



Abstract

The most dangerous microbes for humans are those that are easily transmitted, virulent and invasive to central organs like the blood and lung, robust survivors in the environment, have a low infection dose and are without any specific treatment or vaccine. Most of them are zoonoses transmitted from animals and often with insects as vectors. The most dangerous microbes cause a very high mortality, are identified as high-risk agents or “biohazard-level 4” agents and are treated at the highest level of infection protection with strict isolation measures. Dangerous microbes occur as a problem mostly in countries with low hygiene standards/high population density and in tropical-subtropical areas. Infection control must always be based on hygienic measures and strict infection protection.

This chapter is a short information about the most virulent and pathogenic agents, geographic area and severity of disease.

Keywords

Microbes · Dangerous microbes · Geographic area of virulent agents · Dangerous virus and bacteria · Zoonosis · VHF · Anthrax · Plague · Biosafety level 4 Infection control · Survivors · High-risk microbes · Severity of disease

80.1 Dangerous Microbes

New, emerging or re-emerging infectious diseases and agents still appear. More than 15 new potential human pathogenic microbe types may be registered every year. New infectious diseases and emerging virulence properties still appear, for

Current agents are described in more detail in: Andersen BM. Part 1. Microbiology and infection protection. Fagbokforlaget 2014.

example, avian influenza viruses (H5N1 and others), HTLV and other retroviruses, HPV, Sindbis virus, Parvovirus, Bocavirus, Coronavirus, or bacteria like *Legionella*, *Borrelia*, group A streptococci and meningococci [1–5].

Virus not vaccine preventable or without specific treatment option, low infection dose and high capacity to survive in the environment will be a major problem if associated with incurable disease, disability or death. Virulent and dangerous microbes occur as a problem mostly in countries with low hygiene standards/high population density and in tropical-subtropical areas. Infection control must be based on hygienic measures and proper infection protection [2–7].

The most dangerous microbes for humans are those that are easily transmitted, virulent and invasive to the central organs like the blood and lung, robust survivors in the environment, have a low infection dose and are without any specific treatment or vaccine [2–5]. Most of them are zoonosis transmitted from animals and often with insects as vectors [8–12]. Dangerous microbes have also been used as biological weapons like anthrax, plague, botulism, *Coxiella*, *Brucella*, viral haemorrhagic fever (VHF) viruses, poxviruses and a number of other unusual agents [4, 13–25]. In the United States, there was an anthrax bioterrorism attack in 2001 [18, 19].

If the infectious agent and transmission ways are unknown and the situation is uncontrollable, it is important to follow pre-planned practical measures like strict isolation in negative air pressure isolation, registering of all contacts and the use of personal protective equipment (PPE) for air- and contact-borne infection [4, 8–13, 17, 20, 24, 26–29].

80.1.1 Dangerous Virus

During the last 20 years, there have been several large outbreaks of new and re-emerging viruses. Examples are systemic acute respiratory syndrome (SARS) (2002–2003), avian influenza viruses (H5N1, 2005), pandemic influenza (2009), Middle East respiratory syndrome (MERS) (2012) and Ebola (2014 and 2016) [1, 4, 5, 8, 11, 12].

VHF virus and a number of other special viruses are considered to cause the world's most dangerous infections with very high mortality, lack of therapeutic possibilities and often absence of effective vaccines. Such viruses are identified as high-risk agents or “biohazard-level 4” agents and are treated at the highest level of infection protection with strict isolation measures [4, 11, 12, 26–28].

- Virus families, with members especially dangerous to humans, are *Arenaviridae*, *Filoviridae*, *Flaviviridae*, *Bunyaviridae*, *Togaviridae* and *Paramyxoviridae* (Nipah encephalitis virus, etc.) and several others. They are mostly vector borne by insects and animals (zoonosis), dependent on a tropical-subtropical climate and temperature. Therefore, the colder zones in Europe, America, Asia and Australia are nearly free from more such serious infectious agents (see the table below) [1, 2, 4, 11, 12].

- Some very virulent viruses may be spread on all continents: TBE, RSSE, CCHF, rabies virus (*Rhabdoviridae*), avian influenza virus (AH5N1) and other high-pathogenic influenza viruses (*Orthomyxoviridae*). SARS and MERS (*Coronaviridae*) may be spread globally as nosocomial infections. MERS is a newly discovered coronavirus-zoonosis (dromedaries, bats, etc.) and acts as SARS, also with a tendency for nosocomial spread in hospitals, still going on in the Middle East. [30] These and other viruses are adapted to the climate and spread by direct transmission person-to-person, by increased mobility in the population and/or spread via new vectors, like animals, birds and insects [1, 4].
- A few of these dangerous viruses are vaccine preventable, and specific antiviral therapy is lacking in most cases.

80.1.1.1 Other New Virulent Viruses

- *Zika* virus—newly discovered flavivirus in South America, with mild to serious symptoms and teratogenic effect [11].
- *Polio-like illnesses*, especially among children, discovered in August 2014 in the United States. Probably caused by enterovirus D68 [31].
- *HIV aggressive variants* (CRF19) have been detected in Cuba in 2015 and earlier in Africa, with a faster course from infection to AIDS development [32].

80.1.2 Dangerous Bacteria

Bacteria resistant to antibacterial drugs have developed rapidly among staphylococci (MRSA), enterococci (VRE), tuberculosis bacilli (multidrug-resistant mycobacteria) and gram-negative rods (ESBL) in the last 30–50 years. From 2009 to 2010 onwards, super-resistant gram-negative rods (CRE, CPE) have increased rapidly with transmission of genes with total drug resistance (NDM-1) [1–5]. Bacteria sensitive to common antibacterial agents will probably not be a major problem in the future, unless changed antibacterial sensitivity.

- Anthrax is still endemic or hyperendemic on all continents in the world, mainly as a zoonosis among unvaccinated cattle [1–6, 13, 33]. It has been known for more than 4000 years and was earlier called “Black bane”. Natural anthrax in human is associated with contact with sick animals and animal products. The bacterium *Bacillus anthracis* is producing lethal toxins and spores that can survive in the environments for 100 years or more. Minimum infectious dose is 1–3 spores, and toxin-producing anthrax may cause skin, lung or intestinal anthrax, dependent on the transmission via contact, air or food. The non-skin anthrax has a very high lethality. Today, about 2000 people are infected each year, from eating or handling infected meat. During peace time, there are few incidents of threats using bioterror weapons like anthrax. However, autumn 2001 anthrax was spread in the United States by “powder letters” [18, 19].
- Plague, caused by *Yersinia pestis* (*Enterobacteriaceae*), is a zoonotic disease, vector-transmitted from infected rodents to humans via infected insects (fleas and lice)

[1–5, 8]. It is one of the great historical diseases. In the last 1500 years, plague has killed more than 200 million people during large epidemics (Black Death), especially from the year 1347. Still, plague causes bubonic-glandular pest, lung pest and/or septicæmia in 2000–3000 cases each year, and more than 10 outbreaks (Africa, Asia, Australia, Madagascar) have occurred since the year 2000 [8, 34].

- Cholera caused by *Vibrio cholera* is one of the great quarantine diseases, called “mother of all epidemics”, still very active in Asia and Africa. Cholera is associated with contaminated water, war and nature catastrophes, like in Haiti 2010, with 670,000 cholera cases (profuse diarrhoea) [1–5, 35].
- *Brucella* species (*Brucellaceae*) are one of the most important zoonotic diseases both for animals and humans all over the world. They easily spread via contact and air from animals and food, survive in the environment for months especially during colder seasons, are very easily transmitted and may cause nosocomial infections, chronic febris undulans, septicæmia and lung diseases. Vaccination of animals may eradicate the zoonotic disease [15]. *Brucella* are particularly related to laboratory outbreaks but are easily transferable outside the laboratory and are considered highly infectious [36].
- *Francisella tularensis* (zoonosis) is defined as a category A bioterrorism agent, highly infectious and increasing in the society, has low infection dose (one to ten bacteria) and can be inhaled or infected via food and water [1–5, 8]. Occasionally, such patients are detected in hospitals, even in the operating department [37]. Tularemia is a zoonotic disease or colonization among wild animals as rodents and hares and may survive at colder seasons for long periods in water, amoebas, birds and insects like ticks. The infection (skin, lung, intestine) is transmitted via contact with infected animals, inhalation of airborne bacteria, contaminated water and ticks.
- *Botulism* is caused by a bacterial-produced toxin (*Clostridium botulinum*) that causes paresis and is common in soil as spores [1–5]. The disease can be associated with toxin formation in contaminated and poorly canned foods, shrimp fish, bacon, etc. under anaerobic conditions and randomly affects both healthy people and vulnerable groups, such as infants who have had honey infected with the bacterium, which has happened repeatedly [38]. The toxin is the most dangerous we know and is on the list of bioterrorism.
- Family *Rickettsiaceae* is associated with many different types of small, intracellular microbes that are zoonotic and survive for a long time in the nature and in infected animals, birds, insects, water and amoeba [2, 3, 10]. *Coxiella burnetii* is a global zoonosis among animals like sheep and goats and may be airborne for several kilometres, causing frequent outbreaks of Q-fever in Europe in more than 4000 cases in the Netherlands during 2007–2010 [10]. *Rickettsia* species are more than 25 types, and many of them, especially the typhus group, are causing severe diseases. Humans are mostly infected by insects, including ticks from infected wild animals and rodents usually found in tropical or subtropical areas, but climatic changes, lack of good hygiene, war and natural catastrophes may spread these infections. During the period 1881–1920, 30 million people got epidemic typhus, and three million died in East Europe and Russia [2, 3, 10].

80.1.3 Other Bacteria That Are Causing Concern

- *Borrelia* (*Spirochetaceae*) has an increasing number of species that may infect human cases all over the world. The disease may cause chronic infections in the skin, muscles, heart, nerve tissue and brain. Borreliosis is a typical emerging zoonosis, spread via different ticks from animals and birds over large geographic areas and with large climatic variations [9].
- *Syphilis* (*Spirochetaceae*) and *Treponema pallidum* are old, historical diseases, transmitted via sex, from mother to child during pregnancy and via blood products. Now re-emerging and increasing worldwide [9].
- Other spirochetes or the like may cause zoonosis, like *Borrelia recurrentis* and *Leptospira* [9].
- *Burkholderia pseudomallei* is causing melioidosis, pneumonia, septicaemia, disseminated infection and shock. Incubation period may be up to 20–40 years. It is a long survivor in the environment (2–10 years), robust at tropical-subtropical temperatures >25 °C and is very dangerous. Endemic in Southeast Asia and may be spread by increasing globalization [1–5].

80.1.4 Other Infective/Dangerous Agents

- *Fungi and mould*—different types are especially related to floods, water damage, etc. and to contamination of medical products and equipment [39, 40]. Especially, the newly defined *Candida auris* may be very virulent.
- *Prion disease-new Shy-Drager syndrome* is rediscovered in 2015; Multiple-system atrophy (MSA) [5, 41].
- *Ricin* is a plant-derived toxin that is still used for bioterrorism in letters to, among others, President Obama [42].

Serious and unusual microbial infections

Microbes	Geographic area	Disease
Virus		
<i>Arena virus</i>		
Lassa	West Africa	Severe, often fatal
Guanarito	Venezuela	Severe
Junin (Argentine haemorrhagic fever-HF)	Argentina	Severe
Machupo (Bolivian haemorrhagic fever)	Bolivia	Severe
Sabia	Brazil	Severe
LCM	Global	Mild to severe
<i>Filovirus</i>		
Marburg	Africa	23–100 % fatal
Ebola	Africa	20–100 % fatal

Microbes	Geographic area	Disease
<i>Bunyaviridae (over 60 viral types from asymptomatic to fatal)</i>		
Rift Valley fever	Africa	1 % develops HF
California enceph	United States, Europe	2 % fatal
Crimean-Congo haemorrhagic fever (CCHF)	Africa, Asia, Europe	Severe
Hantaan group	North and South America, Europe, Asia	Moderate to severe
<i>Arbovirus (Togaviridae and Flaviviridae)</i>		
Tick-borne (TBE) encephalitis virus complex	All continents	Moderate to fatal
Russian spring and summer encephalitis (RSSE)		
Omsk haemorrhagic fever		
Central European encephalitis viruses		
Venezuelan equine encephalitis virus		Moderate to severe
Yellow fever virus	Africa, America	Moderate to severe
Semliki Forest virus	Africa, epidemic	Mild to fatal
Dengue virus	All tropical-subtropical areas	Mild to fatal
Japanese B encephalitis	Asia; Korea, Japan, Philippines	Often fatal
<i>Rabies</i>	In all parts of the world	100% fatal without tr.
<i>Monkey pox (B)</i>	Animal experiments	Severe, often fatal
<i>Smallpox Virus</i>	Eradicate, but kept	Severe, often fatal in unvaccinated
<i>Avian influenza A H5N1</i>	Asia, Africa, Europe	80% fatal without treat
<i>Nipah encephalitis virus (paramyxovirus)</i>	Asia, Malaysia, India, Bangladesh	75% fatal
<i>Corona Virus</i>		
Systemic acute respiratory syndrome (SARS)	Asia, Canada, proliferation	Severe, 10% fatal
Middle East respiratory syndrome (MERS)	Middle East, emerging	Severe, 30–40% fatal
Bacteria		
<i>Richettsiaceae</i>		
<i>Rickettsia</i>	All continents	Many types, severe
<i>Orientia</i>	Asia, Australia	Moderate to severe
<i>Bartonellaceae</i>		
<i>Coxiella burnetii</i>	All continents	Moderate to severe
<i>Bacillus anthracis</i>	All continents	Moderate to severe
<i>Brucella</i>	All continents	Mild to severe
<i>Burkholderia pseudomallei</i>	Asia	Mild to severe
<i>Francisella tularensis</i>	All continents	Mild to severe
<i>Vibrio cholera</i>	Asia, Africa and South America	Mild to severe
<i>Bacillus anthracis</i>	All continents	Moderate to severe
<i>Yersinia pestis</i>	Africa and Asia	Moderate to severe

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