Zoonoses

Infectious Diseases
Transmissible Between
Animals and Humans
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Preface

Zoonoses are infectious diseases transmissible from vertebrate animals to humans and vice versa under natural conditions. They comprise a complex spectrum of diseases due to the diversity of pathogenic agents involved. They may confront veterinarians as well as general practitioners, pediatricians, infectious disease specialists, and microbiologists with special diagnostic and therapeutic problems. While we did not intend to write a handbook of zoonoses, we wanted to cover not only well-known diseases but also rare ones that may be of importance to physicians active in developing countries and to travelers going to distant or rarely visited areas.

Our book is based on the 4th German edition of Zoonosen: Zwischen Tier und Mensch übertragbare Infektionskrankheiten which was published in 2013 by Deutscher Ärzte-Verlag, Cologne, Germany. It has been thoroughly revised, updated, and amended.

We have tried to present the most significant aspects of the great variety of zoonotic diseases in a concise manner. However, in some cases readers may even need more detailed information.

We express our appreciation to Christine Charlip, Director, and Larry Klein, Production Manager of ASM Press for their constant encouragement, assistance and advice. We are indebted to Professor Gaby Pfyffer von Altishofen, Lucerne, for helpful suggestions and constructive criticism of the chapter on mycobacterioses, and Dr Tanja Matt, Zürich, for technical help with the figures on transmission chains. We also want to thank Prof. Peter Mayszer, Giessen, for valuable advice on the chapter on fungal zoonoses and Prof. Brigitte Frank, Hohenheim, for her support in the translation. And all of us, particularly those involved in translating the German text into English, are deeply grateful to our families for their patience, tolerance, and support.

Finally it is the particular concern of the authors to commemorate our co-author Hans Gerd Schiefer who unfortunately died shortly before completion of this edition. His work and participation had been extremely important for this book.
Numerous human infectious diseases are caused by agents that are directly or indirectly transmissible from various animal species to humans. Today, more than 200 diseases occurring in humans and animals are known to be mutually transmitted. They are caused by prions, viruses, bacteria (including rickettsiae and chlamydiae), fungi, protozoa, and helminths, as well as arthropods. An Expert Committee of the World Health Organization defined zoonoses in 1958 as “diseases and infections which are naturally transmitted between vertebrates and humans.” This definition is still valid.

Originally, zoonoses were regarded as animal diseases (in Greek zoon means “animal”). In the 19th century, the meaning of the word changed. Thus, in 1855, R. Virchow included in his book, Handbuch der Speciellen Pathologie und Therapie, the chapter “Infectionen durch contagious Thiergifte” (“Infections Caused by Animal Contagious Poisons”) with the subtitle “Zoonosen” (“Zoonoses”). Shortly after this, the word “zoonoses” received a double meaning for the first time. W. Probstmayer (1863) stated in the Etymologisches Wörterbuch der Veterinärmedizin und ihrer Hilfswissenschaften (Etymological Dictionary of Veterinary Medicine and its Auxilliary Sciences) “zoonoses are (i) animal diseases and (ii) diseases of humans transmitted from animals by means of a vector or contact.” Today, no difference is made with regard to the direction of transmission, that is, animal to human or human to animal, although attempts exist to describe precisely the direction of transmission. The term “zooanthroponoses” referred to diseases transmitted from animals to humans, and the term “anthropozoonoses” referred to diseases transmitted from humans to animals. However, the latter play only a minor role in the epidemiology of zoonoses. The term “zoonosis” still underlies conceptual changes. For instance, increasing epidemiological knowledge has put into doubt the traditional associations of some infectious diseases with zoonoses. Diseases that do not require a vertebrate reservoir because of their occurrence in water, in soil, on plants, or in food or fodder, whence they are transmitted to vertebrates (including humans), are also called sapronoses, saprozooonoses, or geonoses.

Zoonoses are a persisting threat to the human society. Classical infectious diseases, such as rabies, plague, and yellow fever, well known for centuries, are zoonoses that have not been eradicated despite major efforts. And the importance of zoonoses still increases. In recent years, new zoonotic entities, for example, Lyme borreliosis, ehrlichiosis, infections with enterohemorrhagic Escherichia coli, cryptosporidiosis, and hantavirus pulmonary syndrome, have been detected.

The steadily increasing threat that zoonoses pose to humans have many causes that differ from country to country. Overpopulation, wars,
and progressive deterioration of living conditions may cause migration of countless people into slums of large cities, with a subsequent breakdown of hygiene and public health care. The proximity of their dwellings to huge garbage dumping grounds and their dependence on water contaminated with sewage facilitate contact with rodents, stray animals, and their parasites.

Scarcity of food forces millions of humans to clear woodlands for cultivation and to produce new settlements in areas where animal populations and their pathogenic agents were formerly separated from humans. Humans may participate unwittingly in unknown parasite-host cycles and become a new link in an infectious chain. In many of these cases, humans, as accidental hosts, are in no way adapted to the new pathogenic species, which may result in high mortality.

Artificial irrigation changes the ecology of whole countries. Artificial lakes and ponds attract animals and their parasites over vast distances and provide optimal breeding grounds, especially for mosquitoes. Increasingly warm and moist winters in the Northern Hemisphere favor the propagation of parasites, especially ticks. Stray animals, usually infected with various pathogens, are reservoirs for infectious agents, not only in developing countries, but also in developed countries.

Worldwide tourism, especially trekking tours to remote areas and so-called adventure challenges (e.g., “survival training” with camping in open areas and consumption of raw or insufficiently cooked food) has encouraged contact of humans from industrialized countries who grew up under nearly aseptic conditions and agents and vectors that they have never encountered before.

Zoonotic agents of low virulence may cause fatal infections in immunosuppressed humans (e.g., patients infected with HIV).

A further potential source of infection is transport of breeding and slaughter animals over vast distances and across borders, often with insufficient inspection for disease control. New disease agents may be introduced to a country by legal, or, even worse, illegal importation of exotic animals for zoos, research purposes, or private homes. Isolated animal organs (xenotransplants) and cultures of animal cells may contain dangerous zoonotic agents. Furthermore, several zoonotic pathogens, for example, Francisella tularensis, Yersinia pestis, Brucella spp., Bacillus anthracis, Coxiella burnetii, and hemorrhagic fever viruses, are considered possible bioterrorism weapons.

The problem of diseases transmitted between animals and humans has many aspects, especially as it is not uncommon for animals serving as reservoir or intermediate hosts to be clinically inapparent carriers and/or excreters of an agent. Undoubtedly, currently unknown zoonoses will emerge in future. New methods for direct or indirect detection of microorganisms contribute to the detection of new zoonoses. When human invasion of hitherto uninhabited areas results in voluntary or involuntary environmental changes, new and potentially dangerous zoonoses may become evident. Severe acute respiratory syndrome, caused by a newly emerged coronavirus, is one of the latest examples of the threat of dangerous infections, although its possible zoonotic background has not yet been clarified.

In the study of zoonoses, medical experts and veterinarians should cooperate closely to study the etiology, epidemiology, and frequently complex developmental cycles and modes of transmission of pathogens and their vectors, as well as the clinical presentation, diagnosis, differential diagnosis, therapy, and prophylaxis of the attendant diseases. Our book is based on such cooperation, which since recently, is also postulated under the concept “One World – One Health.”

REFERENCES

### Abbreviations

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<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>ACA</td>
<td>Acrodermatitis chronica atrophicans</td>
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<tr>
<td>AIDS</td>
<td>Acquired immunodeficiency syndrome</td>
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<td>ARDS</td>
<td>Acute respiratory distress syndrome</td>
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<tr>
<td>a.s.l.</td>
<td>Above sea level</td>
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<tr>
<td>AV</td>
<td>Atrioventricular</td>
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<tr>
<td>BSL</td>
<td>Biosafety level</td>
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<tr>
<td>CD4</td>
<td>Cluster of differentiation 4 (glycoprotein on the surface of several immune cells)</td>
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<tr>
<td>CDC</td>
<td>Centers for Disease Control and Prevention</td>
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<tr>
<td>cDNA</td>
<td>Complementary DNA</td>
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<tr>
<td>CF test</td>
<td>Complement fixation test</td>
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<tr>
<td>CFU</td>
<td>Colony forming units</td>
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<tr>
<td>CIN</td>
<td>Agar cefsulodin-irgasan-novobiocin agar</td>
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<tr>
<td>CMV</td>
<td>Cytomegalovirus</td>
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<tr>
<td>CNS</td>
<td>Central nervous system</td>
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<td>CPK</td>
<td>Creatine phosphokinase</td>
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<td>CSD</td>
<td>Cat scratch disease</td>
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<td>CSF</td>
<td>Cerebrospinal fluid</td>
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<td>CT</td>
<td>Computed tomography</td>
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<tr>
<td>DNA</td>
<td>Deoxyribonucleic acid</td>
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<td>EDTA</td>
<td>Ethylenediaminetetraacetate/etylenediaminetetraacetic acid</td>
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<td>EHEC</td>
<td>Enterohemorrhagic <em>Escherichia coli</em></td>
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<td>EIA</td>
<td>Enzyme immunoassay</td>
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<td>ELISA</td>
<td>Enzyme linked immunosorbent assay</td>
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<td>Enteropathogenic <em>Escherichia coli</em></td>
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<td>Ethambutol</td>
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<td>FDA</td>
<td>US Food and Drug Administration</td>
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<td>HAART</td>
<td>Highly active antiretroviral therapy</td>
</tr>
<tr>
<td>HACCP</td>
<td>Hazard analysis critical control point</td>
</tr>
<tr>
<td>HAT</td>
<td>Human African trypanosomiasis</td>
</tr>
<tr>
<td>HE</td>
<td>Hektoen enteric (agar)</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>HGA</td>
<td>Human granulocytic anaplasmosis</td>
</tr>
<tr>
<td>HGE</td>
<td>Human granulocytic ehrlichiosis</td>
</tr>
<tr>
<td>HIV</td>
<td>Human immunodeficiency virus</td>
</tr>
<tr>
<td>HLA</td>
<td>Human leukocyte antigen</td>
</tr>
<tr>
<td>HME</td>
<td>Human monocytic ehrlichiosis</td>
</tr>
<tr>
<td>HUS</td>
<td>Hemolytic-uremic syndrome</td>
</tr>
<tr>
<td>IARC</td>
<td>International Agency for Research on Cancer (WHO)</td>
</tr>
<tr>
<td>ICU</td>
<td>Intensive care unit</td>
</tr>
<tr>
<td>IF(A)</td>
<td>Immunofluorescence (assay)</td>
</tr>
<tr>
<td>Ig(A,G,M)</td>
<td>Immunoglobulin(A,G,M)</td>
</tr>
<tr>
<td>IGR</td>
<td>Insect growth regulator</td>
</tr>
<tr>
<td>IHA</td>
<td>Indirect hemagglutination assay</td>
</tr>
<tr>
<td>IIFT</td>
<td>Indirect immunofluorescence test</td>
</tr>
<tr>
<td>IL</td>
<td>Interleukin</td>
</tr>
<tr>
<td>i.m.</td>
<td>Intramuscular</td>
</tr>
<tr>
<td>INH</td>
<td>Isonicotinic acid hydrazide/isoniazide</td>
</tr>
<tr>
<td>i.p.</td>
<td>Intraperitoneal</td>
</tr>
<tr>
<td>i.v.</td>
<td>Intravenous</td>
</tr>
<tr>
<td>kbp</td>
<td>Kilobase pairs</td>
</tr>
<tr>
<td>kDa</td>
<td>Kilodalton</td>
</tr>
<tr>
<td>LAMP</td>
<td>Loop-mediated isothermal amplification</td>
</tr>
<tr>
<td>LEE</td>
<td>Locus of enterocyte effacement</td>
</tr>
<tr>
<td>LPS</td>
<td>Lipopolysaccharide</td>
</tr>
<tr>
<td>MAA</td>
<td><em>Mycobacterium avium</em> subsp. <em>avium</em></td>
</tr>
<tr>
<td>MAH</td>
<td><em>Mycobacterium avium</em> subsp. <em>hominissuis</em></td>
</tr>
<tr>
<td>MAI</td>
<td><em>Mycobacterium avium-intracellulare</em></td>
</tr>
<tr>
<td>MALDI-TOF</td>
<td>Matrix-assisted laser desorption ionization-time-of-flight mass spectrometry</td>
</tr>
<tr>
<td>MAP</td>
<td><em>Mycobacterium avium</em> subsp. <em>paratuberculosis</em></td>
</tr>
<tr>
<td>MAT</td>
<td>Microagglutination test</td>
</tr>
<tr>
<td>mb</td>
<td>Megabases</td>
</tr>
<tr>
<td>MHC</td>
<td>Major histocompatibility complex</td>
</tr>
<tr>
<td>MID</td>
<td>Minimum infective dose</td>
</tr>
<tr>
<td>mio</td>
<td>Million</td>
</tr>
<tr>
<td>MPS</td>
<td>Mononuclear phagocytic system</td>
</tr>
<tr>
<td>MRI</td>
<td>Magnetic resonance imaging</td>
</tr>
<tr>
<td>mRNA</td>
<td>Messenger RNA</td>
</tr>
<tr>
<td>MMT</td>
<td>Mendel-Mantoux test</td>
</tr>
<tr>
<td>MOMP</td>
<td>Mitochondrial outer membrane protein</td>
</tr>
<tr>
<td>MRSA</td>
<td>Methicillin-resistant <em>Staphylococcus aureus</em></td>
</tr>
<tr>
<td>NSF</td>
<td>National Science Foundation</td>
</tr>
<tr>
<td>NNN</td>
<td>Novy-McNeal-Nicolle medium</td>
</tr>
<tr>
<td>NTM</td>
<td>Non-tuberculous mycobacterium</td>
</tr>
<tr>
<td>PAHO</td>
<td>Pan American Health Organization</td>
</tr>
<tr>
<td>PCR</td>
<td>Polymerase chain reaction</td>
</tr>
<tr>
<td>PFGE</td>
<td>Pulse field gel electrophoresis</td>
</tr>
<tr>
<td>PFU</td>
<td>Plaque forming unit</td>
</tr>
<tr>
<td>p.i.</td>
<td>Post infection</td>
</tr>
<tr>
<td>PI-IBS</td>
<td>Post infectious irritable bowel syndrome</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>--------------</td>
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</tr>
<tr>
<td>p.o.</td>
<td>Peroral</td>
</tr>
<tr>
<td>p.p.</td>
<td>Post partum</td>
</tr>
<tr>
<td>RES</td>
<td>Reticuloendothelial system</td>
</tr>
<tr>
<td>RFLP</td>
<td>Restriction fragment length polymorphism</td>
</tr>
<tr>
<td>RMP</td>
<td>Rifampicin</td>
</tr>
<tr>
<td>RMSF</td>
<td>Rocky Mountain spotted fever</td>
</tr>
<tr>
<td>RNA</td>
<td>Ribonucleic acid</td>
</tr>
<tr>
<td>rRNA</td>
<td>Ribosomal RNA</td>
</tr>
<tr>
<td>RT-PCR</td>
<td>Reverse transcription PCR</td>
</tr>
<tr>
<td>SAF</td>
<td>Sodium acetic acid formaldehyde</td>
</tr>
<tr>
<td>s.c.</td>
<td>Subcutaneous</td>
</tr>
<tr>
<td>SCV</td>
<td>Small cell variant</td>
</tr>
<tr>
<td>SIRS</td>
<td>Systemic inflammatory response syndrome</td>
</tr>
<tr>
<td>s.l.</td>
<td>Sensu lato</td>
</tr>
<tr>
<td>SMAC</td>
<td>Sorbitol-MacConkey agar</td>
</tr>
<tr>
<td>spf</td>
<td>Specific pathogen free</td>
</tr>
<tr>
<td>SS</td>
<td>Salmonella-Shigella (agar)</td>
</tr>
<tr>
<td>s.s.</td>
<td>Sensu stricto</td>
</tr>
<tr>
<td>SSG</td>
<td>Sodium stibogluconate</td>
</tr>
<tr>
<td>STEC</td>
<td>Shiga toxin producing <em>Escherichia coli</em></td>
</tr>
<tr>
<td>STx</td>
<td>Shiga toxin</td>
</tr>
<tr>
<td>Th (1,2)</td>
<td>T helper cell (1,2)</td>
</tr>
<tr>
<td>Tir</td>
<td>Translocated intimin receptor</td>
</tr>
<tr>
<td>TNF</td>
<td>Tumor necrosis factor</td>
</tr>
<tr>
<td>Tris</td>
<td>Tris(hydroxymethyl)aminomethane</td>
</tr>
<tr>
<td>TTP</td>
<td>Thrombotic thrombocytopenic purpura</td>
</tr>
<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
</tr>
<tr>
<td>UV</td>
<td>Ultraviolet</td>
</tr>
<tr>
<td>VSG</td>
<td>Variant surface glycoprotein(s) of African trypanosomes</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>XLD</td>
<td>Xylose-lysine-deoxycholate (agar)</td>
</tr>
</tbody>
</table>