THE PERIODIC HEALTH EXAMINATION RESEARCH PROGRAM: RESULTS AND PROSPECTS

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The periodic health examination is a medical survey of presumably healthy individuals carried out at predetermined intervals in an effort to diagnose disease in its incipiency, and thus to minimize its seriousness. This concept, long advocated by the medical profession, has been widely accepted by industry. The practice of so-called "preventive maintenance" of machines has proved so successful that its application to humans has seemed a logical extension. The value of these examinations has been judged largely by the kind and amount of disease diagnosed in groups of people in organized programs and by individual experience with a particular disease. For example, the managements of some companies feel that if only one early cancer lesion is discovered in years of examining all executives this, in itself, makes the PHE worthwhile. In view of the increasing amount of time and money being invested in this procedure, however, there is need for a better assessment of its value.

Does it have any effect, for example, on the masses of people in the programs? Does it affect morbidity? Mortality? Is the current type of examination the best? What tests or procedures should be added? Which should be dropped? What is the optimum package for different populations? There are any number of questions which should have been answered by now but have not been.

The United States Public Health Service has been cognizant of this problem for a long time and seven years ago invited representatives of several clinics performing these examinations to Washington to discuss the subject. It became apparent that many of the unanswered questions could only be answered if larger populations were available. To this end, this group of interested people set up a committee to organize cooperative research among the clinics. A director was appointed in April 1961 and several studies were designed for which funds were obtained in August 1961 from the United States Public Health Service.

The first study attempted was an analysis of the people who died while in a PHE program. The physician taking part in a PHE program has more than a casual interest in the obituary page of his local newspaper. There he sometimes finds an old friend whom he has recently examined and possibly given a clean bill of health. When this happens, he starts wondering if there wasn't really something wrong that he should have been able to detect but could not.

It was thought that a review of as many such cases as could be gathered might throw some light on this subject. At the very least, data would be obtained on the proportion of deaths occurring in people having had no diagnoses made associated with the cause of death at their last PHE. In other words, the percentage of people who had died after a PHE giving them a clean bill of health in terms of ultimate cause of death. Data would also be obtained on how this proportion varied when classified by other characteristics such as cause of death, age, interval between last examination and death, etc.

A study such as this might also disclose the fact that certain characteristics are different in a group of people who died while in a PHE program from those in a control group still alive, if in fact they are different. For example, the proportion of heavy cigarette smokers in the dead group might be higher than in the alive control group, or the proportion of overweight people might be higher, etc. This would give one some idea as to which characteristics are important to consider if one wishes to assess risk of death at the periodic health examination of any individual.

A study of this type could also help in evaluating certain tests and procedures in terms of their power to discriminate between people who died and those who did not die in the same interval of time.

Finally, in the process of examining the past PHE records of people who have died, other interesting studies might be suggested.

MATERIALS AND METHODS

Ten Clinics* performing periodic health examinations on people in the same broad socio-economic group - executives of companies and the faculty of a university - supplied data on 350 usable deaths and 350 counterparts still alive and matched with the dead people on clinic, age, date of last examination and time-interval

(*) The ten Clinics supplying the information:
Benjamin Franklin Clinic
Eastman Kodak (Rochester Plant)
General Electric (Schenectady)
The Greenbrier Clinic
Associates of Mass. Memorial Hospitals
Univ. of Pennsylvania Diagnostic Clinic
Univ. of Pittsburgh
Univ. of Michigan, Faculty Program
Standard Oil Company (N.J.)
United States Steel Co.

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in a PHE program.

The data supplied consisted of the findings on every PHE performed on these 700 people, certain items in their family histories, their medical histories, and the diagnoses made by the examining physician at each of these examinations.

These 350 deaths were only the ones classified usable for the purpose of this Study. They were all males, all in a PHE program (did not just present themselves when deemed necessary), all in whom the cause of death could be determined by death certificate and all for whom matched counterparts could be obtained.

Only the data on the last examination on the dead person and the examination performed at the same time on the alive counterpart, were used in this Study. Over time changes, i.e. changes from first examination to last, in all tests and procedures are being analyzed but as yet no patterns are discernible.

The causes of death used were those listed on the death certificates and were combined into 7 categories as follows:

1. Coronary heart disease (including coronary occlusion, coronary thrombosis, myocardial infarction, coronary heart attack, acute coronary insufficiency. International Codes 420x).

2. Other heart disease (including decompensation, myocardial insufficiency, cardiac failure, rheumatic heart disease. 41xx, 421x to 446x).

3. Vascular disease (including cerebral vascular accident, cerebral hemorrhage, emboli, aortic aneurysm, subarachnoid hemorrhage, ruptured aneurysm, etc. 330x to 334x, 45xx, 463x, 464x, 465x, 466x).

4. Cancer, leukemia, and other malignant disease (140x to 207x, 23xx).

5. Post-operative deaths.

6. Accidents and suicides.

7. Other deaths.

To test the validity of causes of death as drawn from death certificates in this Study, a sample of 18 records of autopsies performed on subjects dying in the Philadelphia area was examined. These showed agreement with the death certificate as to cause of death in 17 instances.

In determining whether the cause of death had been detected prior to death, the diagnoses made by the examining physician were compared with those on the death certificate. Agreement was considered to exist if the clinical record included either the specific diagnosis of cause of death, or a diagnosis of a disease closely related to the cause of death.

The first question we wished to answer was:

Question 1 - How often was the cause of death detected on last examination?

The disease which caused death was known on the last examination in just about one-half of those who died. This proportion varied with age, cause of death, interval between last examination and death and other characteristics, one of them being cigarette smoking. It was interesting to note that heavy cigarette smokers who die from coronary artery disease tend not to have the disease diagnosed before death, whereas light smokers and non-smokers who die of it, do. One interpretation is that heavy cigarette smokers tend to die from coronary disease before the onset of clinical manifestations of the disease, whereas non-smokers do not. Putting it another way, one might conclude that non-smokers have a better chance of surviving the first coronary than heavy smokers.

If one wishes to use these figures, i.e. the proportion of people in whom the cause of death was known at the last examination, as an assessment of the accuracy of the PHE a severe limitation arises. If a diagnosis of heart disease is made on everyone being examined then, obviously, in 100 percent of the coronary heart disease deaths would the cause of death be known on last examination. Ideally, in order to draw a valid conclusion about the accuracy of the examination the proportion of heart disease diagnoses made incorrectly should be known. This was impossible to ascertain. It was possible, however, to obtain a sample of people similar to those who died who were still alive at the time of the former, and calculate the proportion in whom heart disease was diagnosed.

For this reason, for each person who died while in a PHE program another person who was alive at the time of death of the former, was selected. This control was matched on several characteristics with his dead counterpart. He was the same age, the same sex, the same race, visited the same Clinic, was examined at approximately the same time as the last examination of the dead person, and had been examined over the same interval of time. These alive matched counterparts can be thought of as a representa-

tive sample of all people who are alive but having the same age distribution, examination date, etc. as the dead group.

As noted, in one-half of the people who died, the cause of death was known at the last examination. In 1/5 of their alive counterparts, the same disease had been diagnosed at the last examination. Thus, it was only 2-1/2 times as likely for a person who died to have had the cause of death diagnosed as it was to have had the same disease diagnosed in those still alive.

A more detailed discussion of this Study and a more comprehensive set of results appear elsewhere.

The data gathered to answer Question 1 can also be used to answer another question, namely: Are there any characteristics which distinguish the people who died from those who survived the same period of time?

If one compares two groups, one containing all who died with the other containing all who survived, one finds that those dying of coronary heart disease had certain abnormalities with significantly greater frequency than did their surviving counterparts. In addition, these characteristics were not the same when one compares deaths with survivals of people in whom coronary heart disease was diagnosed as they were when coronary heart disease was undetected in both groups.

If a test is given to two individuals, one of whom dies and the other survives, the test results will fall into 1 of 4 categories:

1. The test may indicate abnormality, i.e. be positive in the member who dies and negative or normal in the member who lives. In this case the test has correctly discriminated between them in terms of survival ($\mp$).

2. The test results may be exactly the reverse, i.e. positive in the member who survives and negative in the member who dies. This may be termed "false discrimination". A positive test has not only failed to develop in the member who died, but has developed in the survivor (+).

3. The test may be negative or normal in both ($=$).

4. It may be positive in both ($\dot{+}$).

None of the characteristics tested appeared to discriminate very well between people who died and people who did not die in the same interval.

We hope in the future to obtain discriminant functions for these data but they are not as yet available.

Another question which arose after a cursory glance at the collected data is now being attacked. For people who died of coronary disease within a year after the EKG was read as normal was there anything unusual about these EKG tracings, as compared to people with so-called normal tracings and still alive? This is being studied at the University of Michigan and I have as yet no results to report.

At present we are starting two new studies in evaluating the PHE. One is aimed at determining if the PHE has any effect on mortality rates. The other has as its goal the selection of risk factors for certain diseases.

The study of mortality will be attempted in two major sections. The first will be the establishment of life tables for all people in the PHE programs of the cooperating Clinics for specific causes of death. Life tables will also be constructed for executives and for other population subgroups if warranted by size of sample. These tables will be compared with known tables for similar groups. The second will consist of locating life tables for as many different groups as are now or will shortly be available and comparing them with life tables constructed for various comparable segments of our PHE group.

A table of age specific mortality rates will be computed for the executives of certain railroads who have been in a PHE program since 1950. A comparison of these mortality rates will be made with rates available from other sources for all railroads.

A table of age specific mortality rates will be computed for faculty members who have been in a PHE program. A comparison of these mortality rates will be made with rates available from other sources for all teachers.

A table of age specific mortality rates will be computed for various socio-economic groups as similar as possible to those which are soon to become available from another study.

If possible, mortality rates will be constructed from insurance company records for insured people as similar as possible to people in certain segments of the PHE group.

The study of risk factors is a retrospective-prospective type of study - prospective as of 10 years ago. Incidence rates of certain diseases among groups of people with

and without selected characteristics will be compared. The diseases to be studied are: coronary artery disease, hypertension, hypertensive heart disease, and diabetes.

A whole host of risk factors will be tested. As a by-product of this study some light will also be thrown on the question of the relationship between rectal polyps and cancer of the colon.

Some important findings are being uncovered by this cooperative program. But more important than any of these to us is the knowledge that these Clinics can work together and that they realize how important standardization of techniques, records, etc. is. We hope that if nothing else comes out of this effort but standardization, it will have been worthwhile.

We, meaning the research team of Drs. Katharine and Kendall Elsom and Thomas Clark, of the University of Pennsylvania, Dr. James Dunn, formerly of the University of Pittsburgh and now with Western Electric, myself, and the Steering Committee headed by Dr. Norbert Roberts of the Standard Oil Company (N.J.) are indebted to the Long-Term Illness Branch of the Division of Chronic Diseases of the U.S.P:H.S. and especially to Mr. Robert Thorner, for their support, and also to the people at the cooperating Clinics who gave much time and knowledge to this program.