Looking deeper

THE JOURNAL OF THE WATER SAFETY FORUM

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Black box thinking

Looking Deeper Editor, **Susan Pearson**

In the early 20th century, aviation was one of the riskiest forms of transport: in 1912 almost half of US army pilots died in crashes, in peacetime. Fast forward to 2014, and the accident rate has plummeted to just one crash for every 8.3 million major airline take-offs.

According to journalist on high performance and broadcaster Matthew Syed, the aviation industry's spectacular modern day safety record is explained by his 'Black Box Thinking' theory. This success is a result of lessons learned: in the unlikely event of a crash the involved aircraft's black boxes will be closely analysed to tease out any systemic weaknesses. There will be no covering up; instead accidents are seen as particular opportunities to learn.

Black Box Thinking pitches a "growth mindset" against a "fixed mindset". The "fixed mindset" relies on natural talent and fixed traits to achieve success, while the "growth mindset" believes that basic abilities can be developed through dedication and hard work. The focus has to be on other ingredients, such as constant evaluation and the recognition that everyone (and everything) can get better – and this may require learning from mistakes and failures.

"Most closed loops exist because people deny failure or try to spin it."

Matthew Syed, motivational author

But what has this got to do with water safety in healthcare facilities?

The value of this 'no blame' constructive approach was echoed in discussions at the Water Safety Forum's Third Round Table, back after a two year hiatus following the pandemic lockdowns. Focusing on the practical aspects of the new BS 8580-2 Standard for risk assessing *Pseudomonas aeruginosa*, thoughts from our expert panel included discussions on the role of a dynamic relationship between manufacturers and the industry in facilitating improved water safety.

The group outlined how maximised transparency and learning from manufacturers in response to user feedback would enable manufacturers to come up with the best solutions for patient safety, boosting outcomes for both the end users and manufacturers alike and exploiting suppliers' specialist expertise to help spread the word on best practice.

The Round Table panel's animated debate also swept across many other topics, including the implications of the new standard's multi-disciplinary focus, competency and antimicrobial resistance (see pp 5-11).

Looking Deeper's Round Table events plus our 'Back to Basics' Supplements are elements of our remit to promote the latest thinking on water safety in healthcare. Now we're expanding our information stable further: a new series of practical 'how to...' guides begins on pages 14-15 with a step-by-step guide to dismantling a thermostatic mixing tap prior to disinfection.

Contents

Editorial Contributions

Susan is an independent journalist and communications specialist with a background in biology, medical research and publishing. She has been writing on medical issues for over 30 years and on waterborne infection and water management since 2010. She has been a frequent contributor to IHEEM's Health Estate Journal, WMSoc's Waterline and the Clinical Services Journal.

Susan Pearson

Elise is an independent consultant to the water and medical devices industries and a Director of the Water Management Society (WMSoc). She is a state-registered microbiologist and a Fellow of WMSoc, IHEEM, RSPH and IBMS. She chairs and presents at numerous international conferences.

Elise Maynard

Dr Mike Weinbren is a Consultant Clinical Microbiologist, Infection Control doctor and Antimicrobial Resistance Clinical lead for NHS Scotland Assure with a remit to minimise risks from the healthcare built environment. He is the Chair of the Healthcare Infection Society (HIS) Working Group on Water and was closely involved in developing HTM 04-01: 'Safe water in healthcare premises'.

Dr Mike Weinbren

Dates for diaries...

IHEEM: Healthcare Estates Conference, Exhibition and Awards 2022
4-5/10/2022 Manchester, UK
healthcare-estates.com or office@iheem.org.uk

Healthcare Design Conference + Expo
8-11/10/2022 San Antonio, Texas, USA
hcdexpo.com

14th Annual Infection Prevention Conference
17-19/10/2022 Bournemouth, UK
ips.uk.net/conference-2022

American Society for Microbiology: Conference on Biofilms
13-17/11/2022 Charlotte, North Carolina, US
asm.org/Events

2nd International Meeting on Public Health and Healthcare Management
5-7/12/2022 London UK
medigy.com/event/2022/12/05

IWA Biofilms 2022
6-8/12/2022 Phuket, Thailand
iwabiofilms2020.org/

DIPC development day: Navigating the minefield: dealing with complaints, litigation and the media
9/12/2022 On-line
his.org.uk/training-events/events-diary

UN 2023 Water Conference
22-24/3/2023 New York, US
unwater.org/un-2023-water-conference/

Microbiology Society Annual Conference 2023
17-20/4/2023 Birmingham, UK
microbiologysociety.org/event/annual-conference/annual-conference-2023.html

International Conference on Biofilm Research I CBR
28-29/6/2023 London, UK
waset.org/biofilm-research-conference-in-june-2023-in-london

Share your thoughts with us in the next issue

We would really value your reactions to this latest issue of Looking Deeper. We'd like to hear from you about what you liked, what you feel could be improved on and what topics you want to see discussed. You can contact us at **editorial@lookingdeeper.co.uk**

In the news...

Organic green leaves need a good wash

Organic vegetables may not be as healthy as advertised if not washed properly due to the ability of certain free-living amoebae (FLA) that live on organic plants to act as 'Trojan horses' hosting human pathogens such as *Pseudomonas, Salmonella* and *Helicobacter.*

A preliminary study by Dr Yolanda Moreno and colleagues from Universitat Politècnica de València in Spain collected 17 samples of lettuce and spinach from local supermarkets in Valencia between November 2020 and May 2021. The team determined what types of bugs were present inside FLA using a metagenomic technique that identifies the DNA in all bacteria present inside the amoebae.

The predominant bacterial species identified were *Flavobacterium* (found in 10% of vegetable samples) and *Pseudomonas* (10%), many of which do not cause disease in humans. However, a third of samples (34%) contained 52 potentially disease-causing types of bacteria including *Legionella, Salmonella,* and *Arcobacter.*

Dr. Moreno commented: "Contamination can arise as a consequence of treating soil with organic fertilisers such as manure and sewage sludge and from irrigation water. Leafy greens are particularly susceptible to faecal contamination due to their proximity to the ground."

Although a significant insight, the study authors noted that only a small sample of leafy organic vegetables from one city in Spain were analysed. Larger studies will be required from different countries to understand more about the microbiological quality and safety of organic vegetables.

PATHOGENS PUNISH PARLIAMENT

Potentially fatal *Legionella* bacteria, the cause of Legionnaires' disease, were the culprits in an unlikely threat to MPs and their staff, causing the temporary shutdown in June of several showers and a tea point at Westminster.

The bacterial contamination, described as "low level" was discovered in some isolated areas in Portcullis House by the Westminster maintenance team during routine pro-active monitoring.

The Palace of Westminster has long been plagued with problems such as fires, vermin and flooding. *Legionella* bacteria can be a scourge of ancient buildings, because creaking pipework systems have a tendency towards plumbing problems such as 'dead legs', caused when pipework is altered or unused outlets are shut off. However, Portcullis House was only opened in 2001.

A House of Commons spokesperson confirmed: "As a precautionary measure in line with best practice, we have temporarily closed the showers and a tea point affected, while we undertake a disinfection of the water system in line with normal protocols."

WATER SAFETY FORUM

New BS 8580-2 standard for risk assessing *Pseudomonas aeruginosa:* Introduction

By Elise Maynard,
Chair of the Water Safety Forum

BSI (British Standards Institution) is the UK's national standards body (NSB). The first such body in the world, BSI's remit is to help improve the quality and safety of products, services and systems by enabling the creation of standards and encouraging their use. They publish over 2,700 standards a year, engaging industry experts, government bodies, trade associations, businesses of all sizes and consumers to develop consensus standards that reflect good business practice.

Standards are an agreed way of doing something. They are open, consensus-based documents, developed by industry experts who share an interest in improving how things are done. Standards represent the distilled wisdom of what 'best practice' looks like, helping to make things work properly and improve organisational management. Committees are formed of volunteers who develop every standard collaboratively before sending it out for public consultation when a near final format is reached. This process ensures that published standards represent the agreement of the widest possible community of people with a stake in the topic. It also ensures accuracy, balance, rigour and fairness.

The BSI EH 3/4 committee is responsible for developing national water quality standards and contributing to European and International standards development.

Their work over the past few years is now included in a Water Quality Solution Pack which includes:

- **BS 8580-1:2019** Water quality - Risk assessments for *Legionella* control. Code of practice.
- **BS 8680: 2020** Water quality. Water safety plans. Code of practice.
- **BS 8580-2: 2022** Water quality - Risk assessments for *Pseudomonas aeruginosa* and other waterborne pathogens. Code of practice.
- **BS 7592:2022** Sampling for *Legionella* bacteria in water systems. Code of practice.
- **BS 8580-2** is a new British Standard recommending a *Pseudomonas aeruginosa* risk assessment (RA) process and supplying information and support on how to understand microbial hazards, prioritise actions and minimise risks.

Robust RAs are crucial in establishing the Water Safety Plans (WSPs) that lie at the heart of management in healthcare (see Looking Deeper, Issue 8, p8). However, while risks from *Legionella* infections in healthcare have long been acknowledged and backed up by legally enforceable requirements for control and mitigation through the Health and Safety Executive's Approved Code of Practice (ACOP) L8, last updated in 2013, this has not been the case for risks from healthcare acquired infections (HAIs) with *Pseudomonas aeruginosa*, despite their potential to cause serious ill health for the most vulnerable patients and care home residents.

The publication of BS 8580-2 is a landmark document that at last addresses decades-long concerns over the control of *P. aeruginosa* HAIs and their link to water.

Although there has been some awareness of the role of water in the transmission of *P. aeruginosa* to patients since the 1960s, the link between tap water and *P. aeruginosa* was not formally acknowledged until 2012, following the deaths of three babies in a Belfast neonatal unit from infections traced back to contaminated taps. This at last led to guidance on the risks from *P. aeruginosa* associated with water outlets — but as an addendum to HTM 04-01, already in place for the control of *Legionella* in water systems. This was a first

move towards changing the outlook on waterborne organisms other than *Legionella*, but there was no real standard on how to make those changes happen.

The risks from *Legionella* are relatively well understood, but although HTM 04-01 remains a useful document, it is often perceived to be an engineering approach to risks. The same considerations used for *Legionella* RAs have tended to be applied to *P. aeruginosa*, but this does not take into account the many highly specific and clinical issues related to this pathogen. The reality in many hospitals is that numbers of cases in any *P. aeruginosa* outbreaks far exceed the very rare cases of hospital-acquired *Legionella*.

It is ever important that intended users of the new standard include all of those involved in ensuring water is safe and fit for purpose at the point of use. While a good engineering RA, such as those applied for *Legionella*, still needs to be in place, significantly, BS 8580-2 creates a much broader responsibility by emphasising a multi-disciplinary approach aimed at all Water Safety Group (WSG) members. This should include those responsible — from design and specification, construction and installation, commissioning, maintenance and operation, alteration and refurbishment, through to deconstruction of a building or site. Clinical and housekeeping leads are particularly vital in developing a robust RA based on how water is actually used.

While RA guidance for *P. aeruginosa* and other waterborne pathogens has been included in HTM 04-01, this new standard gives far more information. Its recommended processes can be applied to other opportunistic waterborne pathogens, which may include antimicrobial resistant strains. It is particularly powerful when used in conjunction with BS 8680 which gives recommendations and guidance on the development of a WSP.

WATER SAFETY FORUM

New BS 8580-2 standa assessing *Pseudomona* Impacts and implicati

The practical application of the BS 8580-2 was the subject of discussion for the latest Water Safety Forum (WSF) Round Table, back after a long gap following pandemic lockdowns. Held at Ideal Standard's London Design and Specification Centre in June, this third WSF was an opportunity for a group of experts to exchange their views on the potential impacts of the standard on the installation, maintenance and cleaning regimes of sanitary fittings in clinical settings.

The new standard outlines how *P. aeruginosa* can be transmitted via water sources, including waste water and drainage, providing a full step-by-step guide for risk assessment (RA). The importance of the 'competency' of those involved in RAs is highlighted along with the need for record keeping, such as surveillance data, and the management of risks.

BS 8580-2 also for the first time outlines specific RA considerations for numerous other waterborne pathogens.

While *P. aeruginosa* is a 'marker' organism for problems in a water system, an Annexe also covers a long list of other pathogens that have increasingly been identified in a range of niches, highlighting drains as particularly high-risk. This broader scope provided by BS 8580-2 begins to address the issue of numerous unidentified infections that may well represent the tip of an iceberg, in care homes as well as in hospitals.

The WSF panel included healthcare water safety engineers, risk assessors and infection control clinicians, and was chaired by Elise Maynard, a member of the BSI working party for BS 8580-2.

The conversation was wide-ranging and dynamic, extending over topics such as procurement, competency and training, communication between disciplines, cleaning, the role of manufacturers, antimicrobial resistance, design solutions, water balancing requirements for new builds and sampling.

rd for risk
as aeruginosa:
ons — Part 1

In order to represent the key points from such a broad discussion, our Looking Deeper report has been split into two parts. This first part will be followed by Part 2 in the next issue in Spring 2023.

> *"[Until now] "it has been hard to apply the same weight to Pseudomonas prevention as to Legionella prevention...[because Legionella] is considered preventable... It has been hard to say that Pseudomonas infections are preventable because we... don't fully understand transmission...[whereas] with Legionella we don't carry it on our bodies [so] it's not a person to person transmission [as can occur with Pseudomonas]."*
>
> ***Peter Orendecki, a Senior Contract Manager, Water Hygiene AP***

Risk assessments in practice

The need for carrying out specific RAs for *P. aeruginosa* was illustrated by an example where several "troublesome areas" in a hospital had not been resolved through engineering solutions — and, beyond the human cost, re-sampling alone was costing £40,000 per year. An external risk assessor looked beyond engineering to get other disciplines involved, seeing the problem from a cleaning, process and design perspective. Despite various departments feeling they didn't have enough time to input into an RA, an understanding of the potential benefits started to grow.

The upshot is that RAs are now carried out, there are regular inter-disciplinary meetings and these are followed through by actions to work through the RAs. With this more intense focus, people started to find little things that would make a difference, for example, it was discovered that the external contractor had not contracted the cleaners to clean the (outside) of point-of-use filters on taps.

But however good an RA might be, there can be aspects that may need to be overturned in practice — because *"the ideal world of the standard doesn't always work that way in real life"*. An improvement might be put in place that doesn't quite fit in with the recommendations, but works alongside other controls.

This was illustrated by a case of some shelves put up next to a clinical hand wash basin (HWB) on a children's cancer ward because staff had been putting their folders on to the potentially highly contaminated bin next to it. However, the shelves didn't fit into the RA

recommendations because they were within the 2 metre range of the HWB, so still within splashing range. To mitigate this, the shelves are kept clear and cleaned regularly.

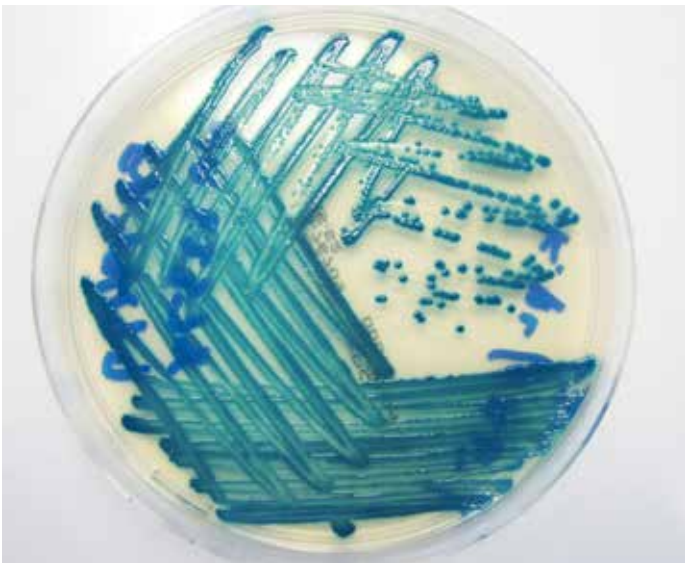
Multidisciplinary approach and communication

The first example above really highlights the value of the new standard's focus on a multi-disciplinary approach — but this needs to happen between different teams that fully understand how *P. aeruginosa* problems can arise and what their role should be in controlling this pathogen. A lack of awareness of *P. aeruginosa's* ecology and transmission, combined with a lack of communication between different teams can be a contributing factor in outbreaks.

The panel agreed that to be really effective, Water Safety Groups (WSGs) need to include attendees from clinical teams and infection control (ideally with experience of the built environment) alongside microbiologists, cleaning services and facilities management/ engineering/maintenance representatives.

Infection Control Nurse Specialist Alyson Prince suggested that an 'everyday' water monitoring team is also needed. This would focus on reviewing water sampling results and planned preventative maintenance (PPM) and escalate any exceptional results to the WSG who would then be better informed with an overall picture.

Peter Orendecki commented that where resources are available some hospitals do have 'Water Action Groups' (WAG). He stressed: *"The RA process should look at engagement [with the WSG] and how that is managed. Engagement and collaboration has to be someone's responsibility."*



The importance of good communication and engagement were mentioned frequently by the panel members. Authorising Engineer (AE) for water Karina Jones emphasised in particular that rather than different departments working in their own silos there is a need to move from a "not my responsibility" culture to a consensus that everyone involved needs to get around the table. *"A no blame culture is vital because people get defensive...When you manage to get everybody engaged... its a big win,"* she said.

Competency and training

The discussion frequently returned to the importance of training, with the panel agreeing that 'competency' is crucial in prevention of transmission of *P. aeruginosa* and other waterborne pathogens. They concurred that relevant and proportionate education is the key to each discipline's full competency in really understanding the significance of their interactions with water — but that sometimes there are gaps.

For example, they noted that Infection Prevention and Control teams (IPC) rarely receive formal training in water management in the built environment, despite HTM 04-01 stating this should fall within their remit. The responsibility for IPC is generally considered to focus solely on patient caseloads and how to manage and audit outbreaks.

Graham Griffiths, an NHS Water Services Manager, emphasised that: *"the cleaners are probably the most important people. Although they were given specific instructions about cleaning taps, without understanding the reason for these instructions, over time their cleaning practices slipped.*

"I introduced the rule of one sink, one cloth, which really cuts down the [bacterial] counts. But I also gave the cleaners further training on best cleaning practice and on ***why*** *they were being asked to follow specific instructions. I showed them the green finger slide..."*

(Green nail syndrome (GNS) is a nail infection caused by *Pseudomonas aeruginosa*, which leads to green discolouration of the nails. Its treatment is often challenging).

Antimicrobial resistance (AMR) and drains

All waterborne pathogens have the potential to develop resistance to antibiotics. Alyson Prince brought up her concern over Carbapenemase Producing Enterobacteriaceae or CPEs which are generally harmless in a healthy population, but can cause infections if they get into urine or the bloodstream. Individuals with weakened immune systems, such as hospital patients, are most at risk. CPEs tend to live in the gut and so easliy get into waste water. These bacteria can then emerge from waste water services and enter the hospital environment via patients who are already colonised, to potentially colonise other patients. There are now increasing reports of patient CPE infections that have originated from hospital waste water.

The panel discussed at some length the role of water outlet drains and wastes as reservoirs of AMR in healthcare settings. Misuse of HWBs was also identified as a major contributor to this problem, particularly due to blockage of all types of basins — often with bits of paper towel and clinical wipes — leading to slow drainage and build-up of biofilm (see Box on p11). These reservoirs of bacteria tend to remain even after the blockage has been cleared. This then creates the potential for splashing and/or regurgitation of contaminated water from the drain. Other material incorrectly disposed of in water outlets, such as drinks, human waste, washing water, antibiotics and even soap, will also literally 'feed' the problem.

This contamination issue isn't just confined to AMRs — it applies to all bacterial water contamination. A building's drainage system can be seen as a 'super highway for microorganisms. This means that although HWBs are generally considered as the culprits; there have been instances of outbreaks originating from both ward and main kitchen sinks and drains because they are all linked via the waste water system.

> *"A CPE is a bit like a Porsche going down the main road blaring its horn and all its lights flashing,"*
> *Dr Mike Weinbren*

However, the panel chair Elise Maynard emphasised that, in reality, it is impossible to maintain a perfectly sterile waste system. For example, even simply washing dirty hands will inevitably introduce bacteria into drains and in any hospital it would be impossible to prevent all manner of things getting into HWBs. *"We know it is going to happen... so we can't entirely stop it to a degree, but we [can] stop it coming back out of the drains."*

Significantly, Clinical Microbiology Consultant Dr Mike Weinbren highlighted that clinical surveillance is often not good at picking up transmission events — or not until a resistant organism turns up. These are picked up because they stand out: *"A CPE is a bit like a Porsche going down the main road blaring its horn and all its lights flashing,"* he said. *"Often, it is only then that a problem with contaminated waste traps comes to light."*

Dr Weinbren stressed that *"[The problem of] AMR and drains needs to be elevated nationally and globally, because at the moment this is seen as [something that happens only] in developing countries...Training, competency and understanding have an important bearing on ... AMR."*

Drains: prevention and mitigation of contamination

Maintenance teams often do not have a process to clean and manage this problem before the outlet goes back into use. This is an issue that should be picked up in RAs, Elise Maynard emphasised — by returning to an understanding of where contamination could take place and what can be done to prevent that risk in future.

So what can be done? After extensive discussion, the following main points emerged:

- *Human factors*
  Education, as discussed above, can play a big part in reducing contamination of drains and waste traps when there is more understanding of the consequences of mis-use of strictly clinical HWBs. Signage can also help to reduce patients' and visitors' use of HWBs for disposal of drinks, food, antibiotics and human waste washing water.

- *Design*
  Addressing this problem should start at the design stage of any facility: consideration should be given to placement of paper towel dispensers so they are not situated directly above HWBs, where small pieces can easily fall into drains when the towel is torn off by the user.

Concentrations of soap can also encourage bacterial proliferation. Likewise, soap dispensers that can continually ooze soap into HWB drains could be placed to the side of outlets.

- *Dealing with blockages*
  AE and Water Consultant Steven Van De Peer stressed the importance of looking for finer detail and understanding of what causes contamination and how that gets into the environment — with basin blockages being one of the more straightforward issues to identify.

  One organisation's approach to drain blockages was described: if contamination is identified and back flow is found from the drains, the room in question is isolated and not put back into use until it has been deep cleaned, including mitigation of the drain contamination.

- *RA: instructions and reporting*
  Reporting blockages can be put into a risk assessment, although detailing how to mitigate these would be outside its scope — this would be in the WSG's remit.

- *Asset lists*
  A list of water assets should be included in any RA. The list would include taps and showers and should extend to clinical assets such as nebulisers and incubators.

  This list could be expanded by defining different groups of 'assets', such as water system assets, clinical assets, maintenance assets and cleaning assets, and establishing which discipline should be responsible for each of these. Involvement of contract managers and cleaning managers was suggested, for example, and this responsibility would also make staff feel closer and more involved.

- *Allocating resources*
  Timing is crucial in breaking the chain of contamination. Karina Jones emphasised that the argument: *"we don't have enough resources...[doesn't help]...if we cross-contaminate five other rooms and we need to address an even bigger area. Bacteria don't stop growing...it's not a case of waiting past the weekend and I'll address this on Monday."*

Role for manufacturers in reducing risk?

The panel also discussed how important not only good design of water outlets is, taps in particular, but also their correct installation: incorrect and shoddy installation has frequently contributed to outlet contamination and the problems described above, for example, elbow-operated levers fixed at the wrong angle (see pp 12-13, 16).

In this context, Peter Orendecki defined two types of risk in water systems: inherent and residual. He said: *"Inherent risk is designed into the system. As long as we work towards the lowest possible inherent risk in a system, we remove all of those choices...If we can try to eliminate that, the rest is process: there wouldn't be many different types of installation and they wouldn't be installed incorrectly. This would also make risk assessment easier."*

The panel discussed the role of manufacturers in reducing risk through design and education. Elise Maynard made the observation that companies who engage with the end user to solve problems through collaboration on design should be able to produce more effective, 'lower risk' products.

Could manufacturers also have a further role in engineering-out risk by producing products for very specific functions to help eliminate unsuitable products being installed in the wrong area, inevitably requiring subsequent remediation? An example might be a 'plug in'

and 'play' 'augmented care sink' that can only be installed in one way and only be suitable to work in conjunction with a selected range of products. However, Karina Jones emphasised that manufacturers *"shouldn't innovate for the sake of innovating"*: products should be kept simple and easy to clean or thermally disinfect and reassemble.

The group also discussed whether there could be scope for manufacturers to go beyond delivering just a physical product — to deliver a full service to ensure that well designed appliances are installed correctly?

Manufacturers could provide 'in-service' training in a package that managers can utilise as part of a training curriculum. After all, as Steven Van De Peer observed, this would offer *"a whole clinical solution [because] you don't buy a car in bits....We need to get to the stage where we have the lowest level of inherent risk for the level of product installation and design."*

And in future, could such an approach create a more constructive role for outlet manufacturers in helping to plug knowledge gaps, spreading the word about best practice for the benefit of patients, filling in where over-loaded IPC professionals may not have the time and resources?

This snapshot of the Third WSF conversations will continue in Part 2, to cover: different types of outlet operation (sensor, elbow, TMVs), hand hygiene, design of wash stations, new build commissioning and procurement, engineering factors and remote monitoring.

A reminder about biofilm

Waterborne pathogens inhabit damp environments because of their ability to form biofilm, an intricate and protective colony of microorganisms that can 'glue' itself to inanimate surfaces such as metal and plastic. 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 in the water system.

In healthcare, the niches that biofilm can inhabit includes: taps, HWBs, baths, shower heads and hoses, hydrotherapy pools and mop heads and cleaning buckets.

Biofilm grows best in: stagnant water, such as dead-end areas of a water system, e.g. where an out-of-use outlet has been blocked off; slow flowing water; anywhere with even a tiny amount of organic matter to provide nutrients, such as trapped debris inside tap fixtures; deposits of soap; shower gel and shampoo around basins; baths and showers; anywhere with lime scale deposits; and basin and sink seals.

Water Safety Forum Panel

Elise Maynard — Chair
Independent consultant to the water and medical devices industries, state registered microbiologist and a Director of the Water Management Society (WMSoc).

Eugene Conroy
Managing Director, at multidisciplinary engineering consultancy Eta Projects Ltd.

Graham Griffiths
Water Services Manager and Responsible Person (Mitie) for Tunbridge Wells Hospital. WMSoc member and former *Legionella* Risk Assessor.

Karina Jones
IHEEM-registered Authorising Engineer (AE) for water at engineering consultancy Eta Projects Ltd and a member of WMSoc and IHEEM.

Peter Orendecki
Senior Contract Manager, Water Hygiene AP, University Hospital Southampton NHS Foundation Trust.

Alyson Prince
Built Environment Infection control Nurse Specialist, Senior Consultant at healthcare infrastructure specialist Archus.

Steven Van De Peer
Principal Consultant and Authorising Engineer (Water), Tetra Consulting Ltd and a member of WMSoc and IHEEM.

Dr Mike Weinbren
Consultant Microbiologist for NHS Scotland Assure, whose remit is to minimise risks from the Healthcare built environment, AMR Clinical Lead and Chair of the Hospital Infection Society Working Group on Water.

ANTIMICROBIAL RESISTAN HAND WASHING — MORE P

By Mike Weinbren, Consultant Clinical Microbiologist

Hand washing/decontamination is a key measure in the prevention of transmission of antimicrobial resistance (AMR) and many other infective risks.

While alcohol hand rub is the preferred method for hand decontamination, when hands are visibly dirty or have been in contact with an organism resistant to alcohol use of a hand wash station (HWS) is required. In the UK operation of HWSs should be hands-free, in general requiring either sensor or elbow operation.

This requirement for hands-free operation at hand wash stations is fundamental to preventing the HWS becoming a source of cross infection. Staff using a HWS will have highly contaminated hands so hand operation will inevitably contaminate a surface such as a conventional tap. If after washing hands the user touches the same surface to turn the outlet off, then hands will become re-contaminated. There is also a further danger: the tap itself could also become contaminated, in turn leading to contamination of the water supply further upstream to cause systemic issues within the plumbing system.

Pros and cons of sensor and elbow operation

Sensor- and elbow-operated outlets have their own advantages and disadvantages.

With sensor-operated outlets there is a concern that the increased complexity predisposes to biofilm (see pp 11) formation (bacterial growth). Additionally, because there is no standard for placement of the sensor for operation of these taps, there may be a learning curve for users during which hands may make contact with the end of the outlet and introduce contamination. However, a major benefit of sensor-operated outlets is that they can be programmed to flush automatically, a potential advantage in areas of infrequent use where a HWS is still required.

Elbow-operated outlets are generally preferred, have been in existence for much longer and therefore might be expected to be a tried and tested solution. They cost less and are thought to represent a lower risk of biofilm formation, despite invariably being fitted with a thermostatic mixer valve or tap in healthcare facilities, even when a risk assessment would show this as unnecessary.

Elbow-operated outlets in practice

What is the evidence that elbow operated outlets work in practice? The minimum requirements for using elbow-operated outlets correctly are listed in Table 1. It is implicit that not only users but also design and installation teams understand the function and requirement for an elbow operated outlet if it is to be used correctly.

Table 1 .Requirements for elbow operated outlets to be used correctly

1. Correct design
2. Correct installation
3. Staff training on correct use

Correct design

The elbow operated lever needs to be long enough and readily accessible to be operated using an elbow. Accessibility is best afforded when the lever is angled forward away from the body of the outlet towards the user (see Figure 1). Some manufacturers recommend that the elbow operated lever is in line with the main body of the outlet i.e. parallel to the inspection panel behind. In my experience this makes it extremely difficult to engage an elbow with the lever. It is both too far away and there is insufficient space between the inspection panel and lever. Furthermore, when in this position, placement of hand detergent or towel dispensers above the outlet further prohibit use of the elbow.

The latest British Standard BS 8580-2:2022 Part 2: Risk assessments for *Pseudomonas aeruginosa* and other waterborne pathogens — Code of practice (see pp 5-6)

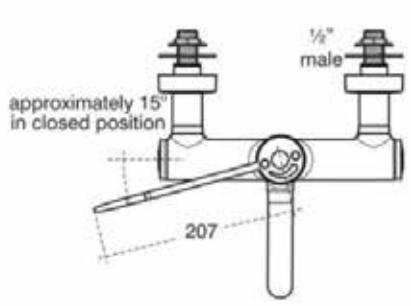


Figure 1. Bird's eye view of outlet

Shows view looking down from above onto an outlet demonstrating the correct placement of elbow-operated lever positioned forward of the main body of the outlet.

CE, INFECTION CONTROL AND POWER TO YOUR ELBOW?

recommends: *"Elbow operated outlet handles need to be set up so elbow can readily engage with lever".*

An additional advantage of sensor-operated outlets is that they always draw on both the hot and cold water supplies. With elbow-operated outlets, many staff only move the elbow lever a short distance, which may not ensure an adequate draw on the hot water supply. With some manufacturers the elbow lever needs to be rotated 180° to maximise hot water flow, but this rarely happens in practice.

Some manufacturers have now designed out this problem. For example, in Armitage Shanks's Markwik 21+ products, since 2016 the lever must be fitted at 45° forward for correct operation and also has a shorter total 90° rotation to achieve maximum rotation. An arrow on the assembly facilitates correct alignment and this is emphasised in the instructions.

Figure 2: The Glo™ box

Hand hygiene training is mainly based around technique, an example of which is the Glo™ box (see picture above). A hand cream (which fluoresces under ultraviolet light) is applied to hands. The person is then asked to wash their hands with soap and water, dry them and then the hands are inspected under UV light. Poor hand wash technique is shown by fluorescence from un-removed cream.

Correct installation

Failure to understand the importance of correct set-up of the elbow lever by installation teams may result in at least 40% of outlets being set up incorrectly. In some cases, even when the outlet is well-designed, manufacturers' layout instructions do not adequately describe or stress that the angle of set-up is key to the proper performance of the outlet.

Staff training on correct use

Most training on hand washing emphasises technique (see Figure 2) — staff are not trained on how to use either a sensor or elbow-operated outlet, even though the name 'elbow-operated' outlet would suggest that use should be intuitive. Studies show that more than 90% of individuals use their hands to turn on elbow-operated outlets and that more than 60% use their hands (re-contaminating) to turn the flow of water off. The elbow operated lever now becomes a highly touched object and a source of cross contamination.

But matters are compounded further. Elbow-operated outlets are frequently installed flush with the inspection panel behind, negating their operation through use of elbows. Even though installed incorrectly, this deficit is not recognised, understood or reported so remains in place.

Compliance with hand hygiene is disappointingly low. Even when allowing for staff usage of a HWS, there is a more than 60% chance that it will have been used incorrectly – making the real figures for compliance become worryingly low.[1]

What is the answer? An effective solution also needs to take into account human nature and likely compliance. Grabowski *et al* found that only 4% of visits to a HWS were for the right purpose.[2] Kearney *et al* when looking at the risk of acquisition of highly antibiotic resistant organisms from HWSs in an ITU setting found the most effective solution was engineering out the risk i.e. removal of the basin. The least effective solution was guidance and training.[3]

To even start to get this right requires manufacturers, installation teams and infection control to understand the correct set-up of an elbow-operated lever. Once infection control personnel understand this, they can then devise

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Step-by-step tap disinfection guide

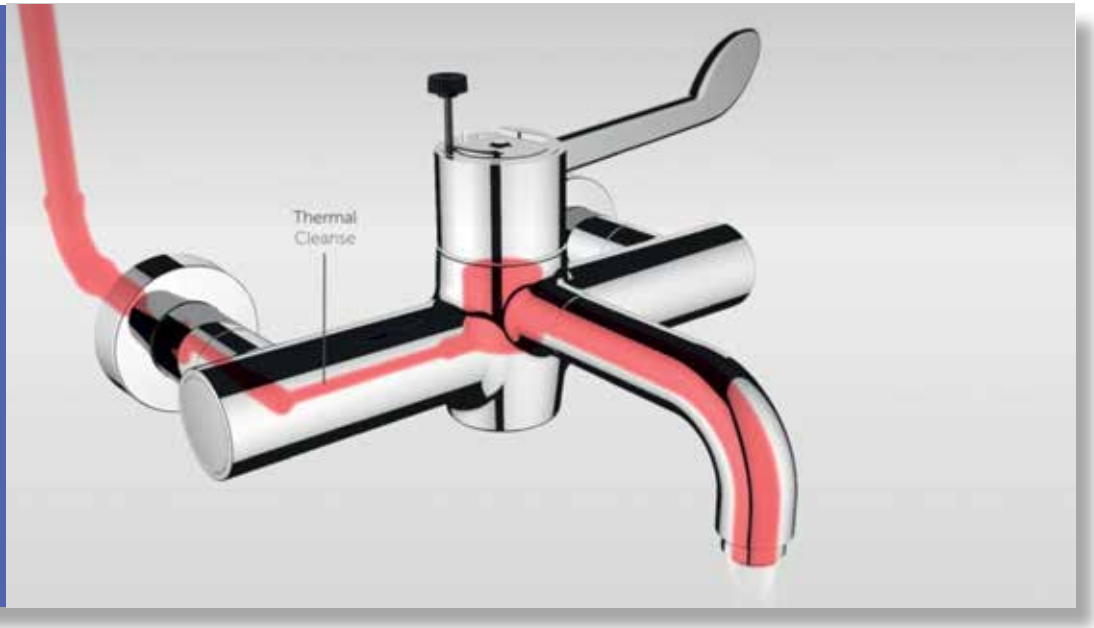
THE MARKWIK 21+ TAP

Markwik has an integral thermostat.

Thermostat situated as close to the point of use as possible to reduce opportunities for bacterial growth.

Markwik Taps can be thermally disinfected.

The thermostatic cartridge has a built in thermal override feature.



Step 1 First release the collars.

Step 2 Shut off the water inlets to isolate the fitting by using an Allen key.

Step 3 The spout can be removed for cleaning in an Auto clave.

Step 4 Once the fitting is isolated it can be removed from the wall.

Step 5 Removing the tap lever is easy by removing the securing screw and lifting it off.

Step 6 The cartridge can then be removed from the body of the tap.

Step 7 The cartridge can be replaced or cleaned and disinfected.

Step 8 Each of the components of the mixer can be disinfected.

Figure 3. Knee operated outlet

training for the healthcare staff. Engineering out the risk is likely to be the most effective solution and sensor operated outlets would appear to offer a significant advantage. However, in the past we have had knee-operated HWSs (see Figure 3). Perhaps this is the way forward.

While hand decontamination is seen as the single most effective intervention to prevent cross infection, we are failing to get the basic design and use of HWBs optimised to ensure effective and safe hand washing practices.

Whilst clinical hand wash stations are required to be operated hands-free, hand wash basins in patient communal bathrooms are hand-operated as they would be in most households across the UK. After going to the toilet, turning on an outlet with contaminated hands will deposit organisms, which are likely to re-contaminate hands when turning the outlet off. Turner *et al* report a CPE outbreak in a communal bathroom linked to contamination of a hand operated tap.[4]

There is no logic to the current operation of outlets used for hand washing where hands are used both to turn on and off the outlet. If paper towels are available, the WHO recommend they should be used to dry hands first and then used to turn off the outlet to prevent re-contamination of hands. However, paper towels are rarely available in domestic settings. There are implications not just for hospitals, but also for public health.

In healthcare, the current use and design of HWBs permits deposition of faecal organisms on the handle used to operate the outlet.

The 2016 O'Neill report forecasts the end of the antibiotic era by 2050, which will inflict an overwhelming burden both financially ($100 trillion) and on human life with 10 million excess deaths year-on-year[5]. A recent report for the year 2019 already shows in excess of one million deaths per year due to antimicrobial resistance[6]. Unless we get hand washing right, these highly antibiotic resistant organisms, which are often carried in the human gut, will inflict a deadly burden on humanity.

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