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OUTLINE OF CHAPTER ON EPIDEMIOLOGICAL SURVEILLANCE FOR THE INTERNATIONAL HEALTH REGULATIONS

Introduction

The International Health Regulations are intended to ensure the maximum security against the international spread of disease with the minimum interference of world traffic. Past experience has shown that these Regulations do not constitute a sufficient deterrent against the introduction of the diseases under the Regulations into any given nation. Efficient national health services therefore will always be of primary importance in the protection of populations against these diseases. Of all the elements that constitute a good health service, that of "epidemiological surveillance" is the most important in this connexion. In this Chapter, the principles of epidemiological surveillance will be outlined and suggestions will be given with regard to surveillance of the diseases under the Regulations as well as certain diseases of international importance grouped under the heading "diseases under international surveillance".

The principles of epidemiological surveillance

Epidemiological surveillance is a prerequisite to modern, effective control and prevention of communicable diseases. It means the epidemiological study of a disease as a dynamic process involving the ecology of the infectious agent, the host, the reservoirs, the vectors and the environment, as well as the complex mechanisms concerned in the spread of infection and the extent to which this spread occurs.

This implies following up specific diseases, or rather, infections, in terms of morbidity and mortality in time and place, and keeping track of the circulation of the etiological agent in man and, where certain diseases are concerned, in animal populations. This involves all kinds of laboratory investigations such as isolation, identification and typing of etiological agents (serological, phage typing), investigations of the biological properties of etiological agents (i.e. changes in antigenic structure, resistance to drugs, etc.), and different serological studies of individual cases or population samples (immunological surveys).

In diseases with natural foci of infection (tularaemia, plague, Q fever, rabies, arbovirus infections, etc.), it is important to study the conditions which favour the spread of infection, e.g. overmultiplication of animal reservoirs or of vectors, as well as their biological properties (resistance to infection in the reservoirs or to insecticides in the vectors).

Attention should also be paid to any other factors which may influence the spread of infection and the incidence of disease, such as social and economic changes in the country, population movements, large industrial and agricultural investment projects (the building of dams, irrigation systems, etc.) or international trade (export and import of live animals, meat and meat products, eggs, etc.).

The collection of epidemiological information from a variety of sources requires the full use of existing knowledge and involves co-operation with several other scientific disciplines (depending on the infection, available resources and stage of control of the infection). An epidemiologist co-operates in a multidisciplinary approach with microbiologists, statisticians, clinicians, pathologists, biochemists, biologists, zoologists, entomologists, veterinarians, hygienists, ecologists, sociologists, economists, and so on.

Elements of surveillance

Surveillance involves a basic series of actions (elements) such as:

1. Mortality registration.

2. Morbidity reporting.

3. Individual case investigation.

4. Epidemic reporting.

5. Laboratory investigation.

6. Epidemic field investigation.

7. Epidemiological surveys, (immunological surveys, tuberculin testing, vaccination scar surveys).

8. Animal reservoir and vector distribution of diseases with natural foci.

9. Biological products and drug utilisation.

10. Demographic and environmental data.

11. Formulation of recommendations for the decision making authority.

12. Dissemination of information to all those who play an active role at the various levels of surveillance.

13. Co-operation with neighbouring countries, (co-ordinating control measures), and mutual assistance in cases of emergency.

14. Research, stimulated by surveillance activities.

It is clear that neither the term surveillance nor the individual elements of surveillance are new or unknown in epidemiology. With the progress in epidemiology and the availability of new laboratory procedures in biology and microbiology, the concept of surveillance was extended creating a scientific basis for the planning, implementation and evaluation of control and prevention of communicable diseases. In the context of the diseases under the Regulations and the diseases under international surveillance, the most important aspect of epidemiological surveillance is the quick identification of a disease, the follow-up of contacts and immediate recommendations to prevent further spread of the disease in the population into which it has been introduced.

PLAGUE

1. INTRODUCTION

Bubonic plague is a zoonosis, an infectious disease of rodents which occasionally is transmitted to man by fleas. However, under certain conditions, bubonic plague can generate outbreaks of pneumonic plague which is transmitted from man to man directly, as droplet infection.

Pneumonic plague today represents a great health hazard only in over-crowded conditions and major disasters, conditions such as war.

Health measures are not applicable to bubonic plague, which is primarily a disease of rodents. These measures are applicable only to pneumonic plague. So far as bubonic plague in man and rodent plague are concerned, up-to-date surveillance is essential of natural foci and areas where plague exists and from which it could potentially spread, or in which humans could contract it.

Rat proofing and rodent control are the most effective deterrent against the spread of rat plague and, therefore, should be enforced on international traffic to prevent transfer of infected rats from one country to another.

2. ENDEMIC AND INFECTED AREAS AND TRANSMISSION TO NON-ENDEMIC AREAS

2.1 Endemic areas exist today and will continue to exist for many years.

Wild rodent plague exists in natural foci of infection in certain geographical areas which are well known and are represented in Map 1.

It is important to study epizootics of plague and the ecological conditions of rodents and their ectoparasites which favour the spread of the infection from wild to peri-domestic rodents and to house rats which transmit infection to man through fleas. The surveillance of plague in animal hosts and of insect vectors such as the rat flea, Xenopsylla cheopis, and other species, as well as their resistance to insecticides and other biological properties, is essential.

Plague foci can be divided into two main groups:

(a) Inveterate natural foci, known for their antiquity and relatively permanent character (to be found in some areas (indicated on Map 1) of Africa, the Americas and Asia). These have always persisted in the same areas and will continue to exist while ecological conditions remain favourable.

(b) Temporary foci, particularly in ports and neighbouring areas, are changing. Foci such as those in central India may be extinguished as their characteristics are of a more temporary nature than inveterate foci.

2.2 Spread of plague from endemic to non-endemic areas is possible at any time. Extention of a natural foci to the vicinity of human dwellings or introduction of infected rodents into ports, e.g. via rat-infested vessels, is likely to produce a spread of infection between synanthropic rodents, especially rats, resulting in the establishment of a temporary, or, under favourable conditions, even a permanent focus in new territory. Human cases can occur during the first or subsequent phases of invasion, and these serve as a signal for plague control action, but the whole process can also thrive silently among rodents only. It must be remembered that the transmission of plague is possible wherever the ubiquitous rodent is present.

3. FOLLOW-UP: BIOLOGICAL PROPERTIES OF ETIOLOGICAL AGENTS, HOSTS AND VECTORS

In surveying a plague epizootic it is essential to clearly delineate the areas of a natural focus and to investigate them. The survey should include isolation of P. pestis and study of its properties. Further, the survey should study the number and territorial distribution of rodent species and their ectoparasites, seasonal and annual changes in number, and the significance of other ecological factors.

4. CONDITIONS INFLUENCING THE SPREAD OF INFECTION

Foci of wild rodent plague have a tendency to enlarge and then shrink as an enzootic spreads and fades, but foci normally maintain a static limit because conditions in other areas are less favourable for the maintenance of the chain of transmission.

Should ecological conditions alter through natural or man-made changes, such as change of climate or patterns of agriculture and irrigation, favourable conditions for the extension of foci may be created.

4.1 Spread from country to country

Natural foci often cross the borders of several countries (e.g. Kurdistan focus on Iranian, Iraquian and Turkish territory). The spread of infection in such a focus could bring the disease from one country to another.

4.2 Spread to other areas of the world

Rat-infested vessels can bring plague not only to neighbouring countries but also to those far away. However, ecological conditions in the country into which infection is introduced will determine whether it will die out or it will spread or even become established.

5. SURVEILLANCE ON PLAGUE AT NATIONAL AND REGIONAL LEVEL

(1) Notification of the disease in man and infection in rodents:

- in humans (suspected and proved cases);
- in rodents ("rat falls" and isolation of P. pestis from rodents).

(2) Laboratory examination (microbiological, serological, entomological):

- of specimens collected from suspected cases (serology, bacteriology);
- of rodents (found dead or captured);
- of rodent ectoparasites (including insecticide resistance);
- of P. pestis isolated (including drug resistance).

(3) Surveillance of natural foci of plague:

(a) Examination of rodents:

- systematic trapping and identification of rodents, mapping;
- complete bacteriological examination of individual or pooled samples for isolation and identification of P. pestis;
- serological examination; passive haemagglutination or complement fixation tests;
- examination of the soil from rodent burrows for the presence of P. pestis may also help trace epizootics.

(b) Examination of ectoparasites:

- collection of ectoparasites from rodents and their burrows;
- identification of ectoparasites;
- inoculation of pooled samples into susceptible experimental animals;
- examination of pooled material by culture and fluorescent microscopy;
- determination of resistance of ectoparasites to insecticides.

(c) Examination of the causative agent:

- determination of biochemical and other properties;
- determination of resistance to antibiotics and sulfonamides.

(4) Surveillance of rodent reservoir of plague in inhabited areas:

- in synanthropic (peri-domestic) rodents and their fleas;
- in domestic rodents (house rat in particular), and their fleas;
- by studying ecological changes;
- by following trends of animal reservoirs and infection in villages, ports, airports and cities.

(5) Alerting health services of existing dangers and assisting countries to be prepared:

- by adequate supplies of insecticides, rodenticides, vaccines and drugs;
- by a ready plan of action for health and other services in case of emergency.

(6) Dissemination of collected information of importance for neighbouring countries and for the rest of the world.

(7) Co-operation with neighbouring countries, regional and interregional agencies:

- by exchange of information;
- by mutual assistance in case of emergency.

5.1 National programme

5.1.1 Surveillance of rodent plague

Public health officials and auxiliaries and persons entering or living in areas of natural foci should immediately report:

1. "rat fall": death, sickness or sluggishness of rodents in the absence of poisoning;
2. unusual increases in rodent numbers;
3. excessive numbers of species of wild rodents;
4. sudden and unexplained decreases in the usual density of animal populations;
5. the precise location of any of the above events;
6. the species of animals involved in any of the above events.

Should an outbreak of rodent plague be reported and confirmed, adequate measures should be taken immediately. Therefore, stocks of equipment, insecticides and rodenticides should be prepared in advance.

The possibility of plague being transmitted by the rat flea, X. cheopis, X. astra, or other species of fleas their resistance to specific insecticides, and the flea index among various rodent species should be ascertained.

Situations in which plague may be spread by human fleas, Pulex irritans, should be taken into account as well.

5.1.2 Surveillance of plague in man

Unfortunately, in many instances, it is the occurrence of one or more cases of human plague which draws the attention of health authorities to the occurrence of plague epizootics which should be investigated.

Bacteriological examination of cases and contacts to identify possible carriers should be carried out as well as a survey of the healthy population in areas threatened by plague for the purpose of detection of mild cases. Systematic and complete examination of the strains of P. pestis isolated from cases and carriers along with determination of the drug sensitivity pattern need also to be done.

5.2 Regional surveillance

Through the co-operation of health services, neighbouring countries can assist each other in the notification of the incidence of plague in border areas. Moreover, they can assist each other in investigation and control of natural foci.

EXCHANGE OF EPIDEMIOLOGICAL INFORMATIONS

6. READINESS TO CONTAIN, CONTROL AND PREVENT PLAGUE

A country in which plague occurs or to which it can be introduced, must be prepared to:

(a) detect the infection in its early stages;

(b) determine the role of factors involved (rodents, fleas, climate, etc.);

(c) establish a plan of action and carry out control measures.

To do this, they should have facilities for:

(a) laboratory diagnosis and investigation of plague (media, diagnostic reagents, etc.);

(b) treatment (antibiotics and sulfur drugs);

(c) prevention through immunization (vaccines, syringes, etc.) and through disinsection and deratization (insecticides and rodenticides).

In surveillance and control work, existing services, such as those dealing with malaria eradication, could be used as such services have often supplies and equipment (insecticides) which are essential for plague control.

7. ROLE OF WHO

WHO's role in surveillance and control of plague is to provide:

(a) Emergency assistance by providing technical advice (consultants) and by providing supplies (insecticides and rodenticides, vaccines and drugs).

(b) Technical assistance in long-term programmes for study and control of plague.

(c) WHO disseminates information on the spread of plague and thus enables countries to prepare for possible action.

(d) WHO international and regional reference centres will be established to facilitate laboratory diagnosis of infection with P. pestis and related organisms, and identification of rodents and fleas and their resistance to rodenticides and insecticides.

CHOLERA

1. INTRODUCTION

Since vaccination against cholera is only partially effective and of short duration, and detection and treatment of carriers is difficult, epidemiological surveillance is a vitally important element in the prevention of spread of this disease. While cholera can theoretically be introduced in any country, it must be recognized that areas of the world with a high standard of environmental sanitation and hygiene are not receptive to this disease and no special precautions are therefore indicated to prevent its introduction into such countries. While vaccination can be considered partially effective protection of individuals, it is of little effect in preventing the spread of infection through extensive international travel. Surveillance of cholera as a protective mechanism is therefore of paramount importance.

2. ENDEMIC AND INFECTED AREAS AND TRANSMISSION TO NON-ENDEMIC AREAS

2.1 Endemic areas

Endemic areas of cholera now exist only in the southern Asian mainland and in Indonesia and the Philippines. In most countries where cholera is endemic and in most areas which are considered receptive to cholera, enteric infections in general play an important role in the over-all morbidity of the populations concerned. Mild cases of cholera are often confused with diarrhoeal disease of other origin.

However, existing statistics could serve as an orientation to the extent of infection. While reports on the presence of cholera are of great value, negative reports are often misleading due to the fact that they can reflect ignorance of the actual facts or deliberate hiding of the known facts.

2.2 Spread from endemic to non-endemic areas

The spread of cholera is possible in spite of available preventive measures, as neither immunization nor detection of carriers is sufficiently effective. Preventive treatment of the contacts with drugs would perhaps give better results; this is not, however, free of risks to the individual and may also give rise to drug-resistant vibrio strains.

Cholera introduced in a country with high levels of sanitation and hygiene does not represent serious danger as it will rapidly be recognized and easily controlled. Unfortunately such unreceptive areas exist only in developed countries. The majority of tropical countries should be considered receptive.

3. BIOLOGICAL PROPERTIES OF THE ETIOLOGICAL AGENT

Until recently it was believed that V. cholerae was the only causative organism of cholera. Now it is known that the El Tor vibrio can also cause a disease clinically indistinguishable from classical cholera, and moreover, that it can spread in pandemic proportions, as cholera caused by classical vibrios.

The most recent outbreak of cholera-like disease in the Sudan indicated that so-called, non-agglutinable vibrios should also be considered as potential pathogens which bring about symptoms similar to those of cholera under certain conditions.

Study of the properties of V. cholerae and other vibrios and enteric pathogens is therefore important.

4. CONDITIONS OF INFLUENCING THE SPREAD OF INFECTION

It was emphasized in the past that climatic conditions in the tropics influence the regularity of cholera epidemics. However, cholera has, both in the past and in recent years,

spread as far north as Korea and Uzbekistan. The essential factor in the spread of cholera is beyond any doubt a low level of environmental sanitation and poor hygienic habits. Poor water supplies, contaminated food, inadequate waste disposal, all contribute to the spread of cholera. In fact, poverty and ignorance, which are unfortunately prevalent in the world, are the main reasons why cholera is able to persist.

Economic and social progress and programmes to improve sanitation and education are the best way to control and possibly eradicate cholera. This is not feasible, however, for most countries.

5. SURVEILLANCE AT THE NATIONAL AND REGIONAL LEVEL

Even in the least developed countries there is an opportunity to carry out surveillance of cholera.

Pre-requisites for effective surveillance are:

(a) effective system of reporting;

(b) availability of laboratory services; and

(c) field teams.

Facilities for treatment, vaccination, disinfection and sanitation are essential for effective control.

5.1 National programme

5.1.1 Morbidity reporting. Prompt reporting of presumed cases of cholera is important in endemic areas. However, in view of the varied clinical picture of cholera and the scarcity of qualified medical staff in many endemic areas, it might be beneficial in these areas to have diarrhoeal diseases reported by either paramedical or lay staff.

5.1.2 Epidemiological field and laboratory investigations. In endemic areas, whenever a case of cholera is diagnosed clinically and confirmed in the laboratory, systematic epidemiological investigations of contacts, supported by bacteriological examination of rectal swabs or stools, should be carried out in order to detect carriers and mild cases.

Serological procedures involving examination of paired sera are too complicated at present to ensure public co-operation to form an effective part of a practical surveillance programme. Although the identification and isolation of all cases of inapparent infection is desirable, with the present state of technical knowledge, availability of resources, public health consciousness and co-operation, it would not seem to be a practical procedure.

One objective of an epidemiological field investigation should be to establish the mode of transmission of infection in a community by examining food, water and other environmental specimens of potential importance, and by investigating the recent movements and habitual eating places of cholera cases and carriers, as well as their possible association with other cases or close contacts of cases. In this manner, the common vehicle of infection may be detected, thereby facilitating control of the disease.

5.2 Co-operation of health services of neighbouring countries.

Health services of neighbouring countries should co-operate most closely in rapid exchange of information on outbreaks of cholera. While health services should have a ready plan of action in case of an unexpected outbreak, surveillance would enable them to take precautionary measures in good time.

5.3 Surveillance on the regional level

One of the most important functions of a regional and international system of surveillance is to report rapidly and correctly the incidence of cholera and its trends. In this way an early warning allows countries to prepare themselves against attack.

Surveillance of cholera is being practised in most of the countries where it occurs. However, reporting is limited only to very gross case finding, and, for various reasons, is often not quite correct. There is no standard international system of reporting cholera. It varies according to national resources, attitudes towards the problem of cholera, and many other factors. Most countries report the number of clinical cholera cases admitted to infectious disease hospitals or other treatment centres; some do so only after bacteriological examinations.

The number of reported cases of cholera and other quarantinable diseases are published in the WHO Weekly Epidemiological Record, but the accuracy of this report depends on the countries, all of whom want it to be as accurate as possible, but who often make little effort to give exact information.

6. READINESS TO CONTROL AND PREVENT INFECTION

The control of cholera and prevention of deaths due to cholera greatly depends on quick detection and immediate treatment. Skilled personnel, epidemiological teams, rapid reporting, and good communications and transport are necessary to ensure timely detection and rapid treatment and control.

The detection of cholera is still unsatisfactory, because it is a disease of developing countries where basic health laboratory services are often poor and inadequate. Furthermore, the clinical manifestations of cholera can be extremely varied; the typical features are seen only in a fraction of cases. Laboratories able to perform essential diagnostic work should be provided.

6.1 Laboratory services

(a) Bacteriological methods. The isolation and identification of V. cholerae is easier now because of the availability of various selective media. An experienced bacteriologist can expect to recover V. cholerae from properly-collected specimens of cholera stools in about 90 per cent. of cases. Judicious use of dark field microscopy and fluorescent antibody technique is helpful for rapid diagnosis. Isolation of the vibrio from individuals with inapparent infection requires more care, and repeated examinations are desirable.

Systematic examination of pooled night soil or of specimens from bucket latrines has also proved useful for the surveillance of infection in a community.

(b) Serological methods. Infection by V. cholerae and vaccination induces antibody formation. The antibodies formed after infection have been detected by vibriocidal, agglutination and skin toxin neutralization techniques. Vibriocidal and agglutinating antibodies appear within three to seven days and reach a peak by the eighth to twenty-first day; a slow and variable decline follows.

Micro-techniques with fingertip samples have been developed for both the vibriocidal and the agglutination tests.

6.2 Treatment facilities

Rehydration centres in hospital and rural health units, mobile or permanent, can greatly diminish fatality rates and save many lives. A supply of rehydration fluid and antibiotics is essential. The training of staff in rehydration practice, and the availability of transport and communications are also essential.

6.3 Facilities for control of cholera

Supplies of disinfectant should be available to treat water, vomit, faeces and waste.

Vaccines, although of limited value, should be made available.

Treatment and control facilities are essential in a cholera emergency, but apart from these, long-term plans should be made to build up health services and raise sanitary conditions and habits to such a level that a cholera-receptive country would no longer face the danger of introduction of cholera in epidemic form.

7. ROLE OF WHO

During the last pandemic, WHO provided emergency aid consisting of teams of experts in bacteriology, cholera treatment and sanitation, supplies of laboratory diagnostic equipment, sera, media, vaccines, disinfectant and other material. The International V. cholerae Reference Centre in Calcutta continues its services in identifying the phage typing of isolated strains.

Technical advice in shaping national cholera control programmes and in training of national personnel through national and international courses continues.

Co-ordination of control and preventive measures between neighbouring countries are carried out by WHO regional offices and cholera control teams.

However important the work of WHO might be, the control of cholera rests with national health authorities. If national authorities were to put into operation long-term plans for surveillance and control of cholera, this disease would cease to be a major public health problem and could be removed from the International Sanitary Regulations.

YELLOW FEVER

Yellow-fever cases are reported regularly from South America and from Africa.

Two main patterns of infection are recognized in yellow fever. The man-mosquito cycle in which man is the only host with only one mosquito species as the vector in an area, and the forest or animal cycle involving animals, mainly primates and several species of mosquitos. The virus involved in each cycle is the same and can be carried out from one cycle to the other.

1. MAN-MOSQUITO CYCLE

The characteristics of this cycle differ in the Americas and in Africa. In the Americas the only vector is Aedes aegypti which is an exclusively domiciliary and peridomiciliary mosquito breeding in artificial containers around human habitations and which usually remains near its breeding place. The human disease caused by Aedes aegypti transmitted infection has been called urban yellow fever because it is observed in towns and cities although it can also occur in villages and rural areas.

In West Africa although Aedes aegypti is also a domiciliary and peridomiciliary mosquito, it is not so exacting as in the Americas in selecting places to deposit its eggs, nor is it so restricted in its habitat. Its larva are found not only in artificial containers, but also in tree holes and bamboo sections in areas surrounding the houses. The imagos, may be found inside the houses, as well as in nearby bushes and forest.

In Central and East Africa Aedes aegypti is also found widely distributed in the forest and it appears to have zoophilic habits, biting man exceptionally in Mesfayfos. It is in addition found breeding in cities and towns where it readily bites man. These characteristics make the control of Aedes aegypti much more difficult in Africa than in America.

Another mosquito, Aedes simpsoni which breeds in the leaf axils of several plant species and is present around human habitations and in the forest edges, is especially abundant in East Africa. Aedes simpsoni is a very efficient vector which can ensure the maintenance of a man-mosquito cycle and can also introduce the virus from the forest into human populations.

2. FOREST OR ANIMAL-MOSQUITO CYCLE

This is the fundamental cycle in the natural history of yellow fever as it ensures the maintenance of the virus in nature.

In America mosquitos of the genus Haemagogus and in certain circumstances of the species Aedes leucocelaenus are the main vectors in the forest. These mosquitos are tree-hole breeders found in greatest abundance in the canopy. They are markedly phototropic and have their peak biting activity at midday. Any disturbance of the forest canopy, especially if accompanied by an increase in light, results in a vigorous attack upon any nearby warm-blooded animal. The animal hosts are primates of which all species are susceptible. It appears that in certain areas marsupials may also act as hosts.

Man can be infected when entering the forest. This form of disease has been called jungle yellow fever to indicate that it is acquired in the forest and is not man-mosquito transmitted. Clinically there is no difference between this form of disease and the urban form. There are, however, differences in its age and sex distribution. Adult males are mainly affected by jungle yellow fever reflecting their larger degree of exposure by entering the forest for purpose of work.

In Africa the virus is maintained in the forest by a cycle involving monkeys and possibly other primates and Aedes africanus. Although other mosquitos are suspected of being able to transmit the virus in the forest, Aedes africanus is undoubtedly the main vector. The normal habitat of this mosquito is the forest canopy but it may descend to ground level and it has been observed biting man and animals in the immediate vicinity of the forest.

Aedes simpsoni which penetrates into the forest where infected monkeys can be found establishes the link between the forest and human populations.

3. YELLOW-FEVER SURVEILLANCE IN THE AMERICAS

The eradication of Aedes aegypti from large areas of the continent has eliminated the danger of severe and large epidemics in most countries of the Americas.

Aedes aegypti has been eradicated from South America with the exception of certain areas in Colombia, Guyana and Venezuela, from Central America with the exception of Salvador and from Mexico. It is still present in some islands of the Caribbean and the United States of America. Reinfestations have occurred after eradication in certain areas of Central America, Brazil and Argentina.

A careful surveillance must be maintained in the countries which have eradicated Aedes aegypti to avoid possible reinfestations and measures should be taken to eliminate the mosquito when it has been reintroduced.

Efforts for the control and eradication of the mosquito are continuing in most of the countries from where it has not yet been eradicated.

A few cases of jungle yellow fever occur every year among individuals entering the forest or in close contact with it who for one reason or another have escaped vaccination.

A careful surveillance of febrile cases and of deaths following febrile disease occurring in persons living in or near the forest is maintained by the health services of the countries concerned for the recognition of yellow fever as soon as it occurs.

Virological, serological, and entomological investigations are carried out in limited areas by a few laboratories.

4. YELLOW-FEVER SURVEILLANCE IN AFRICA

The epidemic of yellow fever in Senegal in 1965 after 12 years during which no cases had been reported called the attention to the importance and potential danger of the disease in West Africa. A permanent surveillance system has been organized by WHO in West Africa. This system has been organized in three levels. The first is formed by "sentinel hospitals". One to four hospitals have been selected in each country according to its size. They are located in areas where according to available or historical data outbreaks are more likely to occur.

The physician in "sentinel hospitals" who normally deals with febrile cases is made responsible for the early detection of definite or suspected cases. The national laboratories or the WHO Regional Reference Centre for Arboviruses, Dakar, supplies the physicians with information about methods of laboratory diagnosis and encourages them to send the appropriate materials to the laboratory. They have been provided with a kit containing tubes, syringes, needles, a viscerotome, etc., to take samples. These samples are sent without delay from the "sentinel hospital" to the national laboratory or directly to the WHO Regional Reference Centre when no national laboratory able to carry out yellow-fever diagnosis is available.

The national laboratory, the second level of the system, prepares the specimens received for histopathological, biological or serological testing. If the national laboratory does not have the facilities to do some or all of the necessary tests, it refers the materials to the WHO Regional Reference Centre which constitutes the third level of this pyramidal system.

The WHO Regional Reference Centre is in a position to do all necessary testing and is ready to assist on request the national laboratory with equipment, personnel and advice. The Regional Reference Centre is responsible for confirming histopathological and virological

diagnosis and for the identification of virus strains isolated at the national level. It makes available to national laboratories recent information regarding laboratory techniques for the diagnosis of yellow fever.

Final notification of cases or epidemics remains a matter of the national health authorities. The role played by the units at the different levels of the surveillance system is strictly technical.

The functions of the different levels of the yellow-fever surveillance system are summarized below:

YELLOW-FEVER SURVEILLANCE SYSTEM IN WEST AFRICA

Level	Unit	Function
National	Sentinel hospital	Detection of cases Collection of specimens
National	National laboratory	Preparation of specimens Histopathological examinations Virological isolations Serological surveys
International	WHO Regional Reference Centre for Arboviruses, Dakar	Confirmatory histopathological examinations on difficult cases Virological identification Serological surveys (assistance to national laboratories) Technical assistance
International	WHO International Reference Centre for vector biology & control centre, Muraz, Bobo Dioulasso	Surveys on vector mosquito distribution Advice on vector control procedures

As Aedes aegypti is the main vector of yellow fever in West Africa WHO has been giving support to a survey on the presence, distribution and density of this mosquito in this area. Aedes aegypti has been found in large numbers in most of the towns and villages of the countries surveyed so far. Detailed maps on the presence and distribution of Aedes aegypti in countries of West Africa are being prepared.

In East Africa the WHO Regional Reference Centre for Arboviruses at Entebbe, Uganda is constantly carrying out virological, entomological and serological studies to determine the possible presence of yellow-fever virus in different areas. A surveillance system similar to the one established in West Africa will be organized as soon as the necessary facilities are made available. The WHO East Africa Aedes Research Unit located in Dar es Salaam, Tanzania, is carrying out surveys in East Africa, and is available for consultation.

5. YELLOW FEVER VECTOR SURVEILLANCE

In any area where yellow fever is either endemic or in which it might appear, it is essential to obtain certain basic information on the known vector species or on suspected vector species; this information may be listed as follows:

1. The distribution of the vector or vectors

Frequent surveys should be carried out to determine the presence and distribution of known or suspected vector species. Aedes aegypti may be spread with international commerce and may appear or reappear in areas which are suitable for its establishment. WHO can advise on the identification of mosquitos taken in surveys and on the design of the surveys themselves in areas in which there is little or no information. Such surveys should also identify the most common larval habitats so that these may be readily dealt with to control the vector.

2. Population density of known or suspected vector species

The population density of mosquitos may vary greatly according to the season. Should it be found that a given geographical area is positive for Ae aegypti or in Africa another vector of yellow fever, it is essential to determine the population density as it varies under different seasonal conditions and the time when the mosquito population is at its peak. Arrangements should therefore be made for such surveys at different seasons and again the Organization or one of its International Reference Centres can advise on the design of such surveys.

3. Insecticide susceptibility

Both adults and larvae of Ae. aegypti are capable of developing a high degree of resistance to the chlorinated hydrocarbon insecticides and tolerance to an organophospherous insecticide has even been reported in one instance. It is therefore important to carry out routine determinations of the insecticide susceptibility of Ae. aegypti larvae using the WHO susceptibility tests kits.

4. Insecticides and application equipment

Based on the information obtained under 3 above, it is essential that the insecticides found to be most effective be readily available as well as the appropriate application equipment. It is also essential that local personnel be trained in the application of the insecticides in the most efficacious manner. In endemic areas every effort should be made to keep vector species at a low density through insecticides or environmental measures.

SMALLPOX

I. INTRODUCTION

The prompt reporting of all cases of smallpox both to national and international health authorities is vitally important if necessary containment measures are to be taken in time to prevent further transmission of the disease. In the context of the global eradication effort, the surveillance of smallpox is considered to be as important as systematic vaccination of the population.

Through prompt reporting and the equally prompt institution of containment measures, smallpox transmission may be interrupted, thus progressively diminishing the reservoir of smallpox and eventually decreasing the time required for an area to become smallpox free. The clinical and epidemiological behaviour of smallpox lend themselves particularly well to this type of attack.

Smallpox spreads from person to person in a continuing, identifiable chain of transmission. The infected individual normally has a noticeable and distinctive rash. Those with mild, atypical illnesses transmit infection much less frequently than those with more severe illnesses. Thus, the failure to detect the occasional mild atypical cases does not often have serious epidemiological implications.

The spread of smallpox in an area proceeds slowly. An infected individual rarely succeeds in infecting more than four to five others even in crowded areas in which few of the contacts are immune. Since two to three weeks must elapse between each generation of cases, outbreaks of significant size require many weeks to emerge.

Additionally, outbreak investigation and case detection are simpler than for many other diseases since transmission of smallpox normally requires close contact, in the household, in schools or in hospitals. Transmission in aeroplanes, buses, trains, markets, etc. is surprisingly infrequent, even when obviously infected persons circulate freely.

In endemic countries, it is recommended that special surveillance teams at national and/or provincial levels be constituted who are responsible for the immediate investigation of all suspect cases. Such teams should verify the diagnosis, search for other cases in the area, trace the chain of transmission and take measures to restrict further spread of the disease.

Although recognizing that the national reporting of smallpox cases in all endemic countries is incomplete, experience has shown that when special assistance of this type is promptly provided in response to the report of cases, reporting rapidly improves.

II. STEPS IN THE SURVEILLANCE OPERATION

A. Reporting

Efforts should be made to develop prompt regular reporting as to whether or not cases of smallpox have been observed at all hospitals, health centres and private physicians. Telephone, radio, telegraph, or special messenger service should be employed when suspect cases are detected. Reports from other sources should be encouraged, e.g. malaria surveillance workers and other types of village development workers, news media, school authorities, etc.

Reporting of all cases suspected of being smallpox is important. If reports are delayed until cases are confirmed by laboratory or other means, valuable time may be lost in instituting control measures. If cases subsequently are found not to be smallpox, the original reports may be amended but this is preferred to a delay in receipt of reports or no report at all.

For surveillance operations, an "outbreak" is defined as one or more cases which are epidemiologically related and occur in a given geographic area. Whether one case or many, the fact that the virus has been introduced into a community is an episode of importance and so is termed an outbreak.

B. Confirmation of diagnosis

As a first step in the investigation of an outbreak the diagnosis must be confirmed clinically and epidemiologically. In smallpox-free areas or those with low incidence, specimens should also be collected for laboratory examination.

While diagnosis of an individual case may sometimes be difficult, the nature of illness among contacts or in the individual from whom infection was acquired should clarify the diagnosis. Another simple test of considerable value is to vaccinate the suspect case with known potent vaccine. If at six to eight days, he exhibits a major response, his illness was not smallpox. If there is an equivocal response to vaccination, the illness may have been smallpox or he may have acquired immunity through prior disease or vaccination.

If on laboratory study, variola virus is detected, the outbreak is, of course, considered to be smallpox. However, failure to detect variola virus does not exclude the diagnosis. Specimens which have been collected may have been improperly handled or some error may have been made in the laboratory.

C. Determination of the source of infection

The individual with smallpox necessarily has been in close contact with a previous case approximately 10 to 16 days before. Frequently, the infected person is aware of his source of infection. If he does not know, four sources particularly should be checked:

1. Other household residents with some form of rash 10 to 16 days before.

2. Visitors to the household during the period 10 to 16 days before.

3. School (if a school-attending child).

4. Hospital (if a visitor or patient in the hospital during the period 10 to 16 days before onset).

Most frequently, infection has been acquired by one of these types of contact.

In turn, the source of infection of the previous identified person should be determined and so on. Tracing of the chain of transmission in this manner may lead to significant outbreaks elsewhere which otherwise would not have come to light until much later.

D. Detection of other cases in the immediate area

To detect additional cases not revealed by contact tracing, health workers, friends and relatives of the patient and schools should routinely be checked to discover other possible cases. Each case so detected should be interviewed to determine the probable infection source and queried about knowledge of other cases.

E. To contain the outbreak

(1) Isolation of cases at home or in the hospital

Where possible, hospital isolation is preferred. Isolation at home may, however, be satisfactory. If the patient is isolated in the hospital, he should be confined to a special area and not be allowed to mix with others. Visitors should be severely restricted to those recently successfully vaccinated or if possible, forbidden. For home isolation, all the family should be vaccinated or revaccinated and instructed to admit no visitors. Instructions should be issued that the patient must remain in isolation until the last scab has separated.

(2) Vaccination of household contacts

Transmission is most frequent in the home. Thus all household contacts should be vaccinated as a first priority.

(3) Vaccination of other residents in the area and special groups at risk such as those in schools and hospitals

In the developed countries, selective vaccination of contacts is normally practised. In other areas, where health facilities are limited, vaccination of contacts as well as a substantial number of residents in the area is carried out.

(a) Area vaccination. In villages or segments of towns where transmission occurs, a lower level of immunity normally is present than in others where no transmission occurs. If a town or village of up to 2000 to 3000 persons is affected, the entire town may be vaccinated. If in a rural area, all residents within perhaps a kilometre of the case should be vaccinated. In a large urban area, vaccination of 1000 persons or so in the adjacent blocks should be undertaken.

(b) Schools. If cases have occurred among schoolchildren, all attending the school should be vaccinated.

(c) Hospitals. If patients have been isolated in the hospital, all in the hospital, including staff and patients, should be vaccinated.

III. SURVEILLANCE IN NON-ENDEMIC AREAS AND IN AREAS ALREADY VACCINATED IN A SYSTEMATIC PROGRAMME

Every suspect case which occurs in areas already systematically vaccinated or in non-endemic areas must be immediately and carefully investigated and vigorous measures taken to interrupt transmission. In areas which have been systematically vaccinated a few cases may occur among migrants and close contacts. If larger outbreaks are detected, detailed investigations are required to determine whether or not the programme had achieved a satisfactory coverage in the area and to ascertain whether or not the vaccine was potent and vaccinator technique satisfactory.

IV. SURVEILLANCE TEAM - ADMINISTRATIVE CONSIDERATIONS

In endemic areas, the surveillance teams should be responsible to those in charge of smallpox activities at the national or state level. In non-endemic areas, national staff should ensure that necessary investigations of suspected cases are promptly carried out. In the past, several countries have assumed that responsibility for activities of case investigation and containment could be assumed by local medical officers. While desirable to encourage local health officials to do all possible, experience has shown that when full responsibility is left to them, the results are frequently unsatisfactory. Local officials are often pre-occupied with other duties; some are not competent in the clinical diagnosis of smallpox; and few have a clear concept as to how investigation and containment activities should be conducted.

The teams must be prepared to move quickly and special administrative arrangements to permit this are often necessary. For each day that is lost, the probability of successful containment of an outbreak is diminished. In general, investigation should begin not more than 24 hours after notification.

V. FORMS FOR USE IN REPORTING RESULTS OF TEAM ACTIVITY

For each case and outbreak investigated the teams should prepare some form of report so that it can be determined what has been found and what has been done. The report should be as simple as possible. A properly constructed form may also serve as a sort of "check list" for the team to ensure that all steps have been taken.

Draft forms are shown as Annex I and Annex II. Annex I is an individual case investigation form. Each investigation in a province may be consecutively numbered for reference and, similarly, each case in the outbreak. In addition to noting basic identifying information, certain additional points are included as a reminder to the investigator. Principal probable sources of infection are itemized. The investigator is requested to indicate whether infection was acquired locally or elsewhere. If acquired elsewhere, further tracing should, of course, be carried out. Finally, provision is made to indicate how the case was discovered. By comparing the proportion of cases already reported through routine notification with the total of cases discovered, an estimate of the completeness of notification may be obtained.

Form II "Resumé of Investigation" provides a simple tabular analysis to summarize individual case records and to report what has been done. A section is provided to summarize the method by which cases were discovered as a reminder that all cases discovered through the investigation should be recorded in the official records of smallpox morbidity. In recording vaccinations performed, investigators may, in the course of vaccination, use single tally sheets for each category noted. For households, a sheet might be prepared on which is entered in one column the numbers of contacts in each infected household and in the second column, the number vaccinated. For vaccination in schools, hospitals and the community, simply the number vaccinated may be recorded.

ANNEX I

CASE INVESTIGATION FORM

STATE/PROVINCE _____
INVESTIGATION NO. _____
CASE NO. _____

NAME _____ AGE _____ SEX _____

DISTRICT _____ VILLAGE _____

DATE OF ONSET OF RASH _____
DAY MONTH YEAR

CONDITION OF PATIENT

☐ RECOVERING

☐ DEAD

☐ OUTCOME UNCERTAIN

VACCINATION SCAR PRESENT
(VACCINATED BEFORE EXPOSURE) ☐ YES ☐ NO

SOURCE OF INFECTION

☐ ANOTHER MEMBER OF HOUSEHOLD

☐ A VISITOR TO HOUSEHOLD

☐ PATIENT VISITED AN INFECTED HOUSEHOLD

☐ HOSPITAL

☐ SCHOOL

☐ OTHER _____

☐ UNKNOWN

PATIENT WAS INFECTED IN TOWN/VILLAGE WHERE HE RESIDES

☐ YES ☐ NO _____
(INDICATE WHERE INFECTED)

METHOD BY WHICH CASE WAS FOUND

☐ ROUTINE NOTIFICATION ☐ INVESTIGATION OF OTHER CASES ☐ OTHER _____

ANNEX II

RESUME OF INVESTIGATION

STATE/PROVINCE	
INVESTIGATION NO.	
DISTRICT	
VILLAGE	
DATES OF INVESTIGATION	
TEAM	

I. RESUME OF CASES

AGE	CASES			DEATHS	VACCINATION SCAR PRESENT		
	SEX M	SEX F	TOTAL		YES	NO	?
<1							
1-4							
5-14							
15-44							
45 +							
?							

II. METHOD BY WHICH CASES WERE FOUND

	NO.
ROUTINE NOTIFICATION	
INVESTIGATION OF OTHER CASES	
OTHER	
TOTAL	

III. VACCINATIONS PERFORMED TO CONTROL OUTBREAK

A. HOUSEHOLD MEMBERS AND CLOSE CONTACTS

NO. _____ NO. VACCINATED _____

B. SCHOOLS

NAME	NO. VACCINATED

C. HOSPITAL

D. COMMUNITY

TOTAL	

INFLUENZA

Influenza is truly an international disease. For centuries the facility with which the disease spreads from country to country has been recognized as one of its most characteristic features. In modern times, it has become clear that only a scheme organized on a world-wide basis will provide the information on which adequate precautions can be taken against influenza. It must be recognized, however, that influenza is not a preventable disease in the true sense of this concept or it may be said that it is preventable only in a very limited sense.

At the root of these problems lies the capricious nature of the influenza virus. In recent times influenza viruses have shown considerable antigenic variation leading to the appearance of strains which differ radically in their antigenic composition from their immediate predecessors. The last major change occurred in 1957 when virus A2 appeared, but before then minor antigenic changes occurred in the previously prevalent strains, virus AO and A1, and such minor antigenic changes may lead to strains showing little reactions with the original strain. Similarly, the virus A2 strains now being isolated (A2/Hong Kong/68) differ considerably from the A2 strains isolated in 1957 and afterwards, and in some tests some of the current strains show little or no cross reactions with the original strains.

As was clearly demonstrated in 1957, the considerable immunity of most adult populations to previous strains of virus A did not prevent clinical illness from infection with virus A2 and the vaccines prepared for previous strains were also ineffective.

Effective epidemiological surveillance of influenza has to be done on a world-wide scale and the co-ordination of this activity is undertaken by the World Health Organization in co-operation with the health authorities of countries and their national influenza laboratories, as well as with two international laboratories, the World Influenza Centre in London, England, and the International Influenza Centre for the Americas in Atlanta, Georgia, United States of America, and also research workers.

The main emphasis in the WHO influenza programme is on the rapid collection and dissemination of epidemiological information and on the rapid isolation of strains in national laboratories and their speedy final characterization in the international influenza centres, particularly at the beginning of epidemics.

It is also important in inter-pandemic periods that regular serological surveys be made by national laboratories to supplement the information obtained from other epidemiological observations. The results of such surveys provide further means of gaining an understanding on the world behaviour of the disease.

The functions of the two international influenza laboratories

The functions of the two centres are:

To obtain, fully characterized and preserved representative strains from outbreaks in different parts of the world and distribute them to the research and production laboratories;

To advise on the strains which should be included in influenza vaccines;

To arrange for the training of research workers in specialized techniques;

In collaboration with WHO, to collect and distribute information about the types of influenza virus prevalent in the different parts of the world.

National influenza centres

National influenza centres are essential for the functioning of an international surveillance programme for influenza. These national centres are designated by the national health authorities and are recognized by WHO as WHO Influenza Centres, if and when they can meet the following requirements:

Ability to isolate influenza viruses from specimens from patients;

Ability to make a reliable serological diagnosis of influenza;

Facilities and willingness to send freshly isolated representative strains from each outbreak quickly to one of the international centres;

Provision of virological and, as far as possible, epidemiological information to WHO headquarters and the international centres.

At present there are 80 centres in 55 countries. More than one laboratory may be recognized in a country. The number depends, in general, on the size of the country, on the density of the population and on the number of competent virus laboratories in existence. Although, in principle, no limit to the number in any one country has been set, it is clearly undesirable to have a large number of laboratories in a single country communicating directly with the international centres.

Collection of information

WHO obtains national information on influenza from two sources. One is the national health authorities and the other the national influenza centres. To avoid misunderstandings a close collaboration should be established between these two sources of information. In addition to the prompt despatch of strains to an international centre, national influenza centres and observers are also providing weekly reports to WHO headquarters in Geneva, during the "influenza season".

These reports include the following items: the date of the report, the approximate date of the start, peak and end of the outbreak that is being reported, the estimated number of cases and attack rate by age-groups, and the laboratory findings. Notes on severity, number of deaths, and the extension and type of population affected are also included.

The first report should be sent as soon as the outbreak occurs and further details should be given in subsequent reports as they become available. Copies of the reports should be sent to the international centres, accompanying the isolated strains.

Distribution of information on the international level

The information received from health authorities and national influenza centres as well as the international centres is collated by WHO in Geneva and published in the Organization's Weekly Epidemiological Record, or in cases of urgency, sent by telegram or, in special cases, reported in the Daily Epidemiological Radio Telegraphic Bulletin. In addition, the international centres send to national centres, information about viruses isolated and on other matters such as vaccines, laboratory studies, and techniques, by letter or telegram as circumstances indicate.

Laboratory examination and transport of specimens

After consultation with the two international centres, WHO sends every year a circular letter to all influenza centres giving details on the methods for collection of specimens, techniques to be used in the laboratory diagnosis and how to ship the specimens to the international centres. At the same time, the centres are reminded of the general lines of the WHO influenza programme for the coming season and which are their functions and duties.

Three points are stressed: the need for a rapid despatch of the strains to the international centres; the use of both fertile eggs and monkey kidney cells for the isolation of viruses; the use of paired sera to serological studies.

Laboratory studies and the World Influenza Centre and the International Influenza Centre for the Americas

Viruses received at the international centres are examined for their antigenic composition and other characteristics as soon as possible, subject to the urgency indicated by the epidemiological information accompanying the specimen. Viruses showing unusual characteristics will be exchanged between the international centres without delay and reports sent immediately to the WHO headquarters and to the laboratory of origin. Should it prove necessary, such strains will immediately be made available to influenza vaccine manufacturers and to interested influenza centres or other research workers. All strains characterized which appear to be of interest or value will be held in the international centres and made available on request to co-operating laboratories.

Another aspect of influenza surveillance is the co-ordinated effort WHO has undertaken to isolate influenza virus strains from naturally occurring influenza epizootics in animals, notably horses, swine and poultry. These strains are studied in various collaborating laboratories and in the World Influenza Centre. The importance and relevance of such strains to human epidemics are not known at present, but since close serological relationships have been established between many human and animal strains of influenza A it is considered that such surveillance is of value to pursue.

Diagnostic reagents

WHO provides national influenza centres with diagnostic reagents for use in the programme. The reagents are prepared in the International Influenza Centre for the Americas and tested in the World Influenza Centre. For detailed information concerning the type of reagents and their availability, contact should be made with the World Influenza Centre in London or with WHO.

MALARIA

1. AIM

The aim of epidemiological surveillance of malaria in an international context is dual: (i) to collect and disseminate information on the present status of malaria in the world, and (ii) to detect cases of malaria among persons entering a country. In this way it will be possible to protect countries having eradicated malaria but in which epidemiological conditions exist for the re-establishment of malaria endemicity following the importation of malaria cases, and to protect the international traveller from the danger of contracting malaria and from the possible serious consequences of having contracted it. These aspects have been thoroughly discussed in a WHO Meeting on Prevention of the Re-introduction of Malaria,[1] the report of which should be consulted.

2. COLLECTION AND DISSEMINATION OF INFORMATION

The purpose of information is to indicate areas of the world where there is risk of contracting malaria, and to provide an indication of the risk of importation of malaria from those countries into receptive areas.

2.1 International information

Each government is requested to provide to WHO at least twice a year detailed information on the status of malaria in its territory. This information is then published twice each year in the Weekly Epidemiological Record and disseminated to all countries. This information includes:

(a) brief comments on the data published;

(b) a map, published annually, indicating areas that have never been or are no longer malarious, areas in the consolidation phase, and areas where malaria transmission occurs or might occur;

(c) a numerical table indicating the epidemiological status of malaria in areas under consolidation and maintenance phases;

(d) a table showing cases of malaria imported into areas in the maintenance phase and, where possible, the country of origin of each case;

(e) the WHO Official Register of areas in which malaria has been eradicated;

(f) a supplementary list of malaria-free areas; and

(g) a list of countries that have reported cases of P. falciparum malaria resistant to 4-aminoquinolines since 1960 (publication of this list has been temporarily suspended because a number of unreliable or incomplete reports have been received).

WHO has also prepared a list of international ports and airports which, although located in countries where malaria still exists, can be considered free from malaria. This list is of importance to malaria-receptive countries. For example, a programme of chemoprophylaxis of crews could be based on detailed knowledge of the degree of endemicity of malaria in ports of call.

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[1] Wld Hlth Org. techn. Rep. Ser., 1967, 374.

A detailed report on the "Development of Malaria Eradication Programme" is published every year as an annex to Part I of the proceedings of the World Health Assembly. Based on reports prepared by regional offices of WHO, it includes maps, numerical tables, and comments on the present status of malaria in each country reporting to WHO.

Border meetings, co-ordination meetings, and regional and inter-regional malaria conferences, held periodically, permit countries to exchange up-to-date information on their respective malaria situations and on the danger of importing malaria cases. Several neighbouring countries regularly exchange such information.

Such international information is of use only if it reaches the national health establishments that are responsible for preventing the re-introduction of malaria, and if there is a means of national co-ordination, to make effective use of it. Effective use includes screening and, where necessary, follow-up treatment and remedial measures.

2.2 National information

National information concerning malaria is exchanged between the national health administration and other government departments and members of the health services of a country. The national health administration should indicate clearly the areas that are receptive to malaria, where special vigilance is necessary to prevent the re-establishment of endemicity.

In many countries, however, notifications of malaria cases are based on clinical information and are, therefore, inaccurate. This deficiency is reflected in international reporting.

The exchange of information between different national agencies must be continuous and must be based on general awareness of the constant danger presented by malaria. In this connexion, appropriate health education of national authorities is necessary. Lack of advice to (or regulation of) emigrants, can be dangerous. The awareness of the public should be increased and the health staff, whether governmental or private, should be appropriately trained or retrained.

In order to ensure greater reliability in diagnosis, general practitioners must be alert to the possibility of encountering malaria infections.

Co-ordination and exchange of information between the health department and the following is particularly important: immigration authorities, the department of labour, the department of agriculture, universities, air and shipping companies, tourist agencies, religious communities, and all other departments or agencies that are involved in movements of people to and from areas where malaria exists.

Communication of information at national level is entirely a national responsibility, the methods by which it is disseminated and used for preventive or remedial measures depending upon the administrative procedures and level of development of the various services.

International information can be useful in preventing the re-establishment of endemicity and protecting lives only if it is speedily disseminated within a country and if the national epidemiological services are organized to use it effectively.

3. DETECTION OF CASES OF MALARIA AMONG PERSONS ENTERING A COUNTRY

The tasks of border authorities in preventing the re-introduction of malaria vary with the type and number of people crossing the border. In order of increasing risk to the

receiving country, such people can be classified as follows: (1) international travellers, (2) immigrants, (3) migratory workers, and (4) people crossing uncontrolled borders by land or arriving at uncontrolled coastlines.

3.1 International travellers

In most instances it would be impractical to apply screening procedures at the borders to international travellers other than returning nationals. Border authorities should, however, inform travellers of the risk of malaria as they either leave malarious areas or arrive from such areas. These authorities can do this only if they are informed of the areas in their own country and the rest of the world that are malarious. To this end, co-ordination with the central health service of the country, which receives regular information from the malaria service (if there is one) and from international sources, is essential.

National health services should also co-ordinate their activities with other governmental and non-governmental agencies that are concerned with tourism.

A map showing the current distribution of malaria could be made available to border stations and tourist bureaux to aid in providing advice.

It is sometimes desirable for border authorities to obtain information on the destination of travellers from areas of high endemicity, although this may be difficult to do. If such information is obtained it should be passed on to the health services, which should institute appropriate vigilance measures.

3.2 Immigrants

There are two general methods of screening immigrants at borders, both of which require co-ordination between border health authorities (quarantine) and national health services (epidemiological surveillance).

(a) The immigrant can be examined and/or treated as he enters the country. Single-dose drug treatment could be administered routinely to immigrants from highly endemic areas and these can be subsequently followed up by the local health service.

(b) Immigrants from malarious countries can be examined before departure from their home countries.

Since all cases of malaria cannot be detected in this way, the destinations of immigrants from highly endemic areas should be given by border or immigration authorities to the local health service so that follow-up measures can be taken.

3.3 Migratory workers

In most areas where malaria has been eradicated there is sufficient control of border crossings so that advance warning of the entry of potentially infective persons can be given. Health authorities can then either examine such persons or exercise vigilance in the area of their destination. Several groups of persons not normally regarded as migrants are liable to re-introduce malaria. These include seamen and air crews and returning military personnel. Air crews or air companies flying to and from malarious areas constitute a special group demanding the attention of the responsible medical service of the company. Civilian health authorities should be notified, by the appropriate government agency, of the destination of troops returning from malarious areas.

3.4 People crossing unchecked borders

Malaria may readily be re-established by migrants crossing unchecked borders, including sea coasts. This possibility is of particular concern in countries that, although free of malaria transmission themselves, are adjacent to other countries that are not.

The problem is of principal concern to a country into which unchecked immigration occurs, but it may also concern the country of origin.

In receptive countries where eradication of malaria has been achieved or is well under way, screening of those who cross boundaries or sea coasts may or may not be practicable. Many countries cannot afford to set up the extensive supervisory network that is necessary. However, in the areas to which most of the migrants proceed, it is essential that vigilance be increased and that certain special measures be taken. Continual barrier spraying may be necessary to prevent the spread of infected anopheline mosquitos across boundaries.

In countries that export malaria cases, where the disease is often unchecked and there is little incentive to prevent its export, it might be possible to obtain, by international agreement, the strengthening of protective measures, including residual spraying and the prophylactic treatment of known emigrant communities.

3.5 General considerations

It is of particular importance to obtain, by means of appropriate health education, the collaboration of the entire population of areas where malaria has been eradicated and where uncontrolled immigration may occur, so that adequare vigilance measures can be instituted.

The intensity of the vigilance and the measures taken at the border must be appropriate to the epidemiological situation in the area from which the groups are coming and receptivity of the area to which they are going.

4. LABORATORY METHODS

The detection of malaria cases among persons entering a country is not easy nor often possible. The life cycle of malaria parasites is such that persons may harbour inapparent infections for long periods. Such carriers are potentially infective to mosquitos and may eventually be responsible for establishing foci of malaria. For the initial screening of immigrants it is essential to know the status of endemicity of the disease in the areas from which they come. Reliable information of this type is obtained through national and international health agencies. In addition, the following information should be obtained from immigrants: place of origin, areas through which they have travelled, dates of residence in such areas, whether or not they have had malaria or experienced any symptoms suggestive of malaria, and current state of health. Such information is of help in deciding on the necessity of laboratory examination, chemotherapy, or follow-up. The considerable danger of overlooking malaria when its symptoms are obscured by a more obvious infection should be stressed.

The only available method for the definitive diagnosis of malaria infection is identification of parasites in stained blood films. The study of serial blood films over a period of several days, or more intermittently, significantly increases the chance of detecting low-grade, intermittent parasitaemias, and certainly reveals heavily-infected carriers.

Negative results are not conclusive, and, particularly in individuals arriving from areas of high endemicity, do not indicate that further investigation or treatment is unnecessary.

Serodiagnostic methods may be of use for detecting carriers in areas cleared of malaria.

One of the newest methods, and perhaps the one showing the greatest promise, is the indirect fluorescent antibody (FA) technique. It can be performed, however, only by highly proficient personnel and requires special equipment; it thus has limitations for widespread use as a screening procedure.

Because of its difficulties, the method is more suitable for central laboratories than for smaller installations.

Regardless of the methods used to detect malaria infections in persons entering malaria-free areas, the only reliable ways to protect such areas are presumptive treatment of persons who enter, and continuous vigilance. The extent to which such treatment should be administered depends upon the epidemiological features of malaria in the areas of origin and destination.

5. SPECIAL PROBLEM: IMPORTATION OF CASES RESISTANT TO 4-AMINOQUINOLINES

Strains of P. falciparum resistant to treatment with 4-aminoquinolines have been recognized in the northern part of South America and in South-East Asia.

As the 4-aminoquinolines are routinely used in the radical cure of falciparum infections, the importation of strains of this parasite that are resistant to these drugs could constitute a threat to countries in the maintenance phase of malaria eradication.

A few cases infected with resistant strains from both Asia and South America have been found in distant countries; some of these have been fatal because of inexpert therapy.

Patterns of travel by potentially dangerous groups can often be identified and this is of assistance in the institution of precautionary measures.

The possibility of resistance should be suspected in all cases coming from countries in which resistant strains are known to occur.

The preventive measures necessary when an imported resistant infection is discovered depend upon the receptivity of the area.

When a person is found to be infected with a resistant strain of malaria parasite, his country of origin should be notified. Countries where resistant strains are known to occur should intensify their efforts to eradicate malaria.

Physicians should be notified that they may find cases of drug-resistant malaria and of the countries likely to export such cases. They should also be informed of the correct method of treatment of such infections.

6. PREVENTIVE MEASURES IN RECEPTIVE AND VULNERABLE AREAS

Once a country has eradicated malaria, the re-establishment of transmission depends on: (a) the receptivity of the country - that is, the extent to which anopheline vectors and ecological conditions favourable to transmission are present; and (b) its vulnerability - that is, the extent to which it is challenged by infective sources (imported cases of malaria or infected anopheline mosquitos).

The Twelfth Report of the WHO Expert Committee on Malaria[1] defined three degrees of receptivity: (1) transmission possible, (2) transmission easily resumed, and (3) transmission likely to lead to explosive outbreaks.

Such a classification is important in that it permits selection of measures that are appropriate to a given situation.

These measures should include the following activities:

(1) detection of all malaria cases; the method used (active and/or passive case detection) and the frequency of active case detection will depend on the structure of the health services of the country and on its malaria history, receptivity, and vulnerability;

(2) administration of radical treatment to each case discovered;

(3) compulsory notification of cases;

(4) thorough epidemiological investigation, including (a) classification of each case; (b) survey of the contacts by blood examination; and (c) follow-up of all cases;

(5) entomological investigation;

(6) proper remedial measures as required by the entomological situation (as a precaution, routine antilarval measures may be taken in receptive and highly vulnerable areas, such as certain ports);

(7) maintenance of a state of readiness to take all necessary measures;

(8) regular dissemination, both nationally and internationally, of information on the malaria situation;

(9) periodic reassessment of the degree of receptivity to malaria;

(10) identification of groups of persons who constitute the principal danger of re-introducing malaria.

In applying these measures, consideration must be given to the structure of the country, the original features of local malaria, the degree of receptivity, and the number of imported cases.

Every country has its own methods of preventing the re-introduction of malaria, but the necessity of the following should be emphasized:

(a) maintenance of the health service budget at least at the same level as before eradication;

(b) maintenance of the nucleus of a malaria eradication staff at a high level in the health service;

(c) training of general health service personnel in vigilance procedures and "refresher" training of malaria eradication personnel.

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[1] Wld Hlth Org. techn. Rep. Ser., 1966, 324.

7. PROTECTION OF INTERNATIONAL TRAVELLERS ENTERING OR LEAVING MALARIOUS AREAS

Information and advice should be given to persons entering or leaving malarious areas regarding dangers to which they may be exposed. The individual traveller should be able to carry out, when necessary, prophylactic measures to protect himself and his family, and to protect countries against the re-introduction of malaria. The development of such advisory services is a joint responsibility of the countries of origin and destination.

Procedures should be developed for obtaining, and circulating to the health authorities of all countries, information provided by WHO on the status and distribution of malaria in individual countries.

Travellers could be given pamphlets and non-technical explanations of the seriousness of malaria, the way it is spread, its incubation period, the possibility of late relapse, and protective measures that should be taken. Such briefing should emphasize the necessity of appropriate chemoprophylaxis and of continuing such treatment for four weeks after departure from malarious areas. They should also be advised to seek medical advice if illness should develop. Particular care should be taken with children.

Travellers should be advised that if any febrile illness (other than a transitory, mild episode) should develop within six months of leaving a malarious area, they should tell their physicians they have been to a malarious area, and suggest that blood films be taken for examination of malaria parasites and sent to a competent laboratory without delay. In this context, efforts should be sustained towards the improvement of performance of doctors in clinical diagnosis, of treatment of malaria and of laboratories in parasitological diagnosis. In addition, persons leaving malarious countries might be given cards indicating that they have resided in a malarious area.

Migratory peasants, who often move across borders where there are no immigration/emigration or health posts, pose a serious problem. The individual approach often cannot be used, and the degree of understanding of the group depends on health education in their country of origin. It is essential that receptive countries be advised, whenever possible, of such movements by the country of origin.

As previously noted, the giving of advice to travellers should be a co-operative effort, at the national level, of many different agencies and individuals, including national health and vaccination centres, practising physicians, and travel agencies.

POLIOMYELITIS

Poliomyelitis is probably the first on the list of infectious diseases needing extension and strengthening of regional and global surveillance.

Being recently one of the most hazardous diseases in temperate climates (on average about 80 000 cases, mainly paralytic, were registered annually in 1951-1955 in 23 European countries, USSR, United States of America and Canada), poliomyelitis is now under effective control with poliovirus vaccines in these areas (only 1000 cases altogether were registered in 1967 in the countries mentioned).

The state of poliomyelitis in this part of the world needs complete surveillance measures for evaluation of complex results of preventive efforts already undertaken and for elaboration of the most effective policy in prophylaxis to keep all groups of the population immune in conditions of absence or great decrease of wild poliovirus circulation in the population, i.e., an absence of the natural factor previously provided basic population immunity. Every effort must be made to prevent accumulation of non-immune persons in various age-groups since such an accumulation would create a high possibility of an outbreak or epidemic increase of incidence if pathogenic poliovirus (local or imported) appears.

At the same time there is epidemiological evidence of an increase in poliomyelitis in many countries in the tropics and semi-tropics.

The inadequacy of public health services in many developing countries in this part of the world and less effectivity of live poliovirus vaccines reported from some of these countries, make the poliomyelitis problem especially complicated in these areas.

The directions and components of poliomyelitis surveillance activity are outlined below:

(a) In temperate climate countries (and in those countries in hot climates where low levels of poliomyelitis were achieved with extensive use of vaccine and where adequate public health services exist)

1. Notification of disease
2. Clinical and laboratory surveillance of all cases of acute diseases of the central nervous system
3. Periodical serological surveys of the immunity status of the population
4. Virological surveys of the existence, circulation, types and genetic characteristics of polioviruses in human populations
5. Continued vaccination programmes for new-born population
6. Periodical vaccination programmes for selected groups of population on the basis of serological survey results
7. Distribution of information (weekly reports are best, followed by quarterly and yearly reports)

(b) In developing countries in hot climate areas

1. Notification of disease with every effort to make it complete and precise (age incidence)

2. Clinical and laboratory surveillance of poliomyelitis cases on the basis of hospitals and laboratory services available

3. Pilot serological surveys of the immunity status of population determined to obtain data for the most balanced immunization programme

4. Virological studies of a proportion of virus isolates to detect the predominant type of poliovirus

5. Vaccination programmes precisely planned, making a balance of age-groups under the most risk, cost of programme organization and medical facilities available

6. Follow-up vaccination programmes planned on the same basis for groups of new-born population

7. Distribution of information (special reports in the case of emergency, quarterly and annual reports)

WHO has already taken steps towards the organization of closer and effective international co-operation on the poliomyelitis problem.

1. The network of WHO Reference Centres and collaborating laboratories takes part in laboratory studies of poliomyelitis and poliomyelitis-like cases (isolation and typing of virus, study of genetic stability of strains, etc.). The results of this activity are combined quarterly and annually in reports prepared by the Virus Diseases unit and distributed regularly to all concerned.

The various aspects of the poliomyelitis problem are regularly under discussion in WHO Virus Reference Centres Directors Meetings.

2. The programme of production, testing and distribution of reference reagents needed in the study of poliomyelitis, is organized and carried out on the basis of co-operating WHO Virus Reference Centres and laboratories.

3. Assistance is given to the organization of the study on the evaluation of long-term vaccination programmes in a group of European countries. This study is going to evaluate the levels of immunity and the situation of wild poliovirus circulation in various population groups in countries carrying out different vaccination programmes.

4. For several years the special emergency fund of live poliovirus vaccine has been available for use in developing countries in the event of an increase of poliomyelitis morbidity or outbreak. The emergency team of specialists can be sent to an epidemic spot or consultation organized by the Virus Diseases unit to evaluate the situation and outline proper recommendations for vaccination.

5. Special studies for evaluation of live vaccine efficacy in tropical conditions are in progress.

6. Regularly for the past few years, the Virus Diseases unit has reviewed the global poliomyelitis situation, and prepares annually a WHO document which is available on request to all who wish to have it.

LOUSE-BORNE TYPHUS AND RELAPSING FEVER

Louse-borne typhus caused by Rickettsia prowazeki and relapsing fever caused by Borrelia recurrentis have two features in common which facilitate the surveillance of these diseases:

1. They are transmitted by the human body louse Pediculus humanus;

2. These two diseases occur in epidemic form mainly under conditions of human misery, characterized by such features as malnutrition, over-crowded quarters combined with poor personal hygiene.

Endemic centres of typhus are found in the mountainous regions of Mexico and South America, south-eastern Europe, Africa and many countries of Asia. Rickettsias can persist in the human host for years (Brill-Zinsser disease) causing recrudescence of the disease years after the first attack. Given the presence of body lice, such a case can spark off an outbreak.

Louse-borne relapsing fever occurs mainly in limited localities in Asia, East Africa (Ethiopia and the Sudan), North and Central Africa and South America.

Louse-borne typhus and relapsing fever occur in epidemics only where conditions for the presence of the human body lice exist, conditions that are usually associated with poverty or deprivation. Spread of the infections to neighbouring countries will mainly take place through uncontrolled population movements whether these consist of nomads or refugees from natural or human disaster areas. In today's world, excepting major social upheavals and war, spread of these infections internationally over large distances would seem to be of limited importance.

Epidemiological surveillance of louse-borne typhus and relapsing fever mainly consists of a surveillance programme on the incidence of human lice under conditions where the presence of this vector seems likely. A surveillance programme should consist of the following elements:

1. Readiness for recognizing the disease by clinical and laboratory examination and prompt reporting of the disease;

2. To follow up and map the endemic areas of these infections;

3. To establish the incidence of body lice, particularly under conditions of social disasters caused by natural catastrophes, war, etc.;

4. In areas where Brill-Zinsser disease may appear, to carry out regular surveys for the human body lice;

5. Instructions on determination of the presence of body, head and pubic lice;

6. An understanding of the ecology of lice and what conditions, as listed in (1) above, may give rise to increased body louse incidence;

7. Instructions for carrying out surveys to determine the degree of insecticide susceptibility in body lice populations in the area concerned;

8. Instructions for the control of body lice especially when the incidence is high or when epidemic outbreaks of disease occur;

9. Instructions for the use of mechanical and powered dusters for the application of insecticide powders;

10. Instructions for the acquisition, preparation and stocking of the insecticidal powders required, taking into account the results of susceptibility tests (see 7 above).

Laboratory facilities should be available for prompt diagnostic investigations whenever one of the two diseases is suspected to be present.

In areas of the world where socio-economic conditions are such that periodic occurrence of louse-borne typhus or relapsing fever is likely the necessary means of control or prevention should be readily available, in particular adequate stocks of equipment and supplies for control of the vector.

The World Health Organization has facilities for emergency aid in case of unexpected outbreaks, primarily in the form of technical advice to local health authorities with regard to prompt measures to be taken both for control and prevention of the disease. WHO will also be able to provide information about the occurrence of these diseases and the body lice on a world-wide basis.

The World Health Organization has two Regional Reference Centres for rickettsias, one in the Rocky Mountain Laboratory, Hamilton, Montana, United States of America, and the other in the Institute of Virology, Slovak Academy of Sciences in Bratislava, Czechoslovakia. These laboratories are particularly concerned with the preparation of reagents that will permit international comparability of studies and investigations of rickettsia.

ZOONOSES[1] IN INTERNATIONAL TRAFFIC

Some of the infections transmissible between vertebrate animals and man (zoonoses) are transferred internationally in live animals and animal products. Although in intercontinental commerce and in highly industrialized regions there is an increasing tendency to transfer products rather than live animals, the pets (dogs, cats, birds), race horses, animals for zoological gardens, and some breeding animals are still transferred alive. In other, less developed, areas where means of refrigeration and quick transport are considered too expensive, live animals of all kinds are transferred on foot or in wagons. Man as a vehicle of zoonoses discussed in this section plays a minor role; in many cases he is merely a dead-end host.

There are no world-wide regulations to ensure zoo-sanitary control but regional or bilateral agreements between exporting and importing countries are in existence. Specialized agencies like the Food and Agriculture Organization and the International Office of Epizootics continue to study these problems and have made some recommendations to serve as guidelines for the regulatory services of Member governments. Furthermore, they encourage surveillance and exchange of information on incidence of all animal diseases including zoonoses. These efforts are often seriously hampered by commercial interests and established trade practices as well as by insufficiently developed veterinary services.

The methods of detection, surveillance and control of zoonoses including those applicable in international traffic are discussed in relevant FAO/WHO publications[2] but the following general features of the more important infections would be of interest to public health workers:

Rabies can be transferred by dogs and cats travelling with their owners on aeroplane, boat or overland. Such spread can usually be checked by holding new arrivals in quarantine or by requiring vaccination before transfer. More difficult to check is the spread in wildlife, especially carnivora and chiroptera (bats) that cross the national borders freely. A surveillance programme covering these as well as domesticated animals can give sufficient warning of an approaching endemic to take protective measures in threatened areas.

Brucellosis can be transferred in live animals, particularly ovines, or in products, especially milk products. Elimination of infected animals and safety of products is best assured in the producing country although the importing country may wish to apply additional checks on arrival.

Tularaemia may be transferred in live rabbits, hares and their ectoparasites. Under certain conditions infected soil mixed with grain or roots (beetroot) may serve as an important vehicle of infection which may become airborne thus producing a confusing clinical picture. In most cases, however, the foci remain localized and should be kept under surveillance.

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[1] Although some of the diseases discussed in other sections of this chapter (plague, yellow fever) are also zoonoses, this section deals with infections in which domesticated and domiciliary animals enter the chain of infection.

[2]
(1) Wld Hlth Org. techn. Rep. Ser., 1967, 378 (Zoonoses)
(2) Wld Hlth Org. techn. Rep. Ser., 1966, 321 (Rabies)
(3) Wld Hlth Org. techn. Rep. Ser., 1964, 289 (Brucellosis)
(4) Wld Hlth Org. techn. Rep. Ser., 1967, 380 (Leptospirosis)
(5) Wld Hlth Org. techn. Rep. Ser., 1960, 197 (Milk hygiene)
(6) Wld Hlth Org. techn. Rep. Ser., 1962, 241 (Meat hygiene)

Anthrax is often transmitted in industrial animal products such as hides, bones, wool, hair, etc. Checks applied in producing countries have often failed to prove effective especially if the laboratory services are weak. Methods of sterilization applicable to these products need further improvement. The infection remains limited to certain endemic areas and has a seasonal distribution, thus making it suitable for keeping under surveillance and for treating the products emanating from these areas.

Psittacosis-ornithosis. Trapped wild psittacine birds as well as those bred in colonies maintained by dealers are important in transfer of infection. The customary holding of birds in quarantine or by dealers according to government regulations encourages spread to healthy susceptible birds which are uninfected when caught in the bush. Quarantine practices should therefore be modified and the birds given preventive antimicrobial therapy (medicated feed) over a sufficient period before and during shipment. This can be undertaken by bird caretakers under supervision.

Other zoonoses. Several other infections, notably Q fever, salmonellosis, vibriosis, toxoplasmosis, hydatidosis, trichinosis, etc., may be transferred in animals, animal products and some (e.g. salmonellosis) even in animal feeds. The causal rickettsia of Q fever (Coxiella burnetii) has been known to be transferred in cotton probably contaminated by rodents. All these infections need adequate laboratory control and exclusion or processing of the infected product.

Wild animal diseases and parasites are often transferred from one area to another when freshly caught animals are transported for scientific purposes (laboratory use), recreation (zoological gardens, pets) or for restocking. The recent episode of vervet monkey disease in laboratory workers in Germany and Yugoslavia has underlined the danger of wild animal infections for man. However, the surveillance methods and control measures for such situations are still to be developed.

In conclusion, it should be stressed that one of the most important measures against imported zoonoses would be the setting up of a joint medical and veterinary surveillance system with the following objectives:

(1) to give warning of threatened importation of a new disease, e.g. an approaching wave of wildlife rabies;

(2) to trace and map the spread of a newly introduced disease; and

(3) to plot progress in a control programme where even good routine reporting would not detect the few infections that might be a starting point for a recrudescence of the disease.