National and International Surveillance of Communicable Diseases  

by Dr Karel Raška

The term “surveillance” has been known and used in epidemiology for a long time. However, in the past it usually meant a form of observation of a subject, or subjects, suspected of disease or infection and kept under various kinds of medical supervision, without the restrictions on their freedom of movement that would be imposed in the case of isolation or quarantine.

In recent years, with progress in epidemiology and the advent of new working procedures and laboratory methods, it has been possible to develop surveillance programmes that relate not only to individuals but to specific diseases or to the spread of infectious agents in a country. This development on both the national and international levels is discussed in the following article.

National surveillance programmes

The surveillance programme developed in the Communicable Disease Center, Atlanta, Ga, USA, includes the systematic collection of data pertaining to the occurrence of specific diseases, the analysis and interpretation of these data, and the dissemination of consolidated and processed information to contributors to the programme and other interested persons. Special epidemiological investigations, field surveys, and individual case studies are frequently undertaken to complete the data collected on a routine basis. No direct responsibility for control activities is involved, however, these being mainly the responsibility of the state and local health authorities. Most of the data collected come from morbidity and mortality reports submitted by individual states. The Center’s surveillance reports on different diseases (poliomyelitis, infectious hepatitis, influenza, salmonellosis, shigellosis, diphtheria, etc.) are very well known and of far more than national significance.

Over the past fifteen years, the national surveillance of communicable diseases has been gradually developed in Czechoslovakia at the Institute of Epidemiology and Microbiology, Prague. Much more use has been made of laboratory data than in the US programme just mentioned. The aim has been to study specific diseases in terms of morbidity and mortality in time and place, and also the spread of infection among the human population (circulation of the etiological agent, immune response) and, in certain diseases (tularemia, Q fever, toxoplasmosis, arbovirus infections), among the animal population. Tracing the spread of infection may involve a variety of laboratory procedures, such as serological studies in poliomyelitis, influenza, measles, pertussis, diphtheria, and streptococcal infections, phage typing in Salmonella and staphylococcal infections, and investigations of properties of the etiological agents such as drug resistance in Shigella, staphylococcal, and streptococcal infections. An attempt has also been made to study the conditions favouring such spread, e.g., overmultiplication of animal reservoirs (in tularemia and tickborne encephalitis) or of vectors such as mosquitoes and ticks, as well as their biological

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properties (resistance to infection in reservoirs or to insecticides in vectors), social and economic conditions in the country, etc. In the studies of streptococcal infections and viral hepatitis, attention has also been paid to possible delayed sequelae.

Surveillance thus means the epidemiological study of a disease as a dynamic process involving the ecology of the infectious agent, the host, the reservoirs, and the vectors, as well as the complex mechanisms concerned in the spread of infection and the extent to which this spread occurs.

As well as being valuable for research, national surveillance activities are fundamental to the planning and assessment of communicable disease control measures. They provide a scientific basis for ascertaining the advisability and extent of mass vaccination (for example, against poliomyelitis, measles, pertussis, or diphtheria) and assessing its effectiveness. In some diseases they can give valuable information on treatment and on changes in the distribution and properties of the infective agents (streptococci, shigellae, influenza viruses, etc.). Surveillance also permits the early recognition of changes in diseases patterns and a prompt adjustment of control measures. Sometime it is possible to make an epidemiological forecast (in pertussis, influenza, poliomyelitis, etc.). Thus surveillance has a clearly defined aim in the study or control of a disease.

Surveillance operations should, however, be conducted differently for different diseases. For some (e.g., poliomyelitis in non-tropical countries, pertussis, and diphtheria), well-known methods of laboratory diagnosis, treatment, and especially prevention can be used; for others, it will be found that the methodology has to be further developed (e.g., hepatitis, tuberculosis at the stage of disappearance). The extent of surveillance activities in any country depends of course on the existing facilities—epidemiological services, laboratories, etc.

The character of the spread of infection in complex social and natural conditions is always developing and changing. It should therefore be studied on a systematic, long-term basis, taking into account the questions arising at each stage of surveillance.

The data obtained will range from simple information on whether a disease exists or not in a given area to detailed epidemiological information. Both are useful: the first to show whether more detailed study is needed or not; the second to provide a scientific basis for public health action—planning and evaluation of control measures such as vaccination, and the choice of vaccine strains and of age groups to be vaccinated—and for epidemiological forecasts.

The effectiveness of a national epidemiological surveillance programme should be evaluated in terms of the adequacy, accuracy, and speed with which the data can be applied to cope with public health problems or potential hazards.

International surveillance

In 1964 the Director-General of WHO approved the further development of the surveillance of communicable diseases of international importance, and in 1965 an Epidemiological Surveillance unit was established in the Division of Communicable Diseases at WHO Headquarters. Some past and present international surveillance activities are reviewed below.

The global surveillance of communicable diseases began with the six quarantinable diseases (plague, cholera, yellow fever, smallpox, typhus, and relapsing fever) and has developed step by step with the International Sanitary Regulations over the past five decades.

Surveillance is an integral part of the world-wide malaria eradication programme. It is “designed to discover evidence of any continuation of transmission, to establish its nature and causes, to eliminate residual foci, to prevent or cure... residual or imported malaria infections... in a given area, and, finally, to substantiate the fact that eradication has been achieved ”. During the consolidation phase, after the withdrawal of residual spraying, surveillance constitutes the sole activity of an eradication campaign.

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Another, rather different, example of surveillance on a global scale is offered by the work of the WHO Influenza Reference Laboratories. By following up the spread of influenza viruses in human and animal populations, and carrying out systematic studies of the biological properties of these viruses and serological responses in the population to all types of viruses circulating during epidemic and inter-epidemic periods in different areas of the world, they help to clarify the epidemiology and ecology of the disease. Their research has shed light on the reasons for the failure to control and prevent influenza epidemics up to the present, the long-term objective being the prediction of the appearance of a virus variant with antigenic changes sufficient to cause a new epidemic, or even pandemic, and the preparation of effective measures for preventing or limiting the spread of the disease. The systematic study and follow-up of the circulation of animal influenza viruses in different animal populations (swine, ducks, horses, etc.) and the investigation of the possible relationship of those viruses to human disease is also of paramount importance, since the source of new virus variants pathogenic for man has not yet been reliably determined.

Surveillance has become an important part of the international campaign against the endemic treponematoses. Thus surveillance programmes in tropical yaws are in operation in the rural areas of Nigeria, the Philippines, Thailand, Togo, and the Western Pacific islands, with technical assistance from WHO. Following the mass penicillin campaigns carried out in these areas several years ago, epidemiological and serological evaluation was undertaken on the basis of random samples of human blood, using lipoidal and treponemal (FTA and TPI tests) antigens. The low-level transmission of infection and the possibilities of a recrudescence of yaws are being studied. In addition, an attempt is being made to locate those susceptible to venereal syphilis in age groups now coming to puberty without the protective cross-immunity that in the past was acquired from yaws.

The surveillance of mosquito-borne haemorrhagic fever has been started because of the spread of this disease (or group of diseases) in the Western Pacific and South-East Asia Regions and the danger of its extension to neighbouring areas. This task was greatly facilitated at the outset by the information assembled by the WHO Vector Control Unit on the distribution, prevalence, and density of Aedes aegypti in different parts of the world.

A. aegypti has been eradicated in several Latin American countries, including Mexico, and an eradication campaign was recently started in the USA. Eradication has not yet been achieved on the north-east coast of Venezuela or in the Guianas, and the development of resistance to chlorinated hydrocarbon insecticides has caused a setback to the campaign in the Caribbean area. Investigations into the genetics of resistance to insecticides have shown that no efficient control measures can be applied without prior knowledge of the actual degree of resistance in mosquito populations. A systematic worldwide study of this question was recently undertaken with WHO support. In addition, the distribution of A. aegypti throughout the world has been mapped.

Immunological surveys of dengue and chikungunya viruses in populations of receptive areas not yet affected are needed in order to estimate the likelihood of a spread of infection westwards from India, and also to learn more about haemorrhagic fever and possibilities for its control and prevention. The recent westward spread of El Tor cholera from India and Pakistan, together with the outbreaks of yellow fever in Africa (in Ethiopia in 1960-62, and in Senegal in 1965), have clearly demonstrated the limitations of the existing services for the monitoring and surveillance of quarantinable diseases.

The responsibility for the provision of data to WHO as well as the decision to take control measures rest with the countries concerned. If there are delays in the transmission of information about the presence of a disease to WHO, the possibility of its introduction to neighbouring countries may not be recognized in time and control and
preventive action may be unnecessarily delayed.

Of primary importance for the surveillance of cholera in receptive countries is the availability of facilities for the immediate laboratory diagnosis and adequate treatment of the disease. On the international level the systematic mapping of the spread of infection in different areas and the prompt recognition of all conditions that are favourable to the spread of infection—such as the migration of populations over national frontiers for reasons of work, religion, etc.—are very important. The possible use of immunological surveys for retrospective investigations of the disease in given areas should also be considered.

The surveillance of yellow fever in Africa is even more complicated. Far-reaching political, social, and economic changes are creating a new ecological situation. Cities are growing, but unfortunately sometimes without adequate water supplies or environmental health facilities, thus creating favourable conditions for the breeding of A. aegypti. In the past, the preventive vaccination of the population in many of the yellow fever receptive areas of Africa has been inadequately carried out.

Given the presence of the vector and the low immunity status of the population—even if the actual situation is better than reported—the risk of the reappearance of an urban form of yellow fever in Africa cannot be excluded. It is therefore urgent to resume the systematic vaccination of the population in many of the yellow fever receptive areas of Africa has been inadequately carried out.

The surveillance of yellow fever is more complicated in Africa than in the Americas, owing to differences in the ecology of A. aegypti. Surveillance activities should therefore be limited to the protection of human populations in the areas where they are densest, i.e., in the cities, and to mapping the distribution and density of A. aegypti populations and the extent of their resistance to insecticides. In order to detect human cases at an early stage, suspicious cases in hospitals should be looked for, the livers of people with febrile diseases dying within 10 days of the onset of illness should be examined histologically, and paired sera of patients, especially children, suffering from febrile disease with clinical symptoms suggestive of yellow fever should be investigated serologically.

WHO is strengthening the network of laboratories for the detection of the yellow fever virus and for the immunological diagnosis of the disease. For effective surveillance, inter-country co-operation and the distribution of information to all interested countries are, of course, of the highest importance.

The surveillance of plague on the basis of a systematic study of the ecology of the disease has been carried out for decades in the USSR and the USA, and more recently in other parts of the world (e.g., Iran and South Africa). Very good surveillance of plague has also been developed in mainland China. In several other countries with natural foci of plague, however, knowledge of its ecology is incomplete and long-term systematic surveillance non-existent. As a result relatively large outbreaks of the disease occur in certain areas from time to time. It would thus be extremely desirable to collect and exchange information on the ecology of plague in different geographical areas and to map systematically the distribution of animal reservoirs and rat fleas, especially in overpopulated areas. In the surveillance of this and other diseases, especially those with natural foci, it will be necessary for all institutions co-operating on the international level to agree on and standardize methods for processing information and documentation. The degree grid outline maps used by De Meillon, Davis & Hardy in their studies on plague ecology in southern Africa would seem to be very useful for this purpose.

Surveillance has recently become an integral part of the WHO smallpox eradication programme on both the national and international levels. Cases are being systematically detected by the simplest means, with the aid of existing health service facilities in each

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country (e.g., weekly reports from all hospitals and health centres), immediate vaccination being carried out in focal areas. Minimum facilities for virological diagnosis are a prerequisite for smallpox surveillance.

The two other quaran tinable diseases—louse-borne typhus and relapsing fever—have lost much of their former importance. At present there are no plans for their further surveillance.

Other diseases of international importance—e.g., tuberculosis, poliomyelitis, measles, hepatitis, and rabies—should be considered for international surveillance. In some developed countries, the surveillance of poliomyelitis and tuberculosis would be of particular interest, since they are “disappearing” diseases.

As well as being valuable for research on the ecology of disease and “posterity” studies of diseases not yet recognized, the collection, storage, and investigation of blood samples from human and animal populations in various parts of the world are extremely important for the immediate analysis of the actual epidemiological situation in a country and for the assignment of priorities for control measures. The value of immunological surveys in communicable disease surveillance and research has repeatedly been stressed. Immunological surveys of a multipurpose type, based on generally accepted methods of sampling and on standardized laboratory techniques, permit much better comparisons of the epidemiological situation among populations living in different environmental conditions than do existing morbidity and mortality statistics collected in areas with widely differing facilities for reporting and varied criteria of diagnosis and accuracy.

WHO is now issuing a series of Communicable Disease Surveillance Reports.3 Based on information supplied to the Organization by countries, WHO Regional Offices, and WHO reference centres and collaborating laboratories, as well as data from scientific reports.

Problems and prospects

The surveillance of communicable diseases on an international or global scale is at present hampered by various practical problems and difficulties. First of all, in many countries the health services have not yet been adequately developed and the epidemiological services are especially weak.

Secondly, well-developed and well-staffed microbiological laboratories are needed to determine the spread of different infectious agents or changes of antibody patterns in human or animal populations, and these are lacking in many developing countries.

Thirdly, in some countries the detailed ecological studies required for surveillance are complicated and teams of specialists in different disciplines are needed to undertake them.

Finally, immunological surveys are sometimes difficult to carry out because they involve complex laboratory procedures, the results are not always easy to interpret, and experienced staff and adequate equipment for the collection of blood samples are often lacking.

These problems, though real, are not insurmountable, and they should not prevent the further development of communicable disease surveillance on a global scale. It would be advisable to wait until all difficulties have been eliminated. The surveillance of some communicable diseases of international importance can be started, or developed, immediately. To take cholera as an example, the first and most important step is to decide which countries are at risk and to train health workers in those countries to recognize the disease immediately, even in its sporadic and mild or atypical forms. An active search for possible cases could then be undertaken in countries lying in the path of the disease, special attention being
paid to those where social and economic conditions might favour its spread.

Looking back on the advances made by cholera El Tor since 1961, it seems that it would have been quite easy to forecast the immediate risk for the countries in its path. It should equally be easy to forecast yellow fever risks under the simple surveillance programme proposed for this disease in African countries. The spread of yellow fever in 1965, for example, was really not so surprising since the existence of the disease in Portuguese Guinea was known at the beginning of that year. It is thus essential to secure recognition of the importance of the surveillance of communicable diseases at both the national and international levels.

There have been many examples of shifting patterns in communicable disease and of the introduction of various human or animal infections from one area of the world to another. In many countries knowledge of the causes of morbidity and mortality and of past and present prevailing infections is inadequate. Certain infections that were, or are, considered important are not as yet registered in most developing countries, where their actual or potential importance is not at all understood.

A simple example is that of certain diseases of bacterial origin—e.g., diphtheria, pertussis, and streptococcal infections—which appear to be almost non-existent or are at least considered unimportant in several tropical countries. Recent surveys in a few countries in the African and South-East Asian Regions have clearly shown that these infections are spreading there. Moreover, in the case of streptococcal infections, there is evidence of a relatively high incidence of sequelae such as rheumatic fever, rheumatic heart disease, or acute glomerulonephritis.

Studies should be carried out to determine whether these infections, which present different clinical pictures in the tropics (for example, cutaneous forms of diphtheria), are truly less important there than in countries with a temperate climate. If not, it would be a pity to delay preventive measures unnecessarily, particularly as they are relatively easy to carry out.

The extent and speed of international travel facilitate exchanges of infections between areas at different levels of social and economic development and with varying environmental conditions. The relative importance of individual infections in tropical countries will accordingly change. The growth in size and density of populations living in cities where sanitary conditions are unsatisfactory will increase the danger of all kinds of communicable diseases—enteric, respiratory, parasitic, and mosquito-borne. The early recognition and follow-up of swiftly changing ecological conditions are tasks of the greatest importance for national public health services.

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The surveillance of communicable diseases on an international or global scale is something more than the sum of national surveillance activities, since it is concerned with the dynamics of the spread of the disease or infection not only within a single country but from one country to another. The simple basic elements of surveillance are of paramount importance. Prompt and accurate reporting is a prerequisite for the early recognition of the danger of further spread of infection and for taking the necessary control measures.

In surveillance, neighbouring countries can co-operate not only in exchanges of information on the spread of infections but also in specialized laboratory investigations or the co-ordinated application of control or preventive measures (vaccination campaigns, vector control, etc.). Such co-operation can be developed on a bilateral basis or with the help of WHO.

WHO has a unique opportunity to collect and process all existing information on the occurrence or spread of different infections and their ecology, whether this information comes from national reports or from various research or health institutions throughout the world. For this purpose, the Organization can use, sometimes with little additional effort or expense, projects already existing in certain countries.
The considerable network of WHO reference and co-operating laboratories that has been developed over the past fifteen years assists the Organization not only with research problems but in various fields of surveillance. It is important to determine whether this form of international co-operation can be extended. International help is also needed in order to obtain the use of standardized methods in immunological surveys carried out in different countries, so that the results may be comparable and reproducible.

Surveillance operations also offer WHO a means of providing technical advice to developing countries in the field of communicable diseases. New research problems will undoubtedly arise at each stage in the surveillance of individual infections in different social, economic, and geographical conditions. The concept of surveillance stimulates the development and use of new methodological approaches in the study and control of disease. Surveillance on a national and international scale must, however, be a long-term programme: it requires close cooperation between all concerned and should be carefully developed step by step.

The need for teachers in medical schools

The most crucial problem in the establishment of a medical school is the provision of a suitable teaching cadre. The gap between the demand for and the supply of suitable teachers is becoming wider. Various calculations indicate that there should be at least one medical school for every two to three million population. There are today throughout the world about 800 medical schools, though these, of course, are not evenly distributed among the world’s population. If the suggested figure of at least one medical school for every two to three million population is accepted, then, in order to satisfy even the present needs in the world, about 250 to 750 new medical schools are required; allowing only 100 teachers of different academic rank for each school, this implies the provision of 25,000 to 75,000 additional teachers. Since many of the existing schools are understaffed, the range of magnitude of the teacher needs of developing countries is even greater.

In order to illustrate this, one might mention that, in India alone, it is intended to establish 30 new medical schools within the next five years and a further 50 by the end of the century. Another example is that of tropical Africa, where there are but eight medical schools for a population of 210 millions. In most developing and emerging countries governments are eager to establish medical schools, in spite of the difficulties of meeting the heavy cost of medical education and the provision of suitable teachers.