THE ROLE OF W.H.O. IN THE STUDY AND CONTROL OF RODENT-BORNE DISEASE

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ABSTRACT: While little information is available on the distribution and incidence of most of the diseases with rodent reservoirs, many of them are known to be widespread and may have considerable public health importance in some of the foci in which they are found. The World Health Organization is carrying out investigations on the epidemiology of several diseases with rodent reservoirs and on the biology and ecology of the rodent reservoir species themselves. These investigations are being carried out both at WHO research units and with collaborating laboratories. Based on the ecological information the organization is attempting to develop effective and economically acceptable methods and materials to control rodent populations to a point where transmission of disease no longer occurs.

THE PUBLIC HEALTH IMPORTANCE OF RODENT-BORNE DISEASES

The mandate given to the World Health Organization by its member nations is to assist them in achieving the highest possible level of health throughout the world. To gain this objective, the rodent-borne diseases as all others, must be considered and effectively dealt with.

Compared to the morbidity caused by such vector-borne diseases as malaria, trypanosomiasis, filariasis and the many species of arboviruses, the reported incidence of rodent-borne diseases, or those with rodent reservoirs, now accounts for a comparatively small burden to public health. However, in reality, little accurate information is available on the true incidence of the rodent-borne diseases in most countries. If one considers the diseases associated with rodents, their number is impressive; plague, murine typhus, leptospirosis, tularaemia, Chagas' disease, leishmaniasis, scrub typhus, salmonelloses, etc., may all exist in rodent reservoirs which serve, at least in part, to maintain the cycle of these diseases in natural foci. Since so little is known about the true extent of many of these diseases only a few brief examples will be given of their global importance.

Plague

Of all of the diseases with rodent or other small mammal reservoirs, only one, plague, is reportable to the World Health Organization under the terms of the International Health Regulations (WHO, 1974).

Certainly the best known and most feared of the rodent-borne diseases, plague itself has very greatly declined from the beginning of the century though there has been something of a recrudescence in the last ten years, Table 1.

Table 1. Number of cases of plague reported to the WHO in the world 1962-1972.*

Year	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	Total
Africa	124	49	540	43	16	18	172	96	28	34	75	1195
Americas	527	423	653	845	890	223	392	409	326	216	392	5296
Asia	788	384	411	676	2926	5691	4371	3882	474	708	1271	21582
Europe	1**	-	-	-	-	-	-	-	1†	-	-	2
Total	1440	856	1604	1564	3832	5932	4935	4387	829	958	1738	28075

*Includes presumptive cases. **Laboratory infection. †Imported case.

These figures are almost insignificant when one considers that as recently as the decade 1939-1948, the annual average number of deaths from plague in India alone was 21,797 and that closer to the beginning of the century from 1909-1918 the annual average number of deaths was 422,153 (Pollitzer, 1954). Today, even where human cases of plague occur they can be readily and successfully treated by any of several antibiotics and the spread of an epidemic prevented by insecticidal control of the vector fleas.

Nevertheless, plague still remains a matter of important public health concern for several reasons. It is endemic in widespread geographical areas and in several different ecological zones including temperate plains or steppes such as in the USA and USSR as well as tropical forested areas as in Viet Nam and Indonesia. Human cases of plague may be absent in some of the endemic areas for periods of several years and then suddenly reappear; the recrudescence of human plague in old foci in which it has been long quiescent shows that these foci must still be considered as potentially dangerous sources of the disease; this is especially the case since the ecological factors that permit such periodic outbreaks to occur are not well understood particularly in the tropical areas (Gratz, 1974). The danger of human plague outbreaks rapidly expanding is especially great in foci in those countries where only a rudimentary rural public health infrastructure exists and where detection and reporting of the disease may therefore be long delayed, retarding the possibility of rapid and effective intervention. Despite the intense study given to plague, its distribution is not yet entirely mapped and in 1973 an outbreak occurred in Libya, a country from which plague had not previously been reported.

Since rapid detection and reporting of either epizootics or human cases of plague can allow effective measures to be taken to suppress its spread, the WHO is attempting to stimulate a more effective system of surveillance of the disease. The Organization has issued "A Technical Guide for a System of Plague Surveillance" (WHO, 1973) which proposes a system of national epidemiological surveillance particularly for those countries in which natural foci of the disease exist. Methods are outlined for carrying out epidemiological investigations, making clinical and bacteriological diagnosis of human cases, as well as for surveys on the vertebrate reservoirs and flea vectors including the insecticide susceptibility of the fleas and finally for a national and international reporting system as recommended by the last WHO Expert Committee on Plague (WHO, 1970b).

Leptospirosis

This group of infections caused by many different types of serotypes of the spirochetal genus Leptospira is remarkably widespread and, in fact, is said to be the world's most widespread zoonosis (van der Hoeden, 1964). The leptospires causing human disease reach man through contamination of food or water by the urine and faeces of infected animals. While various serotypes are common in many different wild and domestic animals, rodents are considered to be the most important reservoirs (WHO, 1967) particularly of L. icterohaemorrhagiae which causes a serious disease known as Weil's disease or leptospiral jaundice in man. Other animal species such as the shrew have also shown to be involved in its transmission (Kundin et al., 1970). A recent two year study showed that this disease was the most common cause of acute fever among American servicemen stationed in suburban and rural South Viet Nam (Berman et al., 1973). In Malaysia, leptospiral antibody rates were as high as 32.6% among people employed in places where they came into close contact with rats, such as workers on oil palm and rubber estates (Tan, 1973). A survey in Israel (Shenberg, 1973) showed that between 20% and 25% of the rats in Ashdod port were positive for leptospirosis and that migration of rodents from the port was apparently creating new endemic zones. Similar rates among humans and rodents could be reported from the extensive literature on surveys in many countries both in the tropical and temperate and the developing and developed countries of the world. Thus, while it would be difficult to arrive at any global figure, the disease clearly represents an important public health problem both in terms of morbidity and in economic loss. If all infection due to different leptospiral serotypes is considered, including those with canine, water buffalo and goat hosts among others, these losses must be very great indeed.

Similar reviews could be presented for other diseases with rodent reservoirs from the vast body of literature that exists on scrub typhus, tularaemia, leishmaniasis and others. However, in addition to these diseases whose distribution, at least, is reasonably well known, there are other diseases that are newly recognized, such as Lassa Fever, where it is already clear that rodents have an important role as reservoirs (US PHS, 1973), though little is known of the distribution and incidence of the disease. The importance of rodents as reservoirs of the comparatively recently emerging diseases, such as Argentine haemorrhagic fever, Bolivian haemorrhagic fever and even Venezuelan equine encephalitis is also known.

The widespread, rapid and unplanned urbanization occurring in most of the developing countries has in many cases encouraged the expansion of rodent populations as well, with the probable consequent increases in rodent-borne disease.

THE ROLE OF THE W.H.O. IN THE STUDY OF RODENT-BORNE DISEASES

Before truly effective and specific control measures can be taken for the control or prevention of rodent-borne disease, particularly in the developing countries, it is still essential to obtain more precise information on their epidemiology and ecology. The WHO is attempting to obtain this information so as to provide more effective assistance to its member states. Either through its own research teams or through consultants provided to assist national governments, the WHO has carried out investigations on plague in Burma, Indonesia, Viet Nam, India, Libya, Zaire, Lesotho, Tanzania and Brazil among others.

An investigation on Korean Haemorrhagic Fever is now underway in Korea and a study on the ecology and control of rodent-borne leptospirosis is being planned for Barbados. There is a WHO/FAO and National Leptospirosis Reference Centre in Israel. A WHO research team is currently investigating the small mammal reservoirs of Chagas' disease in Venezuela as part of a general study on the ecology and control of the vectors and reservoirs of that disease. Between 1969 and 1971 a joint WHO/Iranian group concluded a survey of small mammal-borne diseases in Iran.

While only limited funds are available to the WHO for this purpose, the Organization also supports research on rodent-borne disease ecology through research grants to national research institutes and universities working on these diseases and through exchanges of scientific workers enables scientists to visit other countries to exchange information with scientists working in similar fields.

The Food and Agriculture Organization of the UN, supported by United Nations Development Programme funds, has recently established a Vertebrate Pest Research Centre in Karachi, Pakistan; the WHO is collaborating through the provision of a Medical Zoologist who will study the public health importance of the mainly agricultural pests.

THE ROLE OF THE W.H.O. IN RESEARCH ON AND THE CONTROL OF RODENT RESERVOIRS OF DISEASE

Until recently only limited efforts have been made by the WHO in this field to supplement research on rodenticides in governmental or commercial laboratories. However, the appearance of rodent resistance to the anticoagulant rodenticides has serious implications for rodent-borne disease control programmes. While such resistance is, for the time being, restricted to Europe and the USA, other countries have been making extensive use of the anticoagulants and it may well be only a matter of time until resistance appears in Rattus or other rodent populations in the developing countries. The WHO realized that it was of critical importance that a uniform test be available for the detection and measurement of rodent resistance to the anticoagulants and after consultation with and in cooperation with several groups, a method entitled "Provisional instructions for determining the susceptibility or resistance of rodents to anticoagulant rodenticides" (WHO, 1970a) was released as part of an expert committee report and has since come into widespread use. Since levels of resistance to the anticoagulants can rise so high as to preclude further use of these compounds, it may become imperative to rely on the single dose or acute rodenticides wherever such resistance appears. Unfortunately, the number of satisfactory acute compounds is very limited (Gratz, 1973) and even the number of new candidate rodenticides is small. The WHO has been attempting to expedite, in collaboration with several national laboratories, the screening and field testing of new rodenticides. This scheme was described by Maddock and Schoof (1972) at the Fifth Vertebrate Pest Conference; one of its most important functions will be to enable rodenticides developed in temperate countries and tested mainly against Rattus species to be eventually field tested against rodent genera which are important reservoirs of disease in the tropics such as Bandicota, Mastomys, Tatera, etc. The Organization is also providing small research grants to laboratories in the USA and elsewhere to facilitate rodenticide development. It is now planned to add advanced rodenticide field testing to the functions of the WHO Vector and Rodent Control Research Unit in Jakarta, Indonesia.

Considerable effort has been expended in studying vector flea resistance to insecticides and, as part of the Organization's scheme for the evaluation and testing of new insecticides, several compounds have been field tested against insecticide resistant Xenopsylla cheopis in India.

It is becoming increasingly clear that one of the main impediments to effective urban rodent control programmes in the developing countries is the lack of proper organizations based on adequate ecological knowledge of the rodent species. The WHO is now planning an urban rodent control and demonstration project in a developing country in an effort to show

that an effective and economically acceptable integrated control programme can be carried out and maintained under the conditions existing in a large tropical city.

Attention is also being given to possible alternatives to the chemical control of rodents including, of course, the reduction of food and harbourage for rodents. In addition, field trials have been carried out in the Pacific Islands on certain predators and close attention is being paid to the possibility of genetic control through the use of chemosterilants or the introduction of deleterious genes into populations.

ADVICE TO GOVERNMENTS ON RODENT CONTROL

An important service of the World Health Organization is to respond to governments requesting advice and assistance on the improvement of rodent-borne disease control programmes in urban and rural areas. The Organization usually responds to these requests by providing the assistance of highly experienced short-term consultants who now have served in many countries on behalf of the WHO.

TRAINING OF RODENT CONTROL PERSONNEL

Almost all rodent control programmes in the developed countries are severely hampered by the lack of professionally trained personnel; to overcome this shortage, the WHO holds frequent training courses on rodent control in the developing countries. Some of these courses are held in conjunction with the FAO, some with bilateral agencies such as DANIDA. It also provides traveling fellowships to more senior workers to train in countries where they can see and learn from the examples of existing better organized campaigns.

EXCHANGE OF INFORMATION

Articles on rodent and other small mammal ecology, distribution and control are scattered through a multiplicity of scientific and semi-scientific journals. Much of this literature is not readily available to scientific workers even in the developed countries and is largely inaccessible to workers in the developing countries. Through an Information Circular on Vector and Rodent Ecology and Control, the WHO abstracts more than a thousand articles a year on these subjects and this Circular is made available, at no charge, to workers in the field. In addition, an offset Vector Biology and Control Series enables the rapid reproduction and distribution of pre-publication articles in these same fields.

Access to the past literature on rodent biology and control has also been hampered by its dispersal over many different journals; the WHO has joined with the FAO to issue two bibliographies covering all literature on rodent pests in the decades 1950 to 1959 and 1960 to 1969. Current literature is included in the Information Circular. The bibliography of the 1960-1969 period has almost 8,000 references entered.

Direct exchange of information between scientists is also important and for this purpose, the WHO also held a seminar in 1966 on the ecology and control of rodents of public health importance attended by 30 scientists from 16 countries. The proceedings of this seminar later appeared as a mimeographed document and appeared in part as articles in the Bulletin of the World Health Organization.

More recently, in November 1973, the Organization called a meeting of a Scientific Group on the Ecology and Control of Rodents; the purpose of this meeting was to recommend to the Organization those lines of research which the group believed most important to improve the control of rodent reservoirs and intermediate hosts of disease. The report of this meeting will shortly appear in the Organization's Technical Report Series.

THE SURVEILLANCE OF RODENT-BORNE DISEASE

An increasing effort is being made by the WHO to improve national disease surveillance systems as has been described above for plague. Not only would such systems enable more specific and effective measures to be taken against the diseases, their vectors and reservoirs, but a fuller understanding of the economic losses due to morbidity would enable public health planners to better allocate their limited resources for communicable disease control.

CONCLUSION

Though the incidence and prevalence of most of the rodent-borne diseases is poorly known, it is apparent that the problem is a serious one especially in the developing countries. Unfortunately these countries are seriously lacking in the professional and monetary resources to adequately investigate and control these diseases. Though its resources are limited, the World Health Organization in conjunction with its sister Organization the Food and Agriculture Organization is attempting to reach a fuller understanding of the biology and ecology of vertebrate pests including not only rodents but other small mammals, such as the reservoirs of rabies. Based on this information, it hopes to develop more efficient methods and materials for the control of vertebrate pests and assist its member states in the development of programmes which can efficiently apply this information. To achieve these ends, the Organization must depend not only on its own resources, but on collaboration with and assistance from those scientists and public health officials in the developed countries who have acquired expertise in these fields. As the requirements of the global situation become clearer, the Organization will increasingly turn to its collaborators for such assistance.

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