In Israel, we did not face lobbying by industry, and the equivalent political body did not interfere. Thus, to a certain extent, the decision was entirely in our hands. Still, the data were not adequate to make such a decision, since the alternate risk of excess sugar consumption could be stronger. But the data were also insufficient to make the opposite decision. Thus, when I was asked to approve diet cola, I declined, fearing that an additional load of a dose-dependent substance may tip the delicate balance.

Prospect

Epidemiology, which is often defined as the study of rates and distributions, may shed light on the darkness of administrative routines. Therefore, if it is properly applied, it should help us, the wandering scientists in Bureaucracy to utilize quantitative methods and scientific criteria in the labyrinths of the decision process.

To examine more rigorously and to decide more precisely is, after all, our main responsibility. It is also our duty to the people we serve.

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Uses of Epidemiology in the Development of Health Policy

WILLIAM H. FOEGE, MD

Dr. Foege was Director of the Centers for Disease Control, Public Health Service, when the Second Binational Symposium: United States-Israel was held in Bethesda, Md., October 17–19, 1983. He is presently Special Assistant to the Director for Policy Development.

Tearsheet requests to William H. Foege, MD, Bldg. 1, Rm 3071, Centers for Disease Control, Atlanta, Ga. 30333.

EPIDEMIOLOGY IS WIDELY but quietly used in policy formation. As its use increases, basic systems of data collection, analysis, and distribution must be improved throughout the nation.

For example, the core of epidemiology is to (*a*) define the distribution of a disease or condition, (*b*) define the determinants, and (*c*) define the effects of that disease or condition. The basic tool of this process is the definition and interpretation of ratios between numerators and denominators. As a result, the outcome of epidemiology is highly dependent on a system that collects the right things and collects them right. Some basic improvements are now taking place in this collection system.

I will first describe some general trends in epidemiology and policy and then look at some specific recent examples from the Centers for Disease Control (CDC).

The use of epidemiology is increasing as is the acknowledgement of epidemiology's relevance in public health policy. It is no longer an academic practice, nor is it a phenomenon of the developed world. In the past 30 years at CDC alone, we have trained more than 1,200

'Epidemiology . . . is no longer an academic practice, nor is it a phenomenon of the developed world. In the past 30 years at CDC alone, we have trained more than 1,200 Epidemic Intelligence Service Officers in basic field epidemiology.'

Epidemic Intelligence Service Officers in basic field epidemiology. Around the world, as one result of the Smallpox Eradication Program, surveillance and epidemiology are used daily in a wide variety of field applications.

Collecting the Right Information

As noted, epidemiology is no better than the information on which it is based. The first third of the surveillance arc—the collection of data—has changed rapidly in this country.

No surveillance system existed for any disease in the United States until 1950. That year a national malaria surveillance program was started. With followup of reported cases, and attempts to secure a laboratory diagnosis in each case, it was soon discovered that indigenous malaria had already disappeared in this country. The first national surveillance program was important in proving the absence of a disease.

In 1955, poliomyelitis in persons recently given polio vaccine resulted in the overnight development of a national surveillance system. This system quickly identified a problem with one manufacturer's vaccine, allowing the immunization effort to continue using vaccine from other sources.

It took 2 more years until the third national surveillance system, for influenza, was started in 1957. Now dozens of conditions are reportable to a central system—not because of Federal laws, but because the States have agreed to make them reportable. In addition to the reportable conditions, good surveillance systems have been developed and keep track of many other conditions that are not reported by all States as part of an official national system.

For example, surveillance of Guillain-Barré syndrome was developed, using information from 2,000 neurologists. Surveillance of conditions related to environment and occupation has been instituted with the help of information from emergency room records as well as reports from industry and labor unions. Death certificate reviews, health and nutrition surveys, national probability samples, longitudinal studies, and case-control studies have all been used to improve surveillance, and all of these sources have led to a vast reservoir of raw data unavailable to earlier epidemiologists.

Analysis of the collected data, the second part of the surveillance arc, is the heart of epidemiology. It will determine directions in public health in the decades to come and will make it possible to change methods or process as necessary to deal with both chronic and infectious diseases.

The third part of the surveillance arc is made up of two activities: (*a*) the public health response to analysis of data or information and (*b*) the sharing of information. The second activity raises many new issues—privacy, duty to warn, adequacy of response, improvements in response, and sharing of information. When each of these issues is balanced well in the dissemination of information, our ability to collect information is improved. For example, the Morbidity and Mortality Weekly Report (MMWR) each Tuesday collects information from the States regarding health conditions reported for the previous week; MMWR is mailed to thousands of health workers around the nation and the world. The timeliness of the information, the ability of recipients to do their own analysis of raw data, and the opportunity of those reporting to see how their information compares to, and contributes to, the whole picture have improved the quality and quantity of reporting and the analysis of those reports.

Some specific examples of information sharing illustrate the point.

Epidemiology and the 1990 Objectives

In June 1979, a meeting was held in Atlanta. People attended from around the country, representing the academic world, State and local health departments, the Public Health Service, and other interested groups. They were concerned with developing health objectives, which were attainable by 1990, for this nation. In 15 different areas of health, discussion centered on the art of prevention and what could be achieved if existing knowledge about preventive medicine were applied. More than 200 specific objectives were developed in the 15 areas; epidemiology was used to identify the distribution, the determinants, and the effect of a health condition. To achieve those objectives, some consensus was reached about the vulnerability of the disease problem to known preventive techniques.

These 1990 objectives have been used as a road map for the Public Health Service for the last 5 years. Meetings to correct directions at mid-course have been held with staffs of State and county health departments and representatives from schools of medicine and schools of

public health to determine whether the original objectives are still viable. Changes have been suggested and modifications made for many objectives. In addition, the Public Health Service each month reviews 1 of the 15 areas to determine what progress has been made and what should be changed. These reviews are then published in *Public Health Reports* for distribution to a much larger public health audience.

We now have a national prevention strategy based on epidemiologic analysis of where we were, and are, and what the possibilities are for future progress. The process continues with ongoing surveillance and epidemiologic analysis of what has happened as the nation proceeds toward the 1990 Objectives.

Epidemiology and the Immunization Program

The second example concerns the immunization program. In 1977, despite inexpensive vaccines that were safe and effective, immunization levels had fallen in the United States to inadequate levels. Polio immunization rates, for instance, were only slightly more than 60 percent. A decision was made that two new objectives would be developed for the immunization program. The first was to reach 90 percent coverage of the childhood population and the second, to develop a system for enrolling newborns into the immunization program. The results were so encouraging—the objective of 90 percent was soon found to be unrealistically low—and at present, the immunization coverage of children entering school is more than 96 percent for most of the vaccines. Because of the encouraging results, a new objective was set: to attempt the interruption of measles transmission in this country. All measles cases in the United States then would be traced directly to importation. Weekly meetings were held to review all cases of measles and to determine what had gone wrong with the prevention system. Each problem was detected by, and defined by, epidemiologic techniques, and some problems then required a policy decision to attempt a solution.

As each solution was successful in stopping measles transmission, a new problem become evident. For instance, one of the first problems discovered was that some cases of measles in this country could be traced to refugee children from Southeast Asia. A policy decision was made to send CDC employees to the refugee camps in Southeast Asia to begin immunization before the children arrived in this country. The refugee importation problem totally disappeared.

The next problem detected concerned military recruits; during their basic training, a number of them developed measles. During the incubation period they returned to their homes and spread measles. The solution to this problem was reached with the cooperation of the military. The armed forces agreed to provide measles immunization to all new recruits. That source of measles disappeared.

'Next, it was found that any gathering—whether at sports events, Disneyland, drum and bugle contests, or physicians' offices—could result in the spread of measles. The obvious solution is to provide not only a high level of immunity for those who attend such gatherings, but to make certain that workers, whether they are medical care workers, Disneyland workers, or others, have also been immunized.'

A third problem surfaced in day care centers where children who were pre-school, and therefore not subject to the school entry laws, would transmit measles to other children and sustain community outbreaks. The solution for this problem is to implement the same entrance requirements for day care centers that are in place for schools. This problem is largely being resolved by actions at various levels.

Next, it was found that any gathering—whether at sports events, Disneyland, drum and bugle contests, or physicians' offices—could result in the spread of measles. The obvious solution is to provide not only a high level of immunity for those who attend such gatherings, but to make certain that workers, whether they are medical care workers, Disneyland workers, or others, have also been immunized. Recently our problems have centered around outbreaks among college students, an age group that was missed in the intensified immunization campaign; also they grew up at a time when partial immunization reduced their chances of contracting wild measles. Solving this problem will require the same regulations about immunization before entering college that are being used for pre-college school children.

Finally, importations from other countries remain a source of measles. The United States experiences two to three importations a week from other countries. Analysis of these importations makes us confident that imported outbreaks can be detected and quickly controlled. We believe that the present policy of interrupting indigenous transmission and controlling importations is sound.

Epidemiology and AIDS

The third example of improved epidemiologic analysis and information exchange concerns the acquired immune

deficiency syndrome (AIDS). Descriptive epidemiology has defined high risk groups and, further, has defined risk factors within the groups. Based on epidemiologic analysis, policy decisions have been possible, such as recommending to gay males that they limit sexual contacts and that they particularly limit anonymous contacts. Epidemiologic analysis has made possible recommendations for intravenous drug users concerning their risks and how those risks can be reduced. It has made possible recommendations on blood donations, on the use of Factor VIII, a blood product used by persons with hemophilia, and on other practices to reduce the risk for acquiring AIDS.

Epidemiology and Toxic Shock Syndrome

Some of the most difficult public health decisions arise when epidemiology suggests that a policy decision is required, yet the information is less than desired. For example, when the first cases of toxic shock syndrome were reported to CDC, the response was to publish the information available in the MMWR. This in turn resulted in a great many new cases being reported, which illustrates again the importance of disseminating surveillance data.

A retrospective case-control study soon indicated that one major risk in acquiring toxic shock was the use of tampons. The initial study could not differentiate risks between different tampons because it was not possible to match totally by brand the use of tampons by controls and cases. However, a prospective case control study indicated that a higher relative risk was found among users of Rely brand tampons. Therein lies a public health dilemma. Although the scientific approach in general attempts to verify a new finding by a second study, in the area of public health it is often necessary to make information available on the basis of a single study.

It was decided that consumers must know the finding of that initial study, and when the information was published, the manufacturer voluntarily withdrew Rely tampons from the market, making it impossible to do a second prospective case-control study. A similar dilemma arises with the use of aspirin for children and its possible role in Reye syndrome. The same is true of the use of liquid protein diets and the subsequent risk of death. One must err in favor of protecting health rather than protecting money when such dilemmas exist.

Other Uses of Epidemiology

In some cases, practices change outside of official policy decisions. About 15 years ago, surveillance was started on morbidity and mortality trends among women undergoing abortions. The publication of material on abortion procedures with the highest morbidity and mortality resulted in a change in practice. Morbidity and mortality have been substantially reduced among women undergoing abortions, even though there has not been an official policy decision on how abortions should be done.

Chemical health hazards in the environment are responding to epidemiologic analysis even though they are much more difficult problems than any others previously seen in public health. Instead of following a disease to determine etiology, we are often in a position of following a chemical forward in time to see if there is an association with disease. Policy decisions related to environmental hazards have been required frequently in the past several years, and more will be needed in the future. For instance, at Love Canal, information on the distribution and concentration of chemicals was combined with information on the known human or animal effects of those chemicals, and policy decisions were made about habitation. At Times Beach, information on dioxin concentrations and distribution, again combined with estimated human exposure and animal studies, led to decisions on habitation and clean-up requirements.

We have known for a long time that restraints in automobiles can save lives and reduce injuries. Yet the use of child restraints did not result so much from a national policy decision as it did from the passage of laws by States—first Tennessee and now more than 40 States. The scientific case for air bags is strong, yet the policy decision has been thwarted by other influences, basically political in nature.

With drinking and driving, the epidemiology is clear. We are now seeking some change in this country, not because of logical decision making based on epidemiologic data, but because a group of mothers were personally touched by this tragedy.

Finally, rarely has epidemiologic evidence been as strong as that which now exists linking cigarette smoking and impaired health and premature mortality. One thousand premature deaths per day occur in this country alone because of cigarettes. Yet, rational policy decisions in this area have been difficult and when made, they have often been diluted by political factors. The epidemiologic evidence permits no excuse for allowing cigarette advertising. There is no excuse for nonsmokers having to pay the health bill that results from cigarette smoking. And new ways must be devised to clearly convey what we know to the general public, especially to teenagers.

In summary, the support system for epidemiologic analysis and its role in policy formation continues to improve and broaden. The use of epidemiology is clearly increasing in the making of public policy. Health problems caused by cigarettes, highway injuries, and alcohol abuse make it clear that epidemiology has not yet reached its potential for producing sound public health policies.