Epidemiology and the Future of World Health

The following article reproduces the Robert Cruickshank Lecture given by Dr. Hiroshi Nakajima, Director-General of the World Health Organization at the XII International Scientific Meeting of the International Epidemiological Association, Los Angeles, California, August 1990.

I am honoured indeed by the invitation to deliver this lecture today, in memory of the great Scottish bacteriologist and epidemiologist, Robert Cruickshank. Quite apart from his professional contributions to epidemiology and bacteriology, Cruickshank was undoubtedly an extraordinary human being. Permit me to quote from the British Medical Journal of 7 September 1974.

"His knowledge was wide, his mind open. His concern for public health made him seek practical applications of pure science. His common sense clarified the complex and exposed the impracticable; his kindliness brought out the best in others; his friendliness and fairness resolved conflicts. These qualities, invaluable in committee, also made him a first-class teacher and editor. They multiplied his influence many-fold. This influence will live on and be propagated."

In 1945, when he became Director of the Central Public Health Laboratory in Colindale, near London, Robert Cruickshank realized the paramount importance of international cooperation in preventive medicine. We in WHO remember him as a close collaborator from the early days of our Organization, in numerous consultant assignments in a wide variety of subjects.

I am pleased to address you on a subject that would certainly have been a challenge to Cruickshank himself, Epidemiology and the future of world health. In a sense, I am expanding and developing ideas he himself put forward in his paper on Measurements in medicine, written in 1961 while serving as Lister Fellow of the Royal College of Physicians in Edinburgh. I quote:

"My treatise deals with another form of measurement in medicine which, like the physical and chemical devices, has developed enormously in the past 50 years--I mean measurements of the extent and causes of sickness in the community and, as a corollary, community measurements of methods for prevention and cure. This puts the emphasis on numbers and statistics, but I must hasten to reassure you that I am no statistician or mathematician. Indeed, I still rather feel about statisticians what the

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French lady felt about ghosts. When asked if she believed in them, she said "No. But I'm afraid of them." I intend to address four main questions:

1. What is the contribution that epidemiology has made to the state of the world's health today?

2. How can epidemiology help us to anticipate and meet the health challenges of the future?

3. How can advances in the epidemiological sciences be encouraged and utilized in the service of man?

4. What are the socio-ethical implications of epidemiological studies?

In earlier times, epidemiology was conceived, literally, as "That branch of medical sciences which treats of epidemics". Thus epidemiology originated in response to a need to understand and control the highly infectious epidemic diseases, such as cholera, plague, smallpox, and yellow fever. It was only with time that appreciation grew of the fact that all conditions of disease and ill-health are interrelated, and that the emerging science of epidemiology provided the tools for helping to understand the major factors underlying these issues as well.

International health work also began with a concentration on infectious disease, and then moved towards a wider concept of health as part of overall development. The roots of the World Health Organization, as an international health agency, go back to efforts in the last century and early in this century, particularly to the Rome Agreement of 1907 establishing the Office International d'Hygiène Publique, with the express purpose "to combat infectious diseases". The progressive shift of the concept of health, from the prevention of infectious diseases to health as "A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity", is reflected in the successive evolution of the Pan American Sanitary Bureau, founded in 1902, the health services arm of the League of Nations founded in 1918, and finally the World Health Organization, founded in 1948.

Epidemiology, even in its more restricted sense, has served WHO and the cause of human health very well. It has provided the tools for better understanding the incidence, prevalence, natural history, causes, and effects of control and other measures, that are relevant to each of the communicable disease control programmes of WHO. More than this, the epidemiological sciences have enabled us also to understand noncommunicable diseases such as cancer, cardiovascular diseases, and genetic disorders. In the area of primary prevention this understanding has allowed for intervention before the onset of disease.

Let me take the example of smallpox. In the 1960s and 1970s, WHO was perhaps best known for its efforts to orchestrate the international eradication of this dread disease from the face of the earth. The importance of eradication was recognized in the 1950s, leading to formal declaration of the goal of worldwide eradication in 1965. Thanks to extraordinary international collaboration, smallpox was declared finally eradicated in 1980. We owe this remarkable triumph largely to epidemiology! Let me explain.

To eradicate smallpox, we had the vaccine and the political will to succeed. But conventional wisdom held that we would have to reach 100% vaccination coverage; otherwise the last unreached infected person, somewhere in the world, would start the transmission cycle all over again. And we knew that 100% vaccination coverage at that time was impossible. But our epidemiological analysis of the natural history of the disease suggested something else: if we could cover 80% of the population, maintain surveillance, and track individual cases to contain outbreaks, the smallpox virus, like the dinosaur, would become extinct. Epidemiology gave us the courage of our convictions, and history has proved us right. Such an approach is being used for other infectious diseases, such as poliomyelitis and hepatitis B infection.

Let me take another, more current, example—Acquired Immune Deficiency Syndrome, or AIDS. We owe to epidemiology the discovery of this disease! AIDS was first recognized as a disease in 1981, before the HIV virus was identified about two years later, or even suspected as the causative agent of AIDS. Epidemiological observation noted the prevalence of a curious and inexplicable combination of clinical manifestations of other diseases: asthenia, weight loss, dermatoses, impaired immune system and Kaposi's sarcoma, as well as the presence of "opportunistic" infections, such as Pneumocystis carinii pneumonia. Even today, it is this kind of complex of clinical signs, together with the HIV-positive test result, that defines a "case" of AIDS. You can be HIV-positive and still not have AIDS. Furthermore, it is through epidemiological analysis that the syndrome was correlated initially with certain population groups and associated risk-taking behaviours. If we look at AIDS as a worldwide epidemic, it seems to be something new and sudden, but if we look at AIDS as a disease, and at the virus that causes it, we find that neither is new; they date back at least to the 1950s. It took the tools of epidemiology to tell us we were faced with a discrete, deadly disease.

Even today, our understanding of the three possible routes of AIDS transmission—namely through blood, through sexual contact and from mother to fetus—is derived more from epidemiological evidence than from a strict understanding of the internal mechanisms of the virus itself—although we know a great deal about this as well. Current AIDS control strategies are based on this knowledge. The WHO Global Programme on AIDS is promoting careful epidemiological research, placing particular emphasis on the study of blood, sexual, and mother to fetus transmission of HIV-1 and HIV-2, to serve

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as a basis for the further development of prevention strategies. Unlinked anonymous testing of individuals, and rapid assessment techniques, such as sentinel surveillance, the Delphi method, and the "syndromic" case definition approach to cross-sectional studies, are being promoted by WHO in an effort better to track the secular trends in AIDS and HIV infection. It is estimated that there are between 8 and 10 million people already infected with HIV. Epidemiological experience suggests that half will develop AIDS within ten years, and most of these will die. When you consider the average cost of the life-long treatment of an AIDS patient, and multiply it by several million, it is clear that, in the next decade, AIDS will place an immense burden on health care services, health insurance, and public and private sources of financing. Meanwhile, new cases of HIV and AIDS are being reported every day. Epidemiological trend analysis teaches us not to be complacent about this terrible disease. Trend analysis warns us that the money spent today on successful health education to promote healthy behaviour, and on research to develop an effective drug or vaccine, will result in savings many times over tomorrow, not to mention the price in human suffering.

WHO has a constitutional responsibility for the global epidemiological surveillance of disease. It receives information on outbreaks of communicable disease and distributes this information by telecommunication and printed bulletins throughout the world. You are all familiar with the WHO Weekly Epidemiological Record. The WHO system of international epidemiological surveillance provides countries with access to information. This includes the countries that otherwise would not be able to communicate directly with each other. WHO is responsible for the International Health Regulations, the International Classification of Diseases, and a great many international standards, which make international epidemiological comparisons possible. As you know, WHO publishes the World Health Statistics Quarterly, the World Health Situation report, and other publications of an epidemiological nature. But my purpose today is not to tell you about WHO’s information services. My purpose is to show how new developments in international health work are placing an enormous demand on epidemiology, in the wider sense meant by Professor Cruickshank.

Ladies and gentlemen, 13 years ago, the Thirtieth World Health Assembly decided that the main social target of governments and WHO in the coming decades should be health for all by the year 2000. One year later, in 1978, at a major international conference at Alma-Ata, primary health care was declared to be the key to attaining this goal, in the spirit of social justice. The policies and strategies for "health for all" have subsequently been defined by the World Health Assembly at international level, and by each country at national level, in the light of its own health and socioeconomic situation. Furthermore, WHO’s Member States have committed themselves, with the Organization, to monitoring progress towards, and evaluating the attainment of, this common goal, using a basic set of global indicators, in addition to those applicable within each country. For the first time in the history of international health work, an epidemiological framework is being applied on a global scale. The implication is that the science of epidemiology must be applied for strategic health planning and evaluation, in a systematic manner, in practically all countries of the world, for national and international health development purposes. This is particularly important for the developing countries and for some of the socialist countries of eastern and central Europe where data are either not available or otherwise not reliable.

The health-for-all monitoring and evaluation process is intended to establish a baseline of current health and socioeconomic conditions, against which progress towards defined targets and objectives can be measured. Periodic measurement should establish trends that will permit us to anticipate future conditions, and to start planning for them in advance. The three cycles of monitoring and evaluation of the health-for-all strategy that have taken place so far, make us optimistic that the information obtained can be used to reorient national and international priorities and directions for health development work, on the basis of sound epidemiological evidence, reported by countries with honesty.

This brings me to a further conclusion on the nature and use of epidemiology, with which Professor Cruickshank would surely agree. Epidemiology is not limited to assessment of the existing (or past) health and socioeconomic situation. If we accept Professor Cruickshank’s wider view, we have to place the accent on future trend assessment, i.e., "prospective epidemiology". The question is, what do current trends tell us about the likely future situation, for which we have to plan and take corrective action (or inaction), what will be the likely outcome tomorrow? Thus we are seeing the emergence of a new dimension in the science of epidemiology, which will be of major relevance to health planning, resource allocation, management and evaluation, and potentially will affect the future course of human history.

Have I overstated the case for epidemiology, and in particular for the role of future trend assessment in health planning? I think not. To further make my point, let me mention a few examples, drawn from the health-for-all monitoring experience. The source data are widely published. My intention is to highlight a few salient aspects.

At first sight, the information obtained is encouraging. People are living longer. Infant mortality rates are down, immunization coverage is up. Many communicable diseases are coming under control. Urban and rural water supply services have increased. Literacy is on the rise. Global productivity is still advancing.
But on closer analysis, the picture is not so rosy. In spite of overall technological progress, especially in the developed world, the data show that, for the majority of the population in many developing countries, the basic conditions for health, socioeconomic development, and daily living, remain unacceptable. In these areas, the gap between the rich and the poor is widening, rather than narrowing. In some countries of eastern and central Europe specific situations are being observed: life expectancy has decreased, infant mortality has increased, and has maternal mortality because of abortion practices, and at the same time the high consumption levels of alcohol and tobacco have resulted in an increased incidence of noncommunicable diseases.

However, while in general people are living longer, with life expectancy at birth averaging about 62 years of age, the difference in life expectancy between rich and poor remains significant for both men and women. On average, people in developed countries live about 14 years longer than those in developing countries. By the end of the 1990s, the world's population will increase by about one thousand million, or by 20% over the present 5.3 thousand million. The average birth rate is far higher in the lesser developed countries, and among the poorer populations, than in the industrialized nations and among the more well-to-do. Already we see food shortages and malnutrition among the less privileged populations. The external debt of Third World countries exceeds their capacity to pay, and their prospects of catching up with these social burdens are, at best, uncertain. If these trends continue, what will be the situation by the year 2000?

In 1990, nearly 10% of the world's population is over 60 years of age. By the year 2000, the majority of the world's population aged 60 years and over will be living in developing countries. What will this mean for working populations? Everywhere, the environment is threatened, and greater and greater demands are placed on fewer and fewer natural resources. The burning of fossil fuels appears to be leading to the "greenhouse effect," with untold consequences. Deforestation may result in ecological disaster, and risk of the loss of biological diversity. It has even led to a resurgence of malaria - an epidemiologically proven fact.

Certainly, countries have been working hard to provide health services and to control diseases, and much has been accomplished. But what do future epidemiological trend analyses suggest will happen in the decade of the 1990s, if we maintain only the current rate of progress? Unless the expansion of immunization coverage accelerates, 30 million children will die prematurely of vaccine-preventable diseases. Forty million children will die of diarrhoeal diseases, and an equal number will succumb to acute respiratory diseases, and this includes measles and whooping cough. Thirty million people, mostly in developing countries, will die of tuberculosis. Up to 20 million people will die of malaria. Cancer will take 50 million lives, while cardiovascular diseases will take more than twice that many, largely as a result of unhealthy lifestyles and environmental factors. Many developing countries will carry the triple burden of the continuing prevalence of some age-old infectious diseases, diseases of "modern" society (such as cancer, cardiovascular disease and diabetes, and accidents), and new ones such as AIDS.

In all too many countries, developed and developing alike, we see disturbing behavioural and social trends. On the one hand, the relationship between unemployment, and poverty and alcoholism, drug abuse, and violence, are well recognized. On the other hand, in some industrialized countries, where the basic physical needs have largely been satisfied, the lack of social and intellectual challenges leads to similar substance abuse and antisocial behaviour. An increasing proportion of young people everywhere exhibit signs of alienation from society, and indulge in risk-taking behaviour, for example reckless driving and the use of tobacco. Risk-taking behaviour and attitudes correlate statistically with patterns of disease, including AIDS and the widespread increase in sexually transmitted diseases. What is happening to the young people on whom the future of the world depends? what about our older citizens? Among the elderly, social isolation and alienation lead to a rapid physical and mental decline. In all of these instances, the waste of human resources potential and promise is tragic. For how long can politicians, decision-makers, planners, and citizens, faced with these trends, continue with "business as usual"? The major contributions that epidemiology can make to world health are to sound the alarm before it is too late, and to help decision makers to develop solution strategies.

It is not my intention to confront you with a litany of the current and future ills of mankind. Rather, my intention is to stress the worth of all who are engaged in the epidemiological sciences, in assessing the situation, and influencing corrective action. I am appealing for the responsible involvement of epidemiologists in the health development process. What I mean is that epidemiologists should make their findings known through social marketing to promote health, rather than contribute to the commercial marketing of health industries.

Professor Detels of the International Epidemiological Association has aptly said that epidemiology is the core science of public health and preventive medicine. Epidemiology has recently been defined as the study of the distribution and determinants of health-related states and events in populations, and application of this study to the control of health problems. I can endorse this definition only if it does not ignore the basic principles of health, human rights and social justice. If we take it seriously and fully, it implies that epidemiology is an inseparable component of the health development process. The concepts and approaches of epidemiology must become familiar to all those who deal with the health of the
Epidemiology should ideally permeate the approach to health, without necessarily constituting a specialized branch of health practice, in the same way that the clinical diagnostic sciences permeate the whole approach to individual health care, without constituting a specialty branch of medical practice.

We owe a debt of gratitude to the many fine epidemiologists whose work has lighted our way. I acknowledge particularly the large-scale epidemiological studies of cardiovascular diseases initiated in many countries, as for example the Framingham study in the United States, which have improved our understanding of these diseases and the means of their control. The work of Sir Richard Doll and Sir Austin Bradford Hill on tobacco-related illness opened the area of life-styles to epidemiological approaches. The examples of individual epidemiological research contributions to health for all are legion, and beyond recounting here.

In order to ensure the continuing contribution of epidemiology to health, training is important. Examples can be drawn from all parts of the world. I would mention only a few by way of illustration. The Field Epidemiology Training Programmes initiated, in collaboration with WHO, by the Global Epidemic Intelligence Service of the United States Centers for Disease Control, provide innovative "hands-on" experience. Throughout the WHO Region of the Americas, improved collaboration among schools of public health is strengthening the teaching of epidemiology. The Association of Schools of Public Health in Europe is developing a programme for the training of health professionals, on the basis of European regional health-for-all targets. In several WHO regions, concerted efforts have been made to include epidemiology in the training of health managers and professionals, including nurses, and to strengthen the training of research epidemiologists in designing and carrying out studies.

Epidemiology is an important constituent of essential national health research activities. It requires investment in human resources and institutional capabilities, in establishing national research priorities, and in setting up links between researchers and the users of research in many areas. The development of new measurements and new approaches, for epidemiological research on health policies and programmes, is an important aspect, despite conceptual and technical difficulties. For example, the value of an indicator such as "life expectancy free from disability" is becoming increasingly recognized. A challenging current question is how can epidemiological tools and approaches contribute to the assessment of equity? Future health care systems must satisfy three conditions: (1) continuing improvement of the efficiency and efficacy of our interventions; (2) compatibility with the political and socioeconomic realities; and (3) respect for basic human rights, such as the right to be informed and the integrity of the individual including freedom to decide.

Therefore, the sharing, presentation, and use of epidemiological information involve ethical issues, such as confidentiality, duty to warn, appropriateness of response, and balancing of interests, advantages, disadvantages, and costs. Health communicators, and those who apply the tools and approaches of epidemiology, as well as those who use the results, jointly have a duty to find ways to present epidemiological findings in conformity with the requirements of both science and general information. In this way, an interested public may become an informed one, and in turn provide feedback to policy makers.

Let me turn to developments in the application of epidemiology to the health-for-all strategy, and to the role various partners can play therein. Many countries are increasingly conscious of the actual and potential inputs of epidemiology to progress on the road to health for all. In 1988, the Forty-first World Health Assembly urged Member States "To make greater use of epidemiological data, concepts and methods in preparing, updating, monitoring and evaluating their health-for-all strategies". In 1989, the Forty-second World Health Assembly emphasized the appropriate use of epidemiology in the monitoring and evaluating of progress towards health for all, and gave a clear mandate to WHO to strengthen epidemiological capabilities, both in countries and within its own operations. Unfortunately, experience has shown that it is precisely the countries in greatest need which lack the capabilities necessary for effective epidemiological analysis.

Vigorous and repeated calls from Member States for the better use of epidemiology have thus been received through the WHO governing bodies. Consequently, we are engaged in the preparation and development of a plan of action, covering the next five years, to strengthen the epidemiological capabilities of countries in greatest need. Nongovernmental organizations and professional organizations, including the International Epidemiological Association, have an important role to play in this regard. The plan is for action destined to enhance the pertinence, quality, and timeliness of the epidemiological information produced by the selected countries, and to ensure a greater use of this information in decision-making for health at all levels. Under the plan, activities should progressively extend to other countries.

In support of these efforts, WHO will continue to foster collaborative relationships with other governmental and nongovernmental agencies, to support its Member States, to stress the importance of having and using epidemiological capabilities in health and development, and to disseminate relevant information. WHO will also foster and reinforce the epidemiological capabilities of individual institutions, and encourage them to form the networks that are essential to sustained research and its application. New methodologies will be developed and tested, including new techniques for future trend assessment. Mechanisms are being developed to enhance
the provision to WHO of expert guidance in reviewing current knowledge relating to epidemiology, and in monitoring progress in the strengthening of epidemiological capabilities. The additional resource requirements for the new plan of action are beyond those that are available in the regular budget of WHO. However, the plan can be used as the basis for encouraging donor agencies to develop explicit strategies for long-term support to the strengthening and application of national epidemiological approaches, and the promotion of collaboration among scientists and decision-makers both within and between countries. The International Epidemiological Association, through its resources and networks of personal goodwill and experience, can do much to help us with our plan.

I should, however, introduce a word of caution. With the virtuosity that exists today in the field of information processing technology, all too often we see information being collected almost as an end in itself. We must constantly remind ourselves that there is a cost attached to every bit of information collected. That cost is often paid by those least able to afford it. The challenge is to identify the most relevant data for the purpose intended. Robert Cruickshank, the good Scot that he was, would certainly have said no less.

With this caveat, I am convinced that epidemiology must, and will, play a significant role in the assessment and development of global health. Epidemiology will thus make a vital contribution to fulfill our vision of health for all and the socioeconomic development of the world community.

Cervical Cancer Research

Epidemiologic Studies of Cervical Cancer in Latin America

During the last five years, two large epidemiologic studies were conducted in Latin America to determine risk factors for cervical cancer in this high-risk population and to compare the prevalence and effects of different risk factors in this region and in Spain, a country with a nearly 10-fold lower incidence of invasive cervical cancer.

The Latin American Cervical Cancer Study was conducted between January 1986 and July 1987 in Bogota, Colombia; Mexico City, Mexico; Costa Rica and Panama, by the National Cancer Institute of the United States (NCI) in collaboration with the Gorgas Memorial Laboratory in Panama and research institutes in the participating countries. The study enrolled cases of invasive cervical cancer younger than 70 years of age at the major cancer referral hospitals in the areas of the study. For each case, two controls were selected: in Bogota and Mexico City, two hospital controls were selected, matched on age (in 5 year groups), excluding patients with diagnoses related to the exposures of interest. In Costa Rica and Panama, one hospital and one community control were selected from census listings of the same areas of residence of the cases.

Overall, 99% of 766 eligible cases and 96% of 1532 controls agreed to participate and were interviewed on demographic, sexual, reproductive, medical, dietary and contraceptive history. A cervical swab obtained cells from the cervical lesions of the cases and the cervical lesions of the controls to determine the presence of type-specific human papillomaviruses (HPV) by filter in situ hybridization. In addition, a blood sample was drawn for determination of micronutrients and antibodies against specific sexually transmitted agents. The male sexual partners of those women reporting only one lifetime sexual partner were also interviewed on demographic, socioeconomic, sexual and medical characteristics. A physical examination was performed on participating males (78% of eligible case husbands and 71% of eligible control husbands) and a swab of the coronal sulcus and urethral canal were obtained to test for HPV.

The Spain and Cali Cervical Cancer Study was conducted in nine provinces in Spain and in the city of Cali, Colombia by the International Agency for Research on Cancer (IARC). The main purpose was to explain the 10-fold difference in the incidence of cervical cancer between these two regions: in Spain, 5-7 cases per 100,000 women per year (age adjusted), and in Cali, Colombia, 50 cases per 100,000. Attempts were made to explain this striking difference in terms of sexual behavior of males and females and differences in the prevalence of the common sexually transmitted diseases associated with cervical cancer in the past. Among these, the evaluation of the role of HPV and herpes simplex virus type 2 (HSV-2) was of primary interest.

In total, about 3000 subjects participated in the study. Two groups of cases were included, 406 invasive squamous cell carcinomas and 526 in situ carcinomas/CIN III.