

Pseudomonas aeruginosa

Back to Basics

What is *Pseudomonas aeruginosa*?

Why is *Pseudomonas aeruginosa* dangerous in healthcare and care environments?

How is *Pseudomonas aeruginosa* transmitted?

What can be done to stop *Pseudomonas aeruginosa* infections?

What is *Pseudomonas aeruginosa*?

'*Pseudomonas* species (spp)' refers to a group of free-living bacteria that often occur naturally in the environment in soil and water. The major pathogen is *Pseudomonas aeruginosa*, which can cause severe and frequently deadly infections in individuals with highly compromised immune systems.

However, *P. aeruginosa* is not dangerous to healthy individuals and is rarely found naturally in new-borns — it is usually a sign of infection if found in a neonate.

P. aeruginosa has now become even more dangerous to those affected because it has developed resistance to multiple antibiotics, with few options left for treatment. The World Health Organisation (WHO) has now included *P. aeruginosa* in its list of 12 antibiotic-resistant “priority pathogens”.

In the UK, *P. aeruginosa* causes an estimated 10% of all UK hospital-acquired infections.



Why is *Pseudomonas aeruginosa* dangerous in healthcare and care environments?



P. aeruginosa is particularly dangerous in these environments because hospital and nursing home populations include a high percentage of individuals who are most vulnerable to serious infections. Water is now recognised as a potential source of *P. aeruginosa* outbreaks on intensive care units (ICUs).

Those most at risk of becoming infected with severe *P. aeruginosa* infections are:

- those with a weakened immune system due to long term health conditions
- patients taking immuno-suppressant drugs such as chemotherapy and steroids
- patients who have had surgery or another invasive procedure
- patients fitted with invasive devices
- patients with severe burns or wounds
- the elderly
- alcoholics

What are the symptoms of *Pseudomonas aeruginosa* infections?

The most severe *P. aeruginosa* infections generally occur in the blood and lungs.

Blood infections, known as bacteraemias, cause high fever. Bacteraemias caused by *P. aeruginosa* can lead to low blood pressure (hemodynamic shock), in turn leading to failure of the heart, kidneys and liver.

Lung infections (pneumonias) with *P. aeruginosa* also cause high fevers, as well as coughs and difficulty with breathing.

In the UK, *P. aeruginosa* causes up to 25% of pneumonias in ICUs.

P. aeruginosa can also cause very mild illnesses such as skin rashes and ear infections in healthy individuals, often after exposure to hot tubs and swimming pools that have not been properly chlorinated.



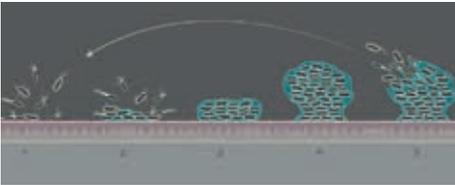
Where does *Pseudomonas aeruginosa* grow in healthcare environments?

These bacteria can grow in any watery or even only slightly damp conditions. In healthcare environments *P. aeruginosa* bacteria can flourish in: potable water, taps, hand wash basins (HWBs) and sinks, HWB and sink drains, baths, shower heads and hoses, hydrotherapy pools, respiratory equipment, IV lines, disinfectants and sanitisers, water coolers, mop heads and cleaning buckets, flower vases.

How does *Pseudomonas aeruginosa* inhabit damp environments?

P. aeruginosa inhabits these damp environments because of its ability to form biofilm, an intricate colony of microorganisms that can 'glue' itself to inanimate surfaces such as metal and plastic. Biofilm provides a safe harbour for the bacteria living in it because the sticky 'glue' it produces also protects the bacteria from chemicals designed to attack biofilm.

As biofilm grows, sections will continually break off to contaminate water with free-living bacteria that can emerge in water flowing from taps and showers, as well as 'seeding' new biofilm colonies.



Biofilm occurs throughout nature: black mould in a damp bathroom is a biofilm; and the reason you need to clean your teeth is to remove biofilm built up by the bacteria living in your mouth.

Biofilm grows best in certain conditions:

- stagnant water or slow-flowing water, such as water trapped in plumbing 'deadlegs', dead end areas of a water system e.g. where an out-of-use pipe, basin or shower has been blocked off
- anywhere with even a tiny amount of organic matter to provide nutrients, for example: trapped debris inside tap fixtures such as tap outlets, flow straighteners and aerators
- deposits of soap and shampoo around basins, baths and showers
- anywhere with limescale deposits
- basin and sink seals

In clinical and care environments, *P. aeruginosa* can contaminate the plastic materials found in devices that are left inside the body, such as urinary tract catheters, IV lines and respiratory equipment tubes.

P. aeruginosa also grows on moist wound surfaces such as burns wounds and diabetic ulcers.



How is *Pseudomonas aeruginosa* transmitted to patients?

P. aeruginosa can be spread to patients and nursing home residents:

- on the hands of healthcare and care workers and visitors
- contaminated equipment
- contact with contaminated water

Splashing also has the potential to transmit *P. aeruginosa* from contaminated water because even the tiniest water droplets in aerosols can carry bacteria.

What can be done to protect patients from *Pseudomonas aeruginosa* infections?

There are a wide range of infection control practices that help protect vulnerable individuals against *P. aeruginosa*, as well as other water-transmitted infections. These may be carried out by different teams of colleagues:



Keeping water free of bacteria

This is the role of a hospital's or nursing home's estates team. It is their job to prevent biofilm building up in their facility's water system. The estates team will do this by:

- keeping water at high temperatures that discourages bacterial growth
- ensuring the water is moving through all parts of the plumbing system by maintaining flushing regimes
- maintaining cleaning routines to prevent biofilm growth on taps, HWBs, showers and surfaces
- decontaminating and/or replacing contaminated fixtures when cleaning fails to resolve contamination
- installing point-of-use (POU) filters on taps and shower heads while contamination problems are being resolved

Little-used outlets



Image courtesy of Dr Paul McDermott

Clinical, ward and care staff can help prevent stagnation by keeping aware of and reporting/flushing rarely used or out-of-use basins, sinks and other water outlets. It is particularly important to flush water outlets in spaces that have become storage areas or ideally remove them entirely.

Good hand hygiene

Following the recommended hand hygiene practices consistently is crucial in preventing transmission of bacteria from health and care workers' hands to vulnerable individuals. This includes:

- using tap handles correctly to prevent recontamination of hands e.g. ensuring that elbow-operated taps are opened and closed with elbows and not hands!
- making sure that tap ends and shower heads do not come into contact with hands and substances such as soap and patient wash water as this can cause contamination – a phenomenon known as 'retrograde contamination'. It is important to be aware of this during hand washing.



Cleaning

Ensuring that all surfaces, both wet and 'dry' are cleaned and disinfected on a regular basis.

There should be particular vigilance around basins, baths, taps, showers and their hoses and even kitchen sinks, to prevent any bacterial growth and build-up of biofilm.

Cleaning regimes will be organised by the soft facilities maintenance team. Cleaners should be trained in correct cleaning methods.

However, clinical, ward staff and carers should also remain alert about removing all items, even shampoos, lotions and cleaning cloths, from WHBs, showers and baths, as these can harbour bacterial growth, not just in water outlet surrounds but in the outlets themselves.

For example, a spilt body wash gel could grow bacteria, which are then transferred back to the end of a tap or to a shower head.

Minimising water contact with patients

Although well-maintained water systems should not contain *P. aeruginosa*, water should, as far as possible, be kept away from wounds, wound dressings and invasive devices. Patients should also be protected from splashed water.

Water droplets can travel up to 2 metres from their source. Water outlets should be arranged so that splashes cannot reach areas where equipment and drugs are being prepared and screens could be used to prevent this happening.

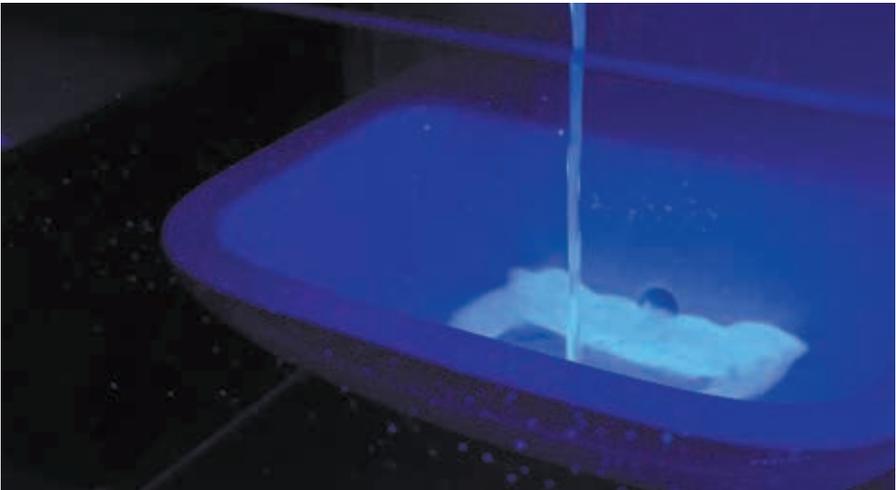
Keeping sink drains clean

There are increasing reports of outbreaks and serious infections originating from antibiotic-resistant bacteria (including *P. aeruginosa*) reservoirs in WHB, bath and shower drains.

These incidents have been linked to drains that contain a build-up of inappropriate substances and items that have been flushed down HWB and shower drains to provide 'nutrients' for bacterial growth. They include drinks, foodstuffs and medications.

'Clinical' hand wash basins should therefore be used ONLY for washing hands.

All other liquids (and substances), such as patient wash water, should be disposed of in sluices and designated non-clinical basins.



Education

Regular training sessions are useful to remind all staff of the dangers of waterborne infections and how best to prevent them.

Design

The choice of sanitaryware and fittings plays an important role in reducing the opportunity for bacterial growth.

Tap outlets

Taps are available that can be stripped down for cleaning; some have spouts that can be removed and autoclaved.

The guidelines recommend the use of open outlets to avoid flow straighteners that can develop limescale, which is attractive for bacterial growth.

Consideration should also be given to the materials used — higher brass content is best, while components made from some polymers encourage bacterial growth.

Fittings with built-in thermostats close to the point of use avoid unnecessary dead legs that can cause stagnation.





Basins

Basins need to drain well, so back outlets should be used in clinical settings. Tap spouts should not be situated directly above wastes (as in the image above) as this can cause the disruption of bacteria in drains and potentially contaminated aerosols.

Some basin designs reduce splashing: splashing can spread bacteria from the basin on to nearby beds, equipment trolleys, drug preparation areas etc.

Smooth ceramic glazes incorporating antimicrobial agents further protect against harmful bacteria.

Many facilities occupy old and adapted buildings where the water system has evolved gradually, often introducing 'low flow' points. Installation of a well thought-out water system is therefore important in new buildings.



What guidelines are there to protect patients and care home residents against *Pseudomonas aeruginosa* infections?

The first definitive guidance on the control of *Pseudomonas aeruginosa* in water systems was only published in 2013 — as an addendum to Health Technical Memorandum 04-01 (on the control of *Legionella* in water systems). It is based on the formation of multidisciplinary Water Safety Groups that include both estates, clinical and other ward staff who collaborate to produce detailed Water Safety Plans. It was updated in 2016 and is now Part C.

See: <https://www.gov.uk/government/publications/hot-and-cold-water-supply-storage-and-distribution-systems-for-healthcare-premises>

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THINK WATER**

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