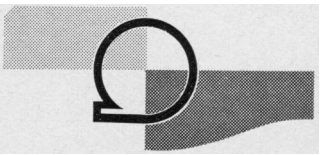


# Epidemiologic Studies in a Large Company Based on Health and Personnel Records

SIDNEY PELL, Ph.D.

AN INDUSTRIAL organization which provides periodic health examinations and other forms of health surveillance to all its employees offers unique opportunities for population-based epidemiologic studies. There are a number of advantages in conducting such studies in this setting.

1. A population to be observed is readily available.

2. Such populations are usually stable enough to permit long-term observation without significant losses.

3. The demographic characteristics of the population can be described accurately since the information can easily be obtained from personnel records.

4. Medical observations intended primarily for a preventive health program can be used at little extra cost for epidemiologic studies.

5. These medical observations are made on persons who are apparently healthy, and therefore the precursors of chronic disease can be identified and their effects measured.

E. I. du Pont de Nemours & Co. employs about 115,000 persons in many installations of greatly varying size, scattered throughout the country. Some installations consist of units with small numbers of employees, such as sales offices, laboratories, and warehouses, while other installations consist of units of medium to large size, such as research facilities, office buildings, and manufacturing plants. In conducting epidemiologic studies in a company of this size and with this kind of structure, problems are encountered that are very different from those that would be found in a small company with an entire complex of facilities in one place.

Under the company's medical program, which was started in 1933, all employees are given preemployment and periodic health examinations by company physicians. Employees 40 years of age and over are examined annually; younger employees are examined biennially. The routine examination provides information for our studies based on physicians' observations, blood and urine analyses, electrocardiograms, blood pressure levels, pulse rates, body weights, and roentgenograms of the chest. Additional tests and examinations are often done, either to obtain a diagnosis or to check workers exposed to special hazards. The employees may also see a company physician for consultation or evaluation upon return to work following a disabling illness. The company maintains contact with private physicians and hospitals. Correspondence to and from these sources is kept in the employees' medical record and thus affords additional material for our studies.

The company's medical program is conducted

*Dr. Pell is on the staff of the medical division of E. I. du Pont de Nemours & Co., Wilmington, Del.*

by 94 full-time and 50 part-time physicians, assisted by nurses, laboratory technicians, radiological technologists, and clerical workers. A medical section is located in all but the very small installations. Private physicians retained by the company examine employees not covered by company physicians.

Epidemiologic studies are carried out by a group consisting of a biostatistician, two statistical assistants, and a keypunch operator. At the direction of the biostatistician, a data processing section in another department does the computer analyses for these studies.

## Data for Epidemiologic Studies

The kinds of information usually required for epidemiologic studies and the sources within the company for each category are as follows:

| *Data on employees* | *Sources* |
|---|---|
| Medical: | |
| Identification of cases of disease. | Periodic health examinations, accident and health insurance claims, life insurance claims, and surveys of company physicians. |
| Medical data (physicians' observations and medical measurements — laboratory tests, electrocardiograms, and so forth). | Periodic health examinations and special examinations. |
| Data on personal health habits. | Interviews with employees and questionnaires. |
| Data on cause of death. | Medical records, accident and health insurance claims, life insurance claims, inquiries to company physicians and private physicians. |
| Demographic data (age, sex, race, occupation, education, socioeconomic class, and marital status). | Accident and health insurance claims and company personnel records. |
| Company population statistics (describing population at risk). | Company personnel records. |
| Data on control subjects | Do. |
| Descriptions of work environment (for use in studies on effects of occupational exposures). | Industrial hygiene surveillance. |
| Followup data (to measure the effect of illness on duration of working life and on survival period) related to: | |
| Recurrence of illness | Accident and health insurance claims, life insurance claims, and inquiries to company physicians. |
| Resignation or termination. | Company personnel records. |
| Retirement | Pension records and personnel records. |
| Death | Accident and health insurance claims, life insurance claims, and pension records. |

## Casefinding

In epidemiologic studies, every person in the study population with the disease under investigation must be identified and included. Otherwise the incidence or prevalence of the disease will be underestimated and epidemiologic associations will be distorted.

One approach to finding cases of disease in a large, widely dispersed industrial population is to have the company physicians report the cases. In instances, however, in which the physicians have been asked to identify new cases of a disease as they occur in a long-term, prospective study, we have not found this method successful. Probably the main reason for failure is that the physicians simply forget to report cases, especially if the disease rarely occurs among the plant employees. Whatever the reasons for failure, our experience indicates that this method should be avoided if a study requires the identification of new cases of disease over a lengthy period.

Case reporting by company physicians has a much better chance of success when they are asked to report existing cases of a disease in a retrospective or cross-sectional study. Under these circumstances, the physician is asked to make a report only once. In the diseases we have studied in this manner, such as diabetes and alcoholism, the plant physician usually knew the afflicted employees well. Even in this kind of study, however, case reporting may not be complete, and the results must therefore be regarded with appropriate caution.

To find cases for prospective studies, we have

used the claims filed under two company benefit plans with remarkably good results. One of these plans, which is found in many business and industrial organizations, provides group accident and health insurance for nonoccupational illnesses or injuries which cause disability of 8 days or longer. To enroll, an employee must have at least 6 months of service and pay a small monthly premium. The participation rate among eligible employees is about 96 percent. Each claim requires a description of the cause of disability, which is certified by the attending physician. When the recorded diagnosis is vague or incomplete, we send inquiries to the plant physician for clarification of the diagnosis.

The other benefit plan provides employees with life insurance after 1 year of service. The company bears the entire cost of this insurance so that participation among eligible employees is complete. The claim filed by the beneficiary is accompanied by a statement as to the cause of death, usually entered on a copy of the death certificate. When necessary, we obtain additional information on the cause of death from the employee's medical records or the plant physician. This insurance remains in force after the employee retires on a company pension.

These insurance claims limit case reporting to episodes of illness which result either in death or in disability of more than 1 week. Within these restrictions, the claims provide an economical and virtually complete source of information on the occurrence of major diseases in the employee population. They are an economical source because a copy of each claim filed throughout the company must be sent to the home office. The mechanism of case reporting is thus incorporated into the routine processing of claims. The claim files are a complete source because the money to which the insured or their beneficiaries are entitled provides the necessary incentive for filing a claim.

The benefit plans have been especially useful in a continuing study of myocardial infarction. If an employee survives the acute phase of an attack, his identity is made known to us by an accident and health insurance claim. If death occurs suddenly or within the 7-day waiting period, the case is reported to us on a life insurance claim form. Because we rely on insurance claims only for casefinding, we have had to exclude those employees with manifestations of coronary heart disease which may be nondisabling, such as silent infarctions, myocardial ischemia, and angina pectoris.

The insurance claims are also used in companywide studies of cataracts, cancer, and cerebrovascular disease.

### Medical Observations and Measurements

The periodic health examination of the employee is not strictly standardized throughout the company so that its content and thoroughness vary with the examining physician. Furthermore, each physician will apply his own diagnostic criteria to a clinical assessment of the examination results. In a study of a segment of the company's medical records several years ago, prevalence rates of disease were found to vary widely at different plant locations when the medical records alone were used to identify employees with disease. Thus, the variation in disease rates could largely be attributed to differences in examination procedures, diagnostic evaluations, and the methods of recording information.

To cope with this variability, those of us conducting epidemiologic studies have established our own diagnostic criteria for the diseases under investigation. We rely upon the medical records mainly for objective information such as body weights, blood pressure levels, pulse rates, electrocardiograms, and laboratory tests results. Although objectively determined, these measurements are nevertheless liable to a certain degree of observer error or bias. We have tried to control the effect of such errors on the elucidation of epidemiologic associations by comparing subjects with matched controls from the same plant location so that the matched pairs will be subject to the same errors in observation.

### Personal Health Habits

Information regarding the personal health habits of employees, such as their diet and use of alcohol, tobacco, and drugs, have been obtained by mail questionnaires in large-scale studies and by personal interviews in studies of relatively few subjects. Mail questionnaires have usually elicited about a 90 percent response among salaried employes after a follow-

up letter to nonrespondents. Among production workers, however, the response to mail questionnaires has been poor—less than 50 percent.

We are planning a questionnaire to submit routinely, perhaps every 3 years, to the employees when they appear for their periodic health examinatioins. It will include questions on symptoms, personal habits, and illness among family members. The questionnaire will provide information that should be useful to the examining physician and which may be incorporated into epidemiologic studies.

### Cause of Death

Notification of the death of an employee comes to us through group life insurance claims. The statement as to the cause of death which accompanies the claim is usually taken from the death certificate. We check this statement with clinical information in the employee's medical records and with diagnostic information on any disability insurance claims filed during his terminal illiness. If the statement as to the cause of death is vague, incomplete, or does not agree with information from other sources, we make further inquiries to the physician at the employee's plant or office or to his private physician. This procedure has revealed errors on death certificates in only a small proportion of cases. If these errors had not been corrected, however, they would have introduced significant errors into the analysis of our epidemiologic and mortality statistics.

### Demographic Information

One important advantage in getting demographic information for an epidemiologic study from within an industrial organization is that much of the information is verified in routine pre-employment personnel investigations. Costly personal interviews are not needed since the information desired is readily available from personnel records stored on computer tape.

Searching the computer personnel tapes is one method of retrieval, but we have found that a much more rapid and less expensive way is to keep on hand a complete alphabetical listing of all employees, which can be easily obtained from the tapes. This list can tell us quickly an employee's year of birth, occupation, plant location, educational attainment, length of service, and marital status. Since personal income is restricted information, it is not available for our studies. However, a salary classification code based on income provides us with a means of studying associations between health and economic status.

The personnel tapes also provide us with periodic, up-to-date statistics on the company population, broken down by age, sex, and payroll category (that is, whether employee is paid hourly or is salaried). These data are obtained for each installation as well as for the company as a whole.

### Selection of Controls

In a retrospective study in which a series of persons with a specific disease are compared with controls, the source of the controls and the manner in which they are selected are very important. Ideally, the controls should be representative of the population in which the cases of disease arose, and they should be drawn at random from that population.

When controls are drawn from a hospital population—a common practice—they are not likely to be representative of the general population. Although presumably free of the disease under investigation, such persons have some kind of illness and therefore are more likely than the nonhospitalized population to have other diseases and the characteristics associated with them. As a result, epidemiologic associations may be underestimated, obscured, or possibly exaggerated.

These potential biases are less likely to be present when the controls (*a*) are drawn from an employed population and are apparently healthy, (*b*) their medical history and demographic characteristics are known, (*c*) their socioeconomic backgrounds are similar to those of the persons with the disease, and (*d*) they receive about the same amount of medical care and observation as those with the disease. Furthermore, in such an employed population, the mechanics of selecting the controls is greatly simplified. Listings of the company employees on numbered pages aid in the random selection of controls. If the study design calls for the matching of cases and controls, a list can easily be constructed to show the matching characteristics of each employee.

### Work Environment

A working population offers excellent opportunities for investigating the effect of physical, chemical, and other stresses in the work environment. Most of the time, these stresses can be easily observed and measured.

We have frequently experienced difficulties, however, in finding a stable group of workers who have been exposed for a sufficiently long period to a specific measurable hazard. This problem may arise for one or more reasons. Workers are often transferred to other jobs or other areas because of production changes or as a result of a promotion. Frequent changes in manufacturing processes alter the work environment. Also, when an exposure is suspected of being hazardous, protective measures are taken, either by modification of the manufacturing process or by the use of protective clothing. Finally, employees believed to be affected by an exposure may be removed promptly to another job, leaving only the apparently resistant workers in the area.

### Followup of Employees

Prognostic studies of employed persons with chronic disease can be used to measure not only survival, but also the effect of the disease on the duration of the working life. The long-term followup required for such studies is greatly simplified by having personnel records available which are maintained routinely and can be easily retrieved.

In our followup of employees, we look for four events following the onset of disease—a recurrent disabling or fatal episode of the disease, resignation from the company, retirement, and death.

Recurrence of illness when it results in disability or death will usually be reported to us through the insurance claims. In addition to relying on these sources, we may also send annual inquiries to the plant physicians to get this information and other data pertaining to the person's health and employment status.

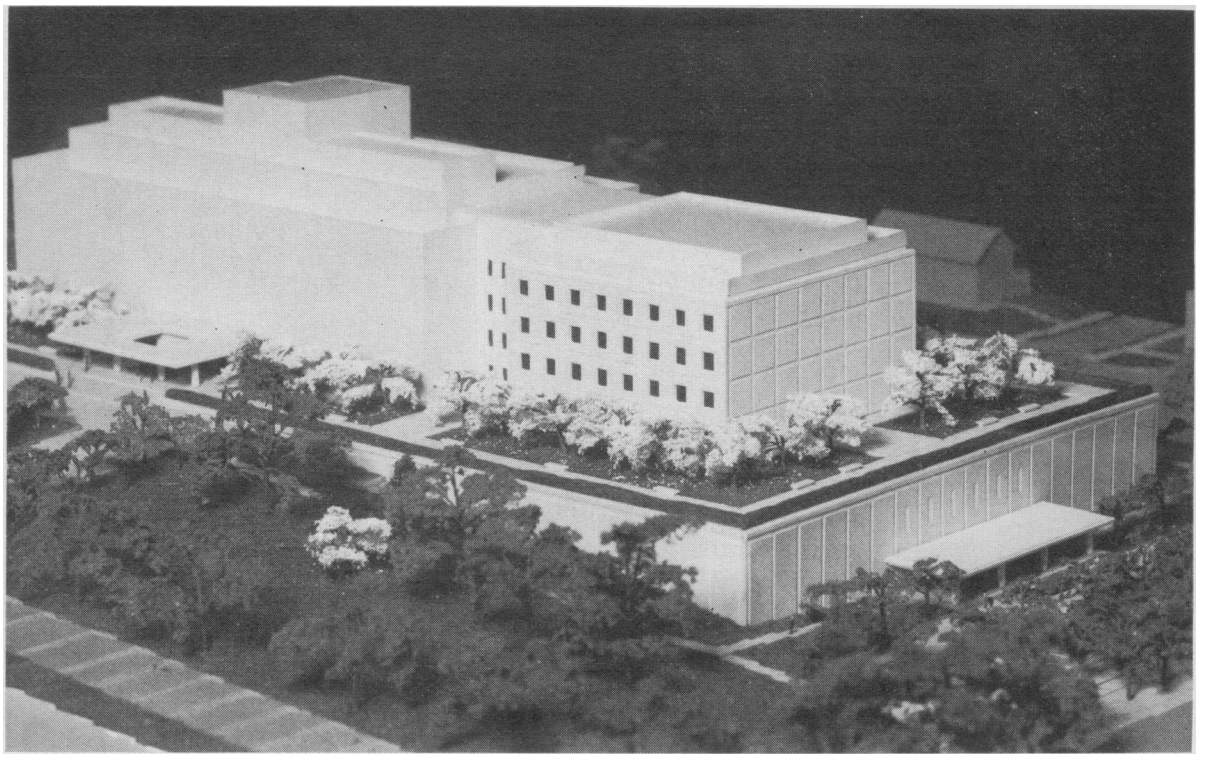
From personnel records we receive routinely, we can identify subjects in our studies who have left the company to work elsewhere. These persons are the only ones we are unable to follow until death. Since they usually constitute only a small proportion of study subjects, we make no attempt to trace them.

Retirement at age 65 is mandatory in the company, but an employee may retire earlier if he becomes so severely disabled by disease that he is no longer able to work. A retirement pension for disability can be given to any employee who has at least 15 years of service. Whatever the reason for retirement, we are able to follow all pensioners until death. Company life insurance in effect during working years remains in force throughout retirement so that we obtain routinely the date and cause of death of all pensioned employees. From the same source, we also receive routine notification of deaths among active employees.

### Summary

Information for epidemiologic studies in a large, widely dispersed population of employees can be obtained economically, since most of the required information is generated routinely and is readily available through computer retrieval systems. The large numbers of observations available increase the reliability of the data and reduce the length of time required to obtain answers to epidemiologic questions.

The size and dispersion of the population, however, results in a proportionate loss in the degree of surveillance over the sources of certain types of information. One way of coping with this problem is to confine the study to a probability sample or a segment of a company's employees. If the investigator uses the entire population, he will have to modify his objectives in accordance with the limitations thus imposed on the data.



# NEW MEDICAL MUSEUM

The Armed Forces Institute of Pathology is constructing a 120,000-square foot wing on the grounds of Walter Reed Army Medical Center. It is expected to be ready for occupancy in 1970.

The 46 laboratories in the new wing have been individually designed for negative and positive pressure, temperature, humidity, and lighting. Offices and laboratories will be equipped for eventual direct contact with the Institute's computer which can make 7,000 reference cases available in 1 day to a pathologist.

The wing will contain the only wound-ballistics experimentation complex and the only public medical museum in any U.S. medical facility. The medical museum will contain many new features, such as an audiovisual complex devoted to each system of the body, and an enlarged section of medical archives.

A professional museum will have 16 study rooms, each devoted to a particular discipline of pathology and equipped with display material, literature, and specimens. Visiting scientists may closely study exotic diseases and tissue reaction to injury.

A five-story laboratory tower will contain the following facilities:

- Military environmental pathology, accident pathology, legal medicine, law library, facilities for the Veterans' Administration and Public Health Service, and related laboratories.
- Ear, nose, and throat laboratories, registries of tissue reaction to drugs and noteworthy research, biomedical materials exchange, and 10 related laboratories.
- Geographic zoonoses, mapping of diseases, and mycobacterial branches, electron microscopy, and special research in muscular disorders.
- Geographic pathology and infectious diseases branch and related laboratories.
- A high-hazard biological area under the supervision of the Veterinary Pathology Division containing three bioexperimentation rooms, necropsy room, and laboratories.