

Looking deeper

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Inside this issue

Sharpening the focus on hospital construction
pg 5-7

In the cut — net zero and water sustainability in healthcare
pg 8-10

Scalding risk guidelines
pg 10-11

Training for TMV maintenance
pg 12-13



More scrutiny equals safer buildings

Looking Deeper Editor, Susan Pearson

Sometimes it takes tragedy to lead to change. This was true of the Belfast paediatric deaths in 2012 – which led to the first water safety guidance for healthcare facilities, HTM 04-01 – and more recently has been the case in Scotland. Following the ensuing scrutiny after a run of serious failings at the new Queen Elizabeth University Hospital and the Royal Hospital for Children in Glasgow, NHS Scotland has since established its Assure Service, a major legal suit has been brought by the NHS against the main contractor and a high profile public enquiry is due to report.

While C.S. Lewis once said: “Failures, repeated failures, are finger posts on the road to achievement. One fails forward toward success”, in this case Bob Dylan may have been more on the mark, when he sang: “...failure’s no success at all.” Some of the failings at the new Glasgow hospitals have allegedly been hiding in plain sight: amongst other issues, it subsequently emerged that at the time of opening, the QEUH was warned of water contamination risks

due to water stagnation in parts of the building and hot water supplies running at incorrect temperatures.

In future, however, as we discuss on pp 5-7, processes have been established that will act to prevent such incidents from ever happening again – as NHS Scotland Assure will now ensure on-going scrutiny of planning for the healthcare built environment in Scotland.

“...failure’s no success at all.”

Bob Dylan: ‘Love minus zero/ No limit’, 1965

In last year’s Spring issue of Looking Deeper (Issue 11, 2022), we discussed the fallout from November 2021’s COP26 meeting on climate change – looking at implications for healthcare of water supply challenges, the effects of weather on waterborne infectious diseases and antimicrobial resistance (AMR). A year later, in the wake of 2023’s extreme summer heatwaves and fires across Europe and North

America, it’s clear there can be no let-up to the need to find solutions to address these issues.

On pages 8-10 we report back from a recent Water Management Society conference that continues the discussion of the impact of climate change in healthcare: how can the need to heat water to prevent microbial proliferation, alongside flushing with large amounts of water to prevent biofilm build-up, be made more sustainable in hospitals and care homes?

We also discuss how proactive training on fitting TMVs can help prevent service callouts (pp 12-14). New workshops run by Armitage Shanks are now available to educate on maintenance of fittings and how to resolve water conditions to optimise rather than compromise the function of thermostatic mixers prior to installation.

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Contents

02

Editorial

03

In the news,
Editorial Contributions

04

In the news

05/07

Safer hospital construction
in Scotland

08/10

Cutting carbon and water
use in healthcare

10/11

Scald risk guidelines

12/14

New training optimises
TMV maintenance

14/15

Letters to
the Editor

16

Latest Research, Diary

*Armitage
Shanks*

For commercial applications, Armitage Shanks, is the definitive British brand with pioneering solutions in washroom fixtures, fittings and water conservation. These solutions extend to bacteria sensitive healthcare environments, where the safe management and delivery of water is critical to infection control, controlling the spread of infectious diseases. Now leading the industry in safe water management, Armitage Shanks is committed to supporting the Water Safety Forum.

In the news...

'Chemical space' exploration identifies new anti-superbug drug

Artificial intelligence doesn't just mean robots: an AI algorithm has now been used by scientists to discover a new antibiotic that can kill the waterborne superbug *Acinetobacter baumannii*.

Listed as a WHO priority pathogen, *A. baumannii* poses a threat in healthcare and nursing homes to patients with open wounds and those who require ventilators and blood catheters.

The AI algorithm was trained by researchers at McMaster University and the Massachusetts Institute of Technology (MIT) to predict new structural classes of antibacterial molecules. The study, published in 'Nature Chemical Biology', analysed 6,680 compounds that the model had not previously encountered, identifying nine potential antibiotics. Of these the new compound abaucin was found to be especially promising because it only targets *A. baumannii*, which means the pathogen is less likely to rapidly develop drug resistance.

"This work validates the benefits of machine learning in the search for new antibiotics" says Jonathan Stokes, lead author on the paper and an assistant professor in McMaster's Department of Biomedicine & Biochemistry, who conducted the work with James J. Collins, a professor of medical engineering and science at MIT.

"Using AI, we can rapidly explore vast regions of chemical space, significantly increasing the chances of discovering fundamentally new antibacterial molecules," says Stokes, who belongs to McMaster's Global Nexus School for Pandemic Prevention and Response.



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 former Chair of the Water Management Society (WMSoc). She is a state-registered microbiologist, a BSI committee member and was on the steering group for Department of Health HTM 04-01: Safe water in healthcare premises. Elise is a Fellow of WMSoc, IBMS, IHEEM and also of the Royal Society of Public Health (RSPH), where she is an active member of the water special interest group. She chairs and presents at numerous international conferences.

Elise Maynard

Breakthrough peptide fights medical biofilms

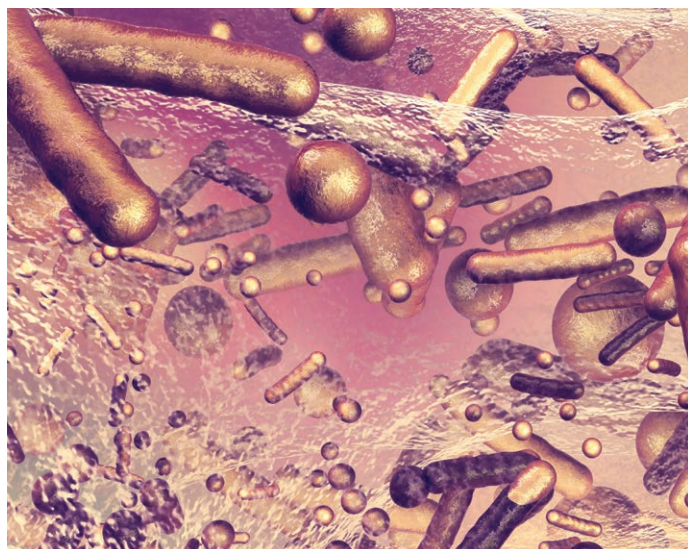
Researchers from the University of St Andrews have published a paper in 'Nature Chemical Biology' describing how they have developed peptides that can help combat bacteria growing in biofilms.

The team of researchers, led by Dr Clarissa Melo Czekster and Dr Christopher Harding from the School of Biology at St Andrews, in collaboration with researchers at the University of Dundee, worked out how a key enzyme (PaAP) in biofilms functions and developed a cutting edge strategy to inhibit the protein. Their inhibitor targets *Pseudomonas aeruginosa* cells in biofilms.

Dr Czekster and the team are currently working in collaboration with the University of St Andrews Technology Transfer Centre and industry partner Locate Bio, a biomedicine spin-off of the University of Nottingham, to commercialise the technology. The Technology Transfer Centre has filed a UK priority patent application.

Dr Czekster said: "Our research reveals how designed inhibitors can target a key enzyme in bacterial virulence, offering molecular insights applicable to aminopeptidases in diverse organisms.

"This remarkable new research presents an innovative strategy to target bacterial biofilms and pave the way for better treatment of bacterial infection."



Powder and sunlight in new combo for rapid drinking water purification

Researchers at Stanford University and the associated SLAC National Accelerator Laboratory in California have developed a simple water treatment that can kill thousands of waterborne bacteria in just seconds — offering a low cost ground-breaking solution for the two billion people around the world without access to clean drinking water.



The team's results published in 'Nature Water' describe a recyclable powder that rapidly kills bacteria when exposed to sunlight. The harmless metallic powder, which consists of nano-size flakes of aluminium oxide, molybdenum sulfide, copper and iron oxide, is able to absorb both solar UV and high-energy visible light.

The powder is stirred into a container of contaminated water and then exposed to sunlight, which rapidly kills the waterborne bacteria. The metallic powder can then be collected on a magnet and re-used in another container of bacteria-laden water.

In contrast, conventional water-treatment technologies can produce toxic by-products or take a relatively long time to disinfect.

Senior author Yi Cui, the Fortinet Founders Professor of MSE and of Energy Science and Engineering in the Stanford Doerr School of Sustainability, said: "The key innovation is that, when immersed in water, [these materials] all function together."

Sharpening the focus on hospital construction

How healthcare buildings are designed and built can have an impact on how well they function for their users — as *Looking Deeper* has discussed in previous issues.^{1,2}

In the wake of some major widely publicised incidents after the opening of the flagship Queen Elizabeth University Hospital (QEUH) and the linked Royal Hospital for Children (RHC) in Glasgow in 2015 — some of which are reported to have been caused by contaminated water systems³ — NHS Scotland has introduced new processes to protect against issues arising from the built environment via its NHS Scotland Assure service.

There have been many twists and turns in the journey to discover the causes of what went wrong at QEUH and RHC. With problems alleged to be related to the water system, ventilation, plant and building services capacity, glazing, doors, heating and atrium roof, in December 2019 the NHS Greater Glasgow and Clyde Health Board instigated a legal action against Brookfield Multiplex, the contractor responsible for the design and construction of the £842 million campus.⁴

In 2020, a public enquiry was launched to investigate the construction of the building. At the time of going to press, the enquiry is yet to report on its final conclusions.



NHS Assure and hospital water systems

Set up in 2022, NHS Scotland Assure's mission is to improve how risk is managed in the healthcare built environment across Scotland. Its terms of reference were set out by a team of experts and will consider all types of risk related to the built environment, covering



the full life-cycle of builds and refurbishments, from strategic assessment, building operations and ongoing maintenance, to decommissioning, in the context of ensuring safety, fitness for purpose, cost effectiveness and capability to deliver sustainable services.^{5,6}

NHS Assure delivers advice and guidance on what Scottish NHS Boards are expected to deliver in terms of how they acquire and commission new buildings and how existing buildings are refurbished.

There is now an increased focus on how the Scottish NHS engages with the architects, the contractors — both main and sub contractors — and consultants during the run-up to the design and during a hospital build. The order of plans and actions has never previously been laid out, but this has now changed. New hospitals and health centres are constantly on the drawing board in Scotland and these all now have involvement from NHS Assure through a team of external advisers for each discipline, such as water, ventilation, medical gases etc.

Where originally (independent) external advisers audited and advised on the operation of hospitals, there has been an increase in the involvement of authorising engineers (AEs) in the design and construction phase, when compared with their involvement with the operational phase of existing buildings. NHS Assure aims to make sure that any potential issues on the drawing board are designed out before any cement and bricks are laid.

For hot and cold water systems, a *Legionella* risk assessment (RA) for each system is a legal requirement.^{7*} Specifically, there is currently a move towards risk assessing water system schematics prior to construction and then assessing them again prior to commissioning.

This means that if things are found obviously wrong at the start they can be fixed before the system is 'wetted'.

A key learning point that has developed from the "Summary of Incident and Findings of the NHS Greater Glasgow and Clyde: Queen Elizabeth University Hospital/ Royal Hospital for Children water contamination incident and recommendations for NHS Scotland",⁸ published in 2018, is that a variety of roles and responsibilities needed to be developed and implemented, i.e. Water Safety Groups (WSG), and that the infection control teams need to be involved from the very start of the project. This is a step that has not happened in many hospital construction plans. Now, Boards will be expected to follow NHS Assure processes from the commissioning stage and must include input from their WSGs to minimise any opportunity for problems down the line.

This is a robust process that should prevent issues. However, if something undesirable is spotted, this would lead to a question of the level of risk posed.

Changing relationship with contractors

In relation to water safety there is now a much greater focus on ensuring that the contractors plumbing in the water systems have an awareness of what is specifically required in relation to healthcare water systems. Experience with hotels and shopping centres is not enough: for example, some plumbers may not know the (unacceptable) healthcare implications of leaving dead legs in place. As a result, NHS Scotland is now running multiple trainings on healthcare plumbing and the

NHS Boards appointing plumbers to carry out remedial works or to build new water systems now expect to see evidence of competency in the plumbers they engage.

However, this is not necessarily straightforward as the following situation could potentially occur: a main contractor winning a major multi-million pound contract for an acute hospital will likely appoint further contractors for plumbing, ventilation etc. These contractors should be competent, but in turn could potentially further sub-contract to operatives whose competency might not have been checked quite so robustly. To avoid this happening, NHS Scotland now requires assurances in a contractor's tender — a requirement that is already having a significant impact.

Construction phase WSP

Contractors building a hospital or new wing or refurbishing an existing part of a hospital are now expected to provide a construction phase water safety plan (WSP) — although this has not yet been outlined anywhere in the guidance.

Risk assessments prior to a system being wetted are now required so that any risks that might arise must be robustly assessed and mitigated prior to the system being filled with water. The system will need to be leak and pressure tested while work continues in the rest of the building. There must be a focus on what will happen during this period, which could be a year or more, before the building is handed over to the NHS. This would include flushing, checking water temperatures and inspection of water storage tanks.

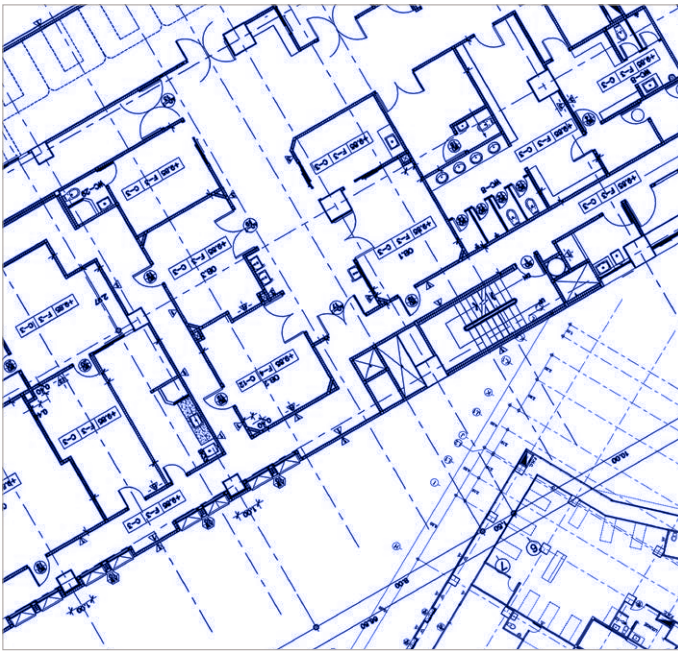
NHS Scotland Assure have an oversight role in this process to check that an AE has been involved, contractors' competence has been checked, that a system is reviewed once wetted and that a competent risk assessor has checked the water system thoroughly.

Climate change and sustainability

The push for net zero carbon and, ideally, a reduction in water usage means that creative new ways are needed to look at how water systems are operated to satisfy these demands — yet these solutions bring in factors that impact risk right from the start of a project. For example, air source heat pump systems should ideally have an "anti-*Legionella*" cycle to heat the water to at least 60°C once a week — but is this sufficient for healthcare properties?

Yet buildings are now going up in Scotland that have radical differences in design, such as a healthcare building with no central hot water system.** This is a large building installed only with a cold water system and fitted with point-of-use (POU) water heaters. Cold water is delivered to the wash hand basins (WHBs) and





sinks, each of which has a water heater below so that hot water runs only through those outlets. While most of the time cold water is fine for hand washing, hot water will still be needed on occasion.

Is current building guidance fit for purpose?

While a number of British Standards have recently been updated, there is always more that can be done as our understanding increases. Organisations such as the Health and Safety Executive and Chartered Institution of Building Services Engineers (CIBSE), in England, are currently undertaking a programme of updates to their guidance, which should take into account more recent knowledge and learning. NHS England also needs to undertake a thorough review of their Health Technical Memoranda (HTMs) and Health Building Notes (HBNs).

In addition, the net zero carbon issue needs to be addressed more thoroughly in the guidance and solutions found for sustainable water use while flushing remains a crucial control measure for prevention of water stagnation (see pp 9-10).

Conclusion

While the public enquiry is still underway, firm conclusions as to the definite causes of the various incidents at QEUH and RHC cannot yet be drawn; however, it is clear that establishing the causes of what happened will help increase scrutiny on how we design and build in future.

Some aspects that need to be considered right from the beginning of a project are:

- Is temperature control alone a sufficient control measure for huge buildings, particularly those housing immuno-suppressed patients?

- A focus on the risk of little used outlets and plumbing dead legs (leading to potential stagnation and biofilm) in large buildings with miles of pipe work.
- Should high risk units be housed with a completely separate water system, with chemical dosing and long term filtration in place?

Editor's note: NHS England and Wales have yet to follow NHS Scotland's Assure scheme in formalising the scrutiny of safety risks at the design and commissioning stage of new healthcare facilities.



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- * Paragraph 28 is explicit in stating that a RA is required wherever work activities take place. Paragraphs 28 and 75 makes clear the duty extends to those involved in constructing a new installation.
8. https://www.nss.nhs.scot/media/2286/1_queen-elizabeth-university-hospital-royal-h.pdf

** Location embargoed at time of going to print.

In the cut — net zero and water reduction in healthcare

Seventy-five years on from the foundation of the NHS, climate change represents a major and rapidly advancing threat to human health, one far beyond the imagination of its 1940s' founders. In 2020, to meet the huge challenges involved, the NHS took the lead to become the first national health service to make a commitment to reach carbon net zero. One year on from its launch, the 'Greener NHS Programme' had already made a huge dent in its carbon emissions — equivalent to powering 1.1 million homes annually.

According to NHS England: the NHS is responsible for 4% of the total carbon emissions of the UK. In 2021/2022, an annual consumption of 11.7 billion kWh for heating and hot water accounted for 80% of NHS carbon emissions.*

The "Delivering a Net Zero Health Service" report on which a greener NHS is based sets out two-evidence-based targets:

- The NHS Carbon Footprint: for directly controlled emissions: net zero by 2040, with an ambition to reach an 80% reduction by 2028 to 2032;
- The NHS Carbon Footprint Plus: for emissions that can be influenced: net zero by 2045, with an ambition to reach an 80% reduction by 2036 to 2039.

However, sustainable healthcare is not just about cutting carbon emissions: in 2021/2022 alone, the NHS consumed 14 million litres of hot water.** As water supplies also increasingly come under pressure, with constantly rising demand for fewer resources, cutting water consumption also needs to be addressed.

Since two of the mainstays of water safety for the healthcare sector are heating water to high temperatures, typically using gas, and flushing with large volumes of water, both net zero and cutting water consumption is a huge challenge across the healthcare water sector.

And while the NHS targets may not necessarily affect private healthcare and care providers in quite the same way, they will be working to similar targets and will be dealing with similar issues.

The problems and some of the possible solutions to these conundrums were recently highlighted at a Water Management Society (WMSoc) event 'Waste Not, Want Not': the discussions that emerged are summarised as follows.

Reducing energy use

The guidance for making water safe in healthcare premises to protect against waterborne pathogens such as *Legionella*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Stenotrophomonas maltophilia* and *Mycobacteria* focuses on keeping hot water very hot, 60°C flow, 55°C return, and cold water very cold, below 20°C or 2°C/4°C below the supply temperature, and keeping all water moving to prevent water stagnation and therefore the opportunity for bacterial biofilm growth.^{1,2,3}

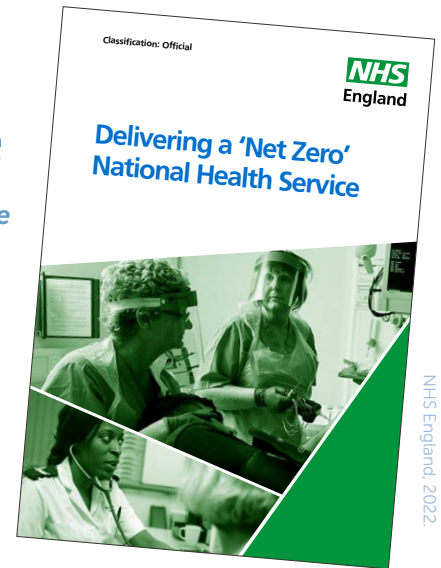
However, hot and cold water must be risk assessed for scalding at the point of (potential) patient use. There is also a requirement to increase flow temperatures to above 70°C to allow for thermal disinfection if any water sampling has indicated an elevated microbial risk.

In searching for ways to reduce energy consumption to achieve the currently required temperatures, new technologies, such as solar, air and ground source heat sources, along with water reduction, will require further time for training and the development of new relevant guidance — although the water regulations guidance is currently under review and being updated on a rolling platform to make it easier and more accessible.

DEFRA NATIONAL WATER TARGETS (THE ENVIRONMENTAL TARGETS (WATER) (ENGLAND) REGULATIONS 2022. ENVIRONMENT ACT 2022)

- Overall 20% reduction in water into public supply by 2038
- The reduction of *per capita* consumption (PCC) to 122 L/per day by 2038 and 110 L/p/d by 2050
- The reduced overall business consumption by 9% by 31 March 2038, and 15% by 2050
- The reduction of leakage by 37% by 2038 and 50% by 2050.

Ten-point plan to achieve these targets for new home and retrofit plumbing, including a mandatory water efficiency labelling scheme.



The following solutions can be considered — but none is perfect, each coming with its own set of potential problems:

- *Reducing flow temperatures:* this would require changing the NHS guidance, which is currently unlikely.
- *Heat pumps:* a standard heat pump has a Coefficient of Performance (CoP) of 3.0-3.5, whereas a high temperature heat pump (needed to ensure flow temperatures) will typically have a CoP of 2.0 or less. This brings significant electricity demand, additional costs and complexity of combined heating and hot water infrastructures. For example, a domestic sized heat pump has a maximum output temperature of 55°C resulting in water being stored at a temperature less than 50°C, possibly resulting in the survival of *Legionella* bacteria. Would a secondary heater be required to raise water temperature? And how often would this secondary thermal inactivation need to be performed?
- *Solar thermal:* could be part of the solution, but may not be able to heat the required quantities of water.



- *Point of use water heating:* has a CoP of 1, which again could lead to a huge electricity demand.
- *Chemical water treatment:* water treatment interventions, such as chlorination, UV light radiation, ozonation and silver stabilised hydrogen peroxide could reduce the need for high water temperatures to kill pathogenic waterborne bacteria. However, there are significant downsides: the potential for harmful by-products — additional monitoring will be needed. UV is only active at the point of contact with the light.
- *Heat recovery from wastewater:* exchange of heat from hot wastewater via a wastewater pipe going through a heat exchanger and back into the gas or oil boiler that heat treats the water, which cannot be carried out with a heat pump. However, heat recovery from wastewater can come at a high price, although can be very successful when delivered at an industrial scale.



Leighton Reservoir in Nidderdale, North Yorkshire, UK in August 2022 with seriously low water levels due to no rainfall for many weeks resulting in a hosepipe ban.

In the meantime, the Health and Safety Executive (HSE) is working alongside other Government departments to develop guidance for developing technologies, such as heat pumps, solar and carbon capture.

Saving water

Why do we need to save water? An increasing population alongside building of new homes is increasing demand, yet available water supplies are reducing; this is largely due to a changing climate, but, according to Ofwat, a fifth of water running through pipes is also lost through to leakage.⁴

Healthcare guidance¹ recommends a nominal 12 hours' total on-site storage capacity, while little used outlets should be flushed according to risk to prevent build up of biofilm, which could be daily in augmented care units. This all amounts to usage of an enormous amount of water, especially where flushing is performed as part of the routine daily sanitary outlet cleaning operations.

In domestic settings, smart metering, use of more water efficient devices and repair of leaks is a way forward, but can only realistically be achieved through policy and regulation. The Government has set reduction targets per capita and for business (see box opposite), but in healthcare, achieving reductions while maintaining safety will be highly problematic. Possible measures include:

- *Reduce flushing of little used outlets:* Technology could address monitoring and automatic flushing of outlets and should be included in future NHS guidance. However, in the meantime it is often difficult to identify and track truly little-used outlets, resulting in more outlets getting flushed unnecessarily as a precaution.
- *Greywater:* This includes the leftover, untreated water generated from washing machines, bathtubs and bathroom sinks. Current healthcare guidance states that greywater should not be used in healthcare premises. However, it would be useful to review in order to identify suitable applications. For example, with suitable monitoring and controls, greywater could be used for flushing certain toilets.

Other considerations: antimicrobial resistance (AMR)

In 2014, in response to the rapidly emerging and very serious threat from AMR, then Prime Minister David Cameron set up the O'Neil Commission on antibiotic resistance – which projected that drug resistant infections will kill more people than cancer by 2050.

Water treatment centres and sewage networks provide the ideal environments for the growth of AMR reservoirs, with AMR organisms then percolating into the environment to effect both humans and livestock.



Available water treatment options include chlorination, UV light radiation, ozonation, membrane filtration and reverse osmosis, but more research is required to determine their effectiveness in relation to AMR. It has been shown that these highly resistant AMRs can be selected out, resulting in them out-growing the normal water flora.

Conclusion

Facilities management in the NHS will need to balance public safety requirements with sustainability and find solutions to reduce demand as well as how to store or provide hot water to achieve thermal disinfection.

This article was based on presentations from: Greg Markham, Serco; Andrew Walker, Thames Water; Duncan Smith, Health and Safety Executive; Dr Donald Morrison, Edinburgh Napier University; Jonathan Gaunt, Cundall.

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*According to ERIC (Estates Returns Information Collection)

**According to analysis of ERIC figures.

GUIDANCE ON THE PRINCIPLES OF SCALD RISK ASSESSMENT



The Water Management Society (WMSoc) have produced several guidance documents: one of the most recent of these concerns the control of scalding risks arising from domestic water systems in any workplace, with particular emphasis on those industry sectors where scalding risks are likely to be greatest, such as health and social care, and education.

Guidance on Legionella

Current national guidance on controls required to manage risks from Legionnaires' disease, published by the Health and Safety Executive^{1,2} and NHS England^{*3-6} (for healthcare facilities), which cover a range of potential waterborne pathogens, recommend the use of temperature as an effective means of controlling microbiological risks in water systems. However, when hot water is heated to temperatures required to effect control, this introduces risks from scalding.

This guidance on managing risks from exposure to *legionellae* (and other opportunistic waterborne pathogens) recommends distributing hot water at temperatures of no less than 55°C in healthcare premises and no less than 50°C elsewhere. Yet water discharged from outlets at these temperatures could present a significant risk to vulnerable individuals, and to others, particularly where whole-body immersion is possible.

HTM 04-01

The HTM 04-01 guidance advises that an assessment for scalding versus risk of infection from waterborne pathogens should be undertaken by water safety groups (WSGs) and that where the scalding risk outweighs the risk of infection, i.e. if there is a risk from whole-body immersion, thermostatic controls should be installed, commissioned, maintained, and tested regularly.

Where hot water is discharged at any outlet at the typical temperatures (50°C or 55°C), scalding risk assessments should use defined criteria to determine the potential scalding risk presented by individual water outlets within a building, or part of a building. This allows identification of those outlets where engineering controls are required.

Conversely, a suitable and sufficient assessment should provide a reasoned argument for the phased removal or substitution of any unnecessary thermostatic control devices. Any decisions made should be fully documented and agreed by the WSG or 'Responsible Person'.

Building regulations

Health Building Note (HBN) 00-10 Part C⁷ recommends that the water temperature at the point of delivery should be controlled by manual control (separate hot and cold-water taps or blending valves controlled manually by the user) and suggests that "assemblies that use manual control should be subject to a 'duty of care' risk assessment." The Building Regulations 2000,⁸ section G3, requires that the hot water supply to a bath be designed and installed to limit the temperature of the water to no more than 48°C. This requirement applies to baths in new accommodation, effectively meaning that a TMV must be fitted on the water supply to the baths concerned.

Risk assessment

The WMSoc guidance provides detailed information on how to assess and manage risk to comply with legal requirements⁹ where a building survey shows a potential for scalding exists. When planning and conducting the risk assessment, reference should be made to HSE published guidance^{10,11} and should be carried out by a person with the necessary competence and experience.¹²

Controlling risk

Where outlets are assessed as presenting a *significant* risk of scalding, suitable and effective controls must be applied, e.g. remove the outlet or install suitable engineering controls.

Where the assessment indicates that scalding risks are *insignificant* and the outlet is served by an engineering control, consideration should be given to its removal. There may be reasons other than



scald risk management that led to the installation of a thermostatic control device, e.g., to provide water conveniently at a comfortable temperature for hand washing or to allow hands-free operation of the outlet. The outlet may be a sensor tap installed for user convenience and/or infection control purposes or it may be an automatic flushing device installed as part of the WSP counter measures.

The WMS guidance contains a useful flow-chart and more detail on recording and reviewing the control measures. It is free to download for Water Management Society Members at www.wmsoc.org.uk.

*There are equivalent guidance documents in Scotland (SHTM), and Wales (WHTM). The English version of HTM 04-01 is usually adopted in Northern Ireland.

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12. What is competence? <https://www.hse.gov.uk/competence/what-is-competence.htm>

NEW TRAINING OPTIMISES TMV



When service engineers are called in to attend to a malfunctioning or poorly performing thermostatic mixer* they often find that the fitting has not been properly installed or set up in the first place, or has not subsequently been maintained correctly. Yet many of the issues that crop up could be prevented through better understanding of how fittings should be maintained and how water system conditions that could compromise their function can be resolved before the thermostatic mixers are put in place.

Armitage Shanks's team of service engineers has often delivered training for estates and facility management personnel following resolution of a service issue, educating users on how taps should be properly commissioned and maintained. However, instead of *reactive* training it would be more ideal for users to receive training to best understand their fittings *before* issues arise, thereby preventing problems and the need for potentially costly intervention from service engineers. Responding to this need, Armitage Shanks has now developed a *proactive* fittings training workshop to help educate and inform clients, thereby preventing many issues.

More recently, this education — much of which can be applied to fittings from any manufacturer — has been rolled out to a much wider audience via an easily accessible video on YouTube. This training, in person or on-line, covers audit and installation procedures, checking of water supplies, removal of components for servicing and thermostat and filter checks.

When things go wrong, or appear to be wrong, the causes of the types of issues that occur tend to fall into three categories:

Water temperature

The most common problem leading to service engineer call-outs relates to water temperature issues, with fittings not functioning properly or the cold water failsafe appearing to malfunction.

Some apparent 'problems' are due to misunderstanding of the specific HTM 04-01 'Safe water in healthcare premises' regulations.¹ To reduce the risk of scalding all thermostatic taps (TMVs) are designed to shut down in the event of cold water failure. However, it is sometimes believed that the hot water should be completely shut off — yet this is not the case; according to the HTM 04-01 D08 supplement after the first five seconds the mixed water should either shut off completely or dribble after five seconds at a rate of 120ml in 60 seconds.

Wash basin mixers (as there are specifically higher temperature sets for bathing applications) in augmented care units have also been found set to the wrong temperature: they should never deliver water above 41°C, but this can be misinterpreted, with temperatures set too high.

Under test conditions such as the cold water isolation (CWI) test, a 2°C increase is permitted, which means that up to 43°C can be recorded. However, the valve should not be set at 43°C before testing commences. The additional 2°C allows for tolerances within the

COMMONLY RAISED CONCERNS

Issues most frequently raised by estates teams during training include:

- Poor quality, and therefore incorrect, spare parts being installed during maintenance
- Poor water quality — which can be resolved by prevention of the issues as discussed in this article
- Lack of finance is a major issue: with particular concern over the cost of replacement parts
- Different makes of taps across a large site, which requires a wide working knowledge of operating and maintenance procedures, plus the costs that this entails in terms of different specialist tools
- Making sure that the different trades on the site have the knowledge to maintain specific outlets.

MAINTENANCE

mechanism that under the shock of a CWI test could be utilised. The valve should be set to a maximum of 41°C.

Sometimes problems arise because of the chain of people who may be involved in installing the taps: the baton is passed through several stages so that aspects of the set-up become 'lost in translation' making it crucial to document all test results.

The installation process often begins with the mechanical and electrical contractor who installs the water supply pipe. This may be followed by someone else who attaches the tap to the IPS panel and possibly a further individual who connects the fitting to the water supply, before the fitting is 'commissioned' — i.e. the hot water and return temperatures are set at 55-65°C and the cold water temperature, 5-20°C, is checked — by yet another person.

To circumvent this happening, logged record keeping is required. The log document, either a paper record or more recently likely to be through a barcode scanning system, should ensure that previous test results can easily be compared against the latest findings so any differences can be used to identify potential issues.



The thermostat and outlet temperature should be checked and the CWI test should be performed. However, this process often doesn't happen until sometime later when the estates personnel start water sampling and temperature checks of the hot, cold and blended outlet water.

If the person who fitted the tap doesn't leave the product isolated until it is commissioned, water may already have been run through it prior to the pipe work being flushed

out — potentially leaving the thermostat's filters and other integral components blocked with detritus from the water system — leading to incorrect performance of the thermostatic mixer.

"Many of the issues that crop up could be prevented through better understanding of how fittings should be maintained"

Thermostatic taps sometimes also fail to work properly when the temperature of the hot water reaching them is too low. According to the TMV 3 guidance for thermostatic taps,^{2,3} the temperature reaching these fittings must be at least 55°C. There have been instances where hot water can leave a hospital's calorifier at 65°C, but may be only 48°C by the time it reaches the tap. No thermostatic mixer, from any manufacturer, will work properly without the correct temperature, 55°C, flowing through it.

Ideally, all information, such as spare parts, fittings guides, how the tap was fitted and how it works and testing log should be passed on by the original installers to the estates teams, but occasionally this doesn't happen. It should be noted that this article focuses on the type of problems that can occur occasionally, but mostly the process runs smoothly.

Debris

A new hospital, new building or refurbished facility water system may contain debris relating to construction work. Newer models of thermostatic taps, such as the Markwik21+, have been designed with narrower waterways that increase flow in the channels and which stimulate a 'shearing' effect as the water passes through. This reduces the opportunity for growth of biofilm that could harbour pathogenic bacteria. To ensure optimal function of all types of fittings it is particularly important to check that water is flowing freely. All pipe work should be flushed and be free from waterborne debris and any filters fitted, including the ones within the fitting, should be clean and promote the free flow of water.

Maintaining tap components

The TMV 3 guidance sets out a requirement to service, audit and commission fittings, which necessitates dismantling the tap, making sure everything is working as it should and replacing any parts as necessary. However, sometimes there is uncertainty that taking fittings apart will void the warranty and so the correct maintenance is not carried out — but this is not the case as these fittings are designed to be dismantled for cleaning.

References

1. Department of Health: "Health Technical Memorandum 04-01: Supplement: Performance specification D 08: thermostatic mixing valves (healthcare premises)", 2017
2. Specific guidance for healthcare found in Reference 1 above
3. HM Government "The Building Regulations 2010: Sanitation, hot water safety and water efficiency G", G3

Conclusions

It is clear that many problems can be averted by a clear understanding of how products work and the guidance surrounding their use. Good record keeping, such as test logs, will allow accurate transfer of essential information between the different teams involved in fitting and setting up outlets.

Maintenance training offers an opportunity to really understand a product and the operating guidance, ensuring that commissioning and set-up procedures are carried out correctly, in the right order, so that products perform as they have been carefully designed to do.

To find out more about Armitage Shanks's training, see: <https://www.idealspec.co.uk/healthcare-fittings-training.html>

* Thermostatic taps/thermostatic mixing valves are interchangeable

Share your thoughts with us in the next issue

We would really value your reactions to this latest issue of Looking Deeper. Let us know your thoughts at: editorial@lookingdeeper.co.uk



Letters to the Editor

Two readers respond to Part 2 of our Report on the Third Water Safety Forum discussion published in the last issue of Looking Deeper (Issue 13, Spring 2023):

Considerations for the client/contractor relationship

As a former NHS Senior Site Estates Manager, with experience of water issues on major extension works, a few further comments/reflections on the 'conclusions and solutions' section:

1. Currently clients and project managers regularly assume (wrongly in my view) that contractor and client have exactly the same agenda. Construction companies will generally operate to minimise their effort/costs, so the signed/agreed contract is where detailed water/electrical/medi-gas requirements (which emphasise the detailed requirements beyond quoted standards) of the specific project need to be specified/defined e.g. training/qualification of plumbers as per your conclusions, etc.
2. Appointment of an Authorised Engineer (Water): the client should have their own AE (W) in place for existing facilities. But I would suggest a requirement for the client/project to appoint an AE (W) independent of the contractor (and not the client's extant AE (W)) to monitor and actively assess/report all project water affecting activity/compliance of the contractor/sub-contractors.
3. Ahead of any water entering systems, the contractor should provide a fully comprehensive maintenance programme for the water systems. This would reflect the full client compliance/servicing maintenance programme to be implemented after handover, but is to be actively implemented by the contractor from the minute any water enters any part of the system(s). The programme would need agreement/approval from client/project water safety/maintenance teams/ AE (W), but could be put together as soon as the





outline system design is produced. This requirement again needs to be in the project contract.

4. Water testing requirements: when specified these need to be realistic, practical and justified.
5. Sea trials' equivalent: we don't send new warships directly into battle — they test all systems in normal and fault conditions, before they're signed off and fully crewed. Yet we hand over complex healthcare sites and immediately fill them with staff and patients as soon as possible without extensive performance testing. Yes, there's backlog/pressure, but the huge risks of current handover patterns not fully operationally fault tested are seldom recorded. Do we just accept the contractors' assurances?
6. Clients need to understand risk; much of so called risk-sharing with contractors is a pantomime in practice — ultimately the client's name gets the adverse publicity. Rectifications/alterations need to be funded by the client quickly as the legal tangle with the constructor to complete rectification will have interminable delay. Time frames for rectifications need to be contractually specified.
7. Time: client extant water safety teams need their managers to allow dedicated time for expansion/project work. 'Design and build' projects in particular need regular time to keep up with the programme pressure, and prevent contractors using the excuse that client staff delayed the project.

I appreciate the publication.

Paul Hogg

C.Eng. FIHEEM MIMechE MCFI MBA DipHE BSc
Former Senior Site Estates Manager, NHS Scotland
National Waiting Times Centre Board, Golden Jubilee
National Hospital, Glasgow.

Architects' involvement, training Legionella risk assessors, testing TMVs...

I found this issue extremely interesting and would offer the following observations/commentary, some of which may be obvious, but are included for clarity:

1. Page 7 under "Procurement" refers to architects, but with no reference to building services design engineers who are generally responsible for designing the hot and cold water systems. Architects usually select the sanitaryware and have a limited involvement with the design of the simple drainage pipe work.
2. When interviewing *Legionella* Risk Assessors, building contractors, including design team members, I have presented them with a schematic of a domestic hot and cold water system that incorporated several errors, some easy, some difficult to spot. If they failed to reach a target figure their score for the interview was adjusted accordingly. If they refused to submit to the 'test' they were removed from the list of potential appointees. Something to consider in future?
3. At the top of page 7 not only are the right clinical people required, but also the design team, including project managers, contractors etc.
4. Under "Hygiene", should the hand washing also reference leaving as well as entering the ward?
5. On page 8 paragraph, re scalding, visitors also need somewhere to wash their hands safe from scald risks.
6. Re the HTM 04-01 testing procedure for thermostatic taps (pp 14-15): time frame for testing etc. following what commissioning phase, contractor, clinical or something else? If a tap is turned on to maximum flow, risk of splashing, spreading of contaminated aerosol and the like, how are these issues addressed?
7. At Step 3, if there is a measurable flow stream and not just a drip (?) should the water discharge temperature be recorded?
8. At Step 4 is the time frame of 1 second realistic? Should the collection of 120ml be time-based i.e. refer to the 60 seconds quoted at Step 3?

Dave Bennett

BSc FIHEEM MCIBSE

Former Engineering and Systems Lead, Capital Projects department, NHS Tayside and former member of NHSS Scottish Engineering Technology Advisory Group.

J Hosp Infect.
2023. May; **135**: 154-156. doi: 10.1016/j.jhin.2023.01.020.

The sink splash zone.

Garvey MI *et al*

Pseudomonas aeruginosa is an important nosocomial pathogen that commonly colonises hospital water supplies, including taps and sinks. It has been reported previously that water outlets are the most likely source of *P. aeruginosa* nosocomial infections in an adult intensive care unit (ICU), and it has been described how widespread introduction of control measures, both human factors and engineering solutions, can reduce infections. Joung *et al* demonstrated how water droplets can release aerosols. Similarly, Estrada-Perez *et al* showed the extent of dispersal of water droplets when showering. Stevens *et al* demonstrated that a wide range of waterborne pathogens can result in infections. Hence, there is a theoretical risk of water droplets harbouring waterborne pathogens contaminating surrounding areas, leading to transmission. This study examined splashing from water outlets on an ICU, and undertook an unannounced audit to determine which items were located within 2 metre of a sink ('splash zone').

Am J Infect Control.

2023. July; **25**: S0196-6553(23)00520-5. doi: 10.1016/j.ajic.2023.07.006..

Unveiling the hidden threat of carbapenemase-producing *Enterobacteriaceae* in hospital water environments: A single centre study.

Najjar-Debbiny R *et al*

This retrospective study examined the presence of carbapenemase-producing *Enterobacteriaceae* (CPE) in hospital water environments. Results showed that CPE was detected in 41.5% of samples within 1 metre of a water source (showers or sinks), with 20.6% of positive samples associated with shower water sources.

Dates for diaries...

IHEEM: Healthcare Estates Conference, Exhibition and Awards 2023

10-11/10/2023 Manchester, UK

healthcare-estates.com or office@iheem.org.uk

WMSoc/University of Greenwich: Sustainable Solutions — Managing water use with creative design

18/10/2023 London, UK

wmsoc.org.uk/events/external-event/164

ESCMID Study Group for Legionella Infections (ESGLI)

23-24/10/2023 Crete, Greece

esglimeeting2023.com/

An introduction to healthcare associated waterborne infections

31/10-2/11/2023 Belfast, UK

escmid.org/fileadmin/src/media/PDFs/1Dates_Events/event_flyers/2023/ESGLI_BELFAST_FLYER_3.pdf

Conference: Infection 360: What's trending in infection prevention and control

8-9/11/2023 Manchester, UK

fitwise.eventsair.com/2023infection360

Federation of Infection Societies (FIS) Conference 2023

14-15/11/2023 Edinburgh, UK & Online

microbiologysociety.org/event/full-events-listing/federation-of-infection-societies-fis-conference.html



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