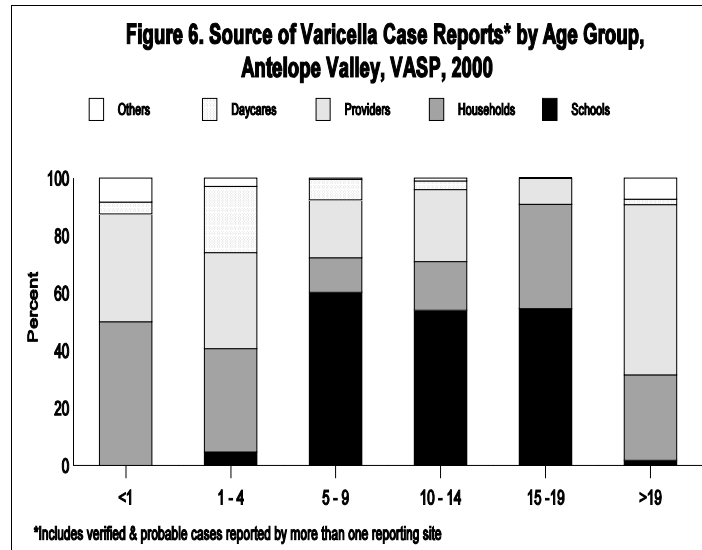
The total number of days of school or work days missed by cases and caretakers decreased 80% from 14,842 days in 1995 to 2,906 days in 1999, then increased 55% to 4,486 days in 2000. The mean and median number of days of school or work missed by cases and caretakers have remained relatively constant from 1995 to 2000 (data not shown).

### Suspected Source of Varicella Infection

Schools were the suspected source of infection for 32.7% of the cases, followed by households for 29.4%. The number of cases reported with “unknown” source of infection decreased from a high of 28.6% in 1999 to 22.6% in 2000. In both 1999 and 2000, adults reported the highest percentage of “unknown” exposure source.

### Source of Report

In 2000, as in previous years, more cases were reported from schools than from any other surveillance unit type (40.5% of all cases were reported by schools). For the first time, in 2000, healthcare providers reported more cases (26.1%) than were ascertained from households of cases being interviewed (20.7%). In 2000, adults were reported by healthcare providers (50.8%) than through household interviews (25.4%). Infants and children aged less than four years were reported primarily by households, and school-aged children (aged five to nineteen years) were reported primarily by schools (Figure 6).



### Source of Diagnosis

Over the study period, an increasing proportion of cases was diagnosed by healthcare providers (16.3% in 1995 compared with 41.9% in 2000). In 2000, the proportions of second varicella cases and breakthrough cases diagnosed by a healthcare provider were 56.6%, 47.5%, and 38.9%, respectively.

---

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

---

## Second Varicella Infections

In 2000, 81 (9.7%) cases reported a history of previous varicella; the mean age at first infection was 3.3 years and at second infection was 10.1 years. Since second cases of varicella have been sporadically reported, the VASP surveillance project provided the opportunity to look more closely at reported occurrence of varicella reinfections. We collaborated with CDC to describe the epidemiology and clinical characteristics of varicella reinfections reported to the surveillance project. From January 1995 through December 1999, 740 (7.3%) cases reported a prior varicella infection. Of 135 cases of varicella with onset between January through September 1998 with history of disease, 98 were reinterviewed. Reinfection cases were younger at 1<sup>st</sup> infection (3 years) and older at 2<sup>nd</sup> (8 years) than those with only one infection (6 years). Second infections increased from 4.5% of reported cases in 1995 to 13.3% in 1999. There were no gender or race/ethnicity differences and all cases with multiple infections occurred in healthy persons and tended to cluster in families. Eleven percent experienced complications for which they consulted a healthcare provider. Although the data from this study must be interpreted with caution since we had no laboratory confirmation of either first or second infections, we concluded that (1) reinfections are more common than previously thought; (2) second infections tended to occur in persons whose first infection was exceptionally mild and occurred at a young age; and (3) first infections did not act like vaccine, as most reinfections were average or severe cases of disease.

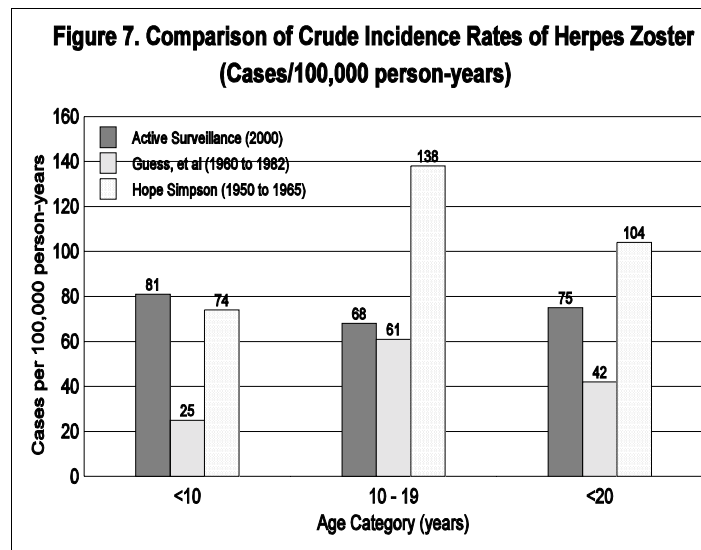
## HERPES ZOSTER SURVEILLANCE

Between January 1 and December 31, 2000, surveillance units reported 320 persons with herpes zoster; nine were duplicates and one was incorrectly reported. The number of reported cases ranged from 16 to 36 cases per month.

There was no apparent seasonality. The majority of the cases were diagnosed by a healthcare provider, but no confirmatory testing was obtained. Additional clinical and demographic variables were collected from cases aged less than 20 years during a telephone interview using a structured questionnaire.

### Age

Of 309 herpes zoster cases, 77 (25%) cases occurred in persons aged less than twenty years, and 788 (25%) cases occurred in adults aged 70 years and older. Four (1.3%) cases occurred



---

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

---

among vaccinated children aged less than five years. The crude incidence rate (without adjusting for prior history of varicella) was 81 cases per 100,000 population for children aged less than 10 years, 68 cases per 100,000 population for children aged 10 to 19 years, and 75 cases per 100,000 population for adults aged 20 years and older. A comparison of these rates and others published in the literature are shown in (Figure 7).

Comparison of herpes zoster rates, especially among children, in different studies and populations are not very meaningful because of differences in study methodology as well as differences in the proportion of children with prior varicella and no vaccination experience. Ascertainment and classification bias also must be addressed before meaningful comparisons can be made.

### **Race/Ethnicity**

The racial/ethnic distribution of the 309 HZ cases is as follows: 186 (60.2%) White, 44 (14.2%) Hispanic, 15 (4.9%) Black, 6 (1.9%) Asian/Other, and 58 (18.7%) unspecified or unknown. The 77 HZ cases in individuals aged <20 years, for which data are most complete, had a racial/ethnic distribution as follows: 50 (88 cases per 100,000 population) White, 17 (56 cases per 100,000 population) Hispanic, 3 (39 cases per 100,000 population) Black, 3 (73 cases per 100,000) Asian/Other, and 4 (5.1%) unspecified or unknown.

### **HZ in Children and Adolescents Aged Less Than 20 Years**

Of the 75 cases of HZ in unvaccinated individuals aged less than 20 years, 68 (93%) were available for the interview. Of these, 67 (99%) were diagnosed by a physician and 1 (1%) was diagnosed by a school nurse. The mean age of these cases was 11 years; 59% had varicella before age four years. The average time between varicella and HZ was nine years.

The estimated diameter of the HZ rash was less than one inch for 10 cases (15%), one to three inches for 48 (71%), four to six inches for eight (12%), and more than six inches for two (3%). Pain levels were assessed as none, mild, moderate, severe, or excruciating. Overall, pain severity averaged moderate with mean duration of 7.4 days among the 56 cases that experienced pain. Pain or paresthesia (burning, itching) was the initial symptom prior to the appearance of the HZ rash in 33 (49%) cases. The majority of cases (74%) involved the thoracic dermatomes, followed by cervical and then lumbar.

Forty-two cases (62%) reported 221 missed days of school or an average of 5.3 days (range 1-30 days). Thirty-one (46%) cases received acyclovir and 11 (16%) took prescription pain medication. The rash was localized to one dermatome in 60 (88%) cases and involved two or more dermatomes in 8 (12%). Rash duration was less than four weeks for 45 (66%) cases, four to eight weeks for 19 (28%), and more than eight weeks for 3 (4%). Residual scarring was reported by 26 (38%) cases. Postherpetic neuralgia (PHN) was reported by 6 (9%) cases; PHN lasted less than two weeks for four cases and a month or longer for two cases. Interviewees cited stress as a

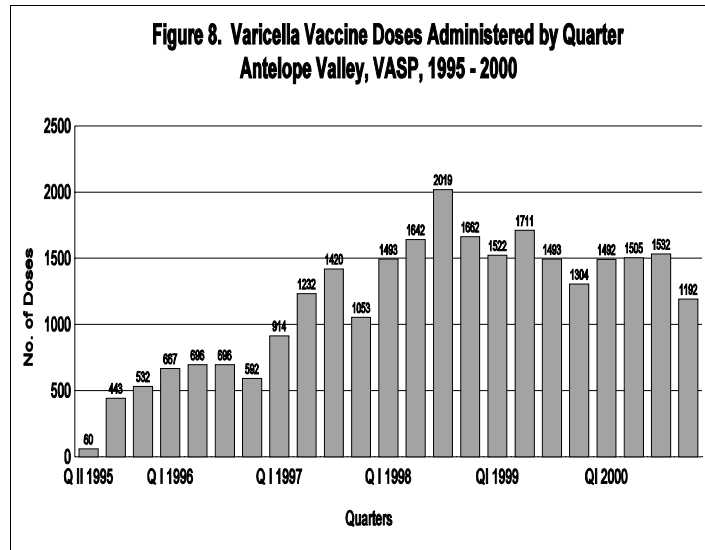
---

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

---

possible contributing factor (e.g., death of a household member, parental divorce, school, etc.) prior to HZ occurrence in 22 (32%) cases.

Four cases of HZ were reported in vaccinated children aged less than five years with an average interval of 2 years (range 10 months to 38 months) between vaccination and occurrence of HZ. No laboratory testing was performed to confirm the diagnosis or to determine the virus strain associated with these cases. Three of the four cases were reported by healthcare providers and one case by a school surveillance unit. Vaccination dates were all confirmed by the healthcare providers administering the vaccine.



### **VARICELLA VACCINE UTILIZATION**

Fifty-nine reporting sites were providers of varicella vaccine in 2000, compared to forty-seven in 1999. Reporting site compliance with returning the monthly immunization report to the VASP office during 2000 was 100%. The number of administered vaccine doses leveled off in 2000 after increasing each preceding year since vaccine licensure in 1995 (Figure 8). One-year-olds represent the largest proportion of vaccine recipients (3,251; 57%) in 2000. Health Maintenance Organizations (HMOs) provided 2,160 (37.8%) of the vaccine doses administered in 2000, followed by private practice healthcare providers (1,880; 32.9%) and Los Angeles County public health clinics and Medi-cal providers (1,681; 29.3%).

### **EVALUATION**

#### **Reporting Completeness**

#### **Capture-Recapture**

We estimated (1) the number of varicella cases among children two to eighteen years of age missed by the surveillance system and (2) the true number of varicella cases in that same age group, by analyzing the degree of overlap between two incomplete lists of cases (two-source capture-recapture methods). The two ascertainment sources used were 'schools' (elementary, middle and secondary schools, preschools, and daycare facilities), and 'healthcare providers' (physicians, clinics, hospitals, and health maintenance organizations). We limited the analysis to children two to eighteen years of age to decrease heterogeneity of the two ascertainment sources;

---

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

---

fewer than 10% of children under two years of age in the study population attend a child care facility with an enrollment of 12 or more (data not shown).

In this model,  $a$  is the number of cases reported by both sources,  $b$  is the number of cases reported by source  $x$  only,  $c$  is the number of cases reported by source  $y$  only, and  $d$  is the number of cases missed by both ascertainment sources. In our calculations we included an adjustment for small samples that yields a nearly unbiased estimator (NUE) for unascertained cases and total cases in the population, as described by Wittes et al.,<sup>1</sup> and Hook and Regal.<sup>2</sup>

Thus, the nearly unbiased estimator of total cases in children aged two to eighteen years not ascertained by school or providers ( $d_{nue}$ ) is given by  $(bc)/(a+1)$ , and the total cases in the population with varicella in this age group ( $p_{nue}$ ) is given by  $[(a+b+1)(a+c+1)/(a+1)]-1$ .

We evaluated possible within-source variation in probability of ascertainment by stratifying by age, race, and overall disease severity. We calculated 95% confidence intervals for  $p_{nue}$  using goodness-of-fit. Using only two ascertainment sources, we estimate 55% completeness during 2000 in the two- to eighteen-year-old age group. Considering cases from all surveillance units, including those outside the selected ascertainment sources (i.e., households), overall completeness of surveillance data for this age group was 67%, down from 74% in 1999.

### **Underreporting of Known Cases**

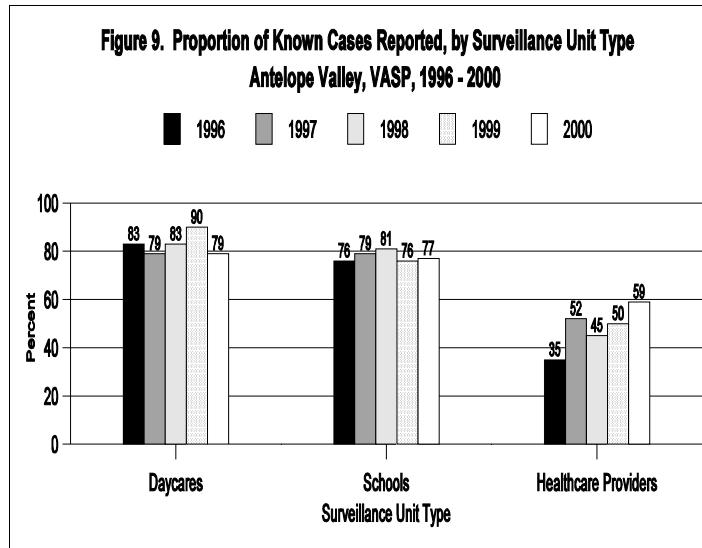
This method of estimating underreporting focuses on those cases in all age groups that were known to, and should have been reported by, surveillance units (pre-schools/daycares, schools and healthcare providers). To obtain this information, the Varicella Case Report form contains an Underreporting Survey which includes the following questions:

- Did case attend preschool? If yes, specify: \_\_\_\_\_
- Did case attend daycare? If yes, specify: \_\_\_\_\_
- Did case attend school? If yes, specify: \_\_\_\_\_
- Did case consult a healthcare provider by telephone? If yes, specify: \_\_\_\_\_
- Did case see a healthcare provider in the office? If yes, specify: \_\_\_\_\_
- Was case out of session (off-track, summer break, spring break, etc.) when case had varicella?

After collecting the responses to the above questions, varicella surveillance staff determine whether or not the specified preschool/day care, school or healthcare provider is a surveillance unit. Under-reporting by surveillance units can be estimated by ascertaining whether or not the case was known to surveillance units other than the one that initially identified (or reported) the case.

**County of Los Angeles • Department of Health Services  
Public Health  
Acute Communicable Disease Control  
Special Studies Report 2000**

The Varicella Surveillance Project (VSP) began collecting this information June 1, 1996. Generally, this study shows that schools, daycares and healthcare providers report 66% of the varicella cases they encounter. Specifically, daycare reporting ranges from 79% to 90%, schools from 76% to 81% and healthcare providers 35% to 59% of the cases they encounter. Reporting by healthcare providers increased by 4% in 2000 compared to 1999 (Figure 9).



**SPECIAL STUDIES**

**Varicella Vaccine Coverage and Disease Susceptibility Survey**

Since there is evidence of herd immunity in the VASP surveillance sites, it will be increasingly important to monitor disease susceptibility and true vaccine coverage in adolescents. As disease declines, an increasing number of older children may not be exposed to infection. The objectives of this survey are (1) to determine the proportion of adolescents who do not have a history of varicella, (2) to determine proportion of adolescents who have been vaccinated and, if needed, (3) to offer varicella vaccine to susceptible adolescents. The single-page survey (in English and Spanish) was given to Antelope Valley middle school parents/guardians through the school health office. As of the writing of this report, 3,996 surveys have been returned to VASP and entered into a database; approximately 600 are pending entry. Of the 3,996 surveys, 3,440 (86.1%) report a prior history of varicella, 469 (11.7%) report a negative history and 87 (2.2%) were unknown. Of the 469 reporting a negative history, 165 (4.1%) report vaccination and supply a date of vaccination after 1995. The percentage of susceptibles is in the range of 5.7% to 7.5%. The racial/ethnic distribution of respondents was 535 (13.4%) Black, 1,906 (47.7%) White, 1,192 (29.8%) Hispanic, 287 (7.2%) Asian/other, and 76 (1.9%) not answered. Figure 17 compares the racial/ethnic distribution of respondents to the 1997 Antelope Valley census projections and CBEDS 2000/2001. Complete analysis of varicella vaccine coverage and disease susceptibility survey is forthcoming pending entry of remaining surveys.

**Laboratory Confirmation of Varicella Disease**

Since an increasing proportion of varicella cases are occurring among vaccinees, the validity of clinical diagnosis has been raised. In addition, it is increasingly important to identify atypical varicella disease of any severity and also confirm whether adverse events following vaccination are

---

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

---

related to vaccine virus or wild virus. By offering free laboratory testing to all physicians in the active surveillance sites, we can examine the validity of a clinical diagnosis compared with PCR testing, IgM, and acute and convalescent IgG tests. The objectives of this study are (1) to provide serology testing to confirm suspected cases of breakthrough varicella in vaccinated individuals, (2) to provide serology testing to confirm suspected cases of varicella in individuals presenting with typical or atypical varicella and a prior history of disease, (3) to provide serology testing of adolescents and adults with a negative history of varicella or for any person with an uncertain history of varicella, and (4) to provide serology testing for suspected adverse events related to varicella vaccination.

The availability of CDC Varicella Zoster Laboratory services was presented in the Varicella Newsletters sent to every healthcare provider (HCP) in the Antelope Valley (AV) three times in 2000. A separate mailing describing the laboratory services in detail was sent to all AV HCPs in September of 2000. In November a dinner meeting for all HCPs was held to address the results of VASP to date and the availability of free laboratory testing. Approximately 60 health care providers attended the meeting and a description of the availability of laboratory testing was distributed to those present. Early in 2001, laboratory testing kits were distributed to AV HCPs who appeared to express special interest in laboratory testing.

### **Prior Varicella Study**

Over a four-year period, varicella case-patients reporting a previous history of varicella increased two-fold, from 4.5% in 1995 to 9.5% in 1998. In order to describe the epidemiology and clinical characteristics of varicella reinfections reported to VASP, we re-interviewed 102 case-patients from 1998, obtaining a more detailed description of first and second varicella infections. In collaboration with the CDC, our analysis of the data suggests that clinical varicella reinfections may occur more commonly than previously thought. A paper of the results, "Second varicella infections: are they more common than previously thought?," is being submitted for publication.

### **COMMENTS**

After six full years of data collection, the project has demonstrated substantial decrease in the number of varicella cases in the Antelope Valley. The Antelope Valley site is currently the only varicella active surveillance site that includes all potential sampling units within a reporting site, thus avoiding problems of sampling error. Large amounts of data have been collected on the epidemiology of varicella pre- and immediate-post vaccine licensure. Further reduction of morbidity and complications from varicella are expected to continue as vaccine coverage increases. California has passed legislation to require proof of varicella immunity at kindergarten entry as of July 2001. Such school laws are expected to further impact the epidemiology of the disease.

Baseline data on incidence of varicella and vaccine coverage levels in Antelope Valley have now been established. With this background, further questions on the disease and vaccine can be

---

**County of Los Angeles • Department of Health Services**  
**Public Health**  
**Acute Communicable Disease Control**  
**Special Studies Report 2000**

---

developed as coverage rates increase. Investigation of vaccine breakthrough cases and failures will continue to be of interest, and may not only involve clinical description of such cases, but viral characterization as well. Another important issue is the potential serious morbidity as a cohort of the children who were not vaccinated as infants reach adolescence. Likewise, more information is needed on the impact of routine varicella immunization in the incidence of herpes zoster. Maintaining active surveillance of epidemiology of varicella clearly remains a public health priority.

## **REFERENCES**

1. Wittes JT, Colton T, Sidel VW. Capture-recapture methods for assessing the completeness of case ascertainment using multiple information sources. *J Chronic Dis* 1974;27:25-36.
2. Hook EB, Regal RR. The value of capture-recapture even for apparent exhaustive surveys: the need for source of ascertainment intersection in attempted prevalence studies. *Am J Epidemiol* 1992;135:1060-67.