

ZOONOSES

edited by

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INTRODUCTION

"Zoonoses are those diseases and infections which are naturally transmitted between vertebrate animals and man".

Second Report of the Joint World Health Organization/
Food and Agriculture Organization Expert Group on
Zoonoses, 1958.

Since the dawn of history the diseases of man have been compared with those of animals. It was not, however, until the discovery of the pathogenic properties of certain bacteria and other lower organisms that similarities between several communicable diseases of man and animals were properly assessed. In consequence of this, many hitherto unknown epidemiological links between human and animal diseases were revealed.

Some diseases of animals, although they are not transmitted to man, may be extremely harmful to him in an indirect way. In certain remote regions of the world, epi- and panzootics deplete domestic and game animals to such an extent, that the local population is deprived of food of animal origin, serious protein deficiency following in its wake.

Until the beginning of the present century, the animal origin of only a small number of human diseases had been recognized (mainly: rabies, cowpox, anthrax, malleus, and a few zooparasitic infections). At the present time, far more than 100 zoonoses are known. Most of those which have been recently recognized are caused by viruses or zooparasites.

Not only have more zoonoses been discerned, but their pathogenesis and epidemiology have also been elucidated. It has, in fact, become evident that the animal world is a reservoir of the agents of numerous human diseases.

Zoonoses are now among the most frequent and most dreaded risks to which mankind is exposed. This is particularly true in the tropics and sub-tropics, where arthropod vectors play a significant part in the transmission of communicable diseases.

There is ample reason to believe that most of the present infectious and parasitic diseases of the human race have originated in animals. The pathogenic organisms adapted themselves to the environment of the human body, either as parasites or commensals, these associations being eventually reversible.

The effects produced in both man and animals are mainly determined by the invasive capacities of the pathogen and the host's resistance to it.

Several zoonoses are almost equally harmful to man and to animals (e.g. anthrax, plague, rabies, bovine-type tuberculosis). Others only rarely or slightly impair animal health, but cause serious illness in man (brucellosis, Q-fever, hydatidosis). A third group includes grave epizootics, which seldom affect man (foot and mouth disease, pasteurellosis, pseudorabies). However, the seriousness of a particular zoonosis may differ considerably in various territories and at different times.

Investigations on the presence of specific antibodies in human and animal populations in given regions have shed new light on the distribution of several zoonoses. Repetition of these investigations at intervals can provide interesting information on the natural history of infectious diseases in a particular region. This is especially true of viral infections which lead to antibody production without provoking clinically perceptible damage to the host. A prolonged carrier-state without serological response may also be established.

The recently acquired data have made necessary to revise in several respects our earlier conceptions of zoonoses.

A major role in the epidemiology of zoonoses is played by wild or domestic animals, which persistently carry and excrete organisms which are potentially pathogenic to man. This may occur not only when animals have recovered from overt disease, but may also be established in host-animals which have never shown signs of illness. Reservoirs of considerable importance are formed by those animals which are fairly resistant to the pathogens, and develop a chronic carrier-state, but are not themselves clinically affected (clinically inapparent-, subclinical-, or latent infections).

Apart from nutritional and industrial zoonotic infections, most zoonoses are characterised by their focal distribution within particular geographical territories (the "landscape epidemiology" of Pavlowsky). *Ecosystems* in these localities include defined *biocenoses* (species networks), which are composed of mutually connected animal communities, combined with the local vegetable and microbial world.

When, among the vertebrate animals living in these ranges, there are hosts of potential pathogens of man, a zoonotic *nidus* is created. Frequently, arthropods and other non-vertebrate animals serve as vectors and play an important, or often necessary, part in the cycles of infection.

Under the influence of seasonally defined climatic conditions, the ecosystem is subject to repeated changes, which affect the hosts, vectors and pathogens in their habitats. Man's infringements of the natural conditions, brought about by such practices as the reclamation of waste lands, artificial irrigation or changing crops, may contribute to alterations of the environment and therefore to the propagation or abatement of zoonoses in nature.

When man becomes involved in a zoonotic nidus, it is likely that the chain of inter-animal infections will be diverted to him. When this happens no further transmission of the parasite usually occurs, so that the human host becomes an end-point of the pathogen's existence. Occasionally, however, circumstances favour inter-human transmission, for instance, in bovine-type pulmonary tuberculosis or diaplacental infection with *Listeria* or *Toxoplasma*. Even actual epidemics may develop out of an individual zoonotic infection, as may happen in secondary pulmonary plague. This situation must be differentiated from pseudo-epidemic spread appearing when numerous individuals are simultaneously exposed to the animal reservoir of a zoonotic agent (bubonic plague in a heavily rat-infested area; leptospirosis among labourers in fields swarming with rodents).

Retrograde infections, from man to animals, only exceptionally occur.

Marked differences exist in the host-parasite relationships of man having contact with infected vertebrate animals living in nature, as compared with persons keeping domestic animals in semi-natural or artificial environments. Man's repeated and intimate contact with the animals he attends, promotes the chances of the transmission of their pathogenic organisms. Under conditions prevailing in nature, man is most frequently infected along indirect routes, e.g. by means of soil and water contaminated with animal excretions, or through the intervention of blood-sucking arthropods.

As a rule, the clinical and pathological characteristics of a zoonosis have many points in common in both man and animals, although the localisation of the lesions, their incidence, and their degree of gravity may vary considerably. These differences are related to the species of the host, his state of immunity and the portals of entry of the pathogens, as well as to the intensity and frequency of the exposure. It is obvious, therefore, that most zoonoses occur among individuals occupationally engaged in the handling of animals, their carcasses and products (veterinary surgeons, slaughter-house personnel, raisers of livestock, milkers, workers employed

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in factories processing animal products, etc.). Another group of people frequently affected comprises persons who repeatedly come into contact with soil, mud or water, which are readily contaminated by animal excretions (agricultural and sewer workers, fishermen, hunters, bathers). The agents causing alimentary zoonoses (*e.g. Salmonella* and helminths) may be present in food of animal origin (milk, meat, and their products).

It is impossible to record in a single volume the enormous amount of knowledge of the zoonoses recently acquired. It has been necessary, therefore, to impose strict limitations on the choice of the facts and problems to be discussed. Only essential historical information has been included. Diagnostic and therapeutic methods and systems have not been described in detail. Most emphasis has been laid on the discussion of epidemiological problems, comparative nosology and questions of preventive medicine.

Further it has been necessary to omit all those animal diseases, the transmission of which to man has only been surmised on weak epidemiological grounds, but has not definitely been established (*e.g. bovine actinomycosis and vesicular coital exanthema*).

Diseases like equine infectious anaemia or enzootic ovine abortion, which affect man extremely rarely, and under particular conditions only, have also been omitted. Likewise, no chapter has been devoted to the relapsing fevers. The importance of animal reservoirs as sources of these human infections has not been definitely proven while, moreover, certain differences have been established between the spirochaetes encountered in rodents in an endemic area and the *Borreliae* which cause relapsing fevers in man.

In addition to the zoonoses, the agents of which are found only or chiefly in animals, there are diseases caused by organisms which frequently occur in both man and the lower animals, so that it is not possible to ascertain which are their main hosts. These diseases differ from the others just mentioned in that man can not be safeguarded merely by the eradication of the causative agents from the animal-world. Because the animals are important, or potentially important as distributors of these pathogenic organisms, some parasitic diseases, such as dracontiasis, hirudiniasis and simian malaria, have been discussed in the following pages.

Considerations of space have, unfortunately, prevented the inclusion of exhaustive lists of references, and have obliged the authors to restrict themselves to the more important publications, preferably to those of recent years.

The reader who is interested in more detailed bibliographical information, may consult the books, monographs and reviews of literature which are inserted in the List of General References and in the separate lists appearing at the end of each chapter.

Ness Ziona, October 1963.

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CHAPTER I

BACTERIAL DISEASES

J. VAN DER HOEDEN

Tuberculosis

The majority of vertebrates are susceptible to tuberculosis, a disease of world-wide incidence. Although the name tuberculosis did not appear in literature before 1840, the disease has existed among man's forbears since the dawn of history.

Tuberculous lesions have been found in mummies of the Rameses dynasties, which are some 30 centuries old. It is said that descriptions of lung lesions given in ancient Hindu manuscripts strongly suggest that these lesions were those of pulmonary tuberculosis. Hippocrates mentioned a disease of the lungs, the course of which was similar to that of tuberculosis pulmonum, and Aristotle knew that this condition is contagious. There are several indications that tuberculosis was widespread among the populations of the ancient Greek and Roman world.

The disease has also long been known in animals. The directions laid down in the Pentateuch and Talmudic scriptures for the conduct of sacrifices and slaughter-rituals, suggest that the ancient Jews were acquainted with the tuberculous lesions in ruminants.

However, considerable time elapsed before the aetiological identity of the disease in man and animals was recognized. In sixteenth century Europe it was generally believed that the multiple tumor-like tuberculous lesions in the serous membranes of cattle (pearl disease) had a syphilitic origin and that they were due to sodomy committed by luetic persons with cows ("Lustseuche", "Gallic disease"). This explains why individuals who consumed the meat of such animals were threatened with severe punishment. This baseless belief was not discredited until the end of the eighteenth century.

In the closing years of that century some physicians expressed their conviction that there was a similarity between human "consumption" and bovine tuberculosis. At that time the bovine tuberculosis was very widespread in Europe and it is beyond doubt that bovine infections affected many human beings, youthful individuals particularly.

R. and J. Dubos established that, in the nineteenth century, approximately half of the English population was afflicted by scrofula (infection of the lymph glands and