

Influenza outbreaks in several states of the Middle West during the winter of 1961-1962 were studied epidemiologically in selected communities. The results indicate that the outbreaks were centered in the schools and that school children were apparently the principal introducers of infection into the homes.

EPIDEMIOLOGIC STUDIES OF TYPE B INFLUENZA IN 1961-1962*

Tom D. Y. Chin, M.D., M.P.H., F.A.P.H.A.; Wiley H. Mosley, M.D.; Jack D. Poland, M.D.; David Rush, M.D.; E. A. Belden, M.D., M.P.H.; and Olive Johnson, R.N.

DURING the winter of 1961-1962 influenza outbreaks were reported in several states of the Middle West. Etiologic studies on several of the outbreaks incriminated Type B influenza virus as the primary causative agent. This virus was isolated from pharyngeal washings of patients in Jefferson City, Potosi, Marshall, and Kansas City, Mo.; Kansas City, Kans.; Lawrence, Kans.; Hazleton, Iowa; and Grand Tower in southern Illinois. Intensive epidemiologic studies were carried out on the sharply localized outbreaks in Potosi, Mo., and Hazleton, Iowa. This report will describe some of the observations made on these two outbreaks. Particular reference will be made to the occurrence of the infection among school children and the spread of the infection to their family contacts.

Description of the Study Areas

Potosi, the county seat of Washington County, has a population of 3,000. It is located in the foothills of the Ozark

Mountains approximately 65 miles southwest of St. Louis. Its economy is based on mining, farming, and shoe manufacturing. Located in town are three separate public schools: the elementary school, the junior high school, and the senior high school.

Hazleton is a considerably smaller community than Potosi. It is located in Buchanan County in northeastern Iowa. A large percentage of the 600 residents are employed in industries in the surrounding towns. It has a single school which contains kindergarten through 12th grade. The school consists of an old brick building, housing grades 2 through 12 and a newer quonset building housing the kindergarten and first grade children. The enrollment of 338 included children from Hazleton and the surrounding rural communities.

Clinical Studies

The illness was characterized by a sudden onset of fever averaging 101-103° F, headache, chills, sore throat, coryza, cough, and myalgia. Cough was present in over 80 per cent of the cases in both outbreaks. Nausea and vomiting

* From the Kansas City Field Station, CDC, PHS, U. S. Department of Health, Education, and Welfare, Kansas City, Kans.; Division of Health of Missouri, Jefferson City; and the Iowa State Department of Health, Des Moines.

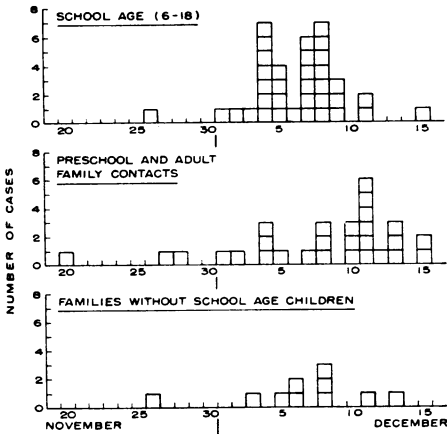


Figure 1—Influenza-Like Illness by Date of Onset, Telephone Survey of 60 Families, Potosi, Mo., 1961

were observed in less than 45 per cent of the children, but diarrhea was relatively uncommon. The average duration of illness was about five days.

Throat and serum specimens were obtained for etiologic studies. Monkey kidney monolayer cultures were used for virus isolation, employing the adsorption-hemagglutination technic described by Vogel and Shelokov.¹ Each throat specimen was inoculated into three cultures using 0.1 ml per culture. The virus isolated was identified by standard technic of hemagglutination-inhibition² and by direct fluorescent-antibody staining of infected monkey kidney cells using specific influenza A and B hyper immune serums conjugated with fluorescein isothiocyanate.*

Type B influenza virus infection was demonstrated in 25 (66 per cent) of 38 patients in Potosi—16 by virus isolation and 9 by antibody rise. Type B influenza virus was isolated from throat washings of 4 of 26 patients in Hazleton. Because of the low frequency of virus recovered

* The specific fluorescein-labeled antisera were kindly supplied by Dr. Chien Liu, University of Kansas School of Medicine.

from the Hazleton specimens, postepidemic serums from 102 Hazleton residents obtained about two months after the peak of the epidemic were tested for presence of hemagglutination-inhibition antibody against a current strain of Type B influenza virus. Antibody against the Type B virus was detected in 98 per cent of the 102 persons tested. All the 71 children under 15 years of age possessed antibody against this virus.

Epidemiologic Studies

The outbreak in Potosi began the first week of December, with daily school absenteeism ranging from 13 to 25 per cent. Forty per cent of the children were absent from school on December 11, seven days after the beginning of the outbreak.

The outbreak in Hazleton occurred about a month later. The incidence of acute respiratory disease began suddenly on January 6, four days after the end of Christmas recess. The peak absenteeism of 47 per cent occurred on January 9.

In an effort to obtain a rapid estimate of the incidence of illness in the com-

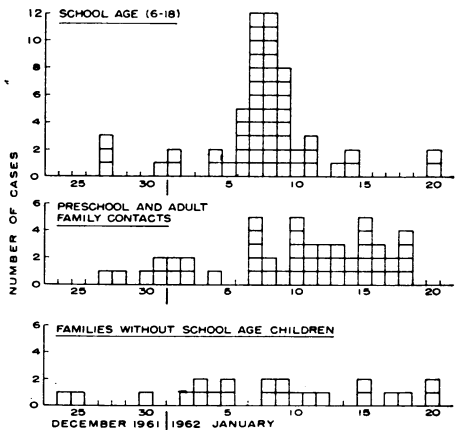
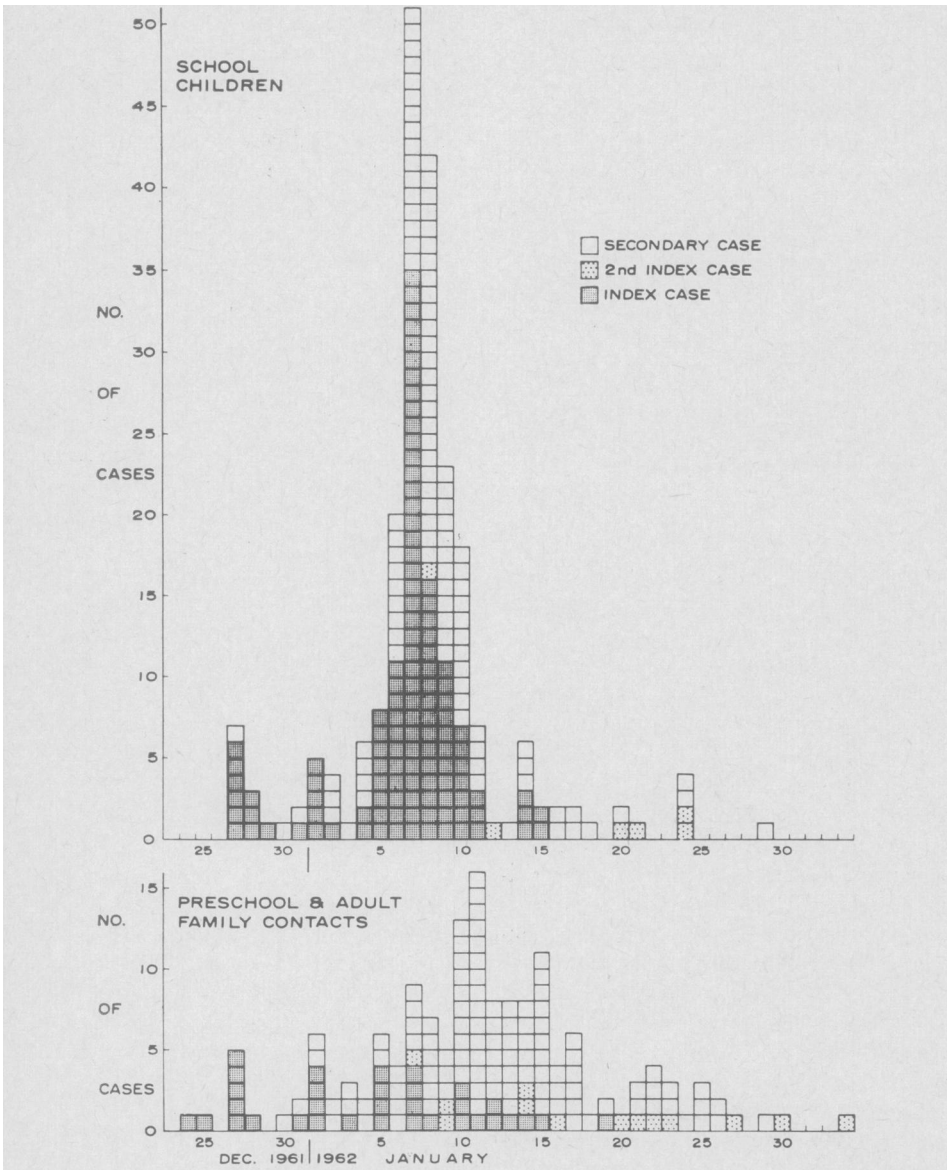


Figure 2—Influenza-Like Illness by Date of Onset, Telephone Survey of 79 Families, Hazleton, Iowa, December, 1961-January, 1962

Figure 3—Influenza-Like Illness* by Date of Onset, Based on a Survey of 109 Families with School-Age Children, Hazleton, Iowa, December, 1961-January, 1962



*The first cases (primary) in a family represent index cases. Cases which occurred one to ten days following index cases were considered secondary cases. The first cases which occurred after the ten-day intervals were considered second index cases.

munity, a telephone survey of a sample of households was conducted in each of the outbreaks. In Potosi every 15th residential number in the telephone directory was selected for interview. A satis-

factory clinical and epidemiologic history was obtained from 60 of the 63 families between December 15 and 18. A similar survey was carried out in Hazleton, selecting every third residential

Table 1—Incidence of Influenza-Like Illness by Class of Individuals in 133 Families, Hazleton, Iowa, December 24, 1961-February 4, 1962

Class of Individuals	Number of Persons	Number Ill	Per cent Ill
Preschool children	82	47	57.3
School children	320	237	74.1
Fathers	122	51	41.8
Mothers	133	56	42.1
Other adults	41	23	56.1
Total	698	414	59.3

number in the directory. A history was obtained from 79 of 89 households. The ten families that could not be contacted consisted of either retired couples or persons who were out of town. Since the survey was conducted at the peak of the epidemic, a second survey of the same families was made a month later.

Of the 209 persons surveyed in Potosi, 73 (35 per cent) had an influenza-like illness. The distribution of the 73 cases by date of onset is shown in Figure 1. Among the school children, the peak incidence occurred between December 4 and 8. The illness among the preschool and adult family contacts occurred several days later, with the peak incidence on December 11. The interval between the peaks of the first and the second curves was about four to five days. The ten cases of influenza-like illness occurring among persons in 28 families without school-age children were relatively evenly distributed, with three cases on December 8.

Of the 297 persons surveyed in Hazleton, 126 (42 per cent) persons gave a history of having had an influenza-like illness. The epidemic curves, shown in Figure 2, were similar to those observed in the Potosi survey. The peak incidence among the school children occurred on

January 7 and 8. It is of note that Christmas recess ended on January 2 and the incidence of acute respiratory illness did not reach a peak until four to five days after the school reopened. The incidence among the preschool and adult family contacts began to rise when the school outbreak was at its peak, and the high rate persisted for about a week after the school outbreak had subsided. As in the Potosi outbreak, no definite peak was present in the distribution curve among those families without school-age children.

The results of the telephone surveys thus suggested that the outbreaks were centered in the schools and the infections were apparently introduced into the homes by the school children. To determine more definitively the mechanism of spread of the infection, a more extensive study was conducted in Hazleton. The data in this study were obtained by using a standard questionnaire which was distributed to 146 families on February 8. The questionnaire requested the usual identifying data: a family roster; occurrence of influenza-like illness since December, 1961; date of onset; duration of illness; a check list of symptoms; and a history of influenza vaccination. The questionnaires were

Table 2—Incidence of Influenza-Like Illness by Age Among 133 Families, Hazleton, Iowa, December 24, 1961-February 4, 1962

Age Group (Years)	Number of Persons	Number Ill	Per cent Ill
0-4	72	42	58.3
5-9	129	93	72.1
10-14	138	106	76.8
15-19	74	52	70.3
20-34	82	41	50.0
35-49	149	58	38.9
50 and above	54	22	40.7
Total	698	414	59.3

Table 3—Secondary Attack Rates of Influenza-Like Illness by Class of Individuals in 109 Families, Hazleton, Iowa, December 24, 1961-February 4, 1962

Class of Individuals	Number of Persons Exposed	Number of Secondary Cases	Secondary Attack Rate (Per cent)
Preschool	62	28	45.2
School	150	98	65.3
Fathers	92	34	37.0
Mothers	95	30	31.6
Other adults	25	7	28.0
Total	424	197	46.5

completed and returned by 133 (91 per cent) of the families. The data obtained included 320 (95 per cent) of 338 children and their families.

An influenza-like illness was reported in 117 families, a family attack rate of 88 per cent. The distribution of the cases in 109 families by date of onset is shown in Figure 3. The upper curve depicts the distribution of 222 school children, and the lower curve shows the distribution of 153 family contacts. The

epidemic among the school children was extremely sharp, with the peak incidence occurring on January 7. The curve representing the family contacts was broader than that of the school children, with the peak occurring four days after that of the school children.

The attack rates by type of individuals in the family are shown in Table 1. The over-all attack rate was 59 per cent. Seventy-four per cent of school children had an influenza-like illness. The rate among the preschool children was 57 per cent and among the parents was 42 per cent. The rates among the fathers and mothers were about equal. It is of note that the attack rates among school children in the age groups 5-9, 10-14, and 15-19 were similar; i.e., 72, 77, and 70 per cent, respectively. The incidence among persons 20 years of age and older was significantly lower than those of school and preschool children (Table 2).

The secondary attack rate was 46 per cent, with the highest incidence among the school children. Table 3 shows the rates by types of individuals within the family. In calculating these rates, the first cases in the family were considered index cases, and those who became ill one to ten days following the index cases

Table 4—Percentage Distribution of Index and Secondary Cases* by Class of Individuals in 102 Families, Hazleton, Iowa, December 24, 1961-February 4, 1962 (Excluding Seven Families with Index Cases in More Than One Class of Individual)

Class of Individuals	Total No. of Persons Ill	First Index Cases		Secondary Cases		Second Index Cases		Second Secondary Cases	
		No. Ill	% Ill	No. Ill	% Ill	No. Ill	% Ill	No. Ill	% Ill
Preschool children	40	6	15.0	28	70.0	3	7.5	3	7.5
School children	203	97†	47.8	98	48.3	6	3.0	2	1.0
Fathers	43	5	11.6	33	76.7	3	7.0	2	4.6
Mothers	45	9	20.0	30	66.7	4	8.9	2	4.4
Other adults	15	3	20.0	7	46.7	2	13.3	3	20.0
Total	346	120	34.7	196	56.6	18	5.2	12	3.5

* The first cases (primary) in a family represent index cases. Cases which occurred one to ten days following index cases were considered secondary cases. Those cases which occurred longer than ten days after the first cases were considered second index and secondary cases.

† In 79 families.

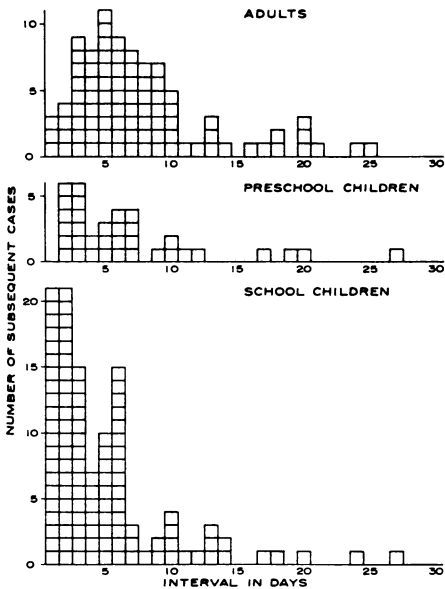


Figure 4—Intervals Between Onset of Index and Subsequent Cases of Influenza-Like Illness in 109 Families, Hazleton, Iowa

were considered secondary cases. The secondary attack rate among the preschool contacts was somewhat higher than those of the adult family contacts.

The percentage distribution of index and secondary cases is shown in Table 4. These data suggest that school children played the most important role in introducing the infection into the homes. Of 203 school children with an influenza-like illness, 48 per cent were index cases. In contrast, only 15 per cent of preschool children with an influenza-like illness were index cases, and 70 per cent of them were secondary cases. Secondary cases were also predominant among the adult family contacts—77 per cent among the fathers and 67 per cent among the mothers.

Figure 4 shows the distribution of the intervals in days between the index and subsequent cases. Two peaks of about four days apart could be recognized in

both the school and preschool children; the peaks among the school children were somewhat more distinct. In contrast, the curve describing the distribution of the adult cases had only one peak, which occurred on the fifth day.

The median interval of the school children was 2.9 days. The median intervals for the family contacts were longer: 5 days among the preschool children and 5.6 days among the adults. Eighty-two per cent of the preschool subsequent cases and 81 per cent of the adult subsequent cases occurred within ten days after the onset of the first family cases.

Comments and Summary

The clinical and epidemiologic characteristics of the acute respiratory disease outbreaks in Potosi, Mo., and Hazleton, Iowa, were typical of influenza. The majority of the illnesses were influenza-like, with a characteristic sudden onset of fever, headache, malaise, sore throat, coryza, and cough. The outbreaks were explosive, and the infection rapidly disseminated through the community and caused high attack rates among persons of all ages, particularly school children. Type B influenza virus was isolated from both outbreaks.

The results of this study indicate that the outbreaks were centered in the schools, and school children were apparently the principal introducers of the infection into the homes. Almost 50 per cent of the cases occurring among school children represented first cases in the family.

The data also suggest that the infection readily spread within the family once the virus was introduced. The secondary attack rate among the household contacts was 46 per cent; about 80 per cent of the subsequent cases occurred within ten days after introduction of the virus into the family.

The median interval between the first

and subsequent cases among the school children was 2.9 days. The intervals among the family contacts were longer: 5 days for the preschool children and 5.6 days for the adults. The relatively long median intervals among the family contacts were comparable to those reported by others in studies of influenza outbreaks.³

The difference in the median intervals between the school children, on the one hand, and the preschool and adult family contacts, on the other, suggests that the risk of effective exposure was greater in the school than at home. It is probable that the majority of the subsequent cases among the school children repre-

sented infections acquired in the school, while the majority of the subsequent cases among the preschool and adult family contacts represented infections acquired at home.

ACKNOWLEDGMENT — We wish to thank Evelyn Welton, microbiologist, CDC, Kansas City, Kans., for laboratory assistance.

REFERENCES

1. Vogel, J., and Shelokov, A. Adsorption-Hemagglutination Test for Influenza Virus in Monkey Kidney Tissue Culture. *Science* 126:358-359, 1957.
2. Jensen, K. E. "Influenza." In *Diagnostic Procedures for Virus and Rickettsial Diseases* (2nd ed.). New York, N. Y.: American Public Health Association, 1956, pp. 241-262.
3. Jordan, W. S., Jr. The Mechanism of Spread of Asian Influenza. *Am. Rev. Resp. Dis.* 83,2 (Part 2): 29-40, 1961.

Dr. Chin, Dr. Mosley, and Dr. Poland are chief and epidemic intelligence service officers, respectively, Kansas City Field Station, Communicable Disease Center, Public Health Service, Department of Health, Education, and Welfare, Kansas City, Kans.; Dr. Rush, formerly epidemic intelligence service officer, Kansas City Field Station, is now with the Communicable Disease Center, Public Health Service, Buffalo, N. Y.; Dr. Belden is communicable disease consultant, Division of Health of Missouri, Jefferson City, Mo.; and Miss Johnson is nurse consultant, Iowa State Department of Health, Des Moines, Iowa.

This paper was presented before the Epidemiology Section of the American Public Health Association at the Ninetieth Annual Meeting in Miami Beach, Fla., October 15, 1962.