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THE ROLE OF EPIDEMIOLOGY IN HELPING CDC IMPROVE PUBLIC HEALTH

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The Centers for Disease Control (CDC) began as a program to eradicate malaria in the southeastern United States in the 1940's. The Istituto Superiore di Sanità, in an interesting parallel, also began as a malaria program. CDC has moved from malaria to vector–borne diseases, then to communicable diseases, and finally to prevention in general. CDC is charged with responsibility for safeguarding the health of the American people by controlling or preventing disease, including the prevention of all unnecessary morbidity and mortality. However, this must be seen in the context of the laws of the US which make health a state subject and the federal role one of coordination and support. CDC's international activity continues to grow, providing staff and consultative support for the World Health Organization and the 80 countries in which CDC staff worked in 1983.

Malaria Control in War Areas (MCWA), a World War II emergency agency, was CDC's immediate ancestor. This Agency was headquartered in Atlanta, Georgia, primarily because at the time malaria was believed to be endemic in the southeastern United States, where troops were being trained for campaigns in Africa and Italy. An epidemiologic investigation conducted by MCWA, as its first project, indicated that there was *no* indigenous malaria in the United States, and that all of the reported cases were either misdiagnosed, or represented importations or recrudescenses of malaria acquired elsewhere. Thus, the Agency's first activity was to show that the existing reporting system was in great need of coordination and evaluation, and was an inadequate tool for surveillance — that is, for knowing *in fact* what was going on.

The next phase of CDC's development is probably encapsulated best by something we refer to as the "Cutter incident". In 1955, shortly after the release of the newly–developed inactivated poliomyelitis vaccine, a small cluster of polio cases was reported. All were children who had recently received polio vaccine. Because of the possibility of a common–source epidemic, the Surgeon General of the Public Health Service directed the establishment of the Poliomyelitis Surveillance Program at CDC. CDC thus became the national clearinghouse for information regarding polio and, as such, rapidly organized and initiated investigations based on the surveillance information which it was collecting. Within two weeks the common source character of the problem had become abundantly clear. More than 80% of all possible vaccine–related cases of poliomyelitis had received one vaccine: Cutter vaccine. This vaccine comprised less than 10% of the total vaccine distributed. In all, 79 cases, 61 of them paralytic, were associated with what is now known as the "Cutter incident". In addition, 105 cases in family contacts of vaccines also occurred. Eighty of these were paralytic. With Cutter vaccine withdrawn, the national polio immunization campaign was successful. During this national emergency, close working relationship were first developed between CDC, the state health departments and many other collaborating laboratories and agencies throughout the country. This experience helped to establish the concept of epidemiologic surveillance at CDC, has served as a basis for many other successful surveillance programs, and reflects the power of epidemiology to change things and not just to study things.

The "Cutter incident" is a parallel to Italy's 1980 earthquake emergency, which led to the establishment of an emergency coordinated national surveillance system, directed here at the Istituto Superiore di Sanità.

From CDC's viewpoint, the last century has been marked by astonishing progress against the infectious diseases world–wide. In 1900, the leading causes of death in the United States were heavily infectious. Indeed, when the question is raised in terms of years of life lost, rather than absolute numbers of deaths, infectious diseases were four of the five leaders in 1900. One by one, these ancient scourges — tetanus, diphtheria, poliomyelitis, typhoid fever, etc. — have yielded to medical knowledge and public health practice, resulting in dramatic reductions in illness and death. So astonishing has been the

change that diphtheria, in 1900 the third leading cause of years of life lost in the U.S., in 1983 accounted for only five cases of disease in children under the age of 15.

The cumulative effect of each of these victories has been an increase in the U.S. of over 25 years in life expectancy at birth.

Absolutely remarkable in this accomplishment is the relatively small part played by miracle drugs, highly technical surgical advances, and a 200 billion dollar–a–year health care industry. By and large, improvements can be credited to very simple, often poorly organized, activities including improved housing, safer water supplies, improved waste disposal, regulations on food safety, environmental improvement, and immunization programs. These programs have, as their primary effect, reduced infant and childhood mortality.

Indeed, it has been said, that if we should lose overnight all hospital beds in the United States, it would have less effect on health than the loss of one of these simple preventive measures. Epidemiology and epidemiologists have been critically important in the development and implementation of these preventive measures.

Epidemiology is a scientific discipline and is thereby a legitimate area of scholarly research. In the last 30 years epidemiologists have:

1) discovered the cause of the vast majority of cases of lung cancer;

2) learned enough about dental caries to be able to prevent a sizable portion of this disease;

3) delineated the health effects of radiation exposures and stimulated adoption of control measures;

4) discovered important risk factors in coronary heart disease and tested the possibility of achieving effective prevention programs;

5) enlarged considerably our knowledge of the various diseases caused by tobacco and alcohol;

6) and have begun to study a broad spectrum of diseases, including drug–induced and other iatrogenic disorders.

They have become bold enough to study medical care services from the epidemiologic standpoint — that is, with regard to their impact on health status.

Epidemiologists have also extended the boundaries of their discipline by including injuries from accidents and violence among their concerns. And finally, they have begun to study the epidemiology of health — of human vitality and well–being — including major investigations of the relationship of prenatal and infant nutrition to the mental and physical development of children.

Epidemiology is widely but quietly used in policy formation. As its use increases, basic systems of data collection, analysis, and distribution must be improved. For example, the core of epidemiology is to define:

1) the distribution of a disease or condition;

2) the determinants;

3) the effects of that disease or condition.

The basic tool of this process is definition and interpretation of ratios between numerators and denominators. As a result epidemiology's output is highly dependent on a system that collects the right information and collects it in the right way. Epidemiology is no better than the information on which it is based.

The first part of the surveillance arc is the collection system, and the collection of data has changed rapidly. Prior to 1950 no national surveillance system existed for any disease in the United States. Then came the MCWA national malaria surveillance program with follow up of reported cases, attempts to secure a laboratory diagnosis in each case, and the discovery that indigenous malaria had already disappeared in the United States.

In 1955, the "Cutter incident" created the impetus for the nearly overnight development of a second national surveillance system, which identified a problem with one vaccine, allowing the immunization effort to continue using other vaccine; it was two more years before the third national surveillance system (for influenza) was begun (1957).

Dozens of conditions are now reportable to a central system, not because of laws, but because states have recognized the utility of a central system and agreed to report. Good surveillance has also been developed for many other conditions not reported on a regular basis as part of an official national system. Surveillance of environment– and occupation–related conditions has been instituted with the help of emergency room information, 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 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 determines directions in public health in the decades to come and makes it possible to change methods or processes as necessary to deal with both acute and chronic conditions.

The third part of the surveillance arc is feedback: the sharing of the analyzed information, ensuring that those who need to know, do know. This raises many new issues: privacy, duty to warn, adequacy of response, etc. Our ability to further collect better information is improved when each of these is well balanced with the dissemination of information. For example, the *Morbidity and Mortality Weekly Report* (MMWR), each Tuesday reports information

from the states regarding health conditions reported in the previous weeks. It 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 analyses of raw data, and the opportunity of those reporting to see how their information compares to and contributes to the whole, all contribute to improving the quality and quantity of reporting and the analysis of those reports. This is true also for your surveillance bulletin, the *Bollettino Epidemiologico Nazionale*.

Thus, epidemiology is seen as a research tool to develop knowledge about the living laboratory that is the community of people in which we all reside. Knowledge is itself neutral; it can both create and destroy. Think of where our atomic research has led us! Epidemiology, in the CDC public health sense, has been applied epidemiology — that is, it has been working toward the development of new knowledge and the application of that knowledge toward achieving some specific improvement.

Largely because of epidemiology, the traditional public health delivery system is becoming better. Almost two centuries after the development of our first vaccine, we finally appear to be capable of protecting most of our citizens from the ravages of vaccine–preventable diseases; incidence rates for these diseases are at an all time low.

New tools have been added as a result of the same technological revolution so important to clinical medicine. Hepatitis B results in an estimated 200,000 infections each year in the United States, and is also associated with chronic and lethal effects such as cirrhosis and primary hepatocellular carcinoma. The licensing of hepatitis B vaccine has provided a new tool to deal with this significant cause of morbidity and mortality. The development of a viral vaccine, before it is even possible to grow the virus in the laboratory, illustrates the complex uses of technology in public health and prevention.

Environmental health and occupational health programs are growing increasingly sensitive to the need for surveillance systems which can detect effects on human beings secondary to hazardous exposures. Understanding Legionnaires' disease and toxic shock syndrome has required melding of the skills of clinical medicine, epidemiological surveillance, laboratory and basic science, and statistical analysis.

Finally, while public health has come to accept our ability to deal with the expected, it is a significant development that we can recognize, understand, and provide solutions for unexpected problems. Our recent knowledge of Lassa fever, Legionnaires' disease, ebola virus and toxic shock syndrome has been expanded. A new vehicle for an old disease was recognized during an outbreak of salmonella resulting from contaminated marijuana. The recent experience with acquired immunodeficiency syndrome (AIDS) has again emphasized the role of epidemiology: risk–reducing recommendations were published by CDC in November, 1982, well in advance of recent laboratory discoveries that may lead toward a vaccine.

The many contributions of epidemiology to the development, implementation, and maintenance of a progressive health sector are increasingly being recognized. More efficient and effective utilization of scarce resources for disease prevention and health promotion is being developed through incorporation of the principles of epidemiology. Whether in relation to an overall objective of "Health for All by the Year 2000" or for other, more specific objectives, epidemiology now plays a growingly important central role. World Health Organization policy now stresses the uses of epidemiology in "providing relevant, valid, timely information support to the health management process".

The utility of epidemiology is not in question. Yet, still in ferment are many issues relating to the training of those who will do the epidemiology. There is an increasing demand by health personnel and others who work in health–related fields for more and various opportunities to be trained in epidemiology. In part, these demands are shown by the increasing number of different types of epidemiology training courses being developed throughout the world. Certainly this has been your experience here in Italy.

Thirty–three years ago, CDC recognized the need for broadly trained epidemiologists and initiated the Epidemic Intelligence Service (EIS). It is a program designed to train epidemiologists in applied field epidemiology, while providing much–needed epidemiologic services. The success of this program in the United States has been well documented and can be measured in various ways. The program has trained more than 1,200 individuals (85% physicians) in applied field epidemiology. With 30% of the graduates now serving in federal or state public health positions, and 30% working in universities and hospitals, these approximately 700 individuals are using epidemiology every day in their professions. Another measure of the impact of the EIS program is the improved quantity and quality of national surveillance information and epidemic investigations, and the increased emphasis on epidemiology in preventive medicine.

CDC, the U.S. Public Health Service, and the Department of Health and Human Services, have recognized the domestic success of the EIS program and see a worldwide need for better–trained and more practically–trained epidemiologists. We have developed an international program directed at encouraging and assisting other countries in the development of their own applied field epidemiology training programs (EIS–type). These countries can then train their own nationals, train them in–country, and use existing resources in working on their own health sector problems. Three countries (Thailand, Indonesia, Mexico) with CDC assistance

have now initiated such field epidemiology training programs.

In support of the 3 existing programs, CDC is providing to each of the respective ministries of health an experienced consultant medical epidemiologist for two or more years. Considering the needs and interests of individual countries, the availability of their resources and CDC's resources, there are many other variations in possible support. Discussions are now underway for collaboration between CDC and this Institute in furthering the already massive improvements in epidemiology that exist for all to see.

The last decade and a half of the 20th century is likely to continue the technological juggernaut still gathering speed all around us. We would like to work with you to assure that applied epidemiology research and technology continues to focus on improving the public health of our respective peoples.

Thank you.