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The Role of Natural Consequences in the Changing Death Patterns*

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ABSTRACT: A comparison of the causes of death listed in autopsy protocols at Graz, Austria, for 1930 and 1970 showed that the major change was a marked decrease in deaths from tuberculosis and a marked rise in deaths from myocardial infarction. In 1930, patients over 50 years of age dying with tuberculosis had advanced coronary atherosclerosis which soon would have caused death if tuberculosis had not won the race. Myocardial infarction did not start its explosive rise until the introduction of specific drugs against the tubercle bacillus. This began in 1946 at a time when the diet was low in cholesterol, smoking was at a low ebb, sedentary life was unknown, and stress was decreasing as the war ended. Moreover, during the early years of the rise in myocardial infarction there was evidence of active or healed tuberculosis in postmortem studies. It appears that a major factor in the rise of coronary disease was prolongation of the life of patients with tuberculosis or a susceptibility to it. Coronary disease and emphysema accounted for 90 per cent of the increase in degenerative diseases. Prostatic cancer, juvenile cancer and lung cancer together accounted for 86 per cent of the rise in malignant diseases. Thus the law of chance did not control the distribution of the causes of death among those escaping death from infections. In myocardial infarction, the preponderance of males is similar to that in tuberculosis, indicating that supply and demand may be to blame. Any theory about the changing death patterns should take into account the factor of natural consequences, as may be revealed in autopsy studies.

During the 20th century the explosive rise in the frequency of certain disorders such as heart attacks, lung cancer and emphysema has caused grave concern among scientists and clinicians. Heroic efforts to change the diet, curtail smoking, increase exercise, and make other alterations in the mode of living have been futile. Before further expenditure of precious manpower and scarce money it seems expedient to examine the role of natural consequences, as reflected in the routine autopsies conducted at Graz, Austria.

Graz is a unique location for the study of changing death patterns. First, only the Landeskrankenhaus is available for routine hospitalization, thus insuring a cross-section of society in a city of 230,000 population. Second, a law passed by the renowned Empress Maria Theresa over 200 years ago requires autopsy for all hospital deaths in the city. Third, the population is relatively stable, with no major disruptions in hundreds of years. Fourth, the diet and the technologic development are comparable to those in the United States. The "Iron Age" was born near Graz over 2000 years ago.

Any change in the incidence of a disease during the year can be detected by counting the number of cases of that disease among the autopsies for that particular year. In the present study, three elementary procedures were employed. First, all diseases showing a marked decrease in incidence were collected into one group. Second, all diseases showing a marked increase in incidence were collected into another group. Third, individual diseases

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in each group were studied for any similarities in characteristics.

Observations were confined to the years 1930 and 1970, since both years are somewhat removed from wars; war materially affects the death pattern and several years are required to recover from its influence. All of the deaths for each year were divided into four categories: 1) those due to infectious diseases; 2) those due to malignant diseases; 3) those due to degenerative diseases; and 4) those due to accidents, suicides and a few other rare diseases not fitting into the other categories. Errors in separating the various diseases should not invalidate the results since the same criteria were used for each year. Table 1 summarizes this distribution.

CHANGES IN CAUSES OF DEATH IN GRAZ, AUSTRIA—1930 VERSUS 1970

It is readily apparent that the most dramatic change during the 40-year interval was the reduction in deaths from infectious diseases. In 1930 almost half of all the deaths were caused by infectious agents. By 1970 more than 50 per cent of this carnage had been eliminated. The moderate rises in the other three categories could have come only from those escaping premature death from infections since only one death occurs for each birth. In 1930 only 47 per cent of the total deaths were of patients over 50 years of age; by 1970 this had risen to 67 per cent. Many more persons were subjected to the diseases of later life.

Analysis of the data on infectious diseases revealed that the most outstanding change was the reduction in the prevalence of tuberculosis. For a century this had been the leading cause of death, hence there were more patients who had this disease. In 1930 deaths from tuberculosis had totaled 170; by 1970 the total had fallen to 18. Hence, of the reduction by 241 in deaths from infectious diseases, tuberculosis alone accounted for 63 per cent. This means that nearly two-thirds of the new patients dying with degenerative or malignant diseases in 1970 had one thing in common, they were unusually susceptible to tuberculosis.

Year-by-year study of the protocols revealed that very little change had occurred in the death patterns until after World War II when the antibiotics became available. In reality the dramatic changes illustrated in Table 1 were not the result of a gradual shift over a period of forty years but a striking alteration occurring in less than twenty-five years.

Having established that only the infectious diseases had shown a marked decline and that the malignant and degenerative diseases accounted for any disproportionate increases, the next step was to quantitate the changes for those diseases showing the more remarkable rises. It became apparent that two degenerative diseases and three malignant diseases accounted for the more dramatic elevations. The data are summarized in Table 2.

It is evident from Table 2 that heart attacks predominated among the diseases showing a rise, just as tuberculosis predominated among those showing a fall. The 60 new cases of myocardial infarction in 1970 represented 57 per cent of the total rise in degenerative diseases listed in Table 1. Emphysema had 36 new victims; this rate, when combined with that for myocardial infarction, accounted for 90 per cent of the rise in degenerative diseases. Obviously the law of chance did not distribute the survivors of premature death from infections.

The same was true of malignant diseases. Although bronchial carcinoma, prostatic cancer and malignant disorders in children shared in a similar rise in percentage, 33 of the 51 cases were bronchial carcinoma. These three malignant diseases represented 86 per cent of the

TABLE 1
Fluctuations in Various Categories of Deaths at Graz, Austria, 1930 and 1970
(number per 100 autopsies)

Category	1930	1970	Percentage Change
Deaths from infections	426	185	−56
Deaths from malignancies	189	240	+27
Deaths from degenerative diseases	238	343	+44
Deaths from accidents	37	47	+27

TABLE 2
Phenomenal Rise in the Incidence of a Few Diseases according to Autopsies at Graz, Austria, between 1930 and 1970
(number per 1000 autopsies)

Disease	1930	1970	Percentage Change
Heart attacks	6.8	69.0	+1000
Emphysema	8.6	40.6	+372
Prostatic cancer	1.8	8.3	+361
Cancer in children	1.2	5.4	+349
Bronchial cancer	11.0	44.0	+300

new cases appearing in 1970. A discussion of the significance of these observations on the disproportionate rise of malignant disorders and emphysema will be left to future publications in order to emphasize here the close relationship between tuberculosis and myocardial infarction.

MYOCARDIAL INFARCTION VERSUS TUBERCULOSIS

Tables 1 and 2 supply quantitative data for the established fact that myocardial infarction has replaced tuberculosis as public-health enemy Number One. It is common knowledge that tuberculosis began to decline in many countries during the latter part of the 19th century. Autopsy studies from many European laboratories indicate that myocardial infarctions began to rise in the last century but have catapulted during the present century. This has not been the case at Graz. Tuberculosis showed only a minor decline until the specific drugs against the tubercle bacillus appeared at the end of World War II. Conversely, myocardial infarctions did not start to rise until tuberculosis decreased. This is probably far more than coincidence.

In a recent monograph by Barnes and Barnes (1), it was demonstrated that the change to a diet low in cholesterol during World War II at Graz did not improve coronary sclerosis. In fact, the reverse was true. Yet myocardial infarctions fell 75 per cent at the time. A marked rise in deaths from tuberculosis during the war, eliminating adult men with advancing coronary disease, offered a better explanation for the decline in myocardial infarctions than did a change in diet.

The autopsy protocols showed that myocardial infarctions reached a low ebb of 3 per 1000 autopsies in 1945, at the close of the war. In 1946 the figure had risen to 7, and a progressive rise followed, reaching 69 in 1970. No record of a comparable explosion has been found elsewhere. This gives rise to two outstanding questions: 1) *Why was Graz so late in experiencing a rise in myocardial infarction?* 2) *How could this disease appear so suddenly and rise so rapidly?*

The answer to the first question seems rather simple. Graz is a goiter area and the entire population has suffered from a relative thyroid deficiency. Iodized salt was not introduced until 1963. It is well established that the hypothyroid patient is highly susceptible to infectious diseases. Sanatarium care and isolation did not curb tuberculosis at Graz as it did in other countries. This disease continued to decimate the young people as well as a few oldsters, until the antibiotics arrived. The average age of the tuberculous patients surviving in Graz in 1944 was 38 years. Myocardial infarction will not often beat tuberculosis to the "draw" in that age group.

The average age at death from myocardial infarction in Graz is 66 years. A study of the coronary arteries in men dying from tuberculosis in 1945 revealed that there were 16 between the ages of 60 and 69. Each of them had advanced coronary disease, and in 7 the degree of damage was 4 on a scale of 0-4. Thus these men were rapidly approaching death from coronary disease as well as from tuberculosis. All that was necessary to tip the balance in favor of myocardial infarction was treatment with antibiotics to delay tuberculosis. This seems a more plausible explanation for the sudden rise than environmental factors.

At the end of the war, the Austrian was not eating the plush diet characteristic of the American. Neither was he smoking an excess of cigarettes. These had been unavailable to civilians during the war, and as late as 1958 smoking was still relatively light. A sedentary life was not in evidence; the automobile had not replaced the bicycle. Stress was decreasing as the war ended. In spite of these favorable environmental factors, suddenly heart attacks began to erupt like Vesuvius.

On the other side of the coin was the fact that the antibiotics were curtailing tuberculosis beyond any dreams. Deaths from tuberculosis plummeted like a shot-albatross and in six years were reduced by 50 per cent. The rise of myocardial infarction was just as rapid. In 1919 Herxheimer (2), on the basis of a voluminous autopsy study at Munich, pointed out that tuberculosis is associated with accelerated atherosclerosis. The autopsies at Graz have confirmed this finding. Only a few more years of life are necessary to convert a statistic on tuberculosis to a statistic on infarction.

The autopsies at Graz on tuberculous patients in 1945 suggest a solution to another perplexing problem in myocardial infarction. In the 60-69 age group there were only 6 females compared to 16 males. This preponderance of males afflicted with tuberculosis is characteristic throughout the world. The 1962

volume of Epidemiological and Vital Statistics of the World Health Organization (3) lists the following distribution of the sexes in deaths from tuberculosis for the years 1947-49:

Country	Deaths per 100,000	
Japan	males 169	females 129
Italy	males 59	females 38
England	males 53	females 33
Canada	males 34	females 28
U.S. (whites)	males 30	females 14

This preponderance of males in tuberculosis is similar to that in myocardial infarction if one considers all age groups in the latter disease. If the rise in myocardial infarction can be attributed to elimination of premature deaths from tuberculosis, there are more male candidates available, and the influence of the female sex hormone may be only a red herring. Certainly attempts to use female hormone on males with myocardial infarction have not only been futile but frustrating because of the feminization. The core of the mystery seems to be: Why are males more susceptible to tuberculosis? The solution of this problem must be left to the future.

INFECTIONS AND ATHEROSCLEROSIS

The autopsy data at Graz points rather strongly to the old tuberculous population being converted into a population with myocardial infarction. However, the majority of the present generation never encounter the tubercle bacillus. This leaves little doubt that the rising incidence of heart disease is not the direct result of tuberculosis, but it does not remove the possibility that the person who is susceptible to tuberculosis is also susceptible to atherosclerosis. In 1925 Zinserling (4) reported that many infants dying from infectious diseases showed the early stage of arterial damage. The infections were not tuberculous. Obviously atherosclerosis is closely associated with susceptibility to infections.

The link between infections and atherosclerosis seems to be through a thyroid deficiency leading to a deposition of mucopolysaccharides in the tissues. This evidence was recently reviewed by Barnes (5). Antibiotic therapy has stopped the ravages of the infectious diseases of infants and children, allowing the progressive accumulation of mucopolysaccharides in those who are hypothyroid, as demonstrated by Andersen et al. (6). Many of these children survive to adulthood with modern medical care. The infant who would have died with pneumonia in 1945 without antibiotics became 25 years old in 1970. This is sufficient time for the development of coronary disease. At Graz an occasional case of fatal myocardial occlusion occurring in a patient below the age of 30 is being observed for the first time in the autopsies. In this goiter area it seems reasonable to assume that these patients might have had a marked degree of hypothyroidism.

It is fitting that the tuberculosis sanatariums of the past are being converted into general hospitals for the management of heart attacks. The identical patients are being cared for, but they are arriving twenty-five years later with a new ailment.

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