

---

# Evaluation of a School-Based Influenza Surveillance System

DENNIS D. LENAWAY, PhD  
AUDREY AMBLER, RN, MPH

Dr. Lenaway is Epidemiologist, Boulder County Health Department, 3450 Broadway, Boulder, CO. Ms. Ambler is School Health Program Manager, Boulder County Health Department.

Tearsheet requests to Dr. Lenaway.

## Synopsis .....

Previous studies have suggested using school-based surveillance to monitor epidemic influenza-like illness in a community. Since the late 1970s, no studies have sought to evaluate this public health measure. The Boulder County Health Department developed, piloted, and implemented a school-based surveillance system beginning with the 1988-89 school year. After five seasons of surveillance, the school-based system was evaluated for sensitivity by comparing the epidemic curves from the school-based system with those of a preexisting communicable disease sentinel surveillance system. Additional attributes evaluated included acceptability, simplicity, timeliness, and overall usefulness.

Comparisons of the overall epidemic patterns suggest a close correlation between the two measures for the influenza seasons 1988-89 through 1992-93.

*The school-based system closely followed the general rise, peak, and fall of epidemic influenza-like illness as measured by the preexisting sentinel system. Three of five epidemic peaks matched on the week of occurrence between the two surveillance systems; for the remaining seasons, 1989-90 and 1991-92, the school-based system peaked 1 week earlier than the sentinel system.*

*The use of school-based surveillance has several positive attributes which suggests schools are an ideal setting for detecting influenza outbreaks, including the epidemiology of influenza which has shown children play an important role in the acquisition and spread of influenza-like illness. Student populations were accessible and easily monitored by absenteeism rates that required no diagnosis or invasive testing.*

*All 44 schools within the school district readily participated in the surveillance of influenza. Only minimal time and resources were needed for the system's maintenance. The school-based surveillance system allowed the local health department to track influenza-like illness activity and provide timely and important information concerning outbreaks to schools, public health officials, health care providers, and the public.*

---

**E**ACH ANNUAL INFLUENZA season holds the potential for significant morbidity and mortality associated with epidemic influenza (1). Community-wide surveillance for infectious diseases, including influenza, is an important public health mechanism for early detection of an epidemic.

Communicable disease surveillance has traditionally relied upon sentinel primary care providers, laboratories, and hospitals for routine reporting of illness (2). Several research studies have used such sentinel providers to obtain viral cultures to confirm influenza activity during periods of epidemic respiratory illness (3-6). However, public health practitioners have more commonly used various indirect measures for community-wide influenza surveillance, such as school or workplace absenteeism.

In the mid-1970s, Peterson and coworkers validated the use of school-based surveillance by comparing

school absenteeism with viral cultures from among a sample of ill students (7). Their data supported the notion that sustained excess school absenteeism was an adequate indicator of the presence and extent of influenza illness. Since this pioneering study, no research has evaluated school-based surveillance for influenza.

The epidemiology of influenza suggests using school-age children as a sentinel population for emerging outbreaks. Several studies have characterized the age distribution and spread of illness during influenza outbreaks (3-6). A consistent finding is that, during an epidemic, illness occurs first among school-aged children and, compared with other age groups, children were shown to exhibit the highest attack rates. Once a school-aged population has developed influenza illness, they efficiently spread the virus vertically among family members, thereby

## Influenza Viruses Detected by Sentinel Surveillance

Influenza season	Circulating virus
1988-89	A (H1N1) and B
1989-90	A (H3N2)
1990-91	A (H1N1) and B
1991-92	A (H3N2)
1992-93	A (H3N2)

SOURCE: Viral Studies Laboratory, University of Colorado School of Medicine, Denver.

*'Recognizing the importance of early influenza detection, the Boulder County (CO) Health Department developed, piloted, and implemented a school-based surveillance system beginning with the 1988-89 school year.'*

shifting the outbreak to older and more diverse populations.

Recognizing the importance of early influenza detection, the Boulder County (CO) Health Department developed, piloted, and implemented a school-based surveillance system beginning with the 1988-89 school year. After five seasons of surveillance, we sought to evaluate this school-based surveillance system as an effective measure of epidemic influenza in our community.

### Methods

An evaluation study was undertaken to compare a school-based influenza surveillance system with a preexisting sentinel communicable disease surveillance system. The primary study objective was to determine the sensitivity of the school-based system in detecting community outbreaks of influenza. Additionally, other system attributes, such as acceptability, simplicity, and timeliness, were evaluated as recommended by the 1988 Centers for Disease Control (CDC) guidelines (8). The study period included the five influenza seasons 1988-89 through 1992-93. During the 1987-88 school year, the health department developed and piloted an influenza surveillance system to operate within the Boulder Valley School District (BVSD). The following school year (1988-89), the surveillance system was ex-

panded to include the entire school district consisting of 30 elementary, 9 middle or junior high, and 5 high schools.

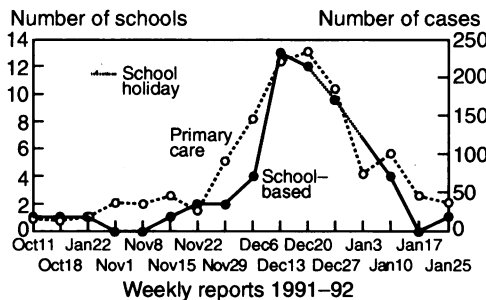
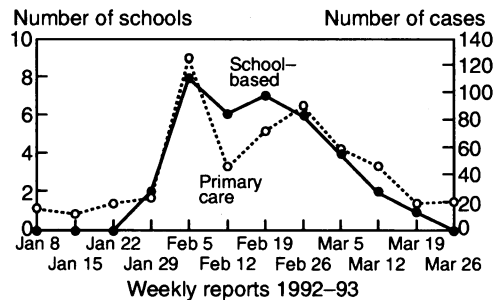
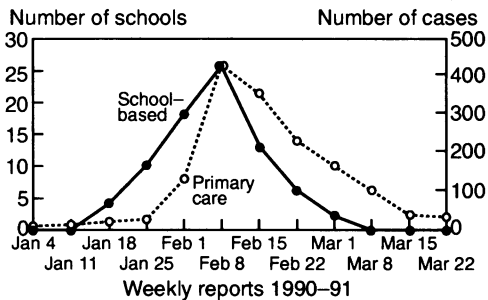
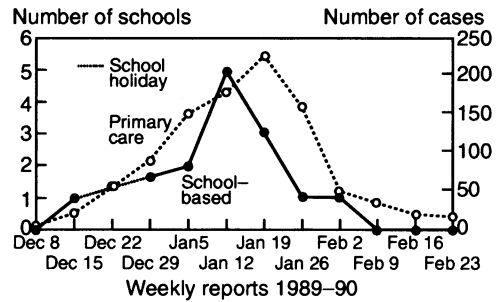
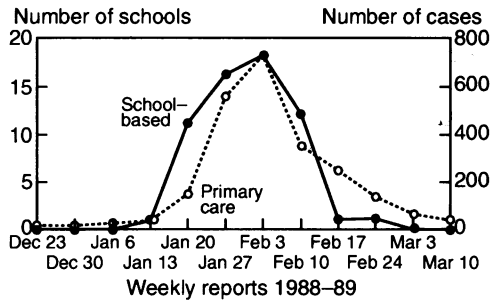
The school district contracts with the health department to provide six full and three half-time school nurses, and one full-time school health program manager. Each school is assigned a health paraprofessional to augment the resources provided by the school health nurses. At the start of each school year, the entire school health program staff is instructed in influenza surveillance and the need for accurate and timely reporting. Periodically throughout the school year, the school nursing staff provides reinforcement.

The school-based influenza surveillance system requires each school to record the weekly absenteeism and to telephone a report each Friday to the health department whenever the weekly average rate exceeds 7.5 percent of the current school census. The total absentee population used in this calculation does not include persons with nonillness-related absences. Likewise, the paraprofessional does not give any clinical description regarding illnesses associated with absence from school.

The health department's preexisting communicable disease surveillance system actively solicits reports of illness from 13 primary care physician group practices, 6 clinics, 3 urgent care facilities, 2 laboratories, and 3 hospitals within the county by weekly telephone contact with each reporting source. Among the physician group practices, only two are primarily pediatric offices. The weekly reports of medically attended influenza-like illness (ILI) are recorded without patient-identifying information. Prior to each influenza season, the participants in the sentinel surveillance system are instructed about influenza diagnosis, treatment, and recommendations concerning the current year's influenza vaccine.

For purposes of the reporting system, a person with a case of ILI is defined as any patient presenting with a febrile respiratory infection with two or more of the following symptoms: cough, headache, sore throat, or myalgia. Neither of the described surveillance systems is intended to quantify the incidence of ILI (that is, rates), but rather to gauge the occurrence and extent of epidemic influenza in the community.

Sentinel virologic surveillance is provided on a region-wide basis by the Viral Studies Laboratory, University of Colorado School of Medicine in Denver, a collaborator with the World Health Organization and CDC influenza virus surveillance program. Specimens from Boulder County, as well as the entire State, are tested for the presence of influenza and typed according to standard methods.



The virologic surveillance provides information about the strain(s) of influenza which are circulating during each season's outbreak.

During the influenza season, surveillance data are published monthly in a communicable disease information newsletter which is widely distributed within the local health care community. When epidemic influenza is detected, news reports about the occurrence and extent of the outbreak are released to the press. Continuous updates are provided to the press until the outbreak subsides.

A comparison of epidemic trends was made for each influenza season between the weekly reported number of ILI cases via the preexisting communicable disease surveillance system and the number of schools reporting excess absenteeism. Inferences about surveillance sensitivity were drawn from the degree of similarity between the epidemic curves for each of the five influenza seasons evaluated.

Overall comparisons were made between the two surveillance systems for basic design, staffing, and

ease of operation to determine simplicity and timeliness. Acceptability was assessed by the willingness of each school within the district to participate and an evaluation of the completeness of each school's reporting. Paraprofessionals assigned to each school and its supervising school nurses were encouraged to report any time during the school year the problems or discrepancies with the system.

## Results

Both surveillance systems detected only one distinct outbreak of influenza occurring during each of the five influenza seasons 1988-89 through 1992-93. According to statewide virologic surveillance, the predominant influenza strains which circulated during each season are presented in the box. During the seasons of 1988-89 and 1990-91, both influenza A and B circulated; in the remaining three seasons, influenza A was predominant.

The epidemic curves for each influenza season,

*'When epidemic influenza is detected, news reports about the occurrence and extent of the outbreak are released to the press. Continuous updates are provided to the press until the outbreak subsides.'*

presented in the five figures, show activity as measured by the school-based surveillance system and the preexisting sentinel surveillance system. The overall pattern suggests concordance between the two measures for each outbreak. The school-based system was able to detect the same peak as the preexisting sentinel system except for the 1989-90 and 1991-92 seasons. Both of these seasons saw the school-based system peak 1 week earlier than the preexisting sentinel system.

An analysis of all five influenza seasons suggests late January to early February as the peak period for influenza in Boulder County. The exception was the outbreak occurring in 1991-92 which began early in October; it was slow to develop and peaked in late December.

It appears that the number of cases of ILI reported through the preexisting sentinel surveillance system subsided more gradually after the peak period than the "number of schools" measure. Also, a portion of the 1989-90 and 1991-92 outbreaks occurred during the holiday break for Christmas. School-based reporting was disrupted on the reporting dates December 22 and 29, 1989, and the December 27 report date during the 1991-92 season.

All 44 schools in the district participated in each of the five influenza seasons in this evaluation. During annual meetings with paraprofessionals and school nurses, the consensus was that a minimum of less than 1 hour was needed each week for surveillance and reporting. No school or staff person indicated that the system was either difficult or burdensome. Periodic evaluation of school records each influenza season uncovered no major discrepancies in reporting.

## **Discussion**

Comparing the epidemic curves for all five influenza seasons clearly indicates a close similarity between influenza activity detected by the school-based system and the preexisting sentinel surveillance system. The school-based system closely followed the general rise, peak, and fall of epidemic influenza as

measured by the preexisting system. Three of the five epidemic peaks matched exactly, and the remaining two peaks showed the school-based surveillance occurring 1 week before the peak shown by the sentinel system. If we assume, as previously stated, that school-aged children develop ILI before the general population, then the school-based epidemic peak would be expected to occur before the overall peak as measured by community-wide surveillance.

The observation that three of five seasonal peaks were concordant may be partially explained by a high proportion of school-aged children having medically attended ILI, leading to some unknown degree of overlap between the two systems for school-aged children with ILI. However, since our study does not have information about the patients who sought medical care for ILI, we could not evaluate this effect.

The use of school-based surveillance has several positive attributes, which suggests that schools are an ideal setting for detecting epidemic influenza. As a sentinel population, children are well-suited for epidemiologic surveillance, since they play an important role in the acquisition and spread of influenza within a community. It has been shown that influenza generally strikes children first, and they exhibit the highest attack rates (4,6). The simplicity of the school-based system is evident when one considers the ease of accessibility of the sentinel population, the lack of invasive testing or diagnosis of ILI, surveillance relying upon a simple computation of the weekly absenteeism for each school, and reports to the health department being necessary only when a particular school exceeds the 7.5 percent threshold.

Importantly, our school-based surveillance system was found acceptable to both school district officials and the school nursing and paraprofessional staff. All 44 schools willingly agreed to participate, and our staff encountered no significant problems with activities related to surveillance or reporting. In addition, school-based surveillance required minimal maintenance and management during the influenza season. Because the local school district contracts with the health department to provide school nursing services, our level of cooperation and acceptability may have been greater than among those districts without such pre-arrangements. The two surveillance systems were essentially equivalent in timeliness since both received reports on a weekly basis covering the occurrence of influenza activity (as measured by absenteeism or office visits) in the previous week.

Neither of the two surveillance systems used in this evaluation incorporated virologic studies during the

influenza outbreaks. The viral cultures performed by the State medical school are primarily used to identify the presence and type of influenza circulating during the current season and are not intended to provide epidemiologic characteristics of an outbreak. It would be assumed that an active sentinel surveillance system seeking case reports of ILI would capture more illnesses than true influenza. However, previous studies have shown that surveillance for increased ILI activity is closely linked to the actual rise, peak, and fall of culture-positive cases (3-7). For most health agencies, it would be expensive and impractical to institute ongoing virologic surveillance on a routine basis when an alternative surveillance mechanism is available.

The opportunity for evaluation of the school-based surveillance system was possible because of the existing active communicable disease surveillance system within our health department. In Colorado, most health departments do not actively solicit reports of ILI on a weekly basis and would not have available this particular measure of epidemic influenza for their community (personal communication with Pam Shillam, Program Administrator, Communicable Disease and Epidemiology Program, Colorado Department of Public Health and Environment).

There is an extensive effort associated with the preexisting sentinel surveillance system in monitoring and tracking ILI in the community. Physicians' offices, clinics, and hospitals must continuously record the number of cases diagnosed during an extended period, in contrast to the occasional reports of other communicable diseases. The results of our study suggest that local health officials remove active surveillance for ILI from the preexisting sentinel system and rely instead on the school-based system.

Earlier work on developing the concept of school-based influenza surveillance showed the usefulness and practicality of this type of system (7). Our study further validates school-based influenza surveillance as a meaningful public health tool for indicating the presence and extent of influenza in the community. When outbreaks of ILI occur within our community, public health officials, health care providers, and the public have all benefited from the timely information provided by our school-based surveillance system.

## References .....

1. Glezen, W. P.: Serious morbidity and mortality associated with influenza epidemics. *Epidemiol Rev* 4: 25-44 (1982).
2. Thacker, S. B., and Berkleman, R. L.: Public health surveillance in the United States. *Epidemiol Rev* 10: 164-190 (1988).
3. Glezen, W. P., and Couch, R. B.: Interpandemic influenza in

the Houston area, 1974-76. *N Engl J Med* 298: 587-592, Mar. 16, 1978.

4. Foy, H. M., Hall, C., Cooney, M. K., and Fox, J. P.: Influenza surveillance by age and target group. *Am J Epidemiol* 109: 582-587 (1979).
5. Couch, R. B., et al.: Influenza: its control in persons and populations. *J Infect Dis* 153: 431-440 (1986).
6. Frank, A. L., et al.: Influenza B virus infections in the community and the family. *Am J Epidemiol* 118: 313-325 (1983).
7. Peterson, D., Andrews, J. S., Levy, B. S., and Mitchell, B.: An effective school-based influenza surveillance system. *Public Health Rep* 94: 88-92, January-February 1979.
8. Centers for Disease Control: Guidelines for evaluating surveillance systems. *MMWR* 37 (supp. S-5), May 6, 1988.