Guide to Hygiene and Sanitation in Aviation

Third Edition

Module 1: Water
Module 2: Cleaning and Disinfection of Facilities

Geneva
2009

World Health Organization

WHO Library Cataloguing-in-Publication Data

Guide to hygiene and sanitation in aviation -- 3rd ed.

Contents: Module 1: Water ; Module 2: Cleaning and Disinfection of Facilities.

1.Aerospace medicine. 2Aircraft. 3.Aviation. 4.Sanitation. 5.Hygiene. 6.Guidelines. I.World Health Organization.

ISBN 978 92 4 154777 2 (NLM classification: WA 810)

Cover designed by Crayonbleu, Lyon, France

Table of contents

ACKNOWLEDGEMENTS

The World Health Organization (WHO) gratefully acknowledges the contributions of the following people to the third edition of the *Guide to Hygiene and Sanitation in Aviation*:

Feroze Ahmed, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh
Katherine B. Andrus, Assistant General Counsel, Air Transport Association of America, Inc., Washington, DC, USA
David Bennitz, Public Health Bureau, Health Canada, Ottawa, Ontario, Canada
Colin Browne, Environmental Health Specialist in charge of Port Health, Ministry of Health, St Michael, Barbados, West Indies
Debbie Chuckman, Government Affairs Committee, International Flight Services Association, Mississauga, Ontario, Canada
Joseph Cotruvo, Joseph Cotruvo & Associates LLC, Washington, DC, USA
Dean Davidson, Center for Food Safety and Applied Nutrition, Food and Drug Administration, College Park, Maryland, USA
Nigel Dowdall, British Airways, Waterside (HMAG), Harmondsworth, United Kingdom
Anthony Evans, Aviation Medicine Section, International Civil Aviation Organization, Montreal, Quebec, Canada
David Gamper, Safety and Technical Affairs, Airports Council International, Geneva, Switzerland
John Grace, National Health Committee, Air Safety, Health and Security Department, Association of Flight Attendants-CWA, Washington, DC, USA
Cathy Hollister, Air Transport Association of Canada, Mississauga, Ontario, Canada
Petra Illig, Division of Global Migration and Quarantine, Centers for Disease Control and Prevention, Anchorage, Alaska, USA
Phyllis Kozarsky, Division of Global Migration and Quarantine, Centers for Disease Control and Prevention, Atlanta, Georgia, USA
Karen J. Marienau, Division of Global Migration and Quarantine, Centers for Disease Control and Prevention, Minneapolis, Minnesota, USA
Dinkar Mokadam, Air, Safety, Health and Security Department, Association of Flight Attendants-CWA, Washington, DC, USA
Jacques Nadeau, Health Canada, Ottawa, Ontario, Canada
Benoît Pilon, Airport and Inflight Services, International Air Transport Association, Geneva, Switzerland
Tim Pohle, Air Transport Association, Washington, DC, USA
Katie Porter, Environmental Protection Agency, Washington, DC, USA
James Ringo, Bio-Cide International, Inc., Norman, Oklahoma, USA
Erica Sheward, University of Central Lancashire, West Sussex, United Kingdom
Claude Thibeault, International Air Transport Association, Montreal, Quebec, Canada
Dulce Maia Trindade, Health Bureau, Centre for Disease Control and Prevention, Macau Special Administrative Region
Christopher Witkowski, Air, Safety, Health and Security Department, Association of Flight Attendants-CWA, Washington, DC, USA

The contributions of the following WHO personnel from WHO Headquarters in Geneva, Switzerland (unless otherwise noted), are also acknowledged:

Ruth Anderson
Jamie Bartram
Yves Chartier
Bruce Gordon
Lena Hope
Emmanuel Jesuthasan
Daniel Lins Menucci, WHO Lyon Office
Bruce Plotkin

Marla Sheffer, Editor, Ottawa, Ontario, Canada

The update of this guide was made possible with the support and collaboration of the United States Environmental Protection Agency; the International Air Transport Association; Health Canada; the United States National Science Foundation; the Ministry of Health, Labour and Welfare, Japan; the Swedish International Development Cooperation Agency; the Federal Ministry of Health, Germany; and the Ministry of Environment and Water Resources, Singapore.

No conflict of interest was declared.

The development of the third edition of the guide to hygiene and sanitation in aviation was motivated by the update of the International Health Regulations 2005. It involved a large number of experts and WHO staff (see names above).

An informal meeting took place in April 2006 in Baltimore, USA, and brought together a number of key international experts. This meeting was to discuss the content of the existing version, define additional contributions, agree on next steps and define key contributors.

A meeting of the Expert Network engaged in the development of the Guide to Hygiene and Sanitation in Aviation, Third Edition, was held in Toronto, Canada, on 24–26 March 2008. The meeting was facilitated by Health Canada.

Once the contents of the update were completed and agreed to by the expert group, the update was shared for peer review with a large number of international experts. Comments were integrated, and the final version was consolidated.

GLOSSARY

Accessible	Capable of being exposed for cleaning and inspection with the use of simple tools, such as a screwdriver, pliers or an open-end wrench.
Adequate hygiene	Level of hygiene sufficient for the prevention of public health risk.
Aircraft water system	Water service panel, filler neck and the onboard water storage tanks and all of the plumbing and fixtures on the aircraft.
Airport water system	On-site airport distribution system and possibly water treatment facilities if the airport is a producer of potable water.
Backflow	Flow of water or other liquids, mixtures or substances into the distribution pipes of a potable supply of water from any source or sources other than the potable water supply. Back-siphonage is one form of backflow. *See also* Back-siphonage.
Backflow preventer	Approved backflow prevention plumbing device that would typically be used on potable water distribution lines where there is a direct connection or a potential connection between the potable water distribution system and other liquids, mixtures or substances from any source other than the potable water supply. Some devices are designed for use under continuous water pressure, whereas others are non-pressure types.
Back-siphonage	Backward flow of used, contaminated or polluted water from a plumbing fixture or vessel or other source into a water supply pipe as a result of negative pressure in the pipe.
Biohazard bag	Bag used to secure biohazard waste that requires microbiological inactivation in an approved manner for final disposal. Such bags must be disposable and impervious to moisture and have sufficient strength to preclude tearing or bursting under normal conditions of usage and handling.
Cleaning	Removal of visible dirt or particles through mechanical action, normally undertaken on a routine and frequent basis. The cleaning process and some products used for cleaning also result in disinfection. *See also* Disinfection.
Communicable disease	Illness caused by organisms such as bacteria, viruses, fungi and parasites that can be directly or indirectly transmitted from an infected person to others. Sometimes the illness is due not to the organism itself, but rather to a toxin that the organism produces after it has been introduced into a human host.
Competent authority	Authority responsible for the implementation and application of health measures under the International Health Regulations (2005).
Control measures	Those steps in the drinking-water supply that directly affect drinking-water quality and that collectively ensure that drinking-water consistently meets health-based targets. They are activities and processes applied to prevent hazard occurrence.
Corrosion resistant	Capable of maintaining original surface characteristics under prolonged influence of the use environment, including the expected food contact and the normal use of cleaning compounds and sanitizing solutions. Corrosion-resistant materials must be non-toxic.

Cross-connection	Any unprotected actual or potential connection or structural arrangement between a potable water plumbing system and any other source or system through which it is possible to introduce into any part of the potable system any used water, industrial fluid, gas or substance other than the intended potable water with which the system is supplied. Bypass arrangements, jumper connections, removable sections, swivel or change-over devices and other temporary or permanent devices through which backflow can occur are considered to be cross-connections.
Disinfection	The procedure whereby measures are taken to control or kill infectious agents on a human or animal body, on a surface or in or on baggage, cargo, containers, conveyances and goods by direct exposure to chemical or physical agents.
Durable materials and constructions	Materials and constructions that can withstand normal use and abuse.
Environmental control system	System that provides air supply, thermal control and pressurization for the passengers and crew travelling on an aircraft used for airline operations.
Food contact surfaces	Surfaces of equipment and utensils with which food normally comes in contact. These include the areas of ice machines over the ice chute to the ice bins. *See also* Non-food contact surfaces.
Food handling area	Any area where food is stored, processed, prepared or served.
Food preparation area	Any area where food is processed, cooked or prepared for service.
Food service area	Any area where food is presented to passengers or crew members (excluding individual cabin service).
Food storage area	Any area where food or food products are stored.
Food transport area	Any area through which unprepared or prepared food is transported during food preparation, storage and service operations (excluding individual cabin service).
Health-based target	A benchmark to guide progress towards a predetermined health or water safety goal. There are four types of health-based targets: health outcome targets, water quality targets, performance targets and specified technology targets.
Non-food contact surfaces	All exposed surfaces, other than food contact or splash contact surfaces, of equipment located in food storage, preparation and service areas.
Non-toxic materials	Materials that, when used in the water distribution system, do not introduce harmful or injurious ingredients or substances into the water.
Operational monitoring	Methods to assess the performance of control measures at appropriate time intervals.
Personal protective equipment	Equipment and materials used to create a protective barrier between a worker and the hazards in the workplace.
Portable	Description of equipment that is readily removable or mounted on casters, gliders or rollers; provided with a mechanical means so that it can be tilted safely for cleaning; or readily movable by one person.

Potable water	Fresh water that is intended for drinking, washing or showering; for handling, preparing or cooking food; and for cleaning food storage and preparation areas, utensils and equipment. Potable water, as defined by the WHO *Guidelines for Drinking-water Quality*, does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages.
Potable water tanks	All tanks in which potable water is stored for distribution and use as potable water.
Public health authority	Government agency or designee responsible for the protection and improvement of the health of entire populations through community-wide action.
Public health surveillance	The ongoing, systematic collection, analysis and interpretation of data about specific environmental hazards, exposure to environmental hazards and health effects potentially related to exposure to environmental hazards, for use in the planning, implementation and evaluation of public health programmes.
Readily removable	Capable of being detached from the main unit without the use of tools.
Removable	Capable of being detached from the main unit with the use of simple tools, such as a screwdriver, pliers or an open-end wrench.
Safe material	Article manufactured from or composed of materials that may not reasonably be expected to result, directly or indirectly, in their becoming a component of any food or water or otherwise affecting the characteristics of any food or water.
Seam	Open juncture between two similar or dissimilar materials. Continuously welded junctures, ground and polished smooth, are not considered seams.
Sewage	Any liquid waste that contains animal or vegetable matter in suspension or solution, including liquids that contain chemicals in solution.
Smooth metal surfaces	• Corrosion-resistant alloys would typically have at least a No. 4 mill finish, properly applied. • Cast iron, cast and forged steel and cast nickel alloys, in the food area, would typically have a surface roughness not exceeding American Standard No. 125 (or equivalent). • Galvanized metal surfaces, where acceptable, would typically have the smoothness of good-quality commercial hot dip. • Other metals would typically be at least as smooth as commercial-grade rolled sheet steel and free of loose scale.
Smooth surfaces	Surfaces having the following finishes: • A food contact surface that is free of pits and inclusions with a cleanability equal to or exceeding that of a No. 3 finish (100 grit) on stainless steel. • A non-food contact surface of equipment that is equal to commercial-grade hot-rolled steel and is free of visible scale. • A deck, bulkhead or deckhead that has an even or level surface with no roughness or projections that render it difficult to clean.

Splash contact surfaces	Surfaces that are subject to routine splash, spillage or other soiling during normal use.
Transfer point	Site of intermittent connection for water transfer between the hard-plumbed airport water distribution system and the aircraft water system. Sometimes referred to as Watering point.
Traveller	A person in transit between locations.
Turbidity	Light-scattering cloudiness or lack of transparency of a solution due to the presence of suspended particles. Turbidity is not necessarily visible to the eye.
Validation	Investigative activity to identify the effectiveness of a control measure. It is typically an intensive activity when a system is initially constructed or rehabilitated. It provides information on reliably achievable quality improvement or maintenance to be used in system assessment in preference to assumed values and also to define the operational criteria required to ensure that the control measure contributes to effective control or hazards.
Verification	Final monitoring for reassurance that the system as a whole is operating safely. Verification may be undertaken by the supplier, by an independent authority or by a combination of these, depending on the administrative regime of a given country. It typically includes testing for faecal indicator organisms and hazardous chemicals.
Watering point	*See* Transfer point.
Water safety plan	Documented comprehensive strategy for managing and operating a water supply system.
Water supply surveillance	Continuous and vigilant public health assessment and review of the safety and acceptability of drinking-water supplies. There are two types of approaches: audit-based approaches and approaches relying on direct assessment. In the audit approach, assessment activities, including verification testing, are undertaken largely by the supplier, with third-party auditing to verify compliance. In direct assessment, the drinking-water supply surveillance agency carries out independent testing of water supplies.

ACRONYMS

ACI	Airports Council International
APHA	Association of Port Health Authorities (United Kingdom)
GDWQ	*Guidelines for Drinking-water Quality*
HPC	heterotrophic plate count
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IHR (2005)	International Health Regulations (2005)
NTU	nephelometric turbidity unit
PVC	polyvinyl chloride
PWS	potable water system
SARS	severe acute respiratory syndrome
USEPA	United States Environmental Protection Agency
VOC	volatile organic chemical
WHA	World Health Assembly
WHO	World Health Organization
WSP	water safety plan

1. INTRODUCTION

1.1 General issue and concern

Health and sanitation aspects of international traffic have been of concern to the World Health Organization (WHO) since 1951, when the Fourth World Health Assembly recommended that all governments should "improve sanitary and environmental conditions, especially in and around ports and airports" (resolution WHA4.80); at the same time, the need for "the sanitary protection of populations in mass movement" was also expressed (resolution WHA4.8l). Subsequent resolutions of both the World Health Assembly and the Executive Board emphasized the importance of maintaining high standards of hygiene and sanitation in international traffic (particularly in relation to the provision of safe water and food and the correct procedures for the collection and disposal of wastes).

The annex to the first report of the WHO Expert Committee on Hygiene and Sanitation in Aviation (WHO, 1960a) was published in 1960 as a *Guide to Hygiene and Sanitation in Aviation* (WHO, 1960b). Its use was recommended by the Twelfth World Health Assembly to guide health administrations in "fulfilling their obligations under the existing International Sanitary Regulations, especially the provisions of Article 14, in providing safe food for international air traffic, and in maintaining satisfactory control of, and protection from, malaria vectors at airports" (resolution WHA12.18).

The reports of the Committee on International Surveillance of Communicable Diseases, as adopted by the World Health Assembly, also emphasized the importance of preventing disease through the improvement of sanitary conditions. The relevant articles of the International Health Regulations (1969) (WHO, 1969) laid down sanitation requirements at airports. The provision of criteria and guidelines for the use of administrations in fulfilling their obligations under the International Health Regulations forms an essential part of WHO's functions.

In 1974, the Twenty-seventh World Health Assembly, "believing that, in view of the growth of international traffic, continuous attention should be given to the safety of food and water and the handling of wastes in such traffic", stressed "the need for each Member State to clarify the ultimate responsibility for the safety of food and water and the proper handling of wastes in international traffic" and, furthermore, recommended that "Member States coordinate and ensure the close and active participation in such a responsibility of health authorities, port and airport management, aircraft operators, shipping companies, tourist associations, and any other service or agency concerned with international traffic" (resolution WHA27.46). At the same time, the Director-General of WHO was requested to maintain close contact with representatives of international organizations concerned with international traffic with a view to promoting the implementation and coordination of activities aimed at improving the safety of food and water and the handling of wastes and to prepare appropriate guidance for the use of health professionals. The outcome of these activities was the publication of a second edition of the *Guide to Hygiene and Sanitation in Aviation*, in 1977 (WHO, 1977).

The basic principles of hygiene have not changed significantly since 1977; however, the magnitude of air transport operations has grown tremendously. The number of passengers flying on scheduled airlines rose from 438 million in 1975 to over 2 billion in 2006 (ICAO, 2006), figures that do not take into account charter flight passengers and global corporation

business jet passengers, whose numbers are in the millions and increasing every year. Furthermore, the current trend in international civil aviation is towards aircraft of larger passenger-carrying capacity and greater range. The introduction of air services into areas with inadequate public health infrastructure, such as food handling and storage, water supply and waste disposal, creates a challenge for aircraft operators. To protect public health, the application of high standards of hygiene should form an integral part of airport and aircraft operations.

Although hygiene standards have improved during the last few decades, there remains a need to safeguard the health of crew and passengers against waterborne and foodborne illnesses. Incidents of foodborne illness associated with international air travel that are reported from time to time (Turner, 1971; Peffers et al., 1973; McMullan et al., 2007) serve as a reminder of the need to ensure the quality of food and drinking-water on board aircraft. More recently, worldwide attention has turned to the potential for transmission of communicable diseases, such as severe acute respiratory syndrome (SARS) and extremely drug-resistant tuberculosis,[1] on board aircraft, which has renewed interest in cleaning and disinfecting aircraft.

The International Health Regulations (2005), hereafter referred to as IHR (2005), are an international WHO legal framework addressing risks of international disease spread and legally binding on 194 States Parties throughout the world, including all 193 WHO Member States. The IHR (2005) are very broad, focusing upon almost all serious public health risks that might spread internationally, whether biological, chemical or radionuclear in origin, and whether transmissible in goods (including food), by persons, on conveyances (aircraft, ships, vehicles), through vectors or through the environment. The IHR (2005) contain rights and obligations for States Parties (and functions for WHO) concerning prevention, surveillance and response; health measures applied by States to international travellers, aircraft, ships, ground vehicles and goods; and public health at international ports, airports and ground crossings. For more information, see http://www.who.int/csr/ihr/en/.

Based on the above considerations and the introduction of the extensively revised and updated International Health Regulations (2005) (WHO, 2005),[2] hereafter referred to as IHR (2005), WHO found it appropriate to revise the second edition of the *Guide to Hygiene and Sanitation in Aviation*.

1.2 Scope, purpose and objective

The third edition of the *Guide to Hygiene and Sanitation in Aviation* (hereafter referred to as "the Guide") addresses water, food, waste disposal, cleaning and disinfection of facilities, vector control and cargo safety, with the ultimate goal of assisting all types of airport and aircraft operators and all other responsible bodies in achieving high standards of hygiene and sanitation, to protect travellers and crews engaged in air transport. Each topic is addressed individually, with guidelines that provide procedures and quality specifications that are to be achieved.

The guidelines in this document apply to domestic and international air travel for all developed and developing countries.

[1] For further information, see the recently revised WHO guidelines for tuberculosis and air travel (WHO, 2008a).

[2] Whereas the IHR (2005) refer to the 194 States to which they apply (including all 193 WHO Member States) as "States Parties", for ease of reference, this document refers to these as either "States" or "countries".

Although aircraft and airport operators should have a plan to respond to deliberate acts that may threaten public health, this issue is not within the purview of the Guide. The Guide does not address cabin air quality at this time, as this issue is covered extensively elsewhere (WHO, 2008a, 2008b). Finally, the Guide will not address the epidemiological aspects of illnesses related to the topics covered.

1.3 Roles and responsibilities

In addition to the responsibilities of the individual stakeholders (aircraft and airport operators, ground service providers, etc.), several international bodies, such as the International Civil Aviation Organization (ICAO), the International Air Transport Association (IATA) and the Airports Council International (ACI), play an important role in protecting the health of passengers and crew.

Aircraft operators are involved at many levels in the chain of events that provide a hygienic and sanitary environment for air travellers and crew. For example, aircraft operators obtain potable water from numerous sources, and they have to ensure that each source provides drinking-water of acceptable quality. Water transfer is a key aspect of loading water onto the aircraft from the mains supply. The aircraft operator has the responsibility, in concert with the airport and relevant health authority, to ensure that proper transfer procedures are observed.

The safety of the potable water supply at the airport (including for provision to aircraft) is generally under the operational responsibility of the airport operator. The airport operator is generally subject to surveillance by the governmental authority responsible for regulating or licensing environmental health standards for facilities open for public use.

The airline has full responsibility for the management of water on board the aircraft; proper water system operation and maintenance procedures are essential to ensure that all of the intended potable water on board is safe. Cleaning of the aircraft water tanks at regular intervals is part of the aircraft maintenance process.

Airlines are responsible for the food they serve on board aircraft, whether it is prepared in an airline-owned “flight kitchen” or obtained from an independently owned catering company. The steps involved—including food preparation, transport to the aircraft, storage and, finally, serving on the aircraft—need to be well coordinated in order to avoid contamination.

Routine cleaning and disinfection are also important aspects of aircraft and airport operations. In addition, aircraft disinfection procedures following transport of a suspected case of communicable disease are a particularly difficult issue that needs to be addressed by many stakeholders in a cooperative approach; not all effective disinfectants are suitable for use on board aircraft, as they may cause corrosion or other damage to the aircraft structure and contents, or their fumes may be noxious to inhale in an unventilated space. WHO, IATA, aircraft manufacturers and ICAO are the main organizations involved in determining a suitable disinfection process at the international level.

Liquid and solid waste disposal is a shared responsibility of the airlines, the airport operators and the ground service providers. Under supervision of the health authority, they must use an effective system for the removal, transport and disposal of solid and liquid waste.

Human populations, livestock and crops must be protected against the spread of disease by insects and rodents that may be inadvertently transported by air. The range of responsibility for this aspect is wide and extends from the site selection of a future airport (away from mosquito breeding zones) to extermination of insects and rodents by airport and aircraft operators. The issue of aircraft disinsection is particularly controversial and will be covered in detail.

Cargo operations, especially with regard to animal transport and hazardous material, are an important concern mainly for aircraft operators. Ensuring compliance of the shippers and maintaining cleanliness of cargo areas are two of the main responsibilities of aircraft operators.

ICAO's primary role has been the prevention of aircraft accidents. However, in 2004, the Assembly of ICAO, its governing body, stated that the "protection of the health of passengers and crews on international flights is an integral element of safe air travel", and ICAO's activities in this area have since increased.

Aircraft and airport operators should cooperate with public health authorities in public health surveillance. Public health surveillance, defined as the ongoing, systematic collection, analysis and interpretation of data about specific environmental hazards, exposure to environmental hazards and health effects potentially related to exposure to environmental hazards, for use in the planning, implementation and evaluation of public health programmes, must be implemented in the aviation sector, including airports and aircraft. The purpose of conducting public health surveillance is to identify outbreaks of disease and other health issues and trace the cause or causes in order to control, and possibly even to eliminate or to eradicate, the health risks under surveillance. Public health surveillance that involves air travellers can be particularly challenging, as this population is exposed to many different potential sources of contagion, including fellow travellers, and it typically disperses quickly upon arrival at an airport. The cooperation of airport and aircraft operators in providing information to the public and to public health authorities is essential in these situations.

1.4 Structure of the *Guide to Hygiene and Sanitation in Aviation*

The Guide is structured into seven chapters:

- Chapter 1—Introduction
- Chapter 2—Water
- Chapter 3—Cleaning and Disinfection of Facilities
- Chapter 4—Food
- Chapter 5—Waste Disposal
- Chapter 6—Vector Control
- Chapter 7—Cargo.

Chapter 1, the Introduction, sets the Guide in its legal context, considering the IHR (2005) and describing the relationship between the Guide and other international documents. It also describes the roles, responsibilities and relationships among the relevant stakeholders.

Each of chapters 2–7 follows the same structural approach, consisting of two sections: "Background" and "Guidelines".

The "Background" section describes critical issues and supporting health evidence, as well as an overview of the public health significance of aircraft, both with respect to the specific topic of the chapter.

The "Guidelines" section in each chapter of the Guide provides user-targeted information and guidance applicable to the topic of the chapter, identifying responsibilities and providing examples of practices that can control risks. This section contains a number of specific **Guidelines** (situations to aim for and maintain), each of which is accompanied by a set of **Indicators** (measures for whether the guidelines are met) and **Guidance notes** (advice on applying the guidelines and indicators in practice, highlighting the most important aspects that need to be considered when setting priorities for action).

1.5 Importance of the modular approach

To properly manage the wide scope of this Guide, a "modular" (i.e. chapter by chapter) approach to its development has been adopted. The modular structure of the Guide will simplify subsequent updating as well.

This Guide includes the chapters on water and cleaning and disinfection of facilities. Future publications will include the remaining chapters.

1.6 Harmonization with the International Health Regulations (2005)

The purpose and scope of the IHR (2005) are to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks and that avoid unnecessary interference with international traffic and trade (Article 2).

Table 1.1 illustrates public health functions related to points of entry and the mechanisms behind the implementation of the IHR (2005), which are applicable to aviation as well as to other types of international transport.

Table 1.1. Public health functions related to points of entry and mechanisms of implementation of the IHR (2005)

Prevention	Early warning	Response
Containing known public health risks at ports, airports, ground crossings	Detecting public health risks/ events of potential international concern	Responding to public health emergencies
Routine control of sanitary conditions at points of entry and on conveyances (e.g. controlling vectors and reservoirs, goods, food, water, waste)	Inspection, entry and exit screening information and verification (e.g. verifying documents, such as the health part of the Aircraft General Declaration, and sanitary conditions on board)	Support to investigation and contingency plans to adopt control measures (e.g. assessment of and care for affected travellers, quarantine, isolation, contact tracing, disinfection)
Risk management	**Risk assessment**	**Event management**

Source: International Health Regulations Coordination, WHO Lyon Office, 2008.

The IHR (2005) are a legally binding agreement for all WHO Member States. Relevant aspects of IHR (2005) implementation include strengthening the use of scientific principles to prevent, detect, reduce or eliminate the sources of infection and contamination, to improve

sanitation in and around international ports, airports and ground crossings, to prevent the international dissemination of vectors and to mandate national and international actions to prevent the international spread of disease. The IHR (2005) also provide a framework within which international harmonization may be fostered and a reference for appropriate public health measures applied to conveyances and at international ports, airports and ground crossings.

The revision and update of the Guide support this function. The aim is to provide specific technical guidance on the application of the IHR (2005) to aviation, in the interest of providing safe drinking-water and food services to travellers as well as enabling sound hygiene and sanitation practices while mitigating infectious disease vectors.

1.7 Development of the *Guide to Hygiene and Sanitation in Aviation*

The Guide has been developed through an iterative series of drafting and peer review steps. These have included expert network meetings, the first being held in Geneva, Switzerland, on 7–8 June 2007, the second in Montreal, Canada, on 22–24 October 2007, and the third and last in Toronto, Canada, on 24–26 March 2008. Draft material was presented, and comments were captured and collated to reach a consensus on structure and content.

A complete list of contributors to the Guide can be found in the Acknowledgements section.

2. WATER

2.1 Background

Travel can facilitate the transfer of communicable disease. The volume and rapidity of travel can have an international impact on disease. This is particularly true for aircraft, as the global span of the aviation industry requires the loading and rapid transport of people and supplies from many locations all over the world. With the 21st-century potential for millions of people to have access to air travel on a global scale come the added problems encountered by aircraft operators that transit both into and out of disease-affected areas or areas with variable and sometimes inadequate standards of general hygiene and sanitation.

One risk is posed by the potential for microbial contamination of aircraft water by animal or human excreta. This contamination may originate from source waters or may occur during transfer operations or while water is stored on board the aircraft. Waterborne disease burdens in many parts of the world include cholera, enteric fevers (*Salmonella*), bacilliary and amoebic dysentery and other enteric infections. These diseases are not unique to water; food may actually be the dominant risk vector in some environments, and, in fact, most airlines have a good record with respect to known contamination incidents. However, any location is at risk if proper procedures and sanitation practices are not continuously followed to ensure the safety of water that is used for drinking and food processing and preparation.

2.1.1 Water supply and transfer chain

Even if the water at the airport is safe, that does not ensure that it will remain safe during the transfer to the aircraft and storage activities that follow. An understanding of the aircraft drinking-water supply and transfer chain will help to illustrate the points at which the water can become contaminated en route to the tap on board the aircraft.

Generally, the aircraft drinking-water supply and transfer chain consists of four major components:

1. the **source** of water coming into the airport;
2. the **airport** water system, which includes the on-site distribution system. It may also include treatment facilities if the airport produces its own potable water;
3. the **transfer point** (sometimes referred to as the watering point), including the water transfer and delivery system. It is typically a temporary interconnection between the hard-plumbed distribution system of the airport (e.g. at a hydrant) and the aircraft water system, by means of potable water vehicles and carts, refillable containers or hoses. This water transfer process provides multiple opportunities for the introduction of contaminants into the drinking-water;
4. the **aircraft water system**, which includes the water service panel, the filler neck of the aircraft finished water storage tank and all finished water storage tanks, including refillable containers/urns, piping, treatment equipment and plumbing fixtures within the aircraft that supply water to passengers or crew.

Figure 2.1 is a flow diagram of a typical aircraft potable water supply and transfer chain. It depicts the water path from potable water source to the aircraft's galley and lavatory taps serving passengers and crew.

Aircraft Potable Water Supply and Transfer Chain

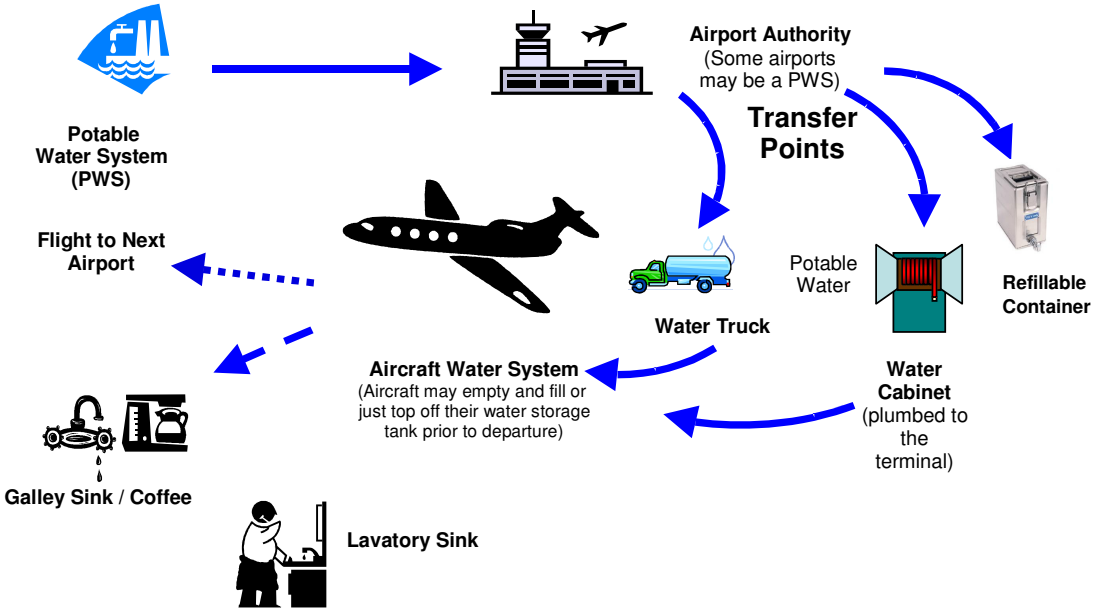

Figure 2.1. Aircraft potable water supply and transfer chain

2.1.2 Water requirements

The water storage capacity required for all purposes on board aircraft is based on the number of occupants (passengers and crew) and the duration of the flight, while being limited by weight, aircraft design and other practical considerations.

In practice, the capacity of aircraft water systems varies considerably. Examples of the potable water carrying capacities of different aircraft are given in Table 2.1.

Table 2.1. Approximate capacity of potable water tanks on select aircraft

Aircraft type	Number of tanks	Quantity per tank (litres)	Total quantity (litres)
A380	6	283.3 (option 377.7)	1700 (option 2266)
A340-500/600	3	356.7	1070
A340-200/300	2	350 (option 525)	700 (option 1050)
744 F/P	4	416.3	1665.2
744Combi	3	416.3	1248.9
MD11	4	238.4	953.6
777-200ER	3	412	1236
777-300ER	3	435	1305
A330	2	350	699
737-300/400/500	1	75.7/113.6/151.4[a]	75.7/113.6/151.4
737-600/700/800/900	1	75.7/113.6/151.4/189.25/227.1[a]	75.7/113.6/151.4/189.25/227.1
787	2	511	1022

[a] Individual size, location and capacity of each tank may vary due to customer preference and use on the aircraft.

2.1.3 Health risks associated with water on aircraft

2.1.3.1 Water quality

The importance of drinking-water as a vehicle for the transmission of infectious disease microorganisms in water supplies has been well documented in public and private water supplies.

The WHO *Guidelines for Drinking-water Quality* (WHO, 2004) (GDWQ) identify the broad spectrum of contaminants, including microorganisms, inorganic and synthetic organic chemicals, disinfection by-products and radionuclides, that can reach hazardous concentrations in potable water supplies and describe systematic approaches to risk management. As a general definition, safe drinking-water, as defined by the GDWQ, does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages.

The WHO *Guidelines for Drinking-water Quality* (GDWQ) (WHO, 2004) provide comprehensive guidance to ensure the quality and safety of drinking-water. Most of the concerns involving the safety of drinking-water on board aircraft focus on acute risks because of the short-term and limited exposure conditions. Thus, microbial risks are the principal concerns, although a few risks associated with acutely toxic chemicals also exist.

Significant microbial risks are associated with ingestion of water that is contaminated with human and animal excreta, although exposure through food preparation and direct human contact are probably more significant contributors to overall microbial disease risks.

Studies that highlight the aircraft water safety concern have been conducted by the United States Environmental Protection Agency (USEPA), Health Canada and the United Kingdom's Association of Port Health Authorities (APHA) (see Box 2.1). Total coliforms, *Escherichia coli*, *Pseudomonas aeruginosa*, enterococci and clostridia were detected in one or more studies. Most total coliforms are not pathogens per se, but a positive test is an indicator of inadequate sanitation practices; *E. coli* are indicative of recent faecal contamination, and some *E. coli* are human pathogens; *P. aeruginosa* are considered to be opportunistic pathogens, particularly from external contact with, for example, open wounds; enterococci are found in the intestines of warm-blooded animals, so they are indicators of faecal contamination; and *Clostridium* bacteria are found in the intestines of some humans and, more so, in dogs, which again points to faecal contamination (WHO, 2004).

Box 2.1. Studies on aircraft water safety

Random testing of water on aircraft by Health Canada in June 2006 found that 15.1% of the aircraft tested positive for total coliform bacteria and 1.2% tested positive for *E. coli*. Most contamination was found in water from lavatory taps or faucets, indicating the possibility of localized contamination rather than general water contamination (Health Canada, personal communication, 2008).

During a USEPA study conducted in 2004, 327 passenger aircraft were randomly tested at 12 airports that served both domestic and international routes. The USEPA analysed the drinking-water samples from galleys and lavatories for total coliforms (in the case of a positive result for total coliforms, the sample was tested for *E. coli*/faecal coliforms), total residual chlorine, heterotrophic plate count, and total nitrate and nitrite. In regard to the presence of microorganisms, 15% (49/327) of the aircraft tested positive for total coliforms in one or more sampling sites, and 4.1% (2/49) of these total coliform–positive aircraft also tested positive for *E. coli*/faecal coliforms. Twenty-one per cent of the aircraft tested had a non-detectable chlorine residual (USEPA, 2008).

The APHA study conducted in 1999 examined 850 samples of water from mains, bowser and aircraft sources from 13 airports in the United Kingdom. *Pseudomonas aeruginosa* was detected in 27% of all samples, total coliforms in 7.8%, *E. coli* in 0.4%, enterococci in 1.2% and sulfite-reducing clostridia in 0.4%. Of the samples with coliform contamination, 7.9% had contamination with faecal indicators, compared with 1.3% of samples without coliforms (APHA, personal communication, 2008).

There are no known reports of illness associated with drinking contaminated water on aircraft. Nevertheless, the potential for serious illness exists, particularly for those with compromised health (e.g. individuals with chronic illness).

The water quality guidelines directly applicable to water on aircraft focus on acute risks from contamination that may be incurred during transfer from the airport, through the transfer point or on board the aircraft. The focus on acute risks is because the exposure that would occur during a flight and be experienced by passengers and crew would be intermittent and of short duration (hours) rather than long term or lifetime, which is the basis for most of the guidelines in the GDWQ. Typically, the GDWQ assume the consumption of 2 litres of drinking-water per day by an average 60-kg adult for a lifetime (70 years), 1 litre per day for a 10-kg child and 0.75 litre per day for a 5-kg bottle-fed infant.

Besides microbial organisms, a few inorganic chemical substances, such as nitrate and nitrite (which can enter the source water from agricultural activity, sewage inflow or sewage cross-contamination in plumbed systems) and copper (which may leach into drinking-water from copper piping), may also be of health concern due to subpopulations that may be at risk from excess short-term exposures. For instance, methaemoglobinaemia may be caused by the temporary exposure of infants to nitrate and nitrite, among other contributing factors; and gastric irritation may result from short-term exposure to copper (WHO, 2004).

Potentially significant cumulative effects of repeated short-term exposures to chemical hazards should not be overlooked, as they may lead to long-term consequences.

2.1.3.2 Water quantity

An insufficient or non-existent quantity of potable water under pressure on board the aircraft for drinking, culinary purposes and personal hygiene can have an impact on the health and welfare of not only the passengers but also the crew.

There may not be enough water for the safe use of lavatories, which may lead to malfunctioning of some types of toilets, unpleasant odours, contaminated surfaces and an inability to wash hands. It may also lead to an inability to prepare or serve food in a sanitary manner, thereby impacting on the provision of safe food to passengers.

Adequate water intake during flight is also important to maintain health and well-being, although there is no need to drink more than usual (WHO, 2008b). The humidity in aircraft cabins gradually decreases on long-distance, high-altitude flights, sometimes reaching below 10% (optimum comfort is at approximately 50% humidity). While this low relative humidity does not cause central dehydration (Stroud et al., 1992; WHO, 2008b), it can cause discomfort for passengers and crew. Dry, itchy or irritated eyes, dry or stuffy nose, dry throat and skin dryness are among the most common complaints of cabin crew (Lee et al., 2000). Regular water intake and use of a skin moisturizer will minimize these symptoms, but it is possible that some individuals may become intolerant of contact lenses and have to revert to spectacle use.

The amount of water required for hand washing and other sanitation needs should be adequately dealt with in typical passenger aircraft designs.

2.1.4 Bottled water and ice

Bottled water is considered as drinking-water by some regulatory agencies and as a food by others (WHO, 2004). For many airlines, bottled water is the primary or exclusive source of water used for direct consumption on board aircraft, with the exception of hot beverages. International bottled water quality specifications exist under the Codex Alimentarius Commission (FAO/WHO, 2001) and are derived from the GDWQ. Since it is commonly designated as a food product, bottled water will not be considered further in this chapter, and the reader is referred to chapter 4 on food.

For the purposes of this Guide, ice supplied to aircraft for both drinking and cooling has been classified as "food". Guidance pertaining to ice used on aircraft is contained in chapter 4 on food. The GDWQ apply to both packaged water and ice intended for human consumption (WHO, 2004).

2.1.5 Uses of potable water on board aircraft

Potable water is used in a variety of ways on board commercial transport aircraft, including direct human consumption, food preparation and sanitation/hygiene activities. Potential uses include:

- preparation of hot and cold beverages, such as coffee, tea and powdered beverages;
- reconstitution of dehydrated foods, such as soups, noodles and infant formula;
- direct ingestion from cold water taps and water fountains;
- reconstitution and/or ingestion of medications;
- brushing of teeth in lavatories;
- hand washing in lavatories and galleys;
- cleaning of utensils and work areas;
- preparation of hot, moist towels for hand and face washing;
- direct face washing in lavatories;
- onboard showering facilities;
- emergency medical use.

Although some of these uses do not necessitate consumption, they involve human contact and possibly incidental ingestion (e.g. tooth brushing).

2.1.6 International Health Regulations (2005)

Annex 1 B 1 (d) of the IHR (2005) requires every airport specifically designated by a State to have or develop within a limited period the capacity to provide safe potable water supplies for travellers using airport facilities.

In accordance with Article 24 (c) of the IHR (2005), all States are required to take all practicable measures to ensure that international conveyance operators keep their conveyances free of sources of contamination and infection, which should include drinking-water. However, it is the responsibility of each aircraft operator to ensure that no sources of infection and contamination are found on board, including in the water system. For this purpose, it is important that these standards are being upheld on the aircraft, in terms of both

the quality of the water taken on board from the source of supply on the ground and maintenance of water quality on board.

For all States, their competent authorities are required to ensure, as far as practicable, that the facilities at international airports are in sanitary condition and kept free of sources of infection and contamination, as per Article 22 (b). This includes providing potable water from a uncontaminated source that should be approved by the competent authority.

2.1.7 Overview of water safety plans

Water safety plans (WSPs) are the most effective management approach for consistently ensuring the safety of a drinking-water supply. A potable water source at the airport is not a guarantee of safe water on board the aircraft, as the water may be contaminated during transfer to or storage or distribution in the aircraft. A WSP covering water management within airports from receipt of the water through to its transfer to the aircraft, complemented by measures (e.g. safe materials and good practices in design, construction, operation and maintenance of aircraft water systems) to ensure that water quality is maintained on the aircraft, provides a framework for water safety in aviation. A general overview of WSPs follows; their specific application to the safety of drinking-water on board aircraft will be described in section 2.2.

A WSP has three key components, which are guided by health-based targets and overseen through drinking-water supply chain surveillance. They are:

1. **system assessment**, which includes
   - description of the water supply system in order to determine whether the drinking-water supply chain (up to the point of consumption) as a whole can deliver water of a quality that meets health-based targets;
   - identification of hazards and evaluation of risks;
   - determination of control measures, reassessment and prioritization of risks;
   - development, implementation and maintenance of an improvement plan;
2. **operational monitoring**, which includes identification of control measures that will control hazards and risks and verification (to determine whether the system meets health-based targets);
3. **management and communication**, including preparation of management procedures and developing supporting programmes to manage people and processes (including upgrade and improvement).

The various steps involved in designing and implementing a WSP are illustrated in Figure 2.2.

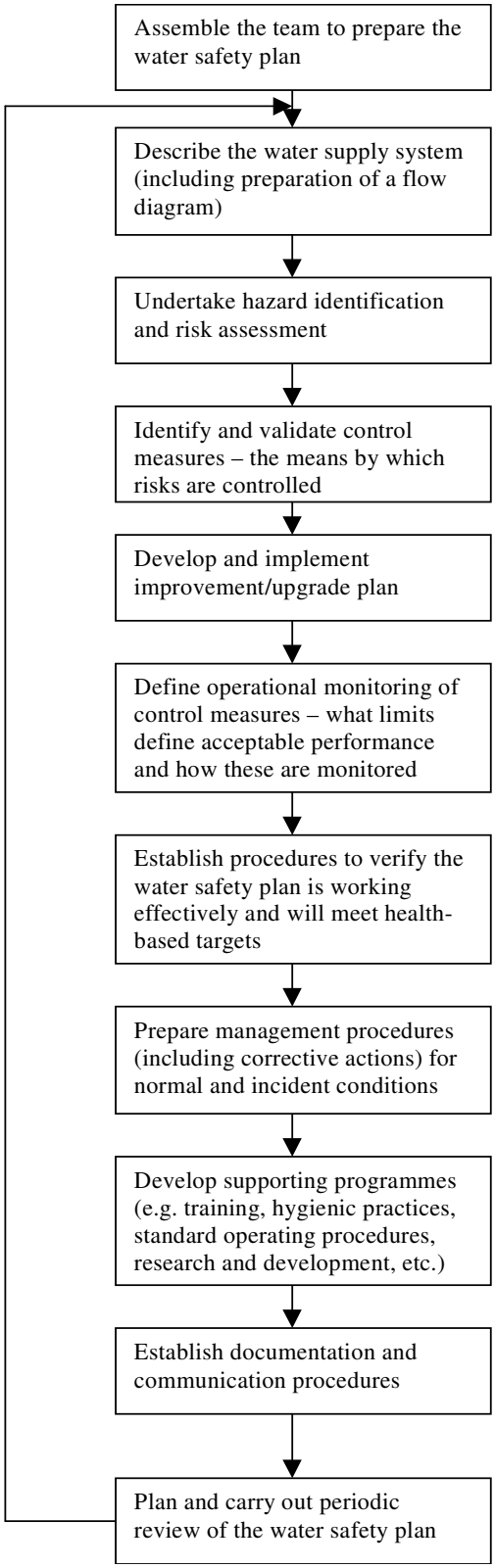

Figure 2.2. Application of water safety plans

For more information on general principles of WSPs, see section 6.7.1 of the GDWQ (WHO, 2004) and the *Water safety plan manual* (WHO, 2009).

2.1.8 Applicability of the GDWQ to the Guide to Hygiene and Sanitation in Aviation

The GDWQ describe reasonable minimum requirements for safe practices to protect the health of consumers and derive numerical guideline values for constituents of water or indicators of water quality. Neither the minimum requirements for safe practices nor the numerical guideline values are mandatory limits, but rather health-based guidance to national authorities to establish their own enforceable standards, which may also consider other factors. In order to define such limits, it is necessary to consider the GDWQ in the context of local or national environmental, social, economic and cultural conditions.

Nevertheless, given the global nature of air travel and the need for aircraft to board water from areas with variable and possibly inadequate standards of general hygiene and sanitation, the GDWQ or national standards should be followed, whichever are more stringent. This approach will provide passengers and crew with consistent reliable protection from the potential risks posed by contaminated drinking-water.

2.2 Guidelines

This section provides user-targeted information and guidance, identifying responsibilities and providing examples of practices that can control risks. Six specific **Guidelines** (situations to aim for and maintain) are presented, each of which is accompanied by a set of **Indicators** (measures for whether the guidelines are met) and **Guidance notes** (advice on applying the guidelines and indicators in practice, highlighting the most important aspects that need to be considered when setting priorities for action).

The guiding principle for this section is ensuring that water is safe for intended use. Five of the guidelines that fall under this principle deal with water quality, and one deals with water quantity.

Guidelines 2.2–2.5 can all be considered components under the umbrella Guideline 2.1. However, their importance in ensuring safe water quality in aviation warrants that they have additional detailed elaboration.

2.2.1 Guideline 2.1: Water safety plans

Guideline 2.1—Water safety plans are in place for each component of the water supply chain.

Indicators for Guideline 2.1

1. Design and implement a water safety plan for the airport water source.
2. Design and implement a water safety plan for the airport.
3. Design and implement a water safety plan for the transfer point.
4. Design and implement a water safety plan for the aircraft.

Guidance notes for Guideline 2.1

A WSP is an effective means of achieving consistency in ensuring the safety of a drinking-water supply. The entity responsible for each component of the drinking-water supply chain

(i.e. water source, airport, transfer point or aircraft) should also be responsible for the preparation and implementation of a WSP for that part of the process. General roles and responsibilities for each such component are as follows:

- **Source water supplier (public or private):** Role is to provide to the airport a safe water supply of sufficient quantity and quality. Responsibilities are to monitor the water system by sampling water and providing sampling results to the airport competent authority on request, advising the airport authority of any adverse results and action to be taken, and advising the airport authority when the water supply has or may become contaminated and of action taken.
- **Airport authority:** Role is to maintain the integrity of the water supplied and to provide safe water to the occupants, travellers, visitors, workers, water haulers and transfer points to the aircraft within the airport grounds. Responsibilities are to monitor the water system by sampling water and sharing sampling results with authorities and also stakeholders on request and to advise not only the water supplier but all concerned parties who use their water of any adverse results and corrective actions. In some circumstances, the airport may be both the source water supplier and provider of treated drinking-water.
- **Water haulers (transfer point):** Role is to provide water to the aircraft. Responsibilities are to maintain a safe water supply from the transfer point to the aircraft, to maintain the equipment in good working order, to monitor the water system by sampling water and sharing sampling results with stakeholders on request and to report adverse results and action to be taken to the aircraft operator and airport authority.
- **Aircraft operator:** Role is to provide a safe water supply to the passengers and crew for drinking, culinary purposes and personal hygiene. Responsibilities are to maintain their onboard water tank(s) clean and free of harmful microbial contamination, to monitor the water system by sampling water, to share sampling results with stakeholders, to report adverse results to the competent authority and take corrective actions, and, when and where required, to advise the crew and passengers of the adverse results.

The WSP for an airport source water supplier and drinking-water provider may be fairly detailed owing to the size and complexity of the facilities, whereas WSPs may be relatively basic for transfers and on board aircraft. The WSP should be reviewed and agreed upon with the authority responsible for protection of public health to ensure that it will deliver water of a quality consistent with the health-based targets.

WSP objectives are met through:

- development of an understanding of the specific system and its capability to supply water that meets health-based targets;
- identification of potential sources of contamination and how they can be controlled;
- validation of control measures employed to control hazards (see Figure 2.3 for examples of hazards);
- implementation of a system for monitoring the control measures within the water system;
- timely corrective actions to ensure that safe water is consistently supplied;
- verification of drinking-water quality to ensure that the WSP is being implemented correctly and is achieving the performance required to meet relevant national, regional and local water quality standards or objectives;
- provision (to include development, assessment and overall management, as necessary) of appropriate training for all personnel involved in installing, maintaining, operating and monitoring all components of the water supply and delivery chain identified in the WSP.

For more information on general principles of WSPs, see section 6.7 of the GDWQ (WHO, 2004) and the *Water safety plan manual* (WHO, 2009).

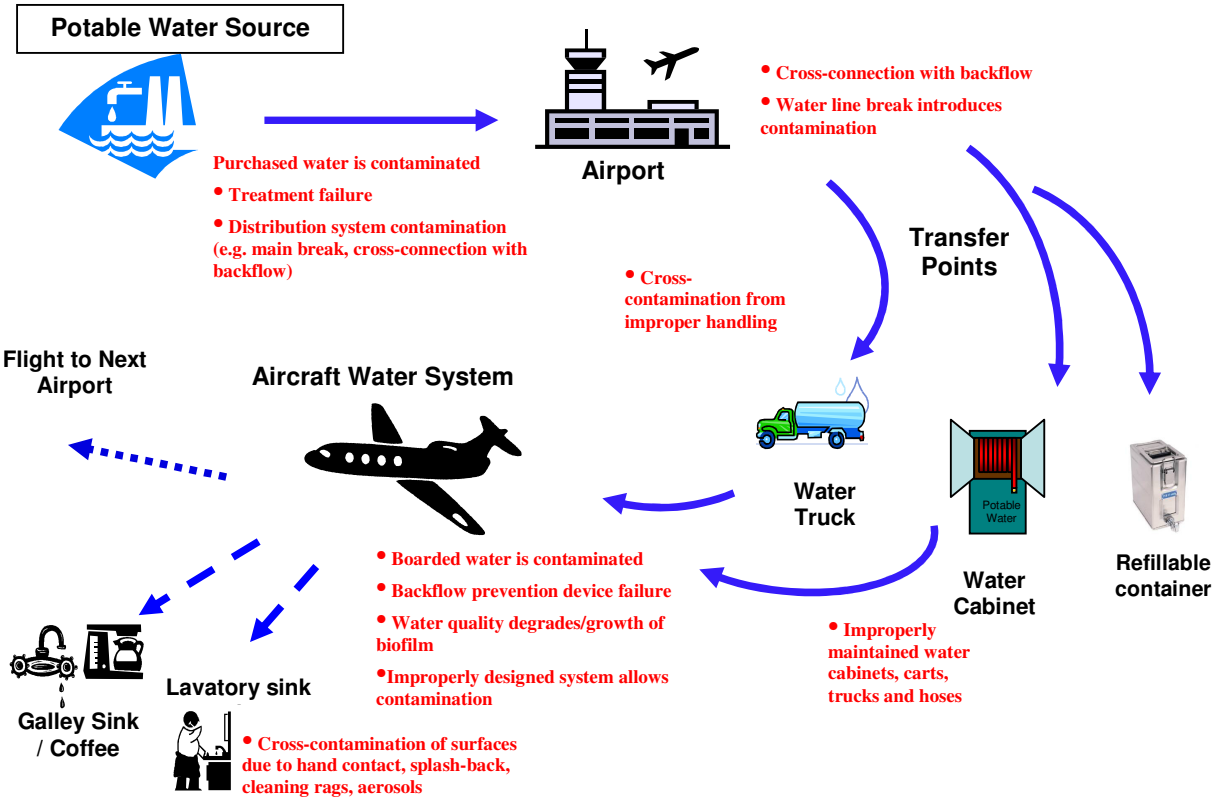

Figure 2.3. Examples of hazards in the aircraft potable water supply and transfer chain

1. Airport water source

Airports should be supplied with the safest water available from the water provider. The condition of the municipal supply source water provided to the airport should be known and controlled. Piped water supply delivered to airports should be obtained from well operated and maintained systems that conform to GDWQ or national standards monitored by competent authorities. If the water provided at the airport does not meet the GDWQ or national requirements, the airport will need to either utilize a higher-quality source or provide water treatment to meet those quality goals.

2. Airport

The airport authority has the responsibility to ensure the availability of a sufficient quantity of appropriate quality water. An airport may receive potable water from either a municipal/public or private supply, or the airport operator itself may be the water supplier responsible for producing the water that it uses. In the latter case, the airport would be almost identical to a public water supplier in its operations and responsibilities. The potable water is delivered to potable water cabinets, water trucks, carts, filling stations and airport buildings through the airport's distribution system. The delivery of the potable water to the aircraft is by designated filling hoses connected to the airport water system either directly or indirectly through water trucks and carts.

Improperly managed drinking-water can be an infectious disease transmission route at airports just as it is in municipal supplies. Most municipal waterborne outbreaks have involved ingestion of water contaminated with pathogens derived from human or animal excreta, which could be either from water that is supplied from the source or from contamination by cross-connection in the distribution system. The aircraft is a closed system, and post-loading contamination should not readily occur with a properly designed system. At an airport, the transfer procedure between the airport water system and the aircraft is another significant potential contamination opportunity.

Another possible cause of waterborne outbreaks is cross-contamination within the airport distribution system. Airports should ensure that water in the airport is potable through operational monitoring and should implement rigorous programmes to control cross-contamination during loading, distribution and treatment (e.g. having a cross-connection and backflow prevention programme).

Periodic self-audits or inspections should be carried out in addition to routine water quality measurements; these may differ in complexity from audits performed on the transfer point or aircraft. Corrective actions or procedures should be established and implemented should contamination be shown or if improper practices are suspected. Communication of this information to public health authorities and other affected individuals, such as persons served in the airport or those with responsibility over the water transfer points, is essential.

An example of a WSP for an airport can be found in Annex A.

3. Transfer point

The water transfer points between the airport source and the aircraft onboard storage and distribution system present significant opportunities for contamination. Common equipment used to transfer water includes (but is not limited to) piping, hoses, potable water cabinets, bowsers, tanks, filling stations, refillable urns and jugs, and hydrants (including taps/faucets). Equipment should be constructed of appropriate materials (e.g. corrosion-resistant materials) certified for this application, properly designed, operated, labelled and maintained, and used for no other purpose that might adversely affect the quality of the water. Assumptions and manufacturer specifications for each piece of equipment need to be validated to ensure that the equipment is effective.

Potable water should be obtained from those transfer points approved by the competent authority. The lines' capacity should be such as to maintain positive pressure at all times to reduce the risk of backflow. There should be no connections between the potable water system and other piping systems. Backflow of contaminated water into the potable water system needs to be prevented by proper installation of piping, backflow prevention devices and plumbing. Water for drinking and culinary use on aircraft should not be taken from water closets, washrooms or other places where danger of contamination exists or may develop.

Post-type or wall-type hydrants are preferred, but ground-level-type hydrants can be acceptable when necessary. Where hoses are used for loading potable water on aircraft, the hydrant outlet should have a type of coupling that will permit quick attachment and removal of the hose. For a hose permanently attached to the hydrant outlet, a threaded fitting will be acceptable. Outlets to all hydrants should terminate in a downward direction or gooseneck, except that ground-level-type hydrants may discharge horizontally. When the hydrant is of

the ground-level type or is located in a pit, precautions should be taken in the construction of the transfer point to ensure that drainage from the hydrant area and from the hydrant box are adequate to prevent flooding. In new servicing areas, hydrants with weep holes are not recommended. Hoses should have smooth interior surfaces, be free of cracks, be checked on a regular basis and be sufficiently durable to withstand hard usage. The nozzle on the end of the hose should be constructed so as to permit a tight connection with the filling connection of the aircraft and should be of a different size from that of any waste connections on the aircraft. All hose connections should be of the quick-coupling type, unless the hose is permanently attached to a water cart or hydrant. Water hose nozzles and the hose ends should not touch the ground or any contaminating materials, such as pools of water on the ground. Hose guard systems are designed in many forms. Guards, discs, balls or other devices, which will protect the nozzle end of the hose from contamination, should be provided and properly maintained. Valves at the filling end of such a hose should not be located on the nozzle side of the disc or protective device. The hose should be stored well away from wastewater equipment and on special reels or in lockers or cabinets that are used for no other purpose. Nozzles, fittings and linkages should be covered so as to avoid contamination. The hose should be flushed thoroughly before being used and periodically sanitized, and it should be immediately sanitized after any observed contamination from ground operations. Transfer procedures should be developed to ensure that contact with the ground and other contaminated surfaces is avoided.

The tanks should be designed so that they can be disinfected and flushed and should be provided with a drain that permits complete drainage of the tank. They should be labelled "DRINKING WATER ONLY". The inlet and outlet to the tank should terminate in a downward direction or gooseneck and should be provided with caps or closures with keeper chains for protection against contamination. The inlet and outlet should be equipped with couplings of a type that permits quick, easy attachment and removal of the hose. When hoses are transported on the water cart, storage facilities should be provided on the cart to protect the hoses from contamination.

Potable water provided in refillable urns or jugs for use at water transfer points between the airport source and the aircraft onboard storage and distribution system should meet relevant international standards. In such cases, the filling area should be dedicated for this purpose only and should be free of food manufacturing waste and by-products, general waste and cleaning agents and should be constructed and maintained in accordance with health regulations.

Appropriate personal hygiene for employees handling water at the transfer point cannot be overemphasized, and responsibilities for potable water transfer should be considered exclusive and separate from wastewater handling to avoid cross-contamination. Under no circumstances should employees be tasked simultaneously with both wastewater handling and potable water transfer. Other issues to consider include the development of transfer procedures to ensure that contact of hose nozzles with the ground and other contaminated surfaces is not permitted and procedures to ensure that water trucks and carts are not parked directly adjacent to sewage equipment.

The above lists of equipment and processes are by no means exhaustive. It is essential that, given the wide range of transfer equipment and processes, the WSP is informed by a fundamental understanding of the specific transfer processes obtained through hazard and risk analysis of each system and each type of aircraft and developing standard operating

procedures when appropriate (e.g. when coupling/decoupling from transfer point and aircraft). Periodic self-audits or inspections should be carried out and can complement routine water quality measurements; these may differ in complexity from audits performed on the airport or aircraft. Corrective actions or procedures should be established and implemented if contamination is shown or improper practices are suspected. Communication of this information to public health authorities and other affected individuals, such as those with responsibility over the aircraft, is essential (USFDA, 1995).

An example of a WSP for a transfer point can be found in Annex B.

4. Aircraft

If WSPs at the airport and transfer points have been developed and implemented correctly, the water provided to the aircraft should be of acceptable quality. If the available water being provided to the aircraft does not meet the GDWQ or national requirements, then the aircraft operator must take measures to ensure that water on board is safe. These may include, for example, a decision not to board water at that location or to obtain water from an alternative source, such as a contract provider.

Aircraft water systems include the water service panel, the filler neck of the aircraft water storage tank and all water tanks, refillable containers/urns, piping, treatment equipment and plumbing fixtures within the aircraft that supply water for use by passengers or crew. In modern aircraft, water is generally stored in tanks. These should be constructed of welded stainless steel or reinforced fibreglass. They feed, either by pressure or by gravity, all aircraft water outlets (i.e. hand-washing basins, galley taps, drinking fountains and water heaters). Tanks should be designed to drain completely. If the aircraft has only one tank or if several tanks are located together, there should be a single fill/overflow point; if, on the other hand, the tanks are located in different parts of the aircraft, each should have its own fill point. In all cases, the fill points should be separated from the toilet servicing panels to avoid cross-contamination. Drinking-water access points should be sited outside lavatories. If appropriate, the water should be cooled by passing through automatic coolers. All components in the water system should be corrosion resistant and suitable for use with hyperchlorinated water. On some aircraft, carbon filters are used to neutralize the chlorine in the drinking-water at the tap for taste purposes. On occasion, these are incorrectly described as purifying filters. If they are not serviced regularly, the cartridges may proliferate bacteria or even disintegrate. Also, once the chlorine content has been removed, the water has no protection against bacteria introduced downstream from the filter, and heterotrophic plate count (HPC) regrowth may also occur. Such filters should therefore be fitted at each water outlet. If desired, point-of-use treatment devices exist with the capability of removing, inactivating or killing microorganisms in drinking-water. Careful testing and selection are necessary to determine the appropriateness and performance characteristics of candidate devices. Point-of-use devices are intended not to replace disinfection of the bulk water, but to provide an extra safety measure, if it becomes necessary.

In some aircraft, potable water is stored in refillable urns or jugs or the aircraft tank supply is supplemented by an extra quantity in flasks. This practice is not recommended—particularly in the case of drinking-water—because of the great risk of contamination of flasks, since these are offloaded at all airports and may not always be properly disinfected before being refilled. However, in the case where refillable urns or jugs are used, suppliers of refillable urns or jugs installed as part of the aircraft onboard water storage and distribution system should meet appropriate international standards. Aircraft onboard water distribution systems

incorporating refillable urns or jugs should be maintained using the original manufacturer's guidance or approved bottle change/cleaning procedures.

Manufacturer specifications and assumptions for proper use of each piece of equipment should be validated to ensure that the equipment is effective. Periodic self-audits or inspections should be carried out and can complement routine water quality measurements; these may differ in complexity from audits performed on the airport or transfer point. Corrective actions or procedures should be established and implemented if and when contamination is shown or improper practices are suspected. Communication of this information to public health authorities and other affected individuals, such as passengers and crew on board the aircraft, is essential (USFDA, 1995).

An example of a WSP for an aircraft can be found in Annex C.

2.2.2 Guideline 2.2: Drinking-water quality standards

Guideline 2.2—All water on board aircraft intended for human contact meets GDWQ or national standards, whichever are more stringent.

Indicators for Guideline 2.2

1. *E. coli* or thermotolerant (faecal) coliforms are not detectable in any 100-ml sample.
2. A disinfectant residual is detectable in water samples at the airport, at the transfer point and on the aircraft.
3. All samples meet GDWQ or national standards for chemicals of acute significance or for chemicals with potentially significant cumulative effects from repeated short-term exposures.
4. Temperature, pH, ionic composition and alkalinity are controlled within appropriate ranges for the particular water type to minimize corrosivity and potential leaching of metals, such as copper, lead and iron.
5. Turbidity is monitored, and increases in turbidity are investigated to ensure that water has not been subjected to post-treatment contamination.
6. No undesirable tastes, colours or odours are present in the drinking-water.
7. All airport and aircraft hand-washing facilities supply potable, hot and cold running water or warm running water. Each drinking-water tap supplies running water at room temperature or colder. The temperature of the water is comfortable for its intended use, but not so scalding as to discourage use or inflict injury. Water pressure is sufficient for the intended purpose.

Guidance notes for Guideline 2.2

All of the water on the aircraft intended for drinking, food preparation or human contact should be potable and meet the GDWQ specifications or national standards, whichever are more stringent. Specific requirements applicable to water on aircraft are provided in Guideline 2.2. If the water provided at the airport, at the transfer point or on the aircraft does not meet the GDWQ or national requirements, the appropriate responsible entity must take measures to ensure that water on board will be safe. These may include, for example, providing water treatment, deciding not to board water at that location and/or obtaining water from an alternative source, such as a contract provider.

More detailed discussions can be found in the GDWQ (WHO, 2004).

1. *E. coli* or thermotolerant (faecal) coliforms

By far the greatest risks in drinking-water are associated with microbial contamination from human excreta sources. *Escherichia coli* or thermotolerant (faecal) coliforms are utilized as the indicators of potential contamination with pathogens associated with human excreta. Total coliforms are not necessarily indicators of faecal contamination, but may reflect lack of general cleanliness. *Escherichia coli* and thermotolerant (faecal) coliforms should be measured using generally accepted analytical techniques.

In some instances, local source water contamination may indicate the potential for presence of protozoan pathogens such as *Cryptosporidium* or viruses, whose presence may not be well indicated by *E. coli* or thermotolerant (faecal) coliforms and that require more stringent treatment. Based upon the findings of the WSP, additional controls and measurements may be necessary.

Heated water utilized for beverage and food preparation adds additional protection of pasteurization if the water is heated to sufficient temperatures for sufficient times. Some organisms, such as certain viruses, are more resistant and require more stringent conditions of time and temperature for inactivation, so water should be managed to ensure their absence.

2. Disinfectant residual

The presence of a measurable disinfectant residual in the water at the point of use provides valuable information that contributes to the assurance that the water is microbially safe for the intended use. First, it demonstrates that the water has been disinfected; then it indicates that some level of protection is being provided during transport and storage and that some control of bacterial growth is being provided. The most common disinfectant used is usually a form of chlorine; in that case, the residual could be free chlorine, hypochlorite or chloramine.

Chlorine disinfection of low-turbidity water with appropriate contact time and pH will control bacteria and viruses. However, some protozoa are resistant to chlorine disinfection, and their control requires other disinfectants or efficient filtration. If present, protozoa should be controlled by source water treatment (e.g. filtration or ultraviolet light for some organisms). The presence of the residual will be affected by the original dose, the disinfectant demand of the water, the type of disinfectant being utilized, the temperature, the time since application of the disinfectant and whether contamination has occurred since application of the disinfectant. A “free chlorine” residual is more biocidal than a “combined chlorine” residual, but combined chlorine will last longer and will suppress HPC regrowth. Disappearance of a free chlorine residual may also indicate post-treatment contamination. Other disinfectants, such as chlorine dioxide, are sometimes used; each has its strengths and weaknesses. Chlorine is a potent disinfectant, but its high chemical reactivity leads to a short life in the system. Chloramines are less potent disinfectants but are more stable in water for longer times. The disinfectant residual for chlorine should be no less than 0.2 mg/l and no more than 5 mg/l. As the concentration increases, the likelihood of taste detection increases.

3. Chemicals of acute significance

Because of the intermittent and short-term exposure to potential contaminants in drinking-water on board aircraft, the main concern, aside from microbial contamination, is associated with acutely toxic chemicals. A few inorganic chemical substances, such as nitrate and nitrite (which can enter the source water from agricultural activity, sewage inflow or sewage cross-contamination in plumbed systems) and copper (which may leach into drinking-water from

copper piping) may be of health concern to certain subpopulations. For instance, methaemoglobinaemia may be caused by the temporary exposure of infants to nitrate and nitrite, among other contributing factors; and gastric irritation may result from short-term exposure to copper (see also No. 4 below). Potentially significant cumulative effects of repeated short-term exposures to chemical hazards (for frequent flyers or crew members, for example) should not be overlooked, as they may lead to long-term consequences. Water on board aircraft should meet the GDWQ or national standards, whichever are more stringent, for such chemicals.

4. Corrosion-related contaminants

Corrosion in plumbing systems is a function of the stability and aggressiveness of the water towards the surfaces and fixtures that the water will contact during transport and storage. Metals such as copper, lead and iron can be leached from some materials into the water and contribute adverse taste or, in some cases, health concerns. Excess copper or iron can cause metallic taste; copper can cause gastrointestinal upset; excess lead can cause cognitive deficits from long-term high-level exposure in young children. The GDWQ guideline value for copper is 2 mg/l; iron can be detectable by taste at about 0.3 mg/l and above; and the lead guideline is 0.01 mg/l. In lieu of or in addition to monitoring for metals, appropriate management could be achieved through a corrosion control programme. The materials used in the construction of all of the surfaces (hoses, couplings, pipes, tanks, fixtures, soldered joints) that the water may contact during production, transfer and storage should be approved for water contact by an appropriate authority (regulatory or independent third party) and meet appropriate standards. The water that is being provided should not be corrosive to those surfaces and fixtures. Factors such as temperature, pH, ionic composition and alkalinity need to be controlled within appropriate ranges for the particular water type (see WHO, 2004).

5. Turbidity

Turbidity (cloudiness) is caused by light being diffused by particulate matter that may be present in the water. However, it may not be obvious just from visual observation. Turbidity present in groundwater is usually of no sanitary significance if it is caused by inorganic matter. It can also be caused by sloughing of biofilms. Excess turbidity in water from the treatment plant can be an indicator of insufficient water filtration or inadequate control of coagulant dosing and sedimentation, and it could indirectly indicate inadequate removal of filterable microorganisms. Disinfectants function more effectively in low-turbidity water because microorganisms are often aggregated on particles rather than freely suspended in the water. Turbidity may increase slightly during transit through pipes due to particle agitation. A turbidity increase in the aircraft water after transfer from the airport to the aircraft could indicate that foreign matter has entered the system during the transfer. The GDWQ do not set a health-related turbidity guideline but recommend 0.1 nephelometric turbidity unit (NTU) as a process performance parameter for effective disinfection (WHO, 2004). However, this value is for water leaving the treatment plant rather than for water in distribution.

6. Aesthetic parameters (odour/colour/taste)

Aesthetic parameters such as undesirable taste, colour or odour that appear after water treatment may be indicative of corrosion or cross-contamination, cross-connections, contamination by foreign substances during transfer to aircraft or inadequate plumbing conditions on board the aircraft. They signify the need to determine their cause and to take corrective actions so that the water on the aircraft is both potable and palatable.

7. Temperature
Cool water is generally more palatable than warm water, and temperature will impact on the acceptability of a number of other inorganic constituents that may affect taste. High water temperature enhances the growth of microorganisms and may increase taste, odour, colour and corrosion problems (WHO, 2004) (see also No. 4 above).

2.2.3 Guideline 2.3: Monitoring

Guideline 2.3—Critical water quality parameters are monitored.

Indicators for Guideline 2.3
1. Monitoring at airport water taps is carried out at locations to ensure that persons served by the airport are provided safe water. Recommended parameters that should be monitored at the entrance to the transfer point are *E. coli* or thermotolerant (faecal) coliforms, disinfectant residual, chemicals of acute significance, corrosion-related contaminants, turbidity and aesthetic parameters.
2. Monitoring at the transfer point takes place to ensure that water boarded on aircraft is safe. Recommended parameters that should be monitored at the transfer point to the aircraft (includes bowsers, trucks, carts, hoses, refillables) are *E. coli* or thermotolerant (faecal) coliforms, disinfectant residual and, if required, turbidity.
3. Monitoring on aircraft is carried out at locations to ensure that persons on board the aircraft are provided safe water. It is recommended that *E. coli* or thermotolerant (faecal) coliforms be monitored at representative taps (e.g. galley, lavatory, drinking fountains). The monitoring should take place at each major servicing, in addition to regular *E. coli* spot checks while in service. Complaints about aesthetic parameters (odour/colour/taste) will trigger further investigations into the water quality and may indicate the need to monitor for turbidity. Additional parameters to be monitored include chemicals of acute significance and corrosion-related contaminants. Disinfectant residuals are also measured after the aircraft has been disinfected and flushed.
4. All critical parameters are monitored at a sufficient frequency to ensure safe water.

Guidance notes for Guideline 2.3
In addition to the GDWQ or national standards applicable to a particular component of the water supply chain:

1. Monitoring at the airport
The piped water supply delivered to airports should be suitable for distribution and consumption without further treatment, except as necessary to maintain water quality in the distribution system (e.g. supplemental disinfection, addition of corrosion control chemicals). In the event of contamination of the water provided to the airport, the airport should complete corrective action and notify the party responsible for transfer of water to the aircraft as soon as possible so it can take mitigation measures or prevent the boarding of contaminated water on the aircraft. Documentation (recordkeeping) of monitoring should be kept for assurance and analysis in the event of an incident.

No *E. coli* or thermotolerant (faecal) coliforms should be detected in any 100-ml sample of the water. A positive test may be an indication of potential pathogenic (primarily bacterial) microorganisms associated with human excreta.

The presence of a measurable disinfectant residual contributes to assurance that the water is microbially safe for the intended use. The presence of the residual will be affected by the original dose, the disinfectant demand of the water, the type of disinfectant being utilized, the temperature, the time since application of the disinfectant and whether contamination has occurred since application of the disinfectant. Disappearance of a disinfectant residual may also indicate post-treatment contamination.

Provided that water entering the airport conforms to acceptable standards as described above, the principal concern for chemicals of acute significance would be nitrate/nitrite contamination at the airport from cross-connections with the liquid waste system and copper leaching.

Corrosion in plumbing systems is a function of the stability and aggressiveness of the water towards the surfaces and fixtures that the water will contact during transport and storage. Metals such as copper, lead and iron can be leached from some materials into the water and contribute adverse taste or, in some cases, health concerns.

Turbidity that increases in the airport could indicate that dirt has entered the system during the transfer.

Detection of aesthetic parameters (odour/colour/taste) may indicate cross-connections with the liquid waste system.

2. Monitoring at the transfer point

Potable water for aircraft, including bowsers, water trucks, water carts, filling stations and potable water cabinets, needs to be obtained only from those water sources and water supplies that provide potable water of a quality in line with the standards recommended in the GDWQ (WHO, 2004), especially in relation to microbial, chemical and physical requirements. In the event of contamination of water at the transfer point, the party responsible for transfer of water should notify the airline as soon as possible so it can take mitigation measures or prevent the boarding of contaminated water on the aircraft. Documentation (recordkeeping) of monitoring should be kept for assurance and analysis in the event of an incident.

No *E. coli* or thermotolerant (faecal) coliforms should be detected in any 100-ml sample of the water. A positive test may be an indication of potential pathogenic (primarily bacterial) microorganisms associated with human excreta.

The presence of a measurable disinfectant residual contributes to the microbial safety of water for the intended use. The presence of the residual will be affected by the original dose, the disinfectant demand of the water, the type of disinfectant being utilized, the temperature, the time since application of the disinfectant and whether subsequent contamination has occurred since application of the disinfectant. Disappearance of a disinfectant residual may also indicate post-treatment contamination.

Turbidity that increases in the aircraft water after transfer from the airport to the aircraft could indicate that dirt has entered the system during the transfer.

3. Monitoring on the aircraft

Potable water should be obtained from those transfer points approved by the competent authority. In the event of contamination of water on the aircraft, the airline should notify persons on board as soon as possible and take mitigation measures or arrange for an alternative water supply. Documentation (recordkeeping) of monitoring should be kept for assurance and analysis in the event of an incident.

No *E. coli* or thermotolerant (faecal) coliforms should be detected in any 100-ml sample of the water. A positive test may be an indication of potential pathogenic (primarily bacterial) microorganisms associated with human excreta.

Detection of aesthetic parameters (odour/colour/taste) may indicate cross-connections with the liquid waste system. On some aircraft, carbon filters are used to neutralize the chlorine in the drinking-water at the tap for taste purposes. On occasion, these are incorrectly described as purifying filters. If they are not serviced regularly, HPC growth will occur, and cartridges may disintegrate. Also, once the chlorine content has been removed, the water has no protection against bacteria introduced downstream from the filter. If used, such filters should therefore be fitted at each water outlet. Complaints about aesthetic parameters may indicate the need to monitor for turbidity or HPC and/or take corrective action. Turbidity that increases in the aircraft water after transfer from the airport to the aircraft could indicate that dirt has entered the system during the transfer.

The principal concern for acutely toxic chemicals in water on board the aircraft would be nitrate/nitrite contamination from cross-connections with the liquid waste system and copper leaching from the distribution system. Other metals, such as lead and iron, can also be leached from some materials into the water and contribute adverse taste or, in some cases, health concerns.

Disinfectant residual should also be measured after the aircraft has been disinfected and flushed as per the aircraft manufacturer's specifications with a test kit that is specific to the disinfectant and used as per the manufacturer's specifications. The disinfectant residual for chlorine (the most common disinfectant) should be no less than 0.2 mg/l and no more than 5 mg/l. Testing of the disinfectant residual should be done at the cold water faucet of galley(s), fountains and some lavatories and prior to the filters being reinserted, where applicable. Results should be recorded. Should the disinfectant residual be above 5 mg/l, the flushing process should be repeated and disinfectant residual remeasured and recorded. It should be noted that monitoring of water in lavatories may detect contamination from the surroundings rather than from the water per se.

4. Frequency of monitoring

Regular monitoring of each parameter is necessary to ensure that safe water quality is maintained, as each step in the water transfer chain provides an opportunity for contamination. Documentation (recordkeeping) of monitoring should be kept for assurance and analysis in the event of an incident.

In certain situations, the frequency of monitoring should be increased for a period necessary to determine appropriate corrective action and/or assurance that measured parameters have returned to safe levels. Examples of situations warranting increased monitoring are positive *E. coli* or thermotolerant (faecal) coliform results, excessively humid conditions, during or

after natural disasters affecting source water quality and immediately after maintenance activities that have the potential to affect water quality.

Aesthetic parameters such as odour, colour or taste are typically "measured" through customer complaints, although the crew may also wish to do an independent periodic check. This is a subjective parameter, as individuals have different sensitivities.

Some countries may request additional monitoring for parameters over and above those suggested by the GDWQ within their jurisdiction for operational or regulatory reasons. Airports, water haulers and aircraft operators should verify with their local competent authority if additional monitoring is required and what parameters the competent authority within their jurisdiction is requesting. These should be included in the WSP.

2.2.4 Guideline 2.4: Corrective action

Guideline 2.4—Appropriate response is ensured when the water safety plan is not properly implemented or a public health risk is detected.

Indicators for Guideline 2.4

1. Investigative action and response procedures are established and documented.
2. Investigative action and response procedures are implemented in a timely manner.
3. Follow-up is performed to ensure that corrective action was effective and water quality is no longer of concern.

Guidance notes for Guideline 2.4

1. Establishment and documentation of procedures

Investigative action and response could be as basic as reviewing records or could include more comprehensive corrective action. Corrective action should involve remedying any mechanical, operational or procedural defect in the water supply system that has led to guideline values being exceeded or when other improper practices are suspected. In the case of mechanical defects, remedies should include maintenance, upgrading or refurbishment of facilities. In the case of operational defects, actions should include changes to supplies and equipment. In the case of procedural defects, such as improper practices, standard operating procedures and training programmes should be evaluated and changed, and personnel should be retrained. Any such changes should be incorporated accordingly into the WSP.

When there is evidence of contamination, appropriate action should be taken immediately to eliminate the public health threat of such contamination. Appropriate action may include additional treatment or flushing and disinfection of transfer equipment or aircraft water tanks.

In addition, emergency/contingency actions may need to be taken, such as the provision of water from alternative sources. During periods when corrective action is being taken, increased monitoring may be advisable.

2. Implementation of procedures

Investigative action and response could be as basic as reviewing records or could include more comprehensive corrective action. Oversight should be provided to ensure that corrective actions are implemented in accordance with written procedures and quickly enough to

minimize exposure of the travelling public, employees, visitors, etc. Such oversight could be performed by the responsible party for that segment of the supply chain or by an independent party, such as a regulatory authority.

3. Verification of procedures
Verification steps should be adequate to provide assurance that water quality has been restored to safe levels. At a minimum, monitoring as described in Guideline 2.3 should be performed.

2.2.5 Guideline 2.5: Water quantity

Guideline 2.5—Potable water is available in sufficient quantities, pressures and temperatures for all uses at the airport, at the water transfer points and on the aircraft.

Indicators for Guideline 2.5
1. Potable water quantities at the airport are sufficient to ensure adequate pressure at all taps to minimize the potential for contamination.
2. Potable water quantities at transfer points are sufficient to ensure adequate pressure to minimize the potential for contamination and to replenish water supplies on board aircraft.
3. Potable water quantities on board aircraft are sufficient to meet foreseeable needs for consumption, cooking and cleaning (e.g. food preparation, sanitation and hygiene activities) and to achieve sufficient water pressure at each tap to minimize the potential for contamination.

Guidance notes for Guideline 2.5
The amount of water required for all purposes on board an aircraft should be adequately dealt with in typical passenger aircraft designs. Quantities of water at all points in the water supply and transfer chain also need to be sufficient to ensure adequate water pressure in order to minimize the potential for contamination.

1. Water quantity at the airport
To achieve minimum pressures, a variety of water pumps or air pressure is used, while pressure-reducing valves are used when the system pressure is too great for the application.

2. Water quantity at transfer points
To achieve minimum pressures, a variety of water pumps or air pressure is used, while pressure-reducing valves are used when the system pressure is too great for the application.

3. Water quantity on the aircraft
Water supplies on aircraft must be sufficient to operate sanitary systems on the aircraft (e.g. vacuum toilet bowl rinsing rings). Additionally, food service fixtures, coffee makers, drinking taps and hand-washing sinks in the lavatories must have sufficient supply under adequate pressure to operate as designed. Water supply tanks on aircraft must be correctly sized and pressurized for these systems to work and serve passengers and crew, and they must be filled with sufficient frequency that meets expected use.

Water at sufficient pressure is required to operate fixtures and equipment on the aircraft. Most fixtures are rated to operate at certain minimum/maximum pressures. To achieve minimum pressures, a variety of water pumps or air pressure is used, while pressure-reducing valves are used when the system pressure is too great for the application.

2.2.6 Guideline 2.6: Independent surveillance

Guideline 2.6—Independent surveillance of drinking-water safety is performed by a competent authority.

Indicators for Guideline 2.6

1. Audit/inspection procedures are put in place by a competent authority.
2. Documentation of a water safety plan and its implementation are reviewed, and feedback is provided.
3. An independent competent authority responds following reports of incidents with the potential to adversely affect public health.

Guidance notes for Guideline 2.6

Aviation water quality surveillance is an ongoing investigative activity undertaken to identify and evaluate potential health risks associated with the use and consumption of potable water in airports and on board aircraft. Surveillance contributes to the protection of public health by promoting the improvement of the quality, quantity, accessibility and continuity of potable water supplies. This guideline addresses surveillance of these factors only and does not address surveillance relating to monitoring of or response to outbreaks or other disease events (i.e. public health surveillance).

The levels of surveillance of drinking-water quality differ widely, just as economic development and provision of community water supplies vary. Surveillance should be developed and expanded progressively, by adapting the level to the local situation and economic resources, with gradual implementation, consolidation and development of the programme to the level ultimately desired. When accepting a WSP, the competent authority in a given jurisdiction may take responsibility for surveillance of the programme, which may include performing random water sampling and the auditing of the WSP programme.

Although this guideline addresses surveillance by oversight authorities, many of the concepts discussed here could be employed by the water supplier to ensure that the WSP is being implemented effectively.

1. Establishment of procedures

In most cases, surveillance consists primarily of sanitary inspections based on the WSP of airports, transfer points or airlines. Sanitary inspection is a tool for determining the state of the water supply infrastructure and the identification of actual or potential faults and should be carried out on a regular basis.

A surveillance agent should have the authority to conduct independent inspections and verify the reliability of the supplier's information. This does not normally need to be as frequent as the continuous control performed by airports/airlines.

Surveillance should be accomplished by authorized and trained officers from public health authorities, or the services of qualified independent auditors and inspectors may be utilized.

Specifications for qualifications of the inspectors should be established, and inspectors should undergo adequate training, including periodic updates and recertification. Independent auditors and inspectors should meet the same requirements as those from the public health authorities.

Annex D provides an example of a format that can be used by on-site inspectors in evaluating the sanitation status of the airline service area or transfer point. It can be adapted to specific circumstances and situations that may exist in various countries and airports.

2. Review of documentation and plan implementation

WSPs should be provided by the airport authority, water haulers (transfer points) and airlines, and all documentation pertaining to the WSPs should be reviewed. The independent review of the WSPs should include a systematic approach, based upon the components of the WSPs, by external auditing of the documentation, implementation and monitoring of critical control points.

Some of the components of the independent review include inspection of employee personal hygiene through demonstration of employees following procedures, inspections and the recording of these inspections of equipment and environmental conditions to ensure that dedicated equipment is used and stored in sanitary conditions, and water sampling through on-site or laboratory tests. Periodic microbiological surveillance of the entire water supply system from the source to the aircraft's galley and lavatory taps or fountains should be a key priority because of the acute risk to health posed by pathogens in contaminated drinking-water. Verification of compliance with water standards should start at the source and extend throughout the water distribution system. Each water point source, transfer point/critical point in the distribution system and end-point should be monitored. If this is not possible, at a minimum end-points should be monitored, but it should be possible to trace back when an unsatisfactory result is found.

Inspection of procedures or control systems should be adequate to provide assurance that responsible parties in the water supply chain are able to implement timely corrective measures. Supporting programmes should be reviewed to ensure that management procedures and training are adequate to ensure a safe supply of water.

Risk communication procedures by and to the water supplier, airport authority, water haulers (transfer points), airlines and the public should also be reviewed. A notification system should be established that integrates all parties within the water supply and transfer chain.

3. Response to incidents

Response to incidents may include written reports from the responsible party or parties or independent inspectors or written or verbal reports from affected individuals or their representatives.

The competent authority should investigate reports of incidents by interviewing reporters, responsible parties and other affected individuals and independently verifying water quality and relevant process parameters (maintenance checklists, training records, etc.) through on-site inspections and other means.

The competent authority should coordinate with and advise the responsible parties on appropriate corrective actions (modifications to water safety, management, training and maintenance plans, notification of potentially affected individuals, etc.) and ensure that remedial action plans are effective and implemented and that completion is verified.

3. CLEANING AND DISINFECTION OF FACILITIES

3.1 Background

This chapter covers cleaning and disinfection procedures for both airports and aircraft.

Cleaning refers primarily to the removal of visible dirt or particles; however, the cleaning process and some products used for cleaning also result in disinfection. Cleaning is normally undertaken on a routine and frequent basis. In this chapter, the primary process of removal of visible dirt and particles is referred to as "cleaning", even if some disinfection occurs at the same time.

Disinfection refers to specific measures taken to control, deactivate or kill infectious agents, such as viruses and bacteria. Disinfection is normally undertaken on an infrequent basis, during periodic maintenance checks or after a public health event, such as the suspected carriage of an infectious passenger. Disinfection is usually preceded by cleaning of the affected area, and this is assumed to occur when "disinfection" is referred to in this chapter.

In 2006, over 2 billion passengers were carried by airlines operating scheduled flights (ICAO, 2006). This fact indicates that commercial air transport is potentially an efficient means for spreading communicable disease widely by surface contact and proximity to infected persons.

Possible routes of infection transmission that might occur on board aircraft fall into three categories:
1. directly inhaled respiratory droplets, suspended airborne particles, or both;
2. direct contact with faecal matter, blood or other body fluids;
3. contact with respiratory secretions, faecal matter or body fluids deposited on surfaces or, for maintenance crews, entrained in ventilation systems.

The main source of infection for other travellers is from an infected person, and proximity to an infected person is an important risk factor for airborne infection. Once an infected person has left the scene, most of the risk from droplet exposure will have been removed. The residence time of suspended airborne particles may be longer and will depend on the particles' mass and on the ventilation rate/air circulation patterns in the cabin (ANSI/ASHRAE, 2008).

Airborne exposure aside, there is a concern that the agent of disease (pathogen) can remain in the airport or aircraft environment by contaminating common surfaces (e.g. fomites) after the infected traveller has departed. However, the guidance in this chapter is directed primarily at the second and third possible routes of transmission. The cause of illness for an individual traveller may not be known immediately and possibly not for some time afterwards; in many cases, the diagnosis may never be known. This guidance therefore adopts a "universal precaution" approach that treats all respiratory secretions, faeces, blood and other body fluids as potentially infectious.

Sometimes, a case of communicable disease is known only several days (or longer) after the infected person has travelled and may have deposited pathogens on surfaces in the airport or on the aircraft. The risk of infection upon contact with such contaminated surfaces will depend on the viability of the organism, the number of organisms, whether the surface has been properly cleaned and/or disinfected, whether the pathogen is touched and transferred

and also the susceptibility of the traveller. Frequent hand washing reduces the risk. As time passes and as a result of routine cleaning activities, the risk that any transmissible pathogens remain in place reduces, even without specific disinfection procedures.

There may be epidemiological information available to guide the public health response, such as an outbreak occurring at the origin of the flight (e.g. the 2003 episode of SARS). In such instances, public health experts recommend specific measures targeted at a particular pathogen.

To reduce the risk of transfer of pathogens from an infected person to others via surfaces or inanimate objects on the aircraft or in the airport, it is necessary for aircraft and airport operators and ground handling agents to have a coordinated plan in place to deal with the arrival of an affected[1] aircraft having carried such a traveller or the presence of a person with a communicable disease in the airport. For aircraft, the plan needs to take into account the unusual features of the aircraft cabin in comparison with a ground-based facility. For airports, the plan should address the challenge of managing potential contamination in a large public space, such as the terminal building. Such plans should also address potential contamination of an aircraft or airport with an infectious agent that is not transmitted person to person. Considering that it may be difficult to identify an aircraft carrying an infected person, the focus should be on (a) the assumption that all aircraft are periodically occupied by infected travellers and therefore require routine and frequent cleaning and disinfection and (b) the fact that certain events (e.g. persistent coughing on board) may increase the risk of disease transmission and that such incidents should be investigated so that, if a case of communicable disease is suspected, it leads to specific disinfection measures.

Disinfectants tend to be oxidizers, and the interior of an aircraft contains many materials susceptible to damage from cleaning products and disinfectants. Metals used in the construction of the aircraft may corrode upon exposure to such products, safety-critical cables and wires may deteriorate on exposure and aircraft furnishings may have their fire resistance properties reduced. It is therefore necessary to exercise caution in selecting suitable products and before applying these products in aircraft. It is important to protect the health of the cleaning personnel and to ensure effective action; therefore, manufacturer's instructions must be followed carefully.

It is essential to provide a hygienic environment for travellers. Areas where food is prepared, stored and served, any surfaces commonly touched by people and washroom facilities, among others, should be kept free from contaminants that might compromise human health, even when there is no identified outbreak of disease. Prevention or mitigation of disease transmission is the goal. Hygienic conditions also minimize the likelihood of infestation by rodents, as vectors of disease.

3.1.1 International Health Regulations (2005)

According to the IHR (2005), States (competent authorities) must ensure, to the extent practicable, that traveller facilities at their international airports and on aircraft are kept free of sources of infection and contamination. In addition, capacity to adopt control measures, such as cleaning and disinfection, should be in place, with oversight by the competent authority, to prevent the spread of disease and its agents at airports and on aircraft.

[1] An affected aircraft refers to one that carries sources of infection or contamination, so as to constitute a public health risk (see IHR (2005) Definitions). Aircraft affected due to criminal activity are outside the scope of the Guide.

If indications of a public health risk, including sources of infection and contamination, are found on board an international aircraft, the aircraft may be required to undergo health measures, such as disinfection, disinsection or decontamination, as appropriate, that are necessary to control risk and to prevent spread of disease (Article 27).

Health measures "shall be carried out so as to avoid injury and as far as possible discomfort to persons, or damage to the environment in a way which impacts on public health, or damage to baggage, cargo, containers, conveyances, goods or postal parcels" (Article 22) and "initiated and completed without delay, and applied in a transparent and non-discriminatory manner" (Article 42).

3.1.2 Critical aspects and rationale of cleaning and disinfection programmes

The critical aspects of cleaning and disinfection programmes include the availability of cleaning schedules and procedures for timely and effective airport and aircraft routine cleaning by designated personnel; procedures for disinfecting after an event; effective cleaning and disinfecting agents that are not detrimental to aircraft materials; appropriate personal protective equipment; and adequate training for designated personnel.

There are several reasons why cleaning and disinfection programmes are critical to ensuring a sanitary environment in airports and on aircraft, which, in turn, ensures that air travellers are exposed to minimum risk. Schedules and procedures for routine, effective airport and aircraft cleaning (and disinfection measures in higher-risk areas, when necessary) are vital in maintaining a hygienic environment. The availability of procedures for disinfecting after an event[1] is also critical, as body fluids, such as respiratory secretions, blood, vomit and faeces, may contain infectious agents that could be transmitted, if not properly contained.

Cleaning and disinfection on aircraft require special attention, as it is necessary to use agents that are not corrosive or otherwise detrimental to aircraft components. For this reason, not all effective cleaning and disinfecting agents can be used in the aircraft cabin.

Cleaning crews[2] need to be adequately trained so they understand and respect the procedures that will ensure effectiveness of the cleaning and disinfecting agents, use the proper personal protective equipment, prevent contamination of other areas and minimize occupational health and safety risks to personnel.

Unlike the routine procedure, post-event disinfection is not a frequent practice, and the requirements are likely to differ. It is therefore particularly important that the training emphasizes these "event-driven" procedures for the cleaning crew, because they will not be as familiar as routine cleaning procedures.

As noted above, competent authorities have responsibilities to ensure that international airports and aircraft are kept free of sources of infection and contamination (Article 22.1(a,b,c,d,e,g)). The competent authority needs to exercise oversight over cleaning and disinfection programmes so that its obligations under the IHR (2005) are fulfilled. Under the IHR (2005), the competent authorities are responsible for supervising service providers

[1] An "event" means a "manifestation of disease or an occurrence that creates a potential for disease" (IHR (2005), Article 1). This may include, for example, the presence in an airport, or carriage by air, of a suspected case of communicable disease.

[2] "Cleaning crew" refers to designated personnel that may undertake cleaning and/or disinfection.

relating to travellers, baggage, cargo, containers, conveyances and goods at points of entry, including with inspections and medical examinations, as necessary. They are also responsible for supervision of disinfection, disinsection and decontamination of conveyances, as well as baggage, cargo, containers and goods under the IHR (2005). Finally, they are responsible for the supervision of the removal and safe disposal of any contaminated water or food, human or animal dejecta, wastewater and any other contaminated matter from a conveyance (Article 22.1(c,e–f)). In the context of conveyances (as well as baggage, cargo and goods) arriving from affected areas, the competent authorities are responsible for monitoring them so that they are free of sources of infection or contamination (Article 22.1(a)).

3.2 Guidelines

This section provides user-targeted information and guidance, identifying responsibilities and providing examples of practices that can control risks. Six specific **Guidelines** (situations to aim for and maintain) are presented, each of which is accompanied by a set of **Indicators** (measures for whether the guidelines are met) and **Guidance notes** (advice on applying the guidelines and indicators in practice, highlighting the most important aspects that need to be considered when setting priorities for action).

3.2.1 Airports: Routine cleaning and disinfection

3.2.1.1 Guideline 3.1: Sanitary condition of airports

Guideline 3.1—Airports are kept in a sanitary condition at all times.

Indicators for Guideline 3.1

1. A documented, tested and updated routine cleaning programme exists, ensuring that premises are regularly and hygienically cleaned.
2. An appropriate number of trained personnel are available, in relation to the volume and complexity of the airport facilities and cleaning procedures.
3. Personal protective techniques and equipment are used by personnel: related equipment and information (operational procedures for its use) are available.
4. Cleaning equipment and supplies are available in relation to the volume and complexity of the airport facilities and cleaning procedures.
5. Cleaning equipment is properly identified and satisfactorily maintained and stored in a designated storage area.

Guidance notes for Guideline 3.1

Several aspects of routine cleaning should be taken into account:

- Programmes for routine cleaning should take into account the volume of passengers (e.g. peak periods, heavily used areas) and the complexity of activities at the airports (e.g. hair salons and spas, food establishments and washroom facilities) and personnel using the terminal and other facilities.
- Airport operators should be prepared to adjust their routine cleaning programmes if a public health risk is detected and/or if advised to do so by public health authorities.
- The routine cleaning programme should be conducted by, or be under the oversight of, the competent authority.

- During high-volume periods within the airport, increased frequency of cleaning should be considered to remove excessive accumulation of waste and debris resulting from the increased use of the airport facilities, especially washrooms.
- Precautionary cleaning, including the use of disinfectant products, of certain targeted areas of the airport may be advised if diseases of concern (e.g. norovirus or cholera) are prevalent in the airport community or at the departure points of a significant number of travellers.
- A routine cleaning programme should consider aspects that are specific to particular areas of an airport. Guidance can be found in Annex E.
- A routine cleaning programme should be periodically reviewed and updated, as needed.

3.2.1.2 Guideline 3.2: Design and construction of airports

Guideline 3.2—Airports are designed and constructed in a manner that facilitates proper cleaning and disinfection.

Indicator for Guideline 3.2

1. Facilities are designed and constructed of suitable materials (e.g. impervious, smooth and without seams) to facilitate cleaning and to reduce the risk of harbouring insects, rodents and other vectors.

Guidance notes for Guideline 3.2

Several aspects of airport design and construction should be taken into account:

- Proper design will minimize the amount of accumulated debris and waste and reduce opportunities for survival of vectors and reservoirs of disease, such as rodents and insects.
- Washrooms designed without doors and with automatic faucets (taps) using "electronic eyes" (which automatically control the flow of the water to the faucet) are preferable, as they will reduce contact with hands/fingers.
- Providing paper wipes for hand drying will reduce the risk of cross-contamination, especially when dispensed using "electronic eyes" (hand dryers can promote spread of pathogens).

3.2.2 Airports: Disinfection after an event

3.2.2.1 Guideline 3.3: Post-event disinfection procedures for airports

Guideline 3.3—Post-event disinfection procedures are in place to prevent the spread of disease and contain contamination at the source.

Indicators for Guideline 3.3

1. Standard operating procedures are documented and in place for timely disinfection after an event, according to technical requirements, and are subject to periodic revision based on emerging evidence of efficacy.
2. An appropriate number of trained personnel are available, in relation to the volume and complexity of the airport facilities and need for post-event cleaning/disinfection procedures.

3. Personal protective equipment and techniques are used by personnel, and related equipment and information (operational procedures for its use) are available.
4. Adequate equipment and supplies are available in relation to the volume and complexity of the airport facilities and disinfection procedures that may be needed after an event.
5. Disinfecting equipment is identified, properly maintained and stored in a designated storage area for post-event use.

Guidance notes for Guideline 3.3

1. Standard operating procedures

The disinfection procedure for flat surfaces (e.g. floors, tables, sinks) should be as follows:

- If required, control pedestrian traffic through the area by directing people away from the site, posting a sign or putting up barrier tape.
- Put on protective gloves.
- Wear eye protection if a danger from splashing exists.
- Prepare the sanitizing solution of bleach according to product specifications.
- Open a biohazard bag, and put it near the spill site. If a biohazard bag is not available, label the regular waste bag as "biohazard".
- Using paper towels or an absorbent material, clean up the soiled material and excess liquid and place into the biohazard bag.
- Change gloves if they become visibly soiled.
- Clean the area (remove solids and soak up liquid waste). Pour detergent solution around the spill site, and use paper towels to move the liquid into the dirty area. Once the area is wet, use the paper towels to clean the area and discard into the biohazard bag.
- Cover the site with clean paper towels, and pour the bleach solution onto the paper towels. Wait an appropriate time, as indicated in the product instructions.
- Remove the paper towels to the biohazard bag.
- Rinse with water, and dry the surface. Put all paper towels into the biohazard bag.
- Remove gloves, and place them into the biohazard bag.
- Seal used biohazard bag, and ensure proper transport and final disposal.
- Wash hands.

3. Personal protective equipment

Those responsible for cleaning up vomit, human excreta and other potentially infectious materials should protect themselves with appropriate personal protective equipment, such as gloves and protective clothing, according to standard operating procedures.

4. Equipment and supplies

The following materials should be preassembled in a spill cleanup kit:

- garbage bags and masking tape;
- disposable gloves;
- eye protection;
- mop;
- paper towel and/or absorbent material;
- detergent solution;
- water;
- sanitizing agent, such as bleach tablets (Presept, 0.5 g sodium dichloroisocyanurate tablets) or 5% domestic liquid bleach;
- signs, barrier tape (optional).

3.2.3 Aircraft: Routine cleaning and disinfection

3.2.3.1 Guideline 3.4: Sanitary condition of aircraft

Guideline 3.4—Aircraft are kept in a sanitary condition at all times.

Indicators for Guideline 3.4

1. A documented, tested and updated routine cleaning programme is available, ensuring that aircraft are regularly and hygienically cleaned.
2. An appropriate number of trained personnel are available, taking into account cleaning procedures, the type of aircraft (e.g. passenger or cargo), the aircraft size and the ground time (stopover time) of the aircraft.
3. Personal protective techniques and equipment are used by personnel, and related equipment and information (operational procedures for its use) are available.
4. Cleaning equipment and supplies are available, taking into account the type (e.g. passenger or cargo), size and ground time (stopover time) of aircraft and cleaning procedures.
5. For aircraft safety and to protect aircraft equipment, the operator's engineering department is consulted on cleaning procedures and agents used.

Guidance notes for Guideline 3.4

1. Routine cleaning programme

The following factors should be considered when designing a programme for routine cleaning:

- Programmes for routine cleaning should take into account the type (e.g. passenger or cargo), size and ground time (stopover time) of aircraft.
- An example of an aircraft routine cleaning schedule can be found in Annex F; the physical areas for which cleaning is specified in Annex F should be so included in the aircraft operator's cleaning programme.
- Aircraft operators should be prepared to adjust their routine cleaning programmes if a public health risk is detected and/or if advised to do so by public health authorities.
- Information concerning aircraft cleaning and disinfection should be available to those concerned, upon request.
- Precautionary cleaning of certain targeted areas of the aircraft, including the use of disinfectant products, may be advised by the public health authority if certain diseases of concern (e.g. norovirus or cholera) are prevalent at the departure points.

5. Cleaning procedures and agents

The operator's engineering department provides a technical review of each cleaning and disinfecting product used, based on manufacturer's recommendations (approved products are normally listed in the aircraft maintenance manual). The use of methods and materials recommended by the operator's engineering department should be mandatory, and public health authorities should consider the aviation aspects when developing specific national standards and technical guidance, to avoid safety-related issues.

3.2.3.2 Guideline 3.5: Design and construction of aircraft

Guideline 3.5—Aircraft are designed and constructed in a manner that facilitates proper cleaning and disinfection.

Indicator for Guideline 3.5

1. Aircraft interiors are designed and constructed of suitable materials (e.g. impervious, smooth and without seams) to facilitate cleaning and to reduce the risk of harbouring insects, rodents and other vectors.

Guidance notes for Guideline 3.5

1. Design and construction of aircraft interiors

Several aspects of aircraft design and construction should be taken into account:

- Proper design will minimize the amount of accumulation of debris and waste and reduce opportunities for survival of vectors and reservoirs of disease, such as rodents and insects.
- Lavatories designed with automatic faucets (taps) using "electronic eyes" (that automatically control the flow of the water to the faucet) will reduce contact with hands/fingers.
- Provide disposable paper wipes for hand drying to reduce the risk of cross-contamination.

3.2.4 Aircraft: Disinfection after an event

3.2.4.1 Guideline 3.6: Post-event disinfection procedures for aircraft

Guideline 3.6—Aircraft disinfection procedures are in place to prevent the spread of disease and contain infection and contamination at the source.

Indicators for Guideline 3.6

1. Standard operational procedures are documented and in place for timely application of disinfection procedures, according to technical requirements, and are subject to periodic revision based on emerging evidence of efficacy.
2. An appropriate number of trained personnel are available, taking into account the type (e.g. passenger or cargo), size and ground time (stopover time) of aircraft and disinfection procedures.
3. Personal protective equipment and techniques are used by personnel, and related equipment is available.
4. Disinfection equipment and supplies are available, taking into account the type (e.g. passenger or cargo), size and ground time (stopover time) of aircraft and disinfection procedures.

Guidance notes for Guideline 3.6

In general, routine cleaning of contaminated surfaces with soap or detergent and water (after use of a spill cleanup kit, if necessary) to remove soil and organic matter, followed by the proper use of disinfectants to inactivate any remaining organisms, constitutes effective environmental management of suspected agents. Reducing the number of infectious agents on a surface by these steps minimizes the chances of transferring them via contaminated hands. The agents that cause the communicable diseases of public health concern are susceptible to

inactivation by a number of chemical disinfectants readily available from consumer and commercial markets. However, care must be taken when using disinfectants on board aircraft because of the potentially harmful effects of such agents on aircraft components. The recommended attributes for post-event aircraft disinfectants are listed in Annex G.

Only disinfectants (including detergent/disinfectants) that are nationally approved for use on aircraft against any of the agents of concern *and* that have been approved by the original equipment (aircraft) manufacturer should be used.

Body fluids/substances (e.g. vomit from the ill traveller) should first be taken up from overtly contaminated surfaces by using an absorbent material, which should then be disposed of. Large areas contaminated with body fluids/substances (e.g. covering most of a tray table) should be treated with disinfectant after removal with absorbent material, then cleaned and given a final disinfection. Since disinfectants are not registered for use on porous surfaces, seat covers and carpeting with a significant contaminated area should be removed carefully, placed in a labelled, sealed plastic bag and laundered in accordance with the manufacturer's instructions, or they should be destroyed. In case of seat contamination that has penetrated the seat cover, the underlying seat upholstery may need to be removed for adequate disinfection.

1. Standard disinfection procedures

A disinfection procedure should include the following steps:

- Put on protective gloves.
- Wear eye protection if a danger from splashing exists.
- Open a biohazard bag, and place it near the site of contamination. If a biohazard bag is not available, label a regular waste bag as "biohazard".
- The following surfaces should be cleaned and then disinfected at the seat of the suspected case(s), adjacent seat(s) in the same row, adjacent row(s) and other areas, as noted below:
  - Seat area
    - armrests
    - seatbacks (the plastic and/or metal part)
    - tray tables
    - seatbelt latches
    - light and air controls, cabin crew call button and overhead compartment handles
    - adjacent walls and windows
    - individual video monitor
  - Lavatories
    - lavatory or lavatories used by the sick traveller: door handle, locking device, toilet seat, faucet (tap), washbasin, adjacent walls and counter.
- Clean the area of soil (remove solids and soak up liquid waste). Apply the disinfectant (see below) according to procedures approved by the original equipment manufacturer and as instructed on the disinfectant manufacturer's label. Once the area is wet, use paper towels to clean the area, and discard paper towels into the biohazard bag.
- Use a suitable disinfectant. Studies of hydrogen peroxide–based disinfectants containing additives such as surfactants and chelators have shown good results in scientific studies, and some industries already using these products are reporting excellent results. Ethanol has also been found to be an effective and suitable disinfectant for aircraft. However, other materials could be considered if they are approved or registered for surface disinfection and sanitization on aircraft by an appropriate government or independent organization.

- Ensure adequate contact time between the disinfectant and the surface for destruction of microorganisms. Adhere to any safety precautions as directed (e.g. ensure adequate ventilation in confined areas such as lavatories, and avoid splashing or generating unintended aerosols).
- Change gloves that become visibly soiled.
- Remove any affected portion of carpet.
- Rinse the surface with water, and dry. Put all paper towels into the biohazard bag.
- Remove gloves, and place them into the biohazard bag.
- Seal the used biohazard bag, and ensure its proper transport and final disposal.
- When cleaning and disinfecting are complete and gloves have been removed, immediately clean hands with soap and water or an alcohol-based hand rub. Avoid touching the face with gloved or unwashed hands.
- Do not use compressed air and/or water under pressure for cleaning, or any other methods that can cause splashing or might reaerosolize infectious material. Vacuum cleaners should be used only after proper disinfection has taken place.
- Operation of the aircraft's environmental control system at least until the suspect traveller has disembarked or until the disembarkation process is complete may also contribute to interrupting transmission of infectious material and should be performed if consistent with safety factors. Otherwise, ventilation should be provided from a ground source.

3. Personal protective equipment

Those responsible for cleaning up vomit, human excreta and other potentially infectious materials should protect themselves with appropriate personal protective equipment, such as gloves and protective clothing, according to standard operating procedure requirements.

4. Disinfection equipment and supplies

The following materials should be preassembled in a spill cleanup kit:

- biohazard bags; if a biohazard bag is not available, label the regular waste bag as "biohazard";
- disposable gloves (non-latex materials to avoid risk of allergic reaction can be considered);
- eye protection;
- paper towels;
- detergent solution;
- water;
- disinfectant;
- signs as necessary to isolate the area.

Note: For the duration of the flight, used airsickness bags should be stored in the waste bin of one lavatory. They should not be flushed down the toilet, and a notice to this effect should be placed in the lavatory. They should be removed from the aircraft by the toilet servicing team and disposed of along with the aircraft toilet wastes. If a specific receptacle is used on the aircraft for storage of used airsickness containers, it should be thoroughly cleaned, washed and disinfected after each use and treated in the same manner as portable toilet containers.

REFERENCES

ANSI/ASHRAE (2008). *ANSI/ASHRAE Standard 161-2007: Air quality within commercial aircraft*. Washington, DC, American National Standards Institute; Atlanta, GA, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

FAO/WHO (2001). *General standard for bottled/packaged drinking waters (other than natural mineral waters)*. Rome, Food and Agriculture Organization of the United Nations; Geneva, World Health Organization; Codex Alimentarius Commission (CODEX STAN 227-2001; http://www.codexalimentarius.net/web/more_info.jsp?id_sta=369).

ICAO (2006). *Annual report to the Council*. Montreal, Quebec, International Civil Aviation Organization (Document No. 9876).

Lee SC et al. (2000) *Questionnaire survey to evaluate the health and comfort of cabin crew. Air quality and comfort in airliner cabins*. West Conshohocken, PA, American Society for Testing and Materials.

McMullan R et al. (2007). Food-poisoning and commercial air travel. *Travel Medicine and Infectious Disease*, 5(5):276–286.

Peffers ASR et al. (1973). *Vibrio parahaemolyticus* gastroenteritis and international air travel. *Lancet*, 1(7795):143–145.

Stroud MA et al. (1992) *Physiological and psychological effects of 24-hour exposure to a low humidity environment.* Farnborough, Royal Air Force Institute of Aviation Medicine, May (IAM Report No. 705).

Turner AC (1971). Food poisoning. *Practitioner*, 206:615–621.

USEPA (2008). National Primary Drinking Water Regulations: Drinking water regulations for aircraft public water systems. Washington, DC, United States Environmental Protection Agency. *Federal Register*, 73(69):19320.

USFDA (1995). *Guide to inspections of interstate carriers and support facilities*. Washington, DC, United States Food and Drug Administration, Office of Regulatory Affairs (http://www.fda.gov/ora/inspect_ref/igs/icsf.html).

WHO (1960a). *Hygiene and sanitation in aviation: First report of the expert committee*. Geneva, World Health Organization (WHO Technical Report Series, No. 174).

WHO (1960b). *Guide to hygiene and sanitation in aviation*. Geneva, World Health Organization.

WHO (1969). *International Health Regulations (1969).* Geneva, World Health Organization (third annotated edition available at http://whqlibdoc.who.int/publications/1983/9241580070.pdf).

WHO (1977). *Guide to hygiene and sanitation in aviation*, 2nd ed. Geneva, World Health Organization (http://libdoc.who.int/hq/pre-wholis/a43045_(p1-p96).pdf and http://libdoc.who.int/hq/pre-wholis/a43045_(p97-p170).pdf).

WHO (2004). *Guidelines for drinking-water quality*, 3rd ed. Geneva, World Health Organization (http://www.who.int/water_sanitation_health/dwq/gdwq3rev/en/index.html).

WHO (2005). *International Health Regulations (2005).* Geneva, World Health Organization (http://www.who.int/csr/ihr/en/).

WHO (2008a). *Tuberculosis and air travel: Guidelines for prevention and control*, 3rd ed. Geneva, World Health Organization (http://www.who.int/tb/features_archive/aviation_guidelines/en/).

WHO (2008b). Mode of travel: Health considerations. In: *International travel and health*. Geneva, World Health Organization (http://www.who.int/ith/chapter_2a_2008.pdf).

WHO (2009). *Water safety plan manual: Step-by-step risk management for drinking-water suppliers*. Geneva, World Health Organization.

FURTHER READING

Some relevant supporting documents to the WHO *Guidelines for Drinking-water Quality* (in support of chapter 2 of this Guide) include the following:

Health Aspects of Plumbing
This publication describes the processes involved in the design, installation and maintenance of effective plumbing systems and recommends effective design and installation specifications as well as a model plumbing code of practice. It also examines microbial, chemical, physical and financial concerns associated with plumbing and outlines major risk management strategies that have been employed, as well as the importance of measures to conserve supplies of safe drinking-water.
Published in 2006 by WHO; available at:
http://www.who.int/water_sanitation_health/publications/plumbinghealthasp/en/

Safe Piped Water: Managing Microbial Water Quality in Piped Distribution Systems
The development of pressurized pipe networks for supplying drinking-water to individual dwellings, buildings and communal taps is an important component in the continuing development and health of many communities. This publication considers the introduction of microbial contaminants and growth of microorganisms in distribution networks and the practices that contribute to ensuring drinking-water safety in piped distribution systems.
Published in 2004 by WHO; available at:
http://www.who.int/water_sanitation_health/dwq/924156251X/en/

Water Safety Plans: Managing Drinking-water Quality from Catchment to Consumer
The improvement of water quality control strategies, in conjunction with improvements in excreta disposal and personal hygiene, can be expected to deliver substantial health gains in the population. This document provides information on improved strategies for the control and monitoring of drinking-water quality.
Published in 2005 by WHO; available at:
http://www.who.int/water_sanitation_health/dwq/wsp0506/en/

Water Treatment and Pathogen Control: Process Efficiency in Achieving Safe Drinking-water
This publication provides a critical analysis of the literature on removal and inactivation of pathogenic microbes in water to aid the water quality specialist and design engineer in making decisions regarding microbial water quality.
Published in 2004 by WHO; available at:
http://www.who.int/water_sanitation_health/dwq/watreatment/en/

Other published documents or documents in preparation may be found on the WHO Water, Sanitation and Hygiene web site at: http://www.who.int/water_sanitation_health/en/

ANNEX A: Example of a water safety plan for an airport

Water Safety Plan – Airport

1) Statement of goal(s)/objective(s)/purpose of WSP

2) Jurisdictional requirements to follow
   - Acts/statutes
   - Regulations
   - Standards
   - Guidelines

3) Organization
   - Define roles and responsibilities
     - Who has overall responsibility for WSP?
     - Who does what? What department/section is responsible for each part of the plan?
   - Define stakeholders – internal/external, and their roles and responsibilities within the plan
     - Water provider to airport – may be public or private
     - Airline operators
     - Water haulers
     - Airport food establishments
     - Responsible government authority
     - Who has responsibility/ownership of transfer points for aircraft, water haulers, etc.?

4) Operational plan
   - Planning, performing work, checking if work plan is working and continual assessment to improve the plan
     - Conduct a sanitary survey, including baseline sampling for chemical and physical parameters, etc.
     - Prepare and create documents for traceability; set up proper recordkeeping for all facets of the WSP, and review at least on an annual basis
     - Develop standard operating procedures
     - Follow industry best practices
     - Create an up-to-date inventory of all water outlet points within the airport; specify transfer points used by airlines and water haulers who supply water to aircraft
     - Define sampling parameters – e.g. *E. coli* or thermotolerant (faecal) coliforms, turbidity, disinfectant residual
     - Use acceptable methodology for sampling
     - Monitor water outlets and transfer points, and share information with stakeholders
     - Provide adequate training to employees – identify training required per position, document, develop checklist for training, etc.
     - Recordkeeping – using spreadsheets, developing database, retaining of records
     - Develop inspection and self-audit programmes and forms

5) Communication plan
   - Have a communication plan in place with identified stakeholders – who to contact – internal and external for incidents and events such as adverse results, natural disasters, construction work on the distribution system, etc.
     - Prepare a sampling strategy communiqué
     - Have a sampling results communiqué
     - Have a notification communication plan for adverse results (e.g. posting signs)
     - Have a water avoidance communiqué in case of natural disasters or events
     - Prepare an inventory of e-mail addresses, telephone numbers of stakeholders – internal/external for notification

6) Incident and emergency plan
   - Should be in place to respond to natural disasters, events or adverse results
     - Identify potential emergency situations, and have a written response plan
     - Train employees and test procedure on the response plan
     - Prepare emergency contact list – internal/external
     - Have a contingency plan to provide potable water

7) Corrective action
   - All corrective action should be documented, and the root causes should be identified

8) Documentation and processes/procedures review
   - All aspects of the WSP should be documented and reviewed at least annually by the person responsible or when there is a change in process, procedure, equipment, etc.

ANNEX B: Example of a water safety plan for a transfer point

Water Safety Plan – Water Haulers/Transfer (Watering) Points

1) Statement of goal(s)/objective(s)/purpose of WSP

2) Jurisdictional requirements to follow
   - Acts/statutes
   - Regulations
   - Standards
   - Guidelines

3) Organization
   - Defining roles and responsibilities
     - Who has overall responsibility for WSP?
     - Who does what? What department/section is responsible for each part of the plan?
   - Defining stakeholders – internal/external, and their roles and responsibilities within the plan
     - Airport authority
     - Airline operators
     - Water haulers – private and those owned and operated by airline
     - Responsible government authority
     - Who has responsibility/ownership of transfer points for aircraft, water haulers, etc.?

4) Operational plan
   - Planning, performing work, checking if work plan is working and continual assessment to improve the plan
     - Prepare and create documents for traceability; set up proper recordkeeping for all facets of the WSP, and review at least on an annual basis
     - Develop standard operating procedures (e.g. coupling/decoupling to aircraft, transfer point, good hygiene practices to follow)
     - Follow industry best practices
     - Create an up-to-date inventory of all transfer points used by airlines and water haulers who supply water to aircraft
     - Have contracts with private water haulers
     - Create an up-to-date inventory of equipment – trucks/carts, hoses, etc.
     - Keep maintenance records of equipment
     - Define sampling parameters (e.g. *E. coli*, turbidity, disinfectant residual)
     - Use acceptable methodology for sampling
     - Monitor transfer points, and share information with stakeholders
     - Provide adequate training to employees – identify training required per position, document, develop checklist for training, etc.
     - Recordkeeping – using spreadsheets, developing database, retaining of records
     - Develop inspection and self-audit programmes and forms

5) Communication plan
   - Have a communication plan in place with identified stakeholders – who to contact – internal and external for natural disasters, incidents and events such as adverse results, etc.
     - Prepare a sampling strategy communiqué
     - Have a sampling results communiqué
     - Have a notification communication plan for adverse results (e.g. aircraft and airport)
     - Prepare an inventory of e-mail addresses, telephone numbers of stakeholders – internal/external for notification

6) Incident and emergency plan
   - Should be in place to respond to natural disasters, events or adverse results
     - Identify potential emergency situations, and have a written response plan
     - Train employees and test procedure on the response plan
     - Prepare emergency contact list – internal/external
     - Have a contingency plan to provide potable water

7) Corrective action
   - All corrective action should be documented, and the root causes should be identified

8) Documentation and processes/procedures review
   - All aspects of the WSP should be documented and reviewed at least annually by the person responsible or when there is a change in process, procedure, equipment, etc.

ANNEX C: Example of a water safety plan for an aircraft

Water Safety Plan – Airlines

1) Statement of goal(s)/objective(s)/purpose of WSP

2) Jurisdictional requirements to follow
   - Acts/statutes
   - Regulations
   - Standards
   - Guidelines

3) Organization
   - Defining roles and responsibilities
     - Who has overall responsibility for WSP?
     - Who does what? What department/section is responsible for each part of the plan?
   - Defining stakeholders – internal/external, and their roles and responsibilities within the plan
     - Airport authority
     - Water haulers – private and those owned and operated by airline
     - Responsible government authority
     - Who has responsibility/ownership of transfer points for aircraft, water haulers, etc.?

4) Operational plan
   - Planning, performing work, checking if work plan is working and continual assessment to improve the plan
     - Prepare and create documents for traceability; set up proper recordkeeping for all facets of the WSP, and review at least on an annual basis
     - Develop standard operating procedures
     - Follow industry best practices
     - Create an up-to-date inventory of all transfer points used by airline and water haulers who supply water to aircraft
     - Where applicable, have contracts with private haulers and companies who perform aircraft disinfection
     - Create an up-to-date inventory of equipment – aircraft, trucks/carts, hoses, etc.
     - Prepare a disinfection schedule for equipment – aircraft, trucks/carts, hoses, etc.
     - Keep maintenance records of equipment
     - Define sampling parameters (e.g. *E. coli*, turbidity, disinfectant residual)
     - Use acceptable methodology for sampling
     - Monitor transfer points, and share information with stakeholders
     - Provide adequate training to employees – identify training required per position, document, develop checklist for training, etc.
     - Recordkeeping – using spreadsheets, developing database, retaining of records
     - Develop inspection and self-audit programmes and forms

5) Communication plan
   - Have a communication plan in place with identified stakeholders – who to contact – internal and external for natural disasters, incidents and events such as adverse results, etc.
     - Prepare a sampling strategy communiqué
     - Have a sampling results communiqué
     - Have a notification communication plan for adverse results (e.g. crew and passengers)
     - Prepare an inventory of e-mail addresses, telephone numbers of stakeholders – internal/external for notification

6) Incident and emergency plan
   - Should be in place to respond to natural disasters, events or adverse results
     - Identify potential emergency situations, and have a written response plan
     - Train employees and test procedure on the response plan
     - Prepare emergency contact list – internal/external
     - Have a contingency plan to provide potable water

7) Corrective action
   - All corrective action should be documented, and the root causes should be identified

8) Documentation and processes/procedures review
   - All aspects of the WSP should be documented and reviewed at least annually by the person responsible or when there is a change in process, procedure, equipment, etc.

ANNEX D: Example format for use by on-site inspectors in evaluating the sanitation status of the airline service area or transfer point

Transfer Point Inspection Form

Regulatory Authority			**INSPECTION SUMMARY -** **AIRLINE SERVICE AREA OR TRANSFER POINT SANITATION**		
NOTE: The items marked below identify deficiencies in operations or facilities that must be corrected within a reasonable time period or by such date as may be specified by the regulatory authority. Failure to comply with any time limits for correction specified in reference to this notice may result in cessation of acceptability of your operations, service or product for use on or by interstate conveyances.					
OWNER/OPERATOR AND ADDRESS			ESTABLISHMENT NAME		
			INSPECTION DATE		
CLASSIFICATION RECOMMENDED *(Check One)* □ APPROVED □ PROVISIONAL *(Expiration Date* _____ *)* □ NOT APPROVED					
REPORT PREPARED BY *(Name and Title)* **DEFICIENCIES ARE INDICATED BY AN "X", NOT OBSERVED BY AN "N", SATISFACTORY BY AN "S".**					
WATER PIPING SYSTEM			**DISPOSAL OF TOILET WASTES**		
1	No cross-connections*		34	Disposal facilities removed from food/drink servicing areas	
2	No backflow connections*		35	Sewage disposal satisfactory*	
3	Adequate pressure		36	Can- or tank-cleaning facilities completely enclosed, flyproof	
HYDRANTS			37	Smooth, impervious floors, sloped to drain	
4	Location satisfactory		38	Room clean, good repair	
5	Acceptable type, good maintenance		39	At least 138 kPa (20 psi) water pressure	
6	Acceptable uses only		40	Hot water or stream available	
7	Quick-type coupling (or threaded for permanent hose connection)		41	Suitable backflow preventer, properly installed*	
8	Outlets downward or horizontal		42	Soil cans emptied and cleaned after removal from aircraft	
9	Proper surface drainage		43	Carts emptied and flushed frequently	
10	Drains from hydrant boxes or pits adequate to prevent flooding*		44	Satisfactory storage of clean soil cans	
WATER HOSE			**HANDLING OF AIRCRAFT REFUSE**		
11	Satisfactory material, smooth, no cracks or checking		45	Refuse handled properly, no spillage	
12	Quick-type couplings, where required		46	Storage containers satisfactory, covered	
13	Satisfactory nozzle guard		47	Storage containers emptied frequently	
14	Hose properly protected and stored		48	Receptacles cleaned, not at soil can cleaning installations	

15	Hose handled properly, flushed before use		49	Receptacles stored properly, not with soil cans	
16	Nozzle different size or shape from waste connections		50	Airsickness containers properly handled and disposed of	
WATER TANKS OR TANK CARTS			**DISPOSAL OF REFUSE**		
17	Separate from toilet waste and sewage tank flushing carts		51	Refuse disposal satisfactory	
18	Smooth, heavy-gauge, corrosion-resistant material		**SANITATION FACILITIES FOR EMPLOYEES**		
19	Completely enclosed from filling inlet to discharge outlet		52	Adequate, convenient toilets, locker rooms and washrooms	
20	Vents, if provided, properly protected		53	Clean, good repair	
21	Complete drainage possible		54	Hand-washing facilities with soap, towels, adequate water	
22	Inlet and outlet directed downward		55	Hand-washing sign posted	
23	Inlet and outlet provided with caps or closures with keeper chains		56	Drinking-water, if provided, of safe quality and properly dispensed; no common cups*	
24	Water tanks labelled*				
25	Quick-type couplings, where required		**OTHER**		
26	If hose transported on cart, proper storage facilities provided		57	Nationally acceptable water supply as required*	
27	Proper transferral of water		58	Conveyance watering operations and procedures acceptable*	
	HANDLING OF TOILET WASTES		59	Conveyance waste removal operations and procedures acceptable*	
28	Personnel who remove wastes do not handle water or food				
29	Soil cans enclosed or covered during transportation to disposal area		60	Other critical areas*	
30	Waste tanks and flushing tanks labelled		61	Other non-critical areas	
31	Sewage removed without spillage				
32	Construction and maintenance of toilet waste carts satisfactory				
33	Equipment available for flushing aircraft sewage retention tanks (not by direct connection to water supply)*		OTHER COMPANIES SERVICED		
REMARKS					
*CRITICAL Items Requiring Immediate Attention.					

ANNEX E: Guidance for cleaning of public areas at an airport

Public areas and rooms

1. Post hand-washing signs to encourage good hand-washing practices among all staff and guests.
2. Use disposable paper wipes for cleaning to avoid the possibility of cross-contamination.
3. Use the proper chemical sanitizing agent, following the manufacturer's instructions concerning contact time.
4. Frequently clean and sanitize handrails, handles, telephones and any other hand contact areas, elevators and landings in all passenger corridors.
5. Frequently clean and sanitize all public rooms.
6. Clean carpets using a steam cleaner that achieves a minimum temperature of 71 °C unless the floor coverings are not heat tolerant (some carpets can be steamed only to 40 °C; otherwise shrinkage and colour runs may occur).
7. Frequently clean and sanitize garbage cans.
8. Clean and sanitize soft furnishings; steam clean if the items are heat tolerant.

Public restrooms

1. Post hand-washing signs to encourage good hand-washing practices among all staff and guests.
2. Frequently clean and sanitize door handles, toilet flushers, faucets, dryers, counters and any other hand contact areas.
3. Provide either an air dryer or disposable paper towels for hand-drying (only single-use cotton towels should be utilized).
4. Check levels of soap and paper towels.
5. Use disposable paper wipes for cleaning to avoid the possibility of cross-contamination.
6. Use the proper chemical sanitizing agent following the manufacturer's instructions concerning contact time.

Bars and lounges

1. Post hand-washing signs at each hand sink to encourage good hand-washing practices among all staff and guests.
2. Require staff to wash hands frequently.
3. Provide hand sanitizers to staff to complement good hand-washing practices.
4. Self-serve unpackaged items (e.g. peanuts, water) should not be available to guests.
5. Provide snacks on request, in small individual containers.
6. Frequently clean condiment containers that are served by staff (recommended to clean between each customer use).
7. Use disposable paper wipes for cleaning to avoid the possibility of cross-contamination.
8. Clean and sanitize all tables and chairs with a detergent solution and sanitizer (with correct contact time) after each shift and after closing.

Spas and salons

1. Post hand-washing signs to encourage good hand-washing practices among all staff and guests.
2. Require staff to wash hands frequently.
3. Use disposable paper wipes for cleaning to avoid the possibility of cross-contamination.
4. Use the proper chemical sanitizing agent following the manufacturer's instructions concerning contact time.

5. As per routine practices, ensure that common-use tools and materials are cleaned with detergent and sanitized after each use (e.g. combs should be kept in sanitizing solution that is regularly refreshed).

Fitness centres

1. Post hand-washing signs to encourage good hand-washing practices among all staff and guests.
2. Require staff to wash hands frequently.
3. Use disposable paper wipes for cleaning to avoid the possibility of cross-contamination.
4. Use the proper chemical sanitizing agent following the manufacturer's contact time.
5. Frequently clean and sanitize all surfaces.
6. Post signs to remind users to wipe down equipment with provided sanitizing spray after use.
7. Clean and sanitize equipment at least once during each shift.

Games rooms

1. Post hand-washing signs to encourage good hand-washing practices among all staff and guests.
2. Require staff to wash hands frequently.
3. Use disposable paper wipes for cleaning to avoid the possibility of cross-contamination.
4. Use the proper chemical sanitizing agent following the manufacturer's instructions concerning contact time.
5. Frequently clean and sanitize all surfaces.
6. Clean and sanitize equipment at least once during each shift, paying special attention to control sticks, handles, knobs and buttons.

ANNEX F: Routine aircraft cleaning schedule

The information provided in this annex is an example of a cleaning schedule for aircraft, written to assist those responsible for routine cleaning immediately after a flight or during a night stop. Although routine cleaning usually includes the use of disinfectants, as components of general-purpose aircraft cleaners, their routine application differs from that of an aircraft that needs disinfection after transporting a suspected case of communicable disease, for which separate guidance is provided in the text of chapter 3.

Cleaning and disinfection schedule

The aircraft operator's engineering department shall grant technical approval for each type of cleaning product used. Approved cleaning products are usually listed in the aircraft maintenance manual. Alternative cleaning products must be approved by the operator's engineering department prior to use.

1. General

1.1 Aircraft contamination

Should aircraft contamination be noticed (insects, liquids, etc.), inform the airline station manager. If an infective source is suspected, the source of infection (e.g. passenger) should be contained in order to minimize the risk of infection to others.

1.2 Handling of flight irregularities

The specifics of each flight irregularity situation will determine the course of action to be taken. However:

- Never compromise on safety.
- Coordinate actions taken with the airline station manager.

2. Interior cleaning

2.1 Classification of interior cleaning types

There are different types of interior cleaning, depending on time available; the following schedule is only an example, which may have to be adjusted to more specific operations. For operations having short flights, minimum service and short turnaround time, the requirement for cleaning between sectors is limited to very few of the procedures mentioned in the chart below.

2.2 Cabin cleaning

Cabin cleaning shall start immediately after passenger disembarkation is completed.

If transit passengers remain on board, cabin cleaning shall be performed so as to minimize passenger disturbance.

Cleaning of cabin windows inside shall be done only with an approved cleaning product and a non-abrasive cloth. Once the window is cleaned, rinse with water using a cloth and dry the surface.

Cloth-covered seats shall be vacuumed. Sticky objects shall be removed with a spatula prior to vacuuming. Stains shall be removed only with an approved stain removal product.

Leather-covered seats shall be cleaned using only an approved dusting product. Stains shall be removed only with an approved stain removal product.

Passenger seat control unit panels shall be cleaned using only approved cleaning materials and non-abrasive paper towels.

In-seat monitors shall be cleaned using only approved cleaning materials and a microfibre cloth.

Carpet stains shall be removed only with an approved stain removal product.

2.3 Interior cleaning chart

The following chart shows applicable cleaning and disinfection activities required for each type of interior cleaning.

"On request" cleaning activities shall be performed if requested by the operator flight crew, cabin crew or airline station manager.

Ashtrays require emptying and cleaning only if not permanently blocked.

Symbols: ✓ Standard ✦ On request

A: Stopover times under 60 minutes

B: Stopover times over 60 minutes

C: Overnight

Area	**Services**	**A**	**B**	**C**	**Remarks**
Flight deck	Empty waste boxes and ashtrays	✓	✓	✓	
	Clean crew tables and glass holders	✦	✓	✓	
	Clean stowage areas and racks	✦	✓	✓	B: As required
	Wipe seats	✦	✓	✓	Remove stains
	Clean floor / Vacuum carpet	✦	✦	✓	
	Clean flight deck windows inside	✦	✦	✓	
	Clean door and walls	✦	✦	✓	
Cabin	Dispose of waste from closets	✓	✓	✓	
	Dispose of litter and newspapers	✓	✓	✓	
	Dispose of waste in seat pockets		✓	✓	
	Collect and restow pillows and blankets (first, business class)	✓	✓	✓	Remove if soiled
	Fold and restow blankets in overhead bins	✓	✓		Remove if soiled
	Restow pillows in overhead bins	✓	✓		Remove if soiled

Symbols: ✓ Standard ✦ On request

A: Stopover times under 60 minutes

B: Stopover times over 60 minutes

C: Overnight

Area	Services	A	B	C	Remarks
	Empty ashtrays		✓	✓	
	Clean tray tables and armrests	✦	✦	✓	
	Clean cabin crew seat tables	✦	✦	✓	
	Clean interphone surfaces	✦	✓	✓	
	Clean cabin windows inside			✓	
	Vacuum passenger and cabin crew cloth-covered seats		✦	✓	Remove stains
	Wipe passenger and cabin crew leather-covered seats		✦	✓	Remove stains
	Dispose of waste in overhead bins and wipe		✦	✓	
	Clean overhead bins outside and latch handle surfaces	✦	✦	✓	
	Clean PVC floors			✓	A: As required
	Vacuum carpet		✦	✓	A: As required
	Empty and clean ashtrays			✓	
	Vacuum ashtray holders			✓	
	Collect and replace blankets			✓	
	Collect and replace pillows			✓	
	Collect and replace headrest covers			✓	
	Clean in-seat monitors			✓	
	Clean passenger seat/service control unit panels	✦	✦	✓	
	Remove passenger seat cushions and vacuum			✓	
	Remove stains from carpets			✓	
	Clean seat rails, cabin fixtures, air inlets, ceiling, sidewalls, closets, doors, service panels and magazine racks			✓	
Galleys	Empty waste bins and insert waste bags	✓	✓	✓	
	Clean doors, latches, ceiling, ventilation grids	✦	✦	✓	
	Clean sinks, faucets and working surfaces	✦	✓	✓	
	Clean retractable tables	✦	✓	✓	
	Clean ovens inside and outside	✦	✦	✓	
	Clean service trolleys	✦	✓	✓	
	Clean PVC floors	✦	✦	✓	
Lavatories	Empty waste bins and insert waste bags	✓	✓	✓	

Symbols: ✓ Standard ✦ On request

A: Stopover times under 60 minutes

B: Stopover times over 60 minutes

C: Overnight

Area	Services	A	B	C	Remarks
	Clean toilet bowl and seat	✓	✓	✓	
	Clean basin, faucets and surfaces	✓	✓	✓	
	Clean mirror	✓	✓	✓	
	Clean change table	✓	✓	✓	
	Clean wall surfaces and interior and exterior door handles and locks	✓	✓	✓	
	Clean PVC floors	✓	✓	✓	
	Replenish soap dispenser	✦	✓	✓	
	Replenish toiletry items	✦	✓	✓	
Crew rest areas	Dispose of waste from closets		✓	✓	
	Dispose of litter and newspapers		✓	✓	
	Remove sheets, pillows and blankets from each sleeping berth		✓	✓	This step followed by next two in sequence
	Clean surfaces within each sleeping berth		✓	✓	
	Place clean sheets on mattresses and clean pillows and blankets in each sleeping berth		✓	✓	
	Clean controls (for lights and ventilation, etc.) and interphone surfaces		✓	✓	
	Empty ashtrays		✓		
	Vacuum carpet				A: As required
	Clean any cabin crew seat tables		✓	✓	
	Clean any cabin windows inside		✓	✓	

If time does not permit completion of all of the above tasks, priority should be given to the removal of waste and cleaning where indicated, especially of galleys and toilets. To expedite cleaning procedures and to reduce the amount of equipment required, disposable swabs impregnated with effective and appropriate cleaning agents can be purchased or prepared in advance, stored in polyethylene bags and used for all wiping operations.

Galleys are extremely difficult to clean satisfactorily at times other than during maintenance checks, since they have many almost inaccessible areas in which foods and beverages—particularly the latter—can penetrate. The introduction of modules in wide-bodied aircraft is an improvement, but much more could be done to design a galley that would be easier to clean than the present type.

Problem areas

Aircraft cleaners need to pay particular attention to the following dirt traps and make sure that they are thoroughly cleaned out:

- catering equipment runners
- bar box recesses

- floor of catering container compartments
- sink drain pipes (frequently blocked)
- drinking-fountain wastes and bottle top remover recesses
- lavatory cupboards
- first-aid stowage holds.

ANNEX G: Recommended attributes for aircraft disinfectant

1) *Safety of active ingredients for humans*: In spite of best practices in the decontamination of environmental surfaces, human exposure to microbiocidal chemicals cannot be prevented altogether; this is particularly the case in confined spaces such as aircraft cabins. Therefore, formulations with the safest possible ingredients must be selected for such use, and proper ventilation should be provided.
2) *Environmental safety*: Chemicals used virtually anywhere eventually end up in the water environment, where they may prove unsafe for the ecology. Persistent chemicals can be particularly undesirable in this regard, as they tend to accumulate in the food-chain with the potential for long-term damage. In view of this, chemicals that can perform the task of decontamination when/where applied and then break down into harmless by-products are preferred.
3) *Spectrum of microbiocidal activity*: Cleaning alone provides some level of improvement and risk reduction. However, many commercially available disinfectants are active against easy-to-kill vegetative bacteria only, while several types of spores, viruses and fungi also have the potential to spread on environmental surfaces. Since in field settings the target pathogen is often unknown, chosen formulations should have demonstrated activity not only against bacteria, but also against viruses and fungi.
4) *Materials compatibility*: This is crucial when choosing disinfectants for decontamination of hard environmental surfaces in aircraft cabins. Any formulation selected for use in such settings must be safe for repeated applications and, as far as possible, must not reach other more sensitive and vital areas of the aircraft. Advice from the equipment manufacturer or aircraft operator's engineering department should be followed.
5) *Transport, storage and inventory control*: Ideally, one type of ready-to-use formulation can eliminate issues with inventory control and dealings with different manufacturers. The product to be selected must also be packaged for safe storage on board the aircraft.
6) *Directions for use*: The label directions must be as simple and easy to understand as possible to avoid misuse of the product.
7) *Speed of activity*: In most cases, the contact time between the targeted environmental surface and the applied product lasts from a few seconds to perhaps a minute or so. However, many commercial products sold for such use claim microbiocidal activity with a contact time of at least 10 minutes. This obvious disparity between label directions and actual field use has the potential to generate a false sense of security in the mind of the user. Further, the application of a relatively weak formulation for a shorter than recommended contact time could result in the spread of microbial contamination over a wider area during the wiping of environmental surfaces. Therefore, products that can achieve decontamination in as short a time as possible are preferred.
8) *Freedom from off-gassing and volatile organic chemicals (VOCs)*: Pungent odours are obviously undesirable, but addition of even strong scents/perfumes to disinfectants is now discouraged because of increasing numbers of individuals with multiple chemical allergies. Formulations that may release corrosive gases (e.g. chlorine) and VOCs must be avoided because of potential exposure of sensitive and vital components of the aircraft. Advice from the equipment manufacturer or aircraft operator's engineering department should be followed. Appropriate ventilation during cleaning is also important.