The vector- and rodent-borne diseases of Europe and North America: their distribution and public health of burden

There are a significant number of diseases carried by insects such as mosquitoes or sand flies or by ticks, mites and rodents, and these are far more common than is often realized. New diseases are constantly being discovered and are becoming more widely distributed with the increase in travelling, to and from tropical, disease-endemic countries. Here, Norman Gratz (former Director, Division of Vector Biology and Control, World Health Organization), reviews the distribution of the vector and rodent-borne diseases in Europe, the USA and Canada; their incidence and prevalence, their costs and hence their public health burdens are detailed, and their arthropod vectors and rodent reservoir hosts described. Armed with such information, the individual clinician is more likely to have a degree of epidemiological suspicion that will lead to an earlier diagnosis and correct treatment of these infections. Equally, authorities will more readily understand the measures necessary to control this group of infectious agents.

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Contents

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Tribute to the author, Norman Gratz

Despite battling with illness Dr Norman Gratz valiantly tried to complete his manuscript of this book and send it to Cambridge University Press for publication. He succeeded in doing this. Sadly, however, he died in Geneva soon afterwards, in November 2005, and so never saw his magnum opus published.

Norman joined the World Health Organization in 1958 and remained with the organization for the rest of his working life. On retirement he continued to serve on WHO committees and act as a consultant for WHO, numerous chemical companies, and government and non-government agencies.

He was one of the few medical entomologists who was also involved with the role of rodent reservoir hosts in disease transmission and soon became recognized worldwide as an authority on vector-borne diseases and their control. Norman travelled extensively for WHO in Africa, Asia and Latin America advising on research and control strategies on the vectors of malaria, filariasis, Chagas disease, murine typhus, plague and various tick-borne diseases.

Norman published more than 100 scientific papers and in 1985 received the Medal of Honour from the American Mosquito Control Association. He built up an amazing database of more than 31 000 abstracts on vector- and rodent-borne infections which became the foundation for this book.

On several occasions I told Norman that because of his vast knowledge of vector- and rodent-borne infections he was probably the only single person who could write this book.

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Preface

Until the early part of the twentieth century many vector-and rodent-borne infections were very serious public health problems in Europe and North America. Thousands of cases of malaria occurred annually throughout these regions and populations suffered greatly from the disease. Malaria transmission persisted in most of southern Europe and the USA until it was eradicated in the 1950s. Among the arboviruses, dengue transmitted by the mosquito *Aedes aegypti*, was the cause of a great epidemic in Athens, Greece in 1928 with over 650 000 cases and more than a thousand deaths. The same species was also the vector of yellow fever which caused many thousands of deaths in the USA during the nineteenth century; the last epidemic of the disease occurred in New Orleans in 1905 with more than 3000 cases and at least 452 deaths being recorded. Great epidemics of louse-borne typhus occurred in many parts of Europe during World War I accounting for great human mortality. The war-associated louse-borne diseases such as epidemic typhus, epidemic relapsing fever and trench fever disappeared after 1945 due to the applications of the newly discovered DDT and related compounds; at the time, optimism ran high that this group of infections was unlikely to again be a problem, and indeed at the time effective control was obtained of most of the group.

Yet by the end of the twentieth century, vector and rodent-borne infections have again become serious public health problems; there has been a recrudescence of several diseases long thought to have been eradicated or under effective control; at the same time, new vector and rodent-borne diseases have been discovered both in Europe and North America, some of which now occur in high incidence. A number of diseases in this group have been introduced into geographical areas in which they have not previously been found such as the introduction of West Nile Virus into New York in 1999; the virus and diseases it causes have subsequently spread throughout the USA and much of Canada. At the time of writing, six years after the introduction of the virus,

there is no sign of a significant diminution in its annual incidence in the USA.

Among the tick-borne infections, Lyme disease was first identified in 1975 as the cause of an epidemic of arthritis occurring near Old Lyme, Connecticut. This infection has now become the most common vector-borne disease in both the USA and Europe and in parts of eastern Canada. Tens of thousands of cases now occur yearly in Europe and the USA. In the years 2001 and 2002, nearly 41 000 cases of Lyme disease were reported to the US Centers for Disease Control and Prevention (CDCP) and, in Europe, it has been estimated that as many as 60 000 cases a year occur in Germany alone.

Tick-borne encephalitis virus transmitted by *Ixodes ricinus* in western Europe is endemic in central, eastern and northern Europe and may cause a wide spectrum of clinical forms, ranging from asymptomatic infection to severe meningoencephalitis. In eastern Europe the virus is transmitted by *I. persulcatus* and its incidence has been increasing. Ecological changes have resulted in an important spread of the tick vectors and they are now commonly found in parks in the middle of many cities throughout Europe. It appears that climate change has resulted in a northward movement of the tick vector and the disease in Sweden.

Human ehrlichiosis and anaplasmosis are tick-borne zoonotic infections that have become increasingly recognized in the USA and Europe. The increased desire of humans to pursue outdoor recreational activities during the summer months has also amplified their potential exposure to pathogenic bacteria that spend a portion of their life cycle in invertebrate bloodsucking enzootic hosts. Just like *Borrelia burgdorferi*, the agent of Lyme borreliosis, *Ehrlichia* and *Anaplasma* species cycle within hard-bodied ticks. Rocky Mountain spotted fever is the most severe and most frequently reported rickettsial illness in the USA. The disease is caused by *Rickettsia rickettsii*.

The number of annual cases of babesiosis, which is transmitted by the same tick vector as Lyme disease, is unknown but in areas of the USA where infected ticks are common, up to 20% of people have antibody results suggesting exposure. Although most of those exposed have no evidence of the disease, about 6% of people with babesiosis severe enough to require hospitalization die.

In Europe, Mediterranean Spotted Fever (MSF), also known as Boutonneuse fever, is transmitted by the dog tick, *Rhipicephalus sanguineus*. The disease is endemic to the Mediterranean area, where, for the last few years, the number of cases has increased, possibly due, in part, to climatic factors; in the last few decades an increased incidence of MSF was reported for Spain, France, Italy, Portugal and Israel. Mediterranean Spotted fever was originally characterized as a benign rickettsiosis. However, there have been recent reports of very severe cases in France, Spain, Israel and South Africa, manifested by cutaneous and

neurological signs, psychological disturbances, respiratory problems and acute renal failure. The presence of the infectious agent, *Rickettsia conorii* appears to be spreading north.

Omsk haemorrhagic fever, louping-ill disease and Crimean–Congo haemorrhagic fever are other tick-borne diseases in Europe.

In both Europe and North America, ectoparasite infestations of humans such as head lice and scabies are present in increasing numbers; both of these serious pests have developed resistance to many of the insecticides that have provided effective control in the past. Scabies is the cause of frequent nosocomial outbreaks in health-care facilities.

It is now realized that house dust mites and cockroaches are responsible for an extraordinary amount of allergies including serious cases of asthma virtually everywhere and their control poses a most difficult problem.

In the last few decades a substantial number of newly emerged rodent-borne diseases of man have been recognized. Some of these infections may be due to agents that were not recognized in the past but others are characterized by such dramatic clinical courses, often with significant mortality and rapid spread, that they are to be considered truly 'emerging diseases'. The hantaviruses belong to the emerging pathogens having gained more and more attention in the last decades. Rodent-borne haemorrhagic fever with renal syndrome has spread widely in rodent populations in Europe, the USA and parts of Canada, with an increasing number of human cases. New species of hantaviruses with greater virulence are emerging in both Europe and North America. Transmission to humans occurs by direct contact with rodents or their excreta or by inhalation of aerosolized infectious material, e.g. dust created by disturbing rodent nests.

A new rodent-borne disease syndrome has appeared in the USA; named the hantavirus pulmonary syndrome (HPS), it is frequently associated with a case fatality rate of 30–60%; the disease was at first determined to be due solely to sin nombre virus, and was thought restricted to the western USA. However, new species of viruses giving rise to HPS have now been found throughout the USA and much of the Americas. As human populations grow and spread to suburban rodent-infested areas, it is likely that hantavirus diseases will become more common in the future especially as the elimination or effective control of their wild rodent reservoir hosts can not be considered as realistic.

Many public health authorities and medical practitioners are not aware of the reappearance of this group of diseases nor of the appearance of new diseases transmitted by insects, ticks and rodents. They are not necessarily familiar with the exotic infectious agents of this group that, with increased tourism, are increasingly being imported from disease-endemic countries. This has often resulted in the delayed or mistaken diagnosis of members of this group of

infections to the detriment of patients. The failure of public health authorities to recognize this group has often resulted in delays before effective measures have been undertaken to control their arthropod vectors or rodent reservoir hosts.

The following book will review the distribution of the vector and rodent-borne diseases in Europe, the USA and Canada; their incidence and prevalence, their costs and hence their public health burden will be detailed and their arthropod vectors and rodent-reservoir hosts described. Armed with such information, the individual clinician is more likely to have a degree of epidemiological suspicion that will lead to an earlier diagnosis and correct treatment of these infections. Equally, authorities will more readily understand the measures necessary to control this group of infectious agents.