



FIGURE 1—Utilization of a Rural Cancer Screening Program by New Adult Female Users by Frequency and Quarter

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Underestimation of the Role of Pneumonia And Influenza in Causing Excess Mortality

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Abstract: Underestimation of pneumonia and influenza (P&I) mortality during influenza epidemics was explored in 38 P&I associated deaths among a population of adults during two influenza A (H3N2) epidemics. Pneumonia or influenza was mentioned on 32 (84 per cent) of the death certificates. However, based on rules for assigning cause of death, only nine (24 per cent, SE = 7) and 23 (61 per cent, SE = 8) of the cases would have been included in P&I mortality statistics compiled by the National Center for Health Statistics and the Center for Disease Control, respectively. (*Am. J. Public Health* 1981; 71:643-645.)

Introduction

Excess pneumonia and influenza (P&I) mortality has long been used to measure both the occurrence and impact

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of influenza epidemics in the United States and other countries.^{1, 2} While excess deaths attributed to P&I represent the most specific measure of epidemic activity, well over 50 per cent of total excess mortality during influenza epidemics has usually been ascribed to other causes, particularly cardiovascular diseases. It has been suggested, but never verified, that much of the excess mortality assigned to these other causes in fact results from influenza-related pneumonia, the role of which is masked by current systems used for assigning cause of death from death certificates.^{3, 4} Such masking could lead to both a delay in detection of influenza epidemics and a significant underestimation of lives to be saved through influenza vaccination programs.^{5, 6}

Since the late 1950s, the Center for Disease Control (CDC) has conducted weekly surveillance of P&I deaths from approximately 121 cities. These data are used for early detection of excesses over expected deaths which would alert health officials to the occurrence of an epidemic. This system was designed to ascertain a high proportion of all deaths involving P&I. It counts all deaths in which "influenza" appears anywhere on the death certificate or in which "pneumonia" appears in Part I either on line A as "immediate" cause of death or on line B or C as lowest listed and hence "underlying" cause of death. Pneumonias listed in Part II of the certificate as "contributing" conditions are not counted.⁷

TABLE 1—Inclusion of Pneumonia or Influenza on Death Certificates and in CDC and NCHS Mortality Statistics for 38 P&I Associated Deaths

| Sections of Death Certificate | No. Certificates Listing Pneumonia or Influenza | No. Included in P&I Mortality Statistics | |
|--|---|--|----------|
| | | CDC | NCHS |
| Part I | | | |
| Death was caused by: | | | |
| Immediate Cause | A | 19 | 8 |
| Underlying Causes | B | 3 | 1 |
| | C | 2 | 0 |
| Part II | | | |
| Conditions contributing to death but not related to conditions in Part I | | 8 | 0 |
| Total P&I Listings | | 32 | 9 |
| Per Cent of all Cases | | 84 | 24 |
| | | (SE = 8) | (SE = 7) |

The National Center for Health Statistics (NCHS) compiles and publishes official national statistics on causes of death. Excess P&I mortality attributed to influenza epidemics is usually estimated from these data. The NCHS adheres to the World Health Organization (WHO) Nomenclature Regulations whereby each death is assigned to a single underlying cause as a by-product of the full medical information contained on the death certificate.⁸

prepaid group practice currently providing medical care for approximately 220,000 persons who are broadly representative of the population of metropolitan Portland.⁹ Approximately 8 per cent of members are over 65 years of age. Computerized records on all hospitalizations are maintained for research purposes. An epidemiological study of this population identified two- to three-fold increases in rates of P&I associated hospitalization and death* during two major influenza A (H3N2) epidemics in 1968–1969 and 1972–1973.¹⁰

Materials and Methods

This study was conducted in cooperation with the Oregon Region Kaiser-Permanente Medical Care Program, a

*P&I associated hospitalizations were defined as all medical admissions during the epidemics in which either pneumonia or influenza was listed among the discharge diagnoses. Those with fatal outcome were defined as P&I associated deaths.

TABLE 2—Selected Characteristics of P&I Associated Deaths Meeting Criteria for Inclusion in NCHS and CDC P&I Mortality Statistics

| Characteristics | Total | | CDC | | NCHS | |
|---|-------|----|-----|----|------|----|
| | N | % | N | % | N | % |
| Characteristics | 38 | | 23 | | 9 | |
| Sex | | | | | | |
| Male | 27 | 71 | 15 | 65 | 5 | 56 |
| Female | 11 | 29 | 8 | 35 | 4 | 44 |
| Age | | | | | | |
| < 70 yrs | 15 | 39 | 6 | 26 | 1 | 11 |
| > 70 yrs | 23 | 61 | 17 | 74 | 8 | 89 |
| Chronic Conditions Present | | | | | | |
| One or more | 36 | 95 | 21 | 91 | 7 | 78 |
| None | 2 | 5 | 2 | 9 | 2 | 22 |
| Category of Major Chronic Condition | | | | | | |
| Cardiovascular | 16 | 42 | 10 | 44 | 4 | 44 |
| Pulmonary | 9 | 24 | 5 | 22 | 2 | 22 |
| Cancer | 9 | 24 | 5 | 22 | 1 | 11 |
| Alcoholism | 1 | 3 | 1 | 4 | 0 | |
| Diabetes | 1 | 3 | 0 | | 0 | |
| Health Status Prior to Terminal Hospitalization | | | | | | |
| Deteriorating | 17 | 45 | 13 | 57 | 4 | 44 |
| Stable | 21 | 55 | 10 | 43 | 5 | 56 |

CDC criteria (above) were applied to the death certificates by the authors; and a medical classification specialist at the NCHS reviewed each certificate and assigned the underlying cause of death in accordance with the aforementioned regulations used by the NCHS.

The patients' past medical records were reviewed to determine whether they were being treated for any major chronic diseases and whether at the time of terminal hospitalization they appeared to be medically stable or in a progressively deteriorating state of health. Distribution of these patient parameters among those deaths assigned to P&I by each system were examined.

Results

Among a total of 310 P&I associated hospitalizations during the two epidemics, there were 39 deaths; hospital records and death certificates were available on 38 of these. Pneumonia was documented by physical examination and chest x-ray in 34 of the cases and by physical examination alone in the other four, three of whom died before x-ray could be obtained.** Sixty per cent were over 70 years of age, all but two had underlying chronic disease, and 55 per cent were judged to be medically stable prior to hospitalization.

Pneumonia or influenza was listed on death certificates of 32 (84 per cent) of the 38 cases (Table 1). The listing appeared in Part I as either immediate or underlying cause in 24 cases and in Part II as contributing cause in eight cases. Twenty-three cases (61 per cent, SE = 8) met criteria for inclusion in the CDC P&I mortality surveillance system. However, only nine (24 per cent, SE = 7) were classified as P&I deaths by the NCHS system; in seven cases, pneumonia was listed as immediate cause of death without mention of any other conditions on the certificate, and in one case influenza was so listed.***

Frequencies of selected characteristics noted in medical records of all 38 cases and among the 23 and 9 cases included in CDC and NCHS P&I mortality statistics, respectively, are shown in Table 2. Most of the frequencies were very similar between groups; thus there was no apparent medical basis for explaining which deaths were included in the respective P&I mortality statistics.

Discussion

The postulated under-ascertainment of the role of P&I as a cause of death during influenza epidemics was confirmed, yet there were few distinguishing features among the

**There was one case of primary influenza pneumonia while the rest were diagnosed as bronchopneumonia of either bacterial or mixed viral-bacterial etiology.

***The 29 cases not counted as P&I deaths by the NCHS were assigned to the following underlying causes: cardiovascular (12), neoplastic (9), chronic pulmonary (5), and cirrhosis, diabetes and malnutrition (1 each).

38 cases. With the exception of one case of primary influenza pneumonia in a previously healthy individual, virtually all cases consisted of bronchopneumonia occurring in persons with underlying chronic disease. Pneumonia or influenza was listed on death certificates of 32 (84 per cent) of the cases. The only factor which clearly differentiated deaths which were included in the P&I mortality statistics from those which were not was how pneumonia or influenza was listed, if at all, on the death certificate.

Although these findings are based on a small number of deaths which occurred during two influenza epidemics, they represent the experience of a large general population cared for by over 150 physicians. If this experience reflects the general status of certifying P&I mortality in the United States, one must conclude that the systems currently in use for generating P&I mortality statistics significantly underestimate the occurrence of this potentially preventable cause of death.¹¹

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