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Water quality

Part 2: Risk assessments for *Pseudomonas aeruginosa* and other waterborne pathogens — Code of practice

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Foreword

Publishing information

This part of BS 8580 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 January 2022. It was prepared by Subcommittee EH/3/4, *Microbiological methods*, under the authority of Technical Committee EH/3, *Water quality*. A list of organizations represented on these committees can be obtained on request to the committee manager.

Relationship with other publications

This standard is part of a series, BS 8580, which includes the following parts:

BS 8580-1, *Water quality – Risk assessments for Legionella control – Code of practice*

BS 8580-2, *Water quality – Part 2: Risk assessments for Pseudomonas aeruginosa and other waterborne pathogens – Code of practice*

This British Standard is intended to be used in conjunction with BS 8580.

Information about this document

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Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

This standard is intended for use in healthcare by Water Safety Groups (WSGs) including by, Authorising Engineer/Independent Advisers (see HTM 04-01 [1] and other relevant national health technical memoranda), Responsible Person(s), infection prevention and control professionals, microbiologists, contractors and service providers including, patient support services etc. It is also relevant to those providing specialist clinical services, for example, cardiology, dental, audiology, dialysis and aquatic therapy.

On non-healthcare premises this British Standard is intended to be used by WSGs, Responsible Person(s) and all relevant advisors, contractors, service providers and suppliers.

Use of this document

As a code of practice, this British Standard takes the form of recommendations and guidance. It is not to be quoted as if it were a specification. Users are expected to ensure that claims of compliance are not misleading.

Users may substitute any of the recommendations in this British Standard with practices of equivalent or better outcome. Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this part of BS 8580 that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

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Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

The word "should" is used to express recommendations of this standard. The word "may" is used in the text to express permissibility, e.g. as an alternative to the primary recommendation of the clause. The word "can" is used to express possibility, e.g. a consequence of an action or an event.

Notes and commentaries are provided throughout the text of this standard. Notes give references and additional information that are important but do not form part of the recommendations. Commentaries give background information.

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Contractual and legal considerations

In particular, attention is drawn to the following:

- WHO Guidelines for Drinking Water Quality [2];
- WHO Guidelines for safe recreational water environments [3];
- Health and Safety at Work etc. Act 1974 [4];
- Health and Social Care 2008 (Regulated Activities) Regulations 2014 [5].

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0 Introduction

0.1 General

Pseudomonas aeruginosa (*PA*) is part of a large group of free-living bacteria that are ubiquitous in the environment including in natural water sources such as lakes and rivers. *PA* can survive and grow in constructed water systems and equipment in very low nutrient conditions including in deionized and distilled water [6], as well as in high nutrient environments such as sewage and the human gut. They can readily colonize water systems and associated equipment within buildings and develop significant biofilms close to and within outlets. Heavy biofilm growth of *PA* resulting in infections has been frequently associated with component parts such as aerators and flow straighteners within tap outlets.

PA can cause a range of infections from self-limiting skin infections in those using colonised swimming pools and hot tubs for example, to severe illness and death in highly susceptible patients in hospitals, particularly those with breaches in skin integrity, such as burns and intensive care patients, especially those who are immunocompromised [7].

Whilst many of the risk factors for *PA* growth and transmission are similar to those identified for *Legionella* (see BS 8580-1), there are many additional considerations which need to be taken into account when assessing risks from *PA*. These are covered within this British Standard.

Risk assessments for the microorganisms covered by this British standard need to take into account not just the engineering factors which can lead to their growth and transmission (including those related to the design and engineering of water systems and associated equipment). They also need to include the way that water systems are used, the individual types of use, the susceptibility of users and those in the vicinity of the systems and equipment being used, as well as a range of other environmental factors and, where relevant, clinical factors. For this reason, a multidisciplinary risk assessment team approach is usually the most effective approach.

Risk assessments form the core of the development and implementation of a water safety plan (WSP) (see BS 8680) and need to be carried out in addition to the *Legionella* risk assessment where relevant (see BS 8580-1). *PA* risk assessments are particularly applicable in healthcare premises, including those providing primary care, nursing, and residential care, and especially in areas designated as augmented care and/or providing specialist services where there is exposure to water for treatment or diagnostic purposes. These include services such as audiology, cardiology, dental, aquatic therapy, decontamination departments and areas with specialist water containing equipment, for example, nebulizers.

Whilst risk assessments for *PA* need to be carried out routinely in healthcare and other settings where it is recognized there is a risk of *PA* infection, risk assessments for other waterborne opportunistic pathogens are usually only carried out when there is an identified risk for particular patient groups, e.g. from non-tuberculous mycobacteria (NTMs) in cystic fibrosis patients and/or where clinical and/or environmental surveillance indicates there is a need. Whilst this standard is primarily intended for assessment of the risk from *PA* infections, the risk assessment processes recommended can be also be applied to risk assessments for other waterborne opportunistic pathogens. These need to be adapted to take into account the relevant ecological niches, susceptibilities of those exposed and the clinical manifestations affecting the risk from individual hazard to be assessed.

This standard aims to assist both risk assessors and users, duty holders, owner/managers and WSG members to understand the microbial hazards (pathogens) associated with different systems, potential hazardous events and other factors which lead to their presence and to provide information and support to WSGs on how to prioritize actions and minimize the risks.

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Use of this British Standard provides the information to aid the development of a holistic water safety plan (WSP). It is intended to be used with BS 8680, which contains recommendations for the development of WSPs. This standard is also intended to be used in conjunction with completed and up to date *Legionella* risk assessments (see BS 8580-1).

0.2 Healthcare settings

PA is a major cause of hospital-acquired infections in augmented care patients; particularly in burns and cystic fibrosis (CF) patients and neonates. *PA* can cause infections in almost every part of the human anatomy where able to gain access, resulting in high levels of morbidity and mortality attributable to infection. Successful treatment is becoming increasingly difficult as *PA* is inherently resistant to many antimicrobial agents and can acquire antibiotic resistance genes, including for the production of carbapenamase [7], [8].

There are many potential routes of infection; *PA* can colonize human skin without causing infection but in healthcare settings, transmission of *PA* can occur directly from person to person and there is also evidence of indirect transmission from person to water system components and then onwards to other people.

Risk assessments for waterborne pathogens other than *PA* might be required when clinical surveillance, outbreaks and/or the Water Safety Group (WSG) identify a need. In most cases, the risk assessment process for *PA* within this standard can be used to inform the process of risk assessment for other opportunistic pathogens. The risk assessment process might need adapting to take account of the specific ecological niches which support the growth of the specific microorganism together with all the potential modes of exposure and transmission and the suitability and effectiveness of control measures.

Additional considerations need to be included when assessing resistant organisms, such as NTMs. NTMs are found in both natural and constructed water systems and equipment with evidence of transmission causing infection obtained from genetic fingerprinting of isolates from the lungs of patients implicating a variety of sources [9]. NTMs, both slow growing and fast-growing forms, are of increasing concern in healthcare settings where there are very vulnerable patients. Risk assessments need to take into account intrinsic resistance to biocides and heat tolerance particularly where measures applied to control *PA* are unlikely to successfully control NTM colonization and growth. Risk assessments for NTMs need to be carried out in areas intended for patients who are severely immunocompromised such as transplant units, haematology-oncology units, cystic fibrosis units and other areas identified by the WSG as being at high risk.

0.3 Non-healthcare premises

PA risk assessments are applicable to other types of premises where there are systems and/or equipment which can pose a risk of *PA* infection for example: *PA* in water and colonized water systems and equipment in leisure and industrial setting can cause infections e.g. *PA* folliculitis, (an infection of the hair follicles) which is usually self-limiting, and also ear, eye, and urinary tract infections. Very rarely, infection in persons outside of healthcare settings can be life threatening, including to healthy individuals [10].

Whilst *PA* is the non-enteric pathogen of most concern in such settings, NTMs have also been associated with causing pneumonitis and respiratory infections associated with spa pool and hot tub use [11], [12], [13] and skin infections associated with whirlpool footbaths [14]. Risk assessments for NTMs might be indicated as a result of a case or cases associated with settings with hot tubs and items of equipment such as whirlpool footbaths including in nail and beauty salons. Water-based metal working fluids have also been associated with causing hypersensitivity pneumonitis in workers [15].

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1 Scope

This British Standard gives recommendations and guidance on how to carry out risk assessments for *Pseudomonas aeruginosa* (*PA*) and other waterborne pathogens whose natural habitat is within constructed water systems and the aqueous environment (autochthonous) rather than those being present as a result of a contamination event. It includes those pathogens that can colonize and grow within water systems and the associated environment. It does not cover risk assessments for *Legionella spp.;* these are covered in BS 8580-1, or risk assessments for enteric microorganisms derived from human or animal faecal contamination or sewage ingress.

This British Standard is especially applicable to all types of healthcare provision, including hospitals, care, nursing and residential homes, together with other settings such as educational, travel, leisure, commercial, industrial, where there are additional systems or equipment which could pose a risk from waterborne pathogens.

It is also applicable to spa baths, hot tubs, pools, and other equipment, including the use of large inflatable equipment in swimming pools. Premises where this standard can be used include the educational, travel, industrial, leisure and beauty sector, including health spas, nail bars and tattoo parlours, and other premises where water systems and associated equipment can pose a risk of infection from waterborne pathogens other than *Legionella* and those associated with gastrointestinal infections.

This British Standard covers risk assessment of distributed water systems and associated equipment, system components and fittings as well as above ground drainage systems. It takes account of all relevant environmental and clinical factors, aspects of human behaviour leading to contamination events, e.g. poor cleaning and storage techniques and all possible modes of transmission. It also takes into account risk factors within the associated environment, such as the potential for transmission from personnel, splashing and the contamination of outlets, sink traps and drains leading to conditions which can encourage the colonization and growth of waterborne pathogens and transfer of antibiotic resistance.

This British Standard also covers *PA* risk assessment reviews and reassessments where a previous assessment has been undertaken and risk factors identified.

For all sites, it is also of relevance to design engineers and architects, providers of fittings, outlets and components for water systems, manufacturers/wholesalers/contractors, installers and commissioners, risk assessors, regulatory bodies, building services engineers, water treatment consultants, travel, leisure and other relevant buildings owners and operators and those responsible for the safe management of water systems, especially within the leisure centres, schools, swimming pool operators, passenger vessel operators, etc.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions of this document[1)]. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 8580-1, *Water quality – Risk assessments for Legionella control – Code of practice*

BS 8680, *Water quality – Water safety plans – Code of practice*

[1)] Documents that are referred to solely in an informative manner are listed in the Bibliography.

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