FOURTH EDITION

Communicable Disease Control and Health Protection Handbook

Jeremy Hawker, Norman Begg, Ralf Reintjes, Karl Ekdahl, Obaghe Edeghere, Jim van Steenbergen

WILEY Blackwell

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Fourth Edition

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Contents

Section 4: Services and organisations

Section 5: Communicable disease control in Europe

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Foreword

Six years have passed since the third edition of the *Communicable Disease Control and Health Protection Handbook* was published. In many other areas of public health this may not seem a long time. However, when it comes to communicable disease control there is always an element of urgency, and each large international (or national) outbreak is an impetus for reflection on what went well and what could be done better next time. Therefore, our area of work is as much driven by the large events as it is by slow developments.

Since the last edition, the WHO has three times invoked formal declarations of public health emergencies of international concern (PHEIC) under the International Health Regulations (IHR 2005); in 2014 the polio declaration, the same year the Ebola declaration, and in 2016 the Zika virus declaration. Each of these emergencies has different characteristics and provides different lessons.

Two of the most tangible consequences of larger international outbreaks the last 10 years, are the new EU legislation on Cross-border Threats to Health (Decision 1082/2013) and the establishment of the new WHO Health Emergencies Programme. Both highlight the importance of increasing the core capacities of the countries to prepare for and respond to health threats, and the need for efficient international co-operation. These tasks cannot be performed by the health sector itself, but need an inter-sectoral and one-health approach. The new edition of the handbook, covers these areas.

However, the challenge does not only lie with the big outbreaks. We are also facing silent and slow, but no less threatening epidemics. Here I am of course referring to the growing problem of antimicrobial resistance, which can only be overcome by proper antibiotic stewardship and consequent infection prevention and control in hospitals. However, everyone needs to contribute, hence the one-health approach, to buy us the time needed for the introduction of new technologies and principles of fighting infections that may in the future save us from a situation similar to the one in the pre-antibiotic era.

The years since the previous edition of this book have also presented new challenges in the shape of increasing lack of trust in authorities, 'alternative facts', and social media filter bubbles, where rumours and myths are spreading. In the age of social media, vaccine sceptics are getting effective platforms for disseminating their messages. As public health professionals, we are, therefore, facing new tasks in debunking these myths. This is requiring new skill sets outside the traditional public health competencies, and as public health professionals, we will need to provide leadership, regardless of our specific position.

Public health professionals are facing numerous challenges. Many are working not only with communicable diseases, but in a broader public health setting, where some of the specific infectious diseases requiring public health actions are only rarely encountered. The practitioner in the field noting an infection case, or cluster of cases, therefore from time to time will need easy access to practical, authoritative and updated information to guide initial assessment and practical response.

In today's information age, we are not lacking sources of information – quite the contrary, but the format is not always relevant to the practical problem at hand. This is where the *Communicable Disease Control and Health Protection Handbook* has its niche. The format of the handbook is designed to provide the on-call public health officer with necessary information at a glance in the acute situation. It provides clear and practical guidance on what needs to be done and when to engage others. It is thus a good compliment to other sources of information, for example relevant national guidelines. At the same

time, the overview chapters are useful for setting the individual cases in a larger public health perspective.

As the Director of the European Centre for Disease Prevention and Control (ECDC), I especially appreciate the specific European dimensions of the book. The country chapters provide a useful overview of the public health systems in each of the EU countries and some more. This European dimension highlights that fighting communicable diseases is not only a national priority, but is a task requiring co-operation across the borders.

July 2018

Andrea Ammon
Director
European Centre for Disease Prevention and Control

Abbreviations

ACDP	Advisory Committee on Dangerous Pathogens
AIDS	Acquired immunodeficiency syndrome
AIH	Autoimmune hepatitis
AMR	Antimicrobial resistance
BBV	Blood-borne virus
BCG	Bacille Calmette–Guérin (vaccine against TB)
BSE	Bovine Spongiform Encephalopathy
CAP	Community acquired pneumonia
CCDC	Consultant in Communicable Disease Control (local public health doctor with executive responsibilities for CDC)
CCG	Clinical Commissioning Groups (health service purchaser)
CDC	Communicable disease control
CDI	*Clostridium difficile* infection
CFR	Case Fatality Rate
CHP	Consultant in Health Protection
CICN	Community infection control nurse
CJD	Creutzfeldt–Jakob Disease
CMV	Cytomegalovirus
CNS	Central nervous system
CRE	Carbapenem-resistant enterobacteriaceae
CSF	Cerebrospinal fluid
D	Diarrhoea
DEET	N,N-diethyl-*m*-toluamide
DNA	Deoxyribonucleic acid
DOT(S)	Directly observed therapy (supervised)
DPH	Director of Public Health
DTP	Diphtheria, tetanus and pertussis (whole-cell)
EBV	Epstein–Barr virus
ECDC	European Centre for Disease Prevention and Control
EEA	European Economic Area
EHO	Environmental health officer
EIA	Enzyme immunoassay
EIEC	Enteroinvasive *Escherichia coli*
ELISA	Enzyme-linked immunosorbent assay
EM	Electron microscopy
EU	European Union
FSA	Food Standards Agency
FWE	Food, water and environment
GI	Gastrointestinal
GP	General Practitioner (Primary Care Physician)
GUM	Genitourinary medicine
HACCP	Hazard Analysis Critical Control Point
HAI	Hospital acquired infection
HAV	Hepatitis A virus
HBV	Hepatitis B virus
HCAI	Health-care associated infection
HCV	Hepatitis C virus
HCW	Health Care Worker
HDV	Delta Hepatitis
HEPA	High-Efficiency Particulate Air (Filters)
HEV	Hepatitis E virus
Hib	*Haemophilus influenzae* type b
HIV	Human Immunodeficiency Virus
HNIG	Human normal immunoglobulin
HP	Health Protection
HPT	Health Protection Team
HPV	Human papillomavirus
HSCT	Haemopoietic Stem Cell Transplantation
HSV	Herpes simplex virus
HUS	Haemolytic uraemic syndrome
ICD	Infection control doctor (hospital)
ICN	Infection control nurse
ICT	Infection control team (hospital)
IDU	Intravenous drug user
IFA(T)	Indirect immunofluorescent antibody (test)
IgG	Immunoglobulin class G
IgM	Immunoglobulin class M
IHR	International Health Regulations
IID	Infectious intestinal disease
IPV	Inactivated poliovirus vaccine
IU	International unit
IV	Intravenous

LA	Local Authority
LBRF	Louse-borne relapsing fever
LD	Legionnaires' disease
LGV	Lymphogranuloma venereum
MDR	Multi-drug resistant (usually referring to TB)
MERS	Middle-East respiratory syndrome
MLST	Multilocus sequence typing
MLVA	Multiple-locus variable number tandem repeat analysis
MMR	Measles, mumps and rubella vaccine
MRSA	Met(h)icillin resistant *Staphylococcus aureus*
MSM	Men who have sex with men
NAAT	Nucleic acid amplification test
NCSP	National Chlamydia Screening Programme
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
NPA	Nasopharyngeal aspirate
OPV	Oral poliovirus vaccine
Pa	Pertussis vaccine (acellular)
PBS	Primary biliary sclerosis
PCR	Polymerase Chain reaction
PEP	Post-exposure prophylaxis
PFGE	Pulsed-field gel electrophoresis
PHE	Public Health England
PPE	Personal protective equipment
PrEP	Pre-exposure prophylaxis
PSC	Primary sclerosing cholangitis
PT	Phage type
RAPD	Random amplified polymorphic DNA typing
RCGP	Royal College of General Practitioners
RNA	Ribonucleic acid
RSV	Respiratory syncytial virus
RT-PCR	Reverse transcription polymerase chain reaction
SARS	Severe acute respiratory syndrome
SCID	Severe Combined Immunodeficiency
SOP	Standard Operating Protocol/ Procedure
Sp/spp	Species
STEC	Shiga-toxin producing *E. coli*
STI	Sexually transmitted infection
TB	Tuberculosis.
TBE	Tick-borne encephalitis
TBRF	Tick-borne relapsing fever
TSE	Transmissible spongiform encephalopathy
TTP	Thrombotic thrombocytopaenia purpura
TWAR	Taiwan Acute Respiratory Agent
UK	United Kingdom of Great Britain and Northern Ireland
UTI	Urinary tract infection
vCJD	Variant Creutzfeldt–Jakob Disease
VHF	Viral haemorrhagic fever
VRE	Vancomycin resistant *Enterococcus*
VZIG	Varicella-zoster immunoglobulin
WGS	Whole genome sequencing
WHO	World Health Organization (OMS)
WNV	West Nile Virus
XDR	Extensively drug resistant (usually referring to TB)

Vaccine abbreviations (used in Section 5)

BCG	Bacille Calmette–Guérin (vaccine against TB)
DTP	Diphtheria, tetanus and pertussis vaccine
HepA	Hepatitis A vaccine
HepB	Hepatitis B vaccine
HiB	Haemophilus influenzae type B vaccine
HPV	Human papilloma virus vaccine
IIV	Inactivated influenza vaccine
IPV	Inactivated polio vaccine
LAIV	Live attenuated influenza vaccine
MCV	Meningococcal conjugated vaccine (4-valent)
MenB	Neisseria meningitidis group B vaccine
MenC	Neisseria meningitidis group C vaccine
MMR	Measles, mumps and rubella vaccine
PCV	Pneumococcal conjugated vaccine
Rota	Rotavirus vaccine
RotaC	Rotavirus species C vaccine
TBE	Tick-borne encephalitis vaccine
VAR	Varicella zoster vaccine

Section 1
Introduction

1.1 How to use this book

This book is for those working in the field of communicable disease control (CDC) and health protection. It provides practical advice for specific situations and important background knowledge that underlies communicable disease control activities; therefore, it will be of interest to all these working in this broad field, including (but not exclusively) public health physicians, epidemiologists, public health nurses, other public health practitioners, infection control nurses, environmental health officers, microbiologists, general practitioners and policy makers at all levels, as well as students in medical, public health and related fields.

Since the publication of the third edition, there have been many important changes in CDC and health protection. The world has faced its first large multi-country epidemic of viral haemorrhagic fever and other new or re-emerging threats, such as Middle East Respiratory Syndrome (MERS) have been identified. There have been successes, such as new vaccine programmes, improvements in knowledge, new evidence reviews, updating of consensus guidelines and new laboratory tests, particularly in relation to molecular epidemiology. The combination of these with administrative changes in the European Union (EU) and in member countries like the UK has led to major revisions in the content of this Handbook.

The structure of the book is as follows:

Section 1 contains important background material. Chapters 1.2 and 1.3 run through the basic principles of transmission and control that underlie later chapters. Chapter 1.4 provides the basics of how action resulting from that knowledge can be communicated to those who need to know and Chapter 1.5 is aimed primarily at those who undertake on-call duties: in this chapter we assume that some may not practice in mainstream communicable disease control or health protection or may be in training and are undertaking health protection response duties for the first time.

Section 2 addresses topics in the way they often present to CDC staff in the field, that is, as syndrome-related topics rather than organism based, such as an outbreak of gastroenteritis of (as yet) undetermined cause, or a needlestick injury. In these chapters, we discuss the differential diagnosis (infectious and non-infectious), including how to decide the most likely cause based on relative incidence, clinical and epidemiological differences and laboratory tests. We also give general advice on prevention and control, including how to respond to a case or cluster when the organism responsible is not yet known.

Section 3 addresses communicable disease control in a more traditional way, by disease/organism. We have continued to make these chapters suitable for a pan-European audience, using EU-wide data and policies where these exist. We have used England and Wales (or the UK if appropriate) as an example in other instances: for differences relating to surveillance and control in other countries, the relevant country specific chapter in Section 5 should be consulted (e.g. those working in Germany should consult Chapter 5.14).

The chapters in Section 3 conform to a standard pattern, which we hope will make instant reference easier. Most chapters are ordered as follows:

1 A short introduction mentioning the syndrome(s) common synonyms and the main public health implications of the organism.

2 A box of *suggested on-call action*. This relates only to what needs to be done if cases are reported outside normal office hours. Further action may be needed during the next working day, which will be identified in 'response to a case'.

Communicable Disease Control and Health Protection Handbook, Fourth Edition. Jeremy Hawker, Norman Begg, Ralf Reintjes, Karl Ekdahl, Obaghe Edeghere and Jim van Steenbergen.

3 *Epidemiology* gives the relevant points on burden of disease; important differences by age/sex/season/year/risk group are given and important differences within Europe are noted.
4 Two sections deal with diagnosis of the infection: *clinical features* and *laboratory confirmation*. Both sections highlight the important points to practising CDC professionals. They are not meant as a substitute for clinical and microbiological textbooks.
5 *Transmission* details the main sources, reservoirs, vehicles and routes of spread of the organism. The main aim of this section is to give the investigator clues as to how a case or outbreak may have arisen to aid identification and control.
6 *Acquisition* deals with the incubation period, infectious period (if communicable), infective dose (if known) and any important factors affecting immunity or susceptibility.
7 The final five sections relate to control of infection. These are based on current available guidance and evidence: where this is unclear, they are often based on practice in the UK, our assessments of the evidence base, our understanding of good public health practice and the application of first principles. These sections are:

- actions likely to be effective in the *prevention* of infection,
- *surveillance* activities relevant to the organism,
- suggested public health actions to be taken in *response to a case,*
- suggested approach to an *investigation of a cluster* of cases of that organism, and suggested actions to help in *control of an outbreak*, including a *suggested case-definition* for use in an epidemiological study.

Diseases that are generally less of a public health issue in Europe are summarised in the tables at the end of Section 3. Some infections may also be mentioned in relevant chapters in Section 2 and in chapters in Section 3 covering related organisms (e.g. information on other diarrhoeagenic *Escherichia coli* is given in a table in the chapter on Shiga-toxin producing *E. coli* (STEC)): please check the index for these.

Section 4 refers to the organisation of CDC/Health Protection services and could be titled 'how to run a CDC service'. For the authors who have worked as Consultants in CDC, this is the textbook that we wished we'd had on appointment! It deals with the services that a CDC department is expected to provide, including the non-communicable disease functions that have been attached to the health protection role in some countries. Some of those chapters are UK focused, although this has been reduced and we try to draw out the general principles underlying each approach, so that most will be of equal use to European colleagues.

Section 5 gives a brief overview of structures for infectious disease notification and public health action internationally and in each EU/European Economic Area (EEA) country. The objective of this section is to allow an orientation on public health structures relevant for infectious disease control in various European countries and to offer a starting point for further information on individual countries. Lengthy descriptions have been avoided, but internet addresses for contact points in the countries and for further information, reports and data have been given.

Finally the appendix and two lists of useful websites detail further sources of information and advice for those undertaking CDC functions routinely or on-call. Please note that the information and suggestions given in this book are not meant to override existing national or international guidelines; please also note that the information is a snapshot of the situation at the time of writing and that further data or advice will become available after writing. It is always sensible to check your national country website for up-to-date guidelines to inform public health action: if there are no national guidelines, then the European Centre for Disease Prevention and Control (ECDC) may give EU-wide guidance and other national centre (e.g. Public Health England [PHE]) or other authoritative websites may have something that can be applied to your situation. For this reason, the lists of websites have been placed inside the front and back covers for easy reference.

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most obviously Iain Blair and Julius Weinberg, who were co-authors on the first three editions and helped to prepare such excellent foundations for this edition. Others helped by commenting on specific chapters, including Orlando Cenciarelli, Eulalia Peris, Geneviève van Liere, Marga Goris, Joost van Hommerig and numerous advisors for the country-specific chapters, including Franz Allerberger and Peter Kreidl (Austria), Sophie Quoilin (Belgium), Angel Kunchev (Bulgaria), Aleksandar Šimunović (Croatia), Irene Cotter (Cyprus), Jan Kyncl (Czech Republic), Kåre Mølbak (Denmark), Tiiu Aro (Estonia), Mika Salminen (Finland), Anne-Catherine Viso (France), Sotirios Tsiodras (Greece), Ágnes Csohan (Hungary), Guðrún Sigmundsdottir (Iceland), Derval Igoe (Ireland), Silvia Declich (Italy), Irina Lucenko (Latvia), Loreta Ašoklienė (Lithuania), Jean-Claude Schmit (Luxemburg), Tanya Melillo Fenech (Malta), Frode Forland (Norway), Małgorzata Sadkowska-Todys (Poland), Paula Vasconcelos (Portugal), Florin Popovici (Romania), Dagmar Némethová and Jan Mikas (Slovak Republic), Irena Klavs (Slovenia), Isabel Noguer (Spain), Anders Tegnell and Mårten Kivi (Sweden), and Daniel Koch and Patricia Waldvogel (Switzerland). We would like to thank Annie Edwards for her administrative support, Yasmin Rehman and Shakeel Suleman for Figures 2.2.1 and 2.2.2, and Claire Bonnett, Yogalakshmi Mohanakrishnan and Bella Talbot at Wiley for their support. Finally, we are grateful to our families and work colleagues for their patience and support whilst we were preoccupied with this project.

1.2 Basic concepts in the epidemiology of infectious disease

Identification

Infections can be identified by their clinical features, epidemiology and the use of appropriate laboratory procedures.

Epidemiological triangle

The traditional model of infectious disease causation is the epidemiological triangle. It has three components: an external agent, a susceptible host and environmental factors that bring the host and the agent together.

The agent is the organism (virus, rickettsia, bacterium, fungus, prion, etc.) that produces the infection. Host factors influence an individual's exposure, susceptibility or response to a causative agent. Age, sex, socio-economic status, ethnicity and lifestyle factors such as smoking, sexual behaviour and diet are among the host factors that affect a person's likelihood of exposure, while age, genetic makeup, nutritional and immunological status, other disease states and psychological makeup influence susceptibility and response to an agent. Environmental factors are extrinsic factors that affect the agent and the opportunity for exposure. These include geology, climate, physical surroundings, biological factors (such as insect vectors), socio-economic factors such as crowding and sanitation and the availability of health services.

Natural history of disease

This refers to the progress of a disease in an individual over time without intervention. Following exposure to an infectious agent there is a period of subclinical or inapparent pathological changes, which ends with the onset of symptoms. This period is known as the *incubation period*. For a given infectious disease, the incubation period has a range and a median and mean value. For hepatitis A, the range is two to six weeks with a mean of three weeks. During the incubation period, pathological changes may be detectable with laboratory or other tests. Most screening programs attempt to identify the disease process during this early phase of its natural history, since early intervention may be more effective than treatment at a later stage. The onset of symptoms marks the transition from the subclinical to the clinical phase. Most diagnoses are made during this stage. In some

people the disease may never progress to a clinically apparent illness. In others the disease process may result in a wide spectrum of clinical illness, ranging from mild to severe or fatal.

Occurrence

Two rates are commonly used to describe the occurrence of infectious diseases:

$$\text{Incidence} = \frac{\text{New cases over a given time period}}{\text{Persons at risk}}$$

$$\text{Prevalence} = \frac{\text{Existing cases at a given point in time}}{\text{Persons at risk}}$$

The occurrence or amount of an infectious disease will vary with place and time. A persistent low or moderate level of disease in a specified geographic area is referred to as *endemic* and a higher persistent level is called *hyper-endemic*. A pattern with occasional cases occurring at irregular intervals is called *sporadic*. A number of cases related in time and space is referred to as a cluster. When the occurrence of an infection exceeds the expected level for a given time period, it is called *epidemic* or *outbreak*. When an epidemic spreads over a wide geographical area affecting several continents it is called *pandemic*. Epidemics vary in size and duration. An *epidemic curve,* a frequency histogram of the number of cases against time or date of onset (see Figures 4.2.1–4.2.3), should be plotted. If exposure to the infectious agent takes place over a relatively brief period, a *point source* outbreak might be suspected. Intermittent or continuous exposure broadens the peaks of the epidemic curve, and so an irregular pattern is observed. An outbreak that spreads from person to person is called a *propagated* outbreak. In theory, the epidemic curve of a propagated outbreak would have a series of peaks at intervals approximating to the incubation period. Usually, the epidemic wanes after a few generations because the number of susceptible people falls below a critical level, or effective control measures have been introduced. Some epidemic curves have both common source epidemic and propagated epidemic features because of secondary person-to-person spread. These are called *mixed epidemics*.

Reservoir

The reservoir of an infectious agent is any person, animal, arthropod, plant, soil or substance (or combination of these) in which the infectious agent normally lives and multiplies. The reservoir may be different from the *source* or *vehicle* of infection. This is the person, animal, object or substance from which an infectious agent actually passes to a host. Many of the common infectious diseases have human reservoirs which include clinical cases, those who are incubating the disease and convalescent carriers. *Colonisation* is the presence of a micro-organism in or on a host, with growth and multiplication, but without evidence of infection. Shedding of an organism from a colonised host may be intermittent. Infectious diseases that are transmissible from animals to humans are called *zoonoses*. The *portal of exit* is the path by which an agent leaves the source host, which usually corresponds with the site at which the agent is localised, for example respiratory tract, genitourinary system, gastrointestinal system, skin or blood. The *portal of entry* is the route by which an agent enters a susceptible host.

For any given infection, understanding the chain of infection allows appropriate control measure to be recommended.

Susceptibility and resistance

Various biological mechanisms present barriers to the invasion and multiplication of infectious agents and to damage by their toxic products. There may be inherent resistance in addition to immunity as a result of previous infection or immunisation.

Box 1.2.1 Terms used to describe the outcomes of exposure to an infectious agent

- *Infectivity*: the proportion of exposed persons who become infected, also known as the *attack rate*.
- *Pathogenicity*: the proportion of infected persons who develop clinical disease.
- *Virulence:* the proportion of persons with clinical disease who become severely ill or die (Case Fatality Rate)

Hepatitis A in children has low pathogenicity and low virulence (Box 1.2.1). Measles has high pathogenicity but low virulence, whereas rabies is both highly pathogenic and highly virulent. Nevertheless, it is difficult to draw a clear line. The case fatality rate (CFR) in measles is low in industrialised countries, but could still be several percent in children with pour nutrition and low access to health care.

The *infectious dose* is the number of organisms that are necessary to produce infection in the host. The infectious dose varies with the route of transmission and host susceptibility factors. Because of the clinical spectrum of disease, cases actually diagnosed by clinicians or in the laboratory often represent only the tip of the iceberg. Many additional cases may remain asymptomatic. People with subclinical disease may nevertheless be infectious and are called carriers.

Infectious period

This is the time during which an infectious agent may be transmitted directly or indirectly from an infected person to another person. Some diseases are more communicable during the incubation period than during the actual illness. In others such as tuberculosis, syphilis and *Salmonella* infection the infectious period may be lengthy and intermittent. This period may be shortened by (antibiotic-) treatment (though in some infections antibiotics may prolong carriage and hence the communicable period).

Mode of transmission

This is the mechanism by which an infectious agent is spread from a source or reservoir to a susceptible person. The mechanisms are detailed in Table 1.2.1.

Table 1.2.1 Modes of transmission of infectious agents

Types of transmission	Examples
Direct transmission Transmission by direct contact such as touching, biting, kissing, sexual intercourse or by droplet spread on to the mucous membranes of the eye, nose or mouth during sneezing, coughing, spitting or talking. Droplet spread is usually limited to a distance of 1 m or less.	**Direct route** Infections of the skin, mouth, and eye may be spread by touching an infected area on another person's body. Examples are scabies, head lice, ringworm, and impetigo. Sexually transmitted infections are also usually spread by the direct route. **Respiratory route** Sneezing, coughing, singing, and even talking may spread respiratory droplets from an infected person to someone close by. Examples are the common cold, influenza, whooping cough, and meningococcal infection. **Faecal-oral route** Gastrointestinal infections can spread when faeces are transferred directly to the mouth of a susceptible host.

(*Continued*)

Table 1.2.1 (*Continued*)

Types of transmission	Examples
Indirect transmission This may be *vehicle-borne* involving inanimate materials or objects (*fomites*) such as toys, soiled clothes, bedding, cooking or eating utensils, surgical instruments or dressings; or water, food, milk or biological products such as blood. The agent may or may not multiply or develop in or on the vehicle before transmission. It may be *vector-borne*. This in turn may be mechanical and includes simple carriage by a crawling or flying insect as a result of soiling of its feet or proboscis or by passage of organisms through its gastrointestinal tract. This does not require multiplication or development of the organism. It may be *biological* when some form of multiplication or development of the organism is required before the arthropod can transmit the infected form of the agent to human when biting.	**Faecal-oral route** Faeces contaminate food or objects like toys or toilet flush handles. Animal vectors such as cockroaches, flies and other pests may transfer faeces. Environmental surfaces may be contaminated. This is particularly important in viral gastroenteritis when vomiting occurs because the vomit contains large numbers of infectious viral particles. Examples of infections spread in this way are food poisoning and hepatitis A. **The blood-borne route** There is transfer of blood or body fluids via a contaminated item from an infected person to another person through a break in the skin such as through inoculation, injection or transfusion. **Respiratory route** Droplets from the mouth and nose may also contaminate hands, cups, toys or other items and spread infection to others who may use or touch those items.
Air-borne spread *Air-borne* spread is the dissemination of a microbial aerosol to a suitable port of entry, usually the respiratory tract. Microbial aerosols are suspensions of particles that may remain suspended in the air for long periods of time. Particles in the range 1–5 μm are easily drawn into the alveoli and may be retained there. Droplets and other larger particles that tend to settle out of the air are not considered air-borne. Microbial aerosols are either droplet nuclei or dust.	Examples are infection with *Legionella*, *Coxiella* and, in some circumstances, TB.

1.3 Basic concepts in the prevention of infection

The information in this chapter might be appropriate for professionals/organisations to provide to the general public. The chapter deals with preventive measures, and more information on community control measures could be found in other parts of this book, for example in Chapters 2.2 and 4.3. For specific information related to immunisations see Chapter 4.7 and the travel health Chapter 4.11.

Individual measures against infections

Hand hygiene

Handwashing with soap is among the most effective and inexpensive ways to prevent gastrointestinal and respiratory infections. This should always be done before and after meals, after visits to the toilet and after direct contact with wounds, blood, nasal discharge and other body fluids (own and others), after direct contact with animals and after spending time in crowded conditions – especially during seasons with much respiratory tract or gastrointestinal infections. Liquid, antibacterial

soap is preferable. Rings and jewellery should be removed before handwashing. It may be more practical to carry a small bottle of alcohol disinfectant than relying on finding a place for handwashing when outdoors.

Prevention of food-borne infection

Food handling

Proper hygiene knowledge is necessary to avoid food-borne infections.

- Minimise transportation time. If it is not possible to return home immediately from the store, use a cool box.
- Always check the 'best before' date to avoid buying food with high bacterial levels. It is important to note that food contaminated with pathogenic bacteria does not necessarily smell bad or look un-fresh. Many bacteria, such as *Yersinia enterocolitica*, *Listeria monocytogenes* and *Clostridium botulinum*, can grow well in low temperatures if stored in the refrigerator too long.
- When preparing large amounts of food it is important to chill the food as quickly as possible. The food could be chilled in small containers.
- Always wash your hands before, during and after preparing food to prevent contamination and cross-contamination. Never cook for others when you have diarrhoea or an infected wound on the hands.
- Rinse vegetables, fresh herbs, and fruit thoroughly before use.
- Cook meat thoroughly. This is especially important for chicken, which often contains *Campylobacter* or *Salmonella*.
- To avoid cross-contamination use different cutting boards for meat, vegetables, and prepared food. Plastic cutting boards can be washed in a dishwasher. Change dishcloths often or boil them in water. Let them dry thoroughly between use.
- When barbequing, never put the meat back on plates that were used for the raw meat.

Risky food

Handling food to be eaten without being heated requires proper hygiene measures to ensure that it does not contain pathogenic microbes. Some food is associated with a higher risk of infection:

- Unpasteurised milk and milk products should be avoided, especially for small children, as diarrhoeagenic *Escherichia coli*, *Salmonella* and *Campylobacter* are not uncommon, even in milk from healthy cows.
- Oysters and mussels filter large amounts of water, and micro-organisms (especially norovirus and hepatitis A virus) could be concentrated in the molluscs if they have been grown in contaminated water.
- Many large *Salmonella* outbreaks and in 2011 a large STEC outbreak in Germany have been caused by contaminated bean sprouts. The sprouts are best stored in refrigerator.
- Fresh vegetables and herbs should always be rinsed, regardless of what is stated on the package.
- Raw or soft-boiled eggs may contain *Salmonella*. Risk for infection is highest if eggs are used in products that are not heated properly (e.g. custard on cakes).
- Frozen raspberries have caused several international outbreaks of Norovirus and hepatitis A.

Measures against respiratory tract infections

Most respiratory tract infections have an airborne mode of transmission or are spread through droplets. An alternative important mode of transmission is through a direct contact between hands and mucous membranes. Especially during the flu season it is advisable to avoid crowded settings, avoid touching the face with the hands and wash the hands regularly. Covering the mouth when coughing and sneezing prevents spread to others. During peak flu season, working from home may be an option in some workplaces.

Other effective measure to avoid respiratory tract infections include stopping smoking, immunisation against respiratory tract pathogens as appropriate (depending on age and risk group) and using a face mask when being exposed for specific pathogens such as

Aspergillus (renovations of cellars and attics), hantavirus infection (environment soiled by urine from the bank vole).

Measures against sexually transmitted infections

Sexually transmitted infections (STIs) require close person-to-person contact for transmission. It should therefore be noted that most other infectious diseases (e.g. gastrointestinal and respiratory tract infections) also easily transmit during sexual contact. All forms of vaginal, oral and anal intercourse are associated with a risk of STI transmission even if condoms are used. It is therefore more appropriate to talk about 'safer sex' than 'safe sex'. Condoms should be used throughout intercourse. Even if they are generally durable, they may be torn by sharp nails or rupture during anal intercourse without lubrication. Lubrication should be water or silicon based, as oil-based lubricants such as Vaseline and skin creams may dissolve the condom.

Measures against blood-borne infections

Hepatitis B, hepatitis C and Human Immunodeficiency Virus (HIV) are the three major viral infections transmitted via blood.

Intravenous drug use

The most important risk factor for blood-borne infections outside medical care settings is intravenous drug use. The infection is mainly transmitted through the use of non-sterile needles and syringes. A lesser-known route of infection, even among drug addicts, is the transmission through the cup or saucer in which the drugs are dissolved before being drawn into the syringe. Viruses can be killed through boiling the syringes and needles (for several minutes), alternatively by cleaning them in chlorine. To affect the hepatitis B viruses, which are hardier than HIV, the needles and syringes must be in contact with chlorine for at least two minutes. Both these methods are effective, but not completely safe. The only safe way is never to share injection equipment. As a harm-reduction measure, most European countries organise needle-exchange and/or oral substitute programmes.

Tattoos

Becoming tattooed with a non-sterile needle carries the risk of blood-borne infection. It is therefore important to ensure that the tattoo is done by a reputable craftsman. In many countries there are associations of professional tattoo artists. If uncertain, it is advisable to consult the local public health/environmental health department. Tattooing abroad in countries with generally low levels of hygiene should be avoided as the prevalence of blood-infected persons may be high, and the regulation of tattoo artists is inadequate in many parts of the world.

Other blood exposure

Exposure to blood occasionally happens outside healthcare environments, for example in relation to accidents. The basic rule for all contact with blood is to consider it as infected. It is especially important to avoid getting blood splashes in the eyes, mouth, or nose. Blood on the skin should be immediately washed with soap and water. Blood spill, even minimal amounts, should be dried as soon as possible. Chlorine solution (one part bleach to nine parts water) effectively destroys the virus on blood-soaked surfaces or objects, but should not be used directly on skin or on textiles. Blood-stained clothes should be washed with pre-wash and then at the highest possible temperature. Plastic or latex gloves and disposable plastic aprons should be included in car and home first aid kits. A nozzle with a check valve for mouth-to-mouth resuscitation is a valuable part of a first aid kit.

The risk of blood contamination increases with cuts and puncture wounds. If the skin is

penetrated by contaminated needles, scalpels or similar, the risk of hepatitis B infection is about 30%, hepatitis C infection about 2% and HIV about 0.3%. The injured area should be bled and the area should be washed thoroughly with soap and water. After any exposure that might have a risk of blood contamination a doctor should be immediately contacted.

Protection against insect-borne infections

Protection against tick bites

The tick season usually lasts from early spring to autumn. The best protection against bites is to avoid the typical tick-infested terrains (damp and shaded terrain with half-high grass). In gardens, the number of ticks could be reduced by keeping the grass short and clearing away shady bushes and trees. Full dress, with trousers stacked in boots, is an effective protection. Furthermore, it is advisable to inspect the skin regularly, as the ticks often take some time before biting. Mosquito repellent has some effect even against ticks.

Ticks prefer to bite through thin skin. Most common areas in adults are the legs, while in children the bite is usually higher up on the body, often in the groins. Transfer of Tick-borne encephalitis (TBE) virus is instantaneous after the bite, while the risk of infection with *Borrelia* and *Ehrlichia* increases with the time the tick is attached. Ticks are best removed with tweezers (preferably special tick tweezers which can be bought in pharmacies in tick-infested regions). A gentle, twisting motion increases the chance that the entire tick is removed and reduces the risk of bacterial transmission. Margarine or cooking oil should not be used. The wound is washed with soap and water. Any remaining tick parts give rise to an inflammatory reaction and can be removed after a few days. These do not increase the risk of infection. Doctors should be contacted if an erythema occurs around the bite site.

Protection against mosquito bites

Personal protection against mosquito bites in risk areas include wearing covering clothes (long-sleeved shirts and long trousers) and regular application of mosquito repellents containing DEET (N,N-diethyl-*m*-toluamide), or alternatively other approved substances such as icaridin, lemon eucalyptus, or citronella in accordance with the manufacturers' instructions. This is especially important for protection against day-time bites of *Aedes* species (transmitting dengue, chikungunya, zika virus and yellow fever). The best effect against mosquito species that have a preference to bite indoors at night, as *Anopheles* species (transmitting malaria), is to sleep in screened, air-conditioned rooms, or otherwise using long-lasting insecticide treated bed nets (LLIN) impregnated with permethrin, deltamitrin or alpha-cypermethrin. Removing mosquito breeding sites in nearby outdoor or indoor premises is a more permanent measure.

Integrated vector management

In case of outbreaks of mosquito-borne infections (dengue, chikungunya, Zika virus) in areas with an abundance of competent vectors it is important to reduce mosquito vector density in a sustainable manner.

- Reduce outdoors and indoors breeding sites by draining or removing sources of stagnant water (e.g. flower pots, vases, used tyres, tree holes and rock pools), or, if that is not possible, treatment with larvicides. Open water containers should be well covered.
- Use physical barriers (window screens and mosquito nets) and air conditioning.
- Elimination of adult mosquitoes through aerial spraying could be considered.

Infection control precautions in care settings

The following infection control measures are general and may need to be adapted

depending on the specific type of care setting, for example community care settings (see also Chapter 4.3) and health care settings (see also Chapter 4.4).

Standard precautions

It is not always possible to identify persons who may spread infection to others, therefore standard precautions to prevent the spread of infection must be followed in health care settings at all times (Box 1.3.1). In addition, for persons with respiratory infections, droplet precautions may be recommended (Box 1.3.2) and in those with diarrhoea and/or vomiting enteric precautions should be followed (Box 1.3.3). These precautions are valid for any care setting.

Handwashing is the single most important part of infection control. Soiled hands should be washed with soap and water. If soap and water is not available, alcohol gel or rub can be used. Hands should be washed before contact with patients, after any activity that contaminates the hands (removal of protective clothing and gloves, using the toilet) and before handling food. Nails should be kept short, rings should not be worn, artificial nails should be avoided and cuts and abrasions should be covered with a waterproof dressing. Adequate handwashing facilities must be available in all patient areas. Liquid soap dispensers, paper hand towels and foot-operated waste bins should be provided.[1]

Box 1.3.1 Infection control standard precautions in health care (abbreviated)[2]

- Hand hygiene: handwashing 40–60 seconds with soap and water or use of an alcohol hand rub or gel. Cover wounds or skin lesions with waterproof dressings.
- Appropriate use of gloves, gowns, aprons and facial protection (eyes, nose and mouth).
- Prevention and management of needlestick injuries, injuries from other sharp instruments and blood splash incidents.
- Respiratory hygiene and cough etiquette.
- Safe disposal of contaminated waste.
- Managing spillages of blood and body fluids.
- Safe collection and transport of specimens.
- Decontaminating equipment including cleaning, disinfection and sterilisation.
- Maintaining a clean clinical environment.
- Safe management of used linen.
- Place patients with infections in appropriate accommodation.

Box 1.3.2 Droplet precautions when managing respiratory infections

- Wear a medical mask if working within approximately 1 m of the patient or upon entering the room/cubicle of a patient.
- When performing aerosol-generating procedures (chest physiotherapy, nebulisation) wear a particulate respirator, perform procedures in an adequately ventilated room and limit other persons in the room only to those required for the patient's care.

[1] World Health Organisation. Guidelines on hand hygiene in health Care. http://apps.who.int/iris/bitstream/10665/44102/1/9789241597906_eng.pdf.

[2] World Health Organisation. Infection control standard precautions in health care. http://www.who.int/csr/resources/publications/4EPR_AM2.pdf.

Box 1.3.3 Enteric precautions when managing diarrhoea and vomiting

- Patients should normally use a flush toilet for the disposal of excretions and soiled materials. Attendants should wear disposable plastic gloves and wash hands thoroughly.
- Faecal material on soiled clothing and bed linen should be flushed into the toilet bowl. Linen should then be washed in washing machine on a 'hot' cycle. Soaking in disinfectant before washing is not necessary.
- Use of disinfectants is important in schools, nursery schools and residential institutions. Toilet seats, flush handles, wash-hand basin taps and toilet door handles should be cleaned daily and after use with a bleach-based household cleaner, diluted according to manufacturer's instructions. Alcohol-based wipes may be used on seats and other hard surfaces. Bedpans and urinals should be emptied into the toilet bowl, washed with a disinfectant and rinsed.
- Patients and carers should be advised about personal hygiene and the hygienic preparation and serving of food. Children and adults in jobs likely to spread infection (e.g. food handlers) should stay away from work or school for 48 hours after the diarrhoea has stopped. In the NL, workers can resume work as soon as diarrhoea has stopped. Day care is not regarded as a job likely to spread infection. Most important criterium is if a worker can adequately comply to hygienic precautions.

1.4 Emergency risk communication

Emergency risk communication is increasingly seen as a fundamental part of preparedness and response to health threats, and is one of the eight core capacities of the International Health Regulations (IHR). When communicating during a crisis, the media should be considered as an ally in protecting the health of the public. They are one of the most powerful influences upon the public. Relationships with the media should be developed proactively; good routine relationships with the media will make dealing with them during emergency situations much easier.

Communicable disease issues arouse interest and anxiety in the public. The public have a right to be informed and the press is often the best route. Virtually all issues can be presented in a way that the public can understand. Professionals should not hide behind technical obfuscations. Do not expect to have any control over material that you provide, press releases can be selectively quoted and interviews can be edited. However, journalists are usually interested in accuracy.

Training

Anyone who is likely to deal with the media should undergo media training. This will help in understanding what the media needs. Journalists often have a similar agenda to public health workers, they wish to inform and educate the public. If they encounter a group of professionals who understand their needs, and are trying to help, then journalists are less likely to be antagonistic. Identify people within the organisation who are particularly good with the media – they may not be the most senior people.

Routine relationships

As for other aspects of preparedness, good emergency risk communication is best based on good relations with media cultured before the crisis. Develop regular contact with your local print and broadcast media. Be available to answer their questions, and treat your local reporters in a friendly way. If they trust you and rely on you as an authoritative source it will make things much easier if a story is breaking.

Local papers may be willing to publish a regular column; this is a powerful way of getting health advice across. Use opportunities

to publish in local papers, women's magazines, parents' magazines, and so on. This will probably have a greater influence on health than publishing in the peer-reviewed medical press. Have basic information packs available for journalists. These should describe the clinical features and importance of an infection and the salient epidemiological features and recent trends.

Communicating during a crisis

During outbreak or emergency situations it is important to maintain good relations with the press. Journalists have a job to do, they can become intrusive, but they will understand that you also have a job to do. Let the journalists know that they will be kept informed, that there will be regular briefings, daily or even twice daily. Ensure that the briefings do happen. Appoint a media spokesperson and ensure that all media briefings are done through that person. The outbreak control team should co-ordinate the local flow of information. Sometimes, several actors (at different levels) are involved, all with their own media contacts, it is then important to have co-ordinated messages and shared lines-to-take. If not, journalists will likely focus on the differences rather than on the main messages.

WHO has developed outbreak communication guidelines that could be used as a reference by anyone involved in outbreak communication. The main principles include the following:

- build, maintain and restore trust,
- announce early,
- aim at maximum transparency (taking into account privacy issues),
- understand the public, and
- plan in advance.

Messages

Decide beforehand what your key messages are; if possible discuss these with the journalist and discuss the questions that will be asked. Decide if there are any areas that you do not wish to be drawn into. Be honest, accurate and keep technical details to a minimum. Get the key message across first, then provide the reasoning behind it. Stress the facts and explain the context. Do not try to hide the truth or lie. If you are uncertain of the facts or some detail say so and offer to get the information. Do not be drawn into areas you feel you cannot or should not discuss, be firm and polite and say that you cannot discuss that issue. Try to avoid discussions of money and cost saving, stress public health action and your concern for safeguarding public health. Avoid being drawn into speculation or criticisms of other groups. Behave as if you were always 'on the record'. Make sure that you know if a broadcast is live or recorded. Always ask to see the article before it is published in order to correct factual mistakes – most serious journalists appreciate that. However, do not expect to be able to change the direction or angle of the article, attempts to do that will likely just upset the journalist.

Press releases

Keep the press release short (8–10 paragraphs), make sure you have considered the message and the audience for the release and consult a press officer. Get the most important message into the first paragraph and support it with a quote from a senior official. In the introduction, describe who, what, where, when, why/how. In the middle, expand the story with supporting detail, conclude by summarising and identifying the next steps.

Social media

As has been seen in the 2016 US election, social media is rapidly replacing traditional media when it comes to forming public opinions, and a strong presence in social media is imperative for any successful emergency risk communication. Compared