Influenza Surveillance in Community-Dwelling Elderly Compared With Children

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**Background:** Acute respiratory illnesses (ARIs) are the leading cause of medical visits for community-dwelling patients of all ages, but virologic and clinical descriptions of these illnesses in older adults are infrequent.

**Objectives:** To determine the feasibility of influenza surveillance in a population of community-dwelling elderly, to compare the patterns of influenza infection in elderly persons with that observed in young populations in which surveillance is usually conducted, and to describe the clinical presentation of influenza infection in elderly outpatients who seek medical attention for ARI.

**Design:** Prospective clinical and viral surveillance of ARIs among ambulatory patients during 3 consecutive winter seasons.

**Setting:** Nine internal medicine and 3 pediatric practices in Upstate New York in cooperation with the Medicare Influenza Vaccine Demonstration Project.

**Patients:** Elderly (n=808) and pediatric (n=2080) outpatients with ARI office visits.

**Measurements:** Frequency of influenza and other respiratory virus isolates and clinical profile of influenza among older adults and children with ARIs.

**Results:** Influenza virus was the viral agent recovered most often from specimens obtained from patients in both age groups with ARI symptoms, especially those with fever. Influenza accounted for 11% of ARIs in adults (87 isolates) and 20% in children (408 isolates). At the initial illness visit, influenza infection was equally common in elderly individuals with or without underlying cardiopulmonary conditions. Lower respiratory tract signs occurred in 13% of the adults and in 7% of the children with influenza documented by laboratory studies. Other respiratory viruses were recovered from specimens obtained from 20 adults and from 259 children.

**Conclusions:** Viruses are important agents of ARIs in elderly outpatients. Children and older adults experience similar patterns of influenza infection and other epidemic respiratory pathogens, such as parainfluenza and respiratory syncytial viruses. Viral identification is feasible in older adults seen in physicians' offices and may contribute to improved measures of effects of influenza and other respiratory viruses on ARIs.

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Influenza viruses cause outbreaks of acute respiratory illness (ARI) each year and are associated with increased acute illness visits at all levels of the health care system. Control of influenza illness requires accurate and timely identification of outbreaks and new vaccine formulations each year to match the changing strains and subtypes of circulating viral agents. Comprehensive descriptions of influenza illness are complicated by different susceptibilities of various populations and by simultaneous outbreaks of illness caused by other respiratory pathogens.

Older adults are particularly vulnerable to complications of influenza infection, with well-documented excess rates of hospitalization and mortality during outbreaks. However, these reports include few descriptions of influenza infection in community-dwelling elderly persons. Most studies of older adults and influenza focus on cases of severe illness, and the hospitalization and mortality rates associated with influenza, or on the effects of influenza in closed populations like nursing homes. The large community-based epidemiologic descriptions of influenza generally include only small numbers of people older than 65 years; in-
PATIENTS, MATERIALS, AND METHODS

SETTING

Sentinel medical offices for the elderly adult surveillance were selected on the basis of having a suitable patient population, willingness to participate in a research project, an office routine that allowed identification of eligible subjects, and proximity to the university laboratories. Five internal medicine groups were recruited in 1989 to 1990, and 4 more were added in the next 2 years (6 in Monroe and 3 in Onondaga counties) to conduct surveillance in older adults. Two large group practices in Monroe County and 1 group in Onondaga County provided enough specimens for viral surveillance in children.

PATIENTS AND SPECIMENS

The methods for this study were based on a long-standing, previously reported surveillance of viral infections in children. Specimen collection was routine and simple (to maintain cooperation of medical personnel and patients). Before the study began, we had visited each site several times to introduce the study to physicians, clinical staff, and managers and to teach procedures for specimen and data collection. We visited the sites several times during the course of the surveillance to replenish supplies and provide any needed training or support.

Because it has been reported that older adults had a more varied clinical presentation with acute influenza, inclusion criteria that we used were broad. All patients with respiratory illnesses with or without fever, and all febrile illnesses, including those without respiratory signs, were eligible for the surveillance. Adults younger than 65 years were excluded from the adult surveillance.

Surveillance was usually conducted on Mondays and Tuesdays, and specimens could be easily collected by physicians, nurses, or other staff assistants. Two 15-cm cotton-tipped swabs were used to collect cells from the respiratory epithelium: one to swab the back of the throat and the other to swab inside the nose. These were combined in 1 vial of media and refrigerated until transported by courier service to our university research laboratories.

Data collection cards were short and easy for any of the office staff to fill out during the patient interview. They relied on “Yes/No” check marks for symptoms or signs and for questions about influenza vaccine or type of underlying disease. Specific variables collected on data cards were as follows: Patient Information—name, age in years, date of visit, number of days ill at visit, influenza vaccine that season (Y/N), underlying disease (Y/N)—if yes, type of underlying disease; Signs and Symptoms—fever (Y/N), nasal congestion (Y/N), sore throat (Y/N), cough (Y/N), malaise (Y/N), rales or rhonchi (Y/N), wheezing (Y/N); Diagnosis ——; and Hospitalized (Y/N).

Fever was counted as present if it was reported by the patient or parent. We did not require a febrile temperature be measured in the office. Because our purpose was to describe the physician diagnoses and associated viral isolation, we accepted the diagnoses given, without specifying clinical criteria.

LABORATORY METHODS

We used standard tissue culture techniques for isolation of viral respiratory pathogens. All specimens were evaluated for influenza virus and parainfluenza virus by inoculation onto 2 cell lines: RhMK (rhesus monkey kidney) and MDCK (Madin-Darby canine kidney) and were incubated and read daily for cytopathic effect, and hemadsorbed with guinea pig red blood cells. Influenza isolates were tested by fluorescent antibody for identification as influenza virus type A or B, and influenza type A isolates were strain typed by hemagglutination inhibition test using standard serum samples provided by the Centers for Disease Control, Atlanta, Ga. Although not the primary focus of the adult surveillance, parainfluenza viruses, which grow on the same cell lines as influenza viruses, were subtyped with monoclonal antibodies to parainfluenza types 1, 2, and 3, with the use of the Bartels kit (Bartels Inc, Issaquah, Wash).

Additional cell lines (HFF [human fetal foreskin] and HEp-2 [human epithelial]) were used in the pediatric surveillance for isolation of respiratory syncytial virus (RSV), enterovirus, rhinovirus, and adenovirus; HEp-2 cells to detect RSV in the specimens obtained from adult patients were used during the second and third years of the study. No RSV isolates were recovered from the specimens obtained from the elderly adults, but a subset of 406 of the nose-throat specimens (obtained from 1 research laboratory) were examined retrospectively for RSV by enzyme-linked immunosorbent assay and their characteristics did not differ from those of the specimens not tested by enzyme-linked immunosorbent assay.

ANALYTIC METHODS

Clinical and laboratory data were recorded on standard forms and entered into a database (Excel) on a personal computer (Macintosh, Apple Inc, Cupertino, Calif); χ² analyses and 95% confidence intervals were performed using Epi Info.
article describes influenza surveillance in a population not previously covered by our community surveillance program and not well described in the literature.

Monroe and Onondaga counties, Upstate New York, have similar demographic profiles, with 11% to 12% of the population 65 years of age or older. Existing viral surveillance programs based on pediatric and young adult populations had shown almost identical patterns of influenza outbreaks in the 2 counties during the 3 years preceding this study (1986-1988) (C.B.H., J. McMillan, MD, and L. Weiner, MD, unpublished data).

In Monroe County, during a 19-year period, we had conducted a weekly community viral surveillance program in 2 pediatric group practices, which has been practical, sensitive, and well received by the participating physicians. We designed a parallel program for viral surveillance of older adults, recruiting physicians to serve as sentinels from November through April from those internal and family medicine groups who had already agreed to participate in the Medicare Influenza Vaccine Demonstration Project.

### RESULTS

**VIRAL ISOLATION**

The number of specimens received and types of influenza virus recovered from adults and children during each of the 3 winter seasons are given in Table 1. Viruses were identified in 13% (107/808) of the specimens obtained from adults and in 32% (667/2080) of the specimens obtained from children. Influenza viruses account for most isolates recovered from older adults during all 3 seasons for an overall frequency of 87 (11%). Other viral identifications in adults included the following isolates: RSVs, 12; parainfluenza viruses (type 1 and type 3), 6; and adenoviruses, 2.

Influenza virus isolates were recovered from specimens obtained from elderly adults of all ages. Eleven percent of adults 64 to 75 years old had positive viral cultures as did 11% of those older than 75 years. Even in those younger than 90 years, 14% had influenza documented by laboratory studies. School-aged children (>6 years old) were more likely to have positive viral influenza cultures than were children younger than 5 years (23% vs 17%, P<.001).

Influenza virus was also the dominant agent recovered from specimens obtained from children each season for an overall frequency of 408 (20%), followed by the following viral isolates: adenovirus, 116 (6%); RSV, 85 (4%); parainfluenza, 44 (2%) (type 1, 14 isolates; type 2, 7; type 3, 18; type 4, 1; and untyped, 4), and rhinovirus, 14 (1%).

**PATTERNS OF INFLUENZA ACTIVITY**

Influenza patterns over time and rates of influenza infection per 100 ARIs are shown in the Figure for adults and children during the peak periods of viral activity during 3 winter seasons. The peak period was defined as the 4 weeks preceding and the 4 weeks following the week when the largest number of influenza isolates were recovered in a given season. The same strain of influenza virus predominated each year in older adults and in children, but the rates of influenza virus isolates differed for adults and children; they also differed by strain type. The timing of influenza outbreaks varied during the 3 years of surveillance, including an unusually early arrival of...
influenza type A in 1991 to 1992, when both influenza A/H1N1 and A/H3N2 viruses circulated for 8 weeks, beginning in November.

Among the elderly, the highest rates of virus isolation during peak influenza activity occurred during the 1991 to 1992 A/H3N2 epidemic, with 26 viral isolates per 100 ARIs, compared with 5.5 viral isolates per 100 ARIs during the influenza type B outbreak in 1990 to 1991. Children had almost equal rates of influenza viral isolates recovered during the 1991 to 1992 influenza type A season (49 isolates per 100 acute illness visits) and the 1990 to 1991 influenza type B outbreak (43 viral isolates per 100 acute illness visits).

All strains and subtypes of influenza infected both children and adults, but the proportion varied with age. Influenza A/H1N1 virus accounted for only 10% of typed influenza A infections in older adults, but it accounted for 23% of typed influenza A infections in children.

CHARACTERISTICS OF PATIENTS AND ILLNESS

The clinical characteristics of all patients with specimens obtained, i.e., those with proved influenza and those with no respiratory viral agent recovered, are given in Table 2. Forty-five percent of older adult patients who were seen with ARI had underlying chronic illnesses that were considered to be high-risk cardiac or pulmonary conditions or both. These conditions were equally common in persons with documented influenza and in those with no virus recovered. Underlying cardiopulmonary conditions were rare in children, occurring in only 2%, including those with asthma.

Influenza-like illness was the most common diagnosis established by physicians for patients whose culture specimens yielded influenza virus (48% in adults and 61% in children), followed by upper respiratory tract infection (39% in adults and 35% in children). Bronchitis and wheezing were reported in 13% of older adults with positive influenza cultures, and none of those patients had pneumonia at the time of the acute illness visit. Twenty-seven adults had other primary complaints such as gastrointestinal tract symptoms along with their ARIs, or they presented with exacerbated underlying pulmonary disease; these individuals, however, did not have documented influenza.

Lower respiratory tract signs were present in 13% of the adults with influenza, a proportion similar to those without confirmed influenza infection (15%). For patients with confirmed influenza infection, 16% of those with cardiopulmonary conditions had lower respiratory tract signs, as did 11% of those without such underlying disease (P=.55). At the time of the initial medical visit,
Table 2. Clinical Characteristics of All Adults and Children With Proved Influenza and With No Virus Recovered

<table>
<thead>
<tr>
<th>Clinical Characteristics</th>
<th>All Specimens</th>
<th>Influenza Proved</th>
<th>No Virus Recovered</th>
<th>Adults</th>
<th>All Specimens</th>
<th>Influenza Proved</th>
<th>No Virus Recovered</th>
<th>Children*</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of specimens</td>
<td>808</td>
<td>87</td>
<td>701</td>
<td></td>
<td>2080</td>
<td>408</td>
<td>1413</td>
<td></td>
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<tr>
<td>Age, y</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Mean</td>
<td>76</td>
<td>76</td>
<td>76</td>
<td>76</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Median</td>
<td>75</td>
<td>74</td>
<td>75</td>
<td>75</td>
<td>4</td>
<td>6</td>
<td>4</td>
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<td>Range</td>
<td>64-101</td>
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<td>64-101</td>
<td>64</td>
<td>&lt;2</td>
<td>&lt;2</td>
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<td></td>
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<tr>
<td>High-risk condition, %</td>
<td>45</td>
<td>44</td>
<td>46</td>
<td>45</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Influenza vaccine, %</td>
<td>64</td>
<td>58†</td>
<td>65†</td>
<td>64</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Days ill at visit</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Mean</td>
<td>8</td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Median</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Percentage of patients with lower respiratory illness</td>
<td>14</td>
<td>13†</td>
<td>15†</td>
<td>14</td>
<td>11</td>
<td>7§</td>
<td>12§</td>
<td></td>
</tr>
<tr>
<td>Febrile illness</td>
<td>36</td>
<td>69†</td>
<td>31†</td>
<td>36</td>
<td>56</td>
<td>81†</td>
<td>44†</td>
<td></td>
</tr>
</tbody>
</table>

*NA indicates not available.
†P < .03.
‡P < .56.
§P < .005.
∥P < .001.

Neither high-risk chronic conditions nor lower respiratory tract signs were good indicators of influenza infection. Reported fever was a more accurate predictor, occurring in 69% of patients with influenza-positive cultures, in contrast to 31% of those with no virus recovered (P < .001).

In older adults, only minor differences were evident in the clinical features of influenza type A/H3N2 and influenza type B illnesses; none statistically significant. Cough was the most common symptom, noted in 97% of elderly patients with confirmed influenza A/H3N2 infection and in 93% of those with influenza B infection (P < .49). Of adults with influenza A/H3N2 and B infections, 69% and 64%, respectively, had fever (P < .73). Malaise was a slightly more frequent complaint in patients with influenza type B than in those with influenza A infection (86% vs 59%) (P < .82). Headache was reported by 78% of the patients with influenza type A and by 57% of those with influenza B infection (P < .53).

Sixty percent of the older adults had received the recommended influenza vaccine for that season. Although this study was not designed to interpret the effect of influenza vaccine, there were no significant differences in vaccine status between adults with or without underlying disease, lower respiratory tract signs, or influenza infection. We had vaccine information on 86 of the adults with positive influenza cultures; 50 of them had received influenza vaccine that season. Together, we had vaccine information on 790 of the adults in the surveillance, 506 of whom reported having received the influenza vaccine. Vaccine status was not collected for children, but the pediatric practices estimated that less than 5% of the children had received influenza vaccine.

Three of the 89 adults with proved influenza were hospitalized. All were infected with influenza virus A/H3N2: 1 patient had received influenza vaccine, 1 had not been vaccinated, and for 1 patient vaccine information was unavailable. No child with influenza infection required admission.

Systematic surveillance during 3 consecutive winters in our communities shows broadly similar patterns of occurrence of influenza and noninfluenza ARIs in elderly adults and children. In both groups, influenza type A and B infections resulted in acute febrile respiratory illness, with few complications noted at the initial visit. The primary contrast between the 2 age groups is the overall lower rate of viral isolation in adults compared with that in children and, in particular, the lower rates of influenza B infection proved by laboratory studies in adults.

Viral isolation in adults and children was most likely to be successful if the patient had been febrile and if the specimen was obtained early in the course of illness. All patients who reported fever at some stage of their illness were significantly more likely to have influenza documented by laboratory studies (Table 3). This was true for adults and children who had had symptoms for a brief period of less than 3 days and for those who had been sick for as many as 7 days when cultures were obtained. Adults and children with fewer were even apt to have influenza virus recovered after a week since onset of illness.

Other clinical features seemed to have no effect on influenza virus isolation; infections were not more common among those elderly with high-risk conditions, nor were the presenting symptoms of influenza infection more complicated in those with and without underlying conditions. This is consistent with other studies that show that most adults with influenza infections requiring medical visits and hospitalization do not have recognized high-risk conditions.

In our communities, several types of influenza virus, parainfluenza virus, and RSV typically circulate concurrently among children during a 4- to 8-week period each winter, and all apparently contribute to the seasonal rise in cases of ARI. Studies in long-term care set-
tions have noted the difficulty in distinguishing between influenza virus and RSV illnesses by features of clinical presentation, and an analysis of community-wide rates of respiratory morbidity and mortality in Great Britain also highlights the overlapping effects of influenza virus and RSV. These studies support the need for virologic studies to accurately ascribe rates of illness or death to the causative viral agent.

The identification of other respiratory viruses in elderly patients is a secondary finding of this surveillance, but it suggests that patterns of infection with the parainfluenza viruses and RSV may be similar to those in children. Respiratory syncytial viruses accounted for 11% and 13% of positive viral identifications in adults and children, respectively, and the parainfluenza viruses accounted for 6% and 7% of such identifications.

For patients of all ages, the respiratory tract viruses identified in this surveillance accounted for more than one third of acute febrile illnesses when patients were evaluated early in the course of illness: 39% (35/90) of the older adults and 53% (324/612) of the children with fever had influenza or other virus recovered from specimens obtained during the first few days of illness.

Limitations of this surveillance include the low number of influenza isolates recovered from specimens obtained from adults during the outbreak of influenza type A/H3N2 in 1989 to 1990, limiting our ability to make a fair comparison with the influenza type A outbreak of 1991 to 1992. The lower numbers in 1989 may be attributable to only 1 strain of influenza virus type A circulating or, possibly, to inexperience in obtaining adult specimens during the first year of surveillance. However, the surveillance program in the pediatric population was well established and it too showed lower rates of influenza type A isolates in 1989 to 1990 than in 1991 to 1992. Another report of these 3 influenza seasons from different parts of the country also show a stronger presence of influenza type A in the fall of 1991 season. It is possible, therefore, that factors not identified in this study account for a true difference in effects between the strains circulating in the 1989 to 1990 and in late 1991 to 1992 season.

This study probably underestimates the proportion of ARIs in older adults, which may be attributed to influenza and other respiratory viruses, most likely because adults in this study waited longer than children until seeking medical consultation. Adults with ARI had been sick for an average of 8 days when they visited their physicians’ office, while children, with higher rates of viral isolates, had had symptoms for an average of 3 days. More accurate estimates of the incidence of influenza infection in community-dwelling older adults would require viral evaluation at the onset of symptoms.

The full array of effects of influenza infection includes not only the severity and duration of acute illness, but also the long-term effect on function and well-being and the number of subsequent medical visits. These important dimensions of influenza illness, excluded from this research design, are being studied in our ongoing surveillance of viral respiratory tract infection in older adults.

Concurrent viral, clinical, and epidemiologic studies are necessary to interpret community outbreaks of respiratory illness. Effective prophylactic and antiviral agents already exist, more are on the horizon, and studies in community-dwelling elderly will enhance our understanding of respiratory infections and lead to useful interventions in this growing population.

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