# An Effective School-Based Influenza Surveillance System

DENTON PETERSON, BA
JOHN S. ANDREWS, Jr., MD
BARRY S. LEVY, MD
BILL MITCHELL, BS

EFFECTIVE SURVEILLANCE OF INFLUENZA in large populations is difficult because the signs and symptoms of influenza can mimic those of other illnesses and vice versa. Therefore, laboratory confirmation is frequently required to make an accurate diagnosis. Based on our experience at the Minnesota Department of Health, however, relying on laboratory confirmation for influenza surveillance has certain limitations: (*a*) laboratory results give little information on the extent of influenza illness, (*b*) fewer than 8 percent of the specimens the laboratory receives for respiratory virus isolation grow any virus, (*c*) virus isolation frequently takes 1 week or more to complete, (*d*) serologic confirmation takes 2 weeks or more because convalescent-phase serum specimens are needed, and (*e*) the cost of processing each specimen is $27. As a result, various indirect methods, including monitoring emergency room and physician visits and industrial and school absenteeism, have been used in Minnesota and elsewhere for influenza surveillance.

In the winter of 1974–75, Minnesota's influenza surveillance was based on data from 7 sentinel physicians, 6 industrial plants, and 11 school systems in the State. The results were disappointing. Although we learned from sporadic telephone reports from physicians, positive laboratory specimens, and reports in the mass media that influenza was present, our surveillance system failed to show it.

In the winter of 1975–76, we tested a school-based influenza surveillance system in all 1,900 public

*At the time this paper was prepared, all the authors were assigned to the Minnesota Department of Health, Minneapolis. Mr. Peterson was an intern, Communicable Disease Epidemiology Unit, and graduate student, Division of Environmental Health, University of Minnesota School of Public Health; currently he is an immunization consultant, Minnesota Department of Health. Dr. Andrews was supervisor, Communicable Disease Epidemiology Unit, and medical epidemiologist, Field Services Division, Bureau of Epidemiology, Center for Disease Control; he is now a geographic medicine fellow, Department of Medicine, University Hospitals, Cleveland. Dr. Levy was acting State epidemiologist and medical epidemiologist, Field Services Division, Bureau of Epidemiology, Center for Disease Control; he is now assistant professor, Department of Family and Community Medicine, University of Massachusetts Medical School, Worcester. Mr. Mitchell was supervisor, Communicable Disease Field Services Unit, and public health adviser, Tuberculosis Control Division, Bureau of State Services, Center for Disease Control; he is currently assigned to the Division of Respiratory Disease, Maryland Department of Health, Baltimore.*

*Tearsheet requests to Denton Peterson, Minnesota Department of Health, 717 Delaware Street, SE., Minneapolis, Minn. 55440.*

schools in the State. This system enabled us to determine when and where cases of influenza were occurring throughout the winter. The methods used in this system and our findings follow.

## Methods

**Initiation of system.** In November 1975, we sent to the principal of each public school in Minnesota a letter describing the symptoms of influenza, the importance of influenza surveillance, and the assistance needed from the school. We enclosed two pre-addressed, unstamped post cards. We requested that the principal forward the letter and post cards to the person in the school most likely to know when cases of influenza-like illness occurred and when absenteeism doubled above usual levels. If either of these situations occurred, the responsible person was to check the appropriate box or boxes on a post card and mail it to us.

**Followup telephone interviews.** We telephoned everyone who returned a post card and asked for information about: (*a*) total enrollment, (*b*) number of students ill, (*c*) symptoms, and (*d*) dates of onset of illness and recovery. We classified illnesses as "possible influenza" or "noninfluenza." We considered a reported outbreak as possible influenza if ill students did not have prominent gastrointestinal symptoms but had temperatures higher than 101° F and at least two of the following symptoms: sore throat, cough, or headache.

**Laboratory specimens.** During January 1976 we obtained throat swabs from 4 to 10 students in each of 7 outbreaks; the swabs were brought immediately to the Division of Medical Laboratories of our department, where they were cultured for influenza and other respiratory viruses (*1*). After confirming influenza in several urban and rural outbreaks detected by physicians, our laboratory, and our school-based surveillance system, we stopped collecting specimens.

**Data analysis.** We recorded the dates we received post cards and the dates of onset of possible influenza outbreaks. We compared onset dates of the influenza outbreaks identified by our surveillance system with virus isolations and serologic test results of the State laboratory and with pneumonia and influenza mortality data from Duluth, Minneapolis, and St. Paul (*2*). We also compared influenza onset dates with all Minnesota death certificates in which

influenza was either the cause of death or an existing condition at the time of death.

To evaluate the sensitivity of this surveillance system, in June 1976 we conducted a retrospective survey of 163 schools (11 percent random sample) in the State. We administered a questionnaire by telephone on the occurrence of influenza, absenteeism, and enrollment during the past winter.

## Results

**Post card reports.** Between December 1, 1975, and April 15, 1976, we received post cards from all regions of the State, representing 323 (17 percent) of the 1,900 public schools. Some returned post cards indicated influenza-like illness in as many as six schools.

**Followup telephone interviews.** Although we had sent an initial letter describing influenza to each school, the schools' representatives who returned post cards frequently misidentified influenza. Based on symptoms reported in interviews, 199 (62 percent) of the 323 schools met the criteria for possible cases of influenza—no prominent gastrointestinal symptoms, temperature above 101° F, and two of the following: sore throat, cough, or headache. The percentages of schools with sick children who possibly had influenza, according to the preceding criteria, and those schools in which sick children did not have influenza were as follows:

| *Sign or symptom* | *Possible influenza (199 schools)* | *Noninfluenza (124 schools)* |
|---|---|---|
| Temperature 101°F | 100.0 | 34.0 |
| Headache | 100.0 | 48.0 |
| Sore throat | 98.0 | 39.0 |
| Cough | 67.0 | 15.0 |
| Myalgia | 35.0 | 22.0 |
| Vomiting | 23.0 | 63.0 |
| Nausea | 22.0 | 23.0 |
| Stomach cramps | 16.0 | 21.0 |
| Coryza | 14.0 | 13.0 |
| Diarrhea | 8.0 | 31.0 |
| Rash | 4.0 | 5.0 |

**Laboratory specimens.** Eight specimens from students affected in the two initial outbreaks that met the possible influenza criteria were obtained on January 15 and plated on fresh monkey kidney cells; three of these specimens were positive for influenza A. In the fourth week of January, 51 specimens taken from students who may have been affected in the next 5 possible influenza outbreaks were plated on monkey kidney cells that were more than a week old; none of these specimens grew influenza virus. All 59 specimens were also inoculated on skin fibroblast and human amnion cell lines; no other viruses were isolated.

**Symptoms of students in laboratory confirmed influenza outbreaks.** The two schools with laboratory confirmed influenza reported that students had symptoms of temperature greater than 101° F, headache, cough, sore throat, and myalgia, without gastrointestinal symptoms or rash. Absenteeism at both schools was more than doubled.

**Comparison with other surveillance data and with mortality data.** The school-based influenza surveillance system detected influenza at the same time specimens submitted by physicians grew influenza virus and showed a fourfold antibody titer rise and 3 to 4 weeks before deaths due to influenza increased in Minnesota (see chart).

The first specimens submitted by physicians that were positive for influenza A were taken on January 3. These specimens were submitted voluntarily by physicians to help diagnose illness in their patients; they were not part of an active surveillance system. The largest number of specimens positive for influenza virus were collected during the weeks ending January 31 and March 6. Between January 1 and April 1, only 25 (3 percent) of 753 throat swabs, nasal swabs, and lung and sputum specimens submitted for virus isolation grew influenza A virus. The following other viruses were isolated: *Herpes hominis,* 12; cytomegalovirus, 11; adenovirus, 6; poliovirus 2, 1; ECHO 6, 1; mumps, 1; and parainfluenza, 1.

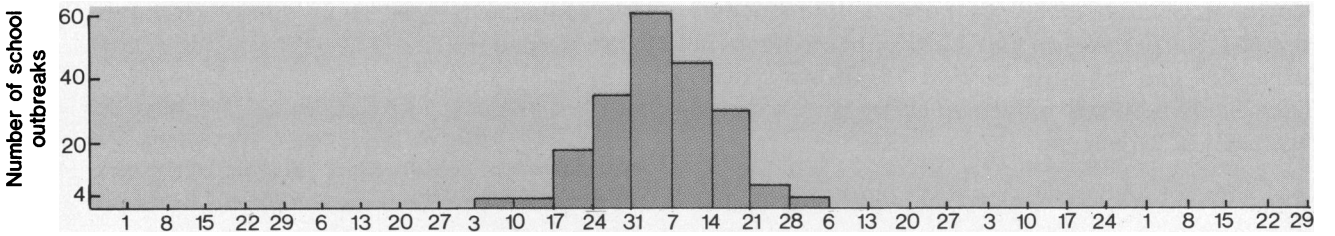
The first patient with a fourfold rise in antibody to influenza A, had an acute-phase serum specimen drawn during the week ending January 3. From most of the patients showing this fourfold titer rise, an acute-phase serum specimen was drawn during the weeks ending February 14 or February 28. Convalescent-phase serum samples were collected 2 to 4 weeks later.

Mortality due to pneumonia and influenza in St. Paul, Minneapolis, and Duluth peaked in the weeks ending February 7, March 6, and March 20, respectively (2). Influenza mortality in Minnesota as a whole peaked during the week ending March 6. Death certificate data could not be used for surveillance purposes until 4 to 6 weeks after the deaths occurred because mailing of the certificates to the health department was often delayed.

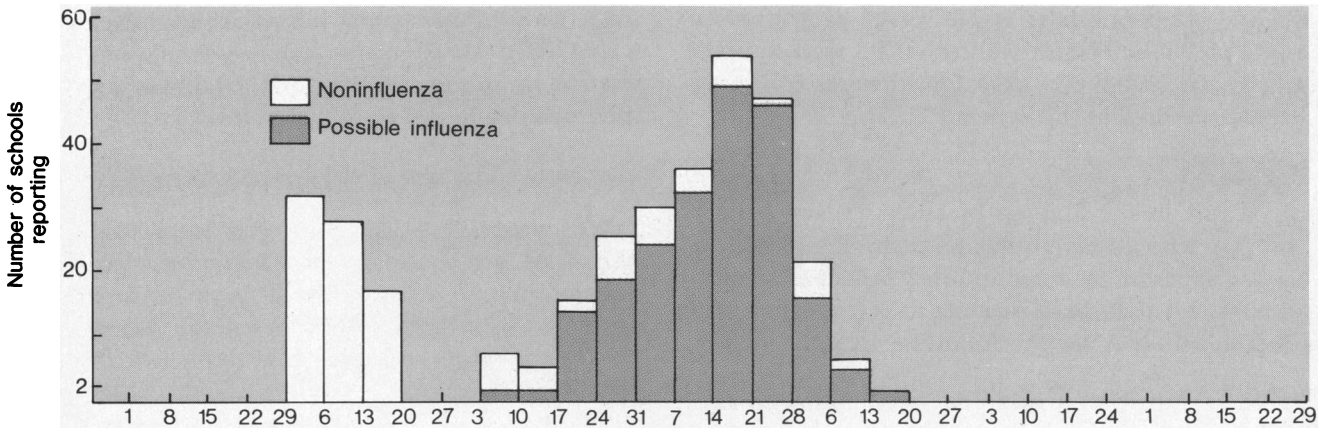
**Followup survey to evaluate sensitivity.** Of the 163 schools we contacted in the retrospective survey, 129

## Influenza in Minnesota, 1975–76, by week

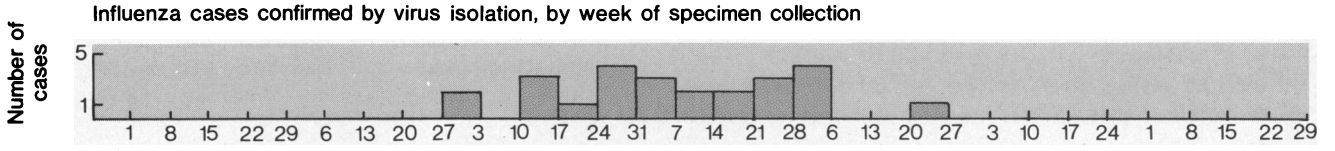
Date of onset of influenza outbreaks identified by school surveillance system



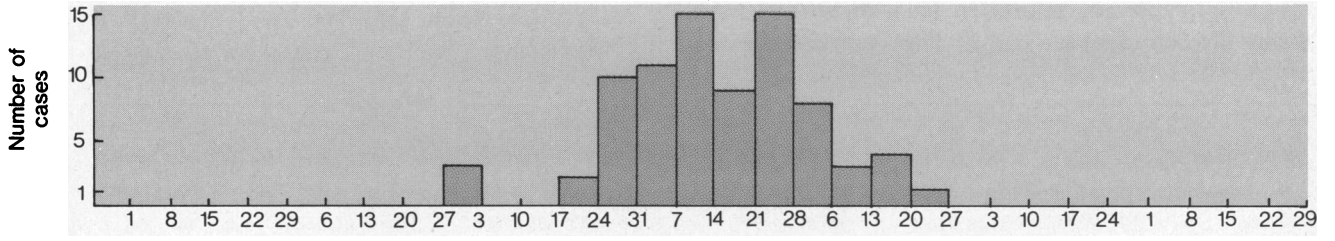

Date of report of school influenza and noninfluenza outbreaks



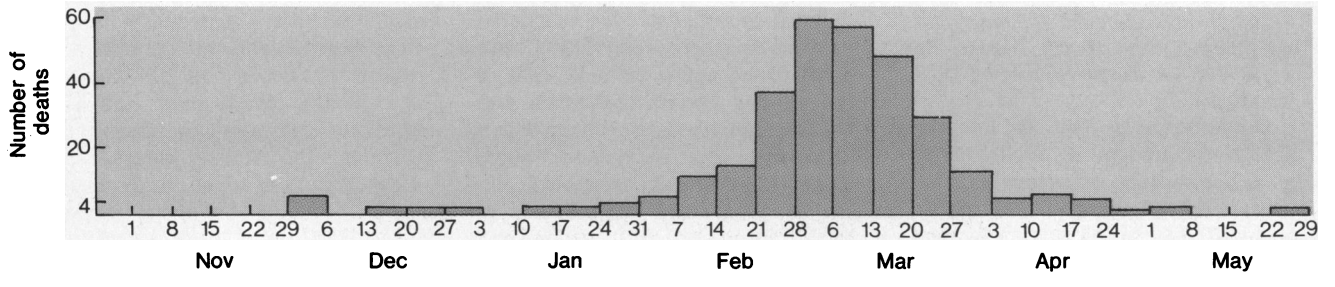

Influenza cases confirmed by virus isolation, by week of specimen collection




Influenza cases confirmed by serology, by week acute phase specimen was collected




Minnesota mortality due to influenza



(79 percent) reported that students had had influenza during the 1975–76 school year; 50 (39 percent) of these 129 schools had returned the post cards. Extrapolating from this survey, we estimate that students in 1,504 (79 percent) of the 1,900 public schools in Minnesota had influenza in 1975–76. In our system, 323 schools reported influenza, giving an estimated sensitivity of 21 percent.

**Cost.** The cost of our surveillance system was $2,400, of which $1,600 was spent for processing laboratory specimens for virus isolation. The rest was for supervisors, stationery, post cards, printing, postage, and telephone calls. A University of Minnesota School of Public Health student (D.P.) worked without pay for 10 hours a week for 18 weeks collecting surveillance data in this system.

## Discussion

In contrast to the findings of others (*3*), we believe that this school-based influenza surveillance system was far superior to other indirect influenza surveillance systems used in Minnesota in recent winters to detect influenza A for the following reasons:

**Probably improved sensitivity.** Our followup survey indicated that our system had an estimated sensitivity of 21 percent. However, no data are available to compare the sensitivity of this system with that of other influenza surveillance systems. In previous winters we had relied on a "coarse" net of a small number of sentinel physicians, schools, and industries to report indirect evidence of influenza activity. Many localized influenza outbreaks, however, escaped detection by this surveillance system because we had only a few reporting points. In 1975–76, with the use of our direct system we had a "fine" surveillance net with many reporting points, which detected 21 percent of the outbreaks. Nonresponding schools could be surveyed periodically by telephone throughout the influenza season if a "finer" surveillance net were needed.

**High specificity.** Unfortunately, we obtained relatively few positive laboratory specimens from the schools where we detected possible outbreaks. However, we believe that most of these outbreaks were actually influenza because (*a*) we obtained positive specimens from students in the earliest suspected influenza outbreaks and (*b*) there were consistent time relationships among outbreaks detected by our school-based system, laboratory confirmation of influenza in specimens submited by physicians, and increased deaths due to influenza (see chart).

**Low cost.** The cost of the system was relatively low.

We encourage other State and local health departments to consider adopting school-based influenza surveillance systems to augment laboratory surveillance in order to obtain reliable information on the presence and extent of influenza in large populations.

### *References*


1. Lennette, E. H., and Schmidt, N. J., editors: Diagnostic procedures for viral and rickettsial infections. American Public Health Association, New York, 1969, pp. 414–433.
2. Center for Disease Control: Morbidity and Mortality Weekly Reports, Atlanta, Ga., 1975, vol. 24, pp. 378, 386, 394, 402, 410, 418, 426, 434, 442, 454; 1976, vol. 25, pp. 6, 14, 22, 30, 38, 46, 54, 62, 72, 82, 90, 98, 106, 114, 122, 130, 138, 146, 154, 162. Atlanta, Ga.
3. Rubin, R. J., and Gregg, M. B.: Influenza surveillance in the United States, 1972–1974. Am J Epidemiol 102: 225–232 (1975).


## SYNOPSIS


PETERSON, DENTON (Minnesota Department of Health, Minneapolis), ANDREWS, JOHN S., Jr., LEVY, BARRY S., and MITCHELL, BILL: *An effective school-based influenza surveillance system. Public Health Reports, Vol. 94, January-February 1979, pp. 88–92.*

In the winter of 1975–76, the Minnesota Department of Health tested a school-based influenza surveillance system using 1,900 public schools in the State as reporting points. Self-addressed post cards were sent to the principals of each school in early November, and they were to be completed and returned to the department when absenteeism doubled or influenza was suspected. Post cards representing 323 (17 percent) of the public schools were returned, and health department personnel administered questionnaires to all persons who returned post cards. Based on clinical symptoms, epidemic spread, and the temporal relationship of illness to isolation of influenza virus and deaths due to influenza, students in 199 schools were determined to have had influenza-like illness.

This school-based influenza surveillance system gave the Minnesota Department of Health current information on the extent of influenza-like illness, which had not been possible with previous surveillance systems. The authors suggest that other State and local health departments consider adopting school-based influenza surveillance systems.