Looking deeper

THE JOURNAL OF THE WATER SAFETY FORUM

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Inside this issue

Advanced healthcare solutions from Armitage Shanks

Can we fix the future in time?

Looking Deeper Editor, **Susan Pearson**

On paper, the approach of the New Hospitals Programme (NHP) for England looks like a breath of fresh air — a real chance to provide efficient modern hospitals that have, as far as possible, had real thought applied to their planning. The outline ambition so far is to plan blueprints that deliver construction models designed to bypass the causes of the potentially dangerous problems, in some cases leading to fatalities, that have beset several recently constructed flagship hospitals (see pp 5-6).

But how will this crucial design stage work in practice? The details are currently hazy, yet the NHP's ambition to deliver new healthcare infrastructure using modern modular construction models by 2030 will need to knuckle down fast if this target is to be achieved.

The healthcare built environment has been a significant and largely underestimated source of infection to patients. The types of issues that must be addressed will be familiar to IPC teams and everyone working in the healthcare water safety industry.

For example: close attention must be paid to provide plumbing layouts that won't be vulnerable to water stagnation that leads to microbial proliferation; or to the need for subsequent alterations that create dead legs, and again lead to biofilm growth; the numbers of water outlets needed in different areas of usage will need to be considered; as will the types (and therefore design) of the water outlets themselves, again in relation to usage and local water conditions.

> *"The patient has to be at the centre of the project from the beginning."*
>
> *George McCracken, Director of Estates of the Belfast Health and Social Care Trust, Looking Deeper, Autumn 2021*

What strategy will there be to take into account the effect of wastewater when even the most sophisticated healthcare systems around the world are increasingly recognised as a source for dispersal of escalating antimicrobial resistance?

And the list goes on.

On pages 6-9, we take a closer look at some further considerations around hospital design. For example, the patient user experience in new healthcare facilities would be boosted by dedicated green spaces — but why could that be problematic? And how might any problems be addressed? Planning for new hospitals will also need to take into account how plumbing qualifications feed into best healthcare construction practices (pp 10-11).

In order to achieve the outcome put forward in the NHSE and DHSC's ambition for "40 new healthcare facilities" there must be close engagement with NHSE's team of experts and a clear pathway outlined for the input of their recommendations to inform the new buildings' design.

At the end of the day, we must never forget that there is only one reason for building a new hospital: to make healthcare safer for patients.

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 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

Dr Shanom Ali is an NHS microbiologist and lead of the Environmental Research Laboratory (ERL) — a multi-disciplinary microbiology diagnostics and research facility based in London — and Director of a UKAS-accredited microbiology laboratory. He is an associate professor at University College London and the London School of Hygiene and Tropical Medicine and a trustee for the Healthcare and Infection Society (HIS).

Dr Shanom Ali

Paul Millard has been the Technical Manager for Water Regs UK (formerly WRAS) since 2012, providing technical support to the water industry and other professional organisations. With over 30 years in the water industry, he has previously been Water Regulations Manager for Anglian Water and worked for Cambridge Water. Paul's focus for the last 20 years has been on providing technical expertise and guidance on the enforcement and interpretation of the Water Fittings Regulations and involvement in national standards.

Paul Millard

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In the news...

Life on Mars

Four bacteria species that are dangerous to humans have been found to be capable of surviving exposure to hostile Mars conditions — raising concerns for the safety of astronauts who might venture to the planet if the bacteria were carried with them from Earth.

An international team of radiation specialists, biologists and infectious disease experts publishing in 'Astrobiology' described how they exposed the bacteria to Mars-like conditions. Certain bacteria have already been found capable of surviving extremes of temperature, salt, drought and high radiation, with one species found on the outside of a space station.

Serratia marcescens, Pseudomonas aeruginosa, Klebsiella pneumoniae and *Burkholderia cepacia* were subjected to a Mars-like environment in a box with cold temperatures, a no-oxygen atmosphere, radiation exposure and a regolith stand-in.

The bacteria were first tested individually to each of the simulated conditions — with variable responses. However, the team also found that all the species survived to some extent when exposed to everything they would encounter on Mars. *P. aeruginosa* in particular seemed to thrive.

The researchers concluded that there is indeed a danger that bacteria carried inadvertently to Mars could pose a health risk to astronauts.

Penetrating *Pseudomonas*

Infections with *Pseudomonas aeruginosa* are notoriously difficult to treat thanks to its virtually impenetrable outer membrane — yet professor Paul Hergenrother and his team at the University of Illinois at Urbana-Champaign in the US, in collaboration with Roche, have now reported doing exactly that.

Writing in 'Nature', the team describes bombarding the bacterium with hundreds of compounds before using machine learning to establish the physical and chemical traits of the molecules that made it through to accumulate inside the bacterial cells.

P. aeruginosa is a Gram-negative bacterium, so it has a tightly packed negatively charged outer membrane that makes it hard for other molecules to penetrate.

The machine learning approach revealed that compounds with a positive charge on the surface and those with more hydrogen-bond-donor surface area were more likely to accumulate inside *P. aeruginosa*. The researchers then took fusidic acid that is used to treat Gram-positive infections, but has no activity against Gram-negative bacteria, and modified it to create a derivative form, FA prodrug. As the positive charge and hydrogen-bond-donor surface area were increased, there was a corresponding increase in accumulation of the FA prodrug in *Pseudomonas*.

While this is not likely to make it as a candidate drug, the principles used in this research will inform the design of new compounds to fight these notoriously drug-resistant infections.

NHS England — looking to the future

In our last issue, Looking Deeper discussed how the NHS Scotland Assure framework has been set up to address risk management in the healthcare built environment following some profound problems with Glasgow's new flagship hospitals (pp 5-7). In this current issue, we now consider what similar forethought should be applied to the construction of new healthcare facilities in England.

NHS Scotland Assure now delivers advice and guidance on what Scottish NHS Boards should deliver when they commission new buildings or refurbish existing ones, on the basis of recommendations from a team of experts. Such a framework aims to ensure that tragedies, such as the following in relation to water contamination, should never happen in healthcare: infections with a range of waterborne bacteria in paediatric blood cancer patients at the new Glasgow Royal Hospital for Children, including one child fatality; and 21 infections with *Mycobacterium abscessus* following the opening of the Royal Papworth Hospital for transplants in Cambridge in 2019, which included two fatalities in lung transplant patients.

These types of water-related incidents are one of the major reasons that new hospitals hit the headlines. Such challenges are not only costly for new builds, but more importantly, they result in significant morbidity and sometimes mortality of patients, as well as causing an unnecessary extra use of antibiotics.

New Hospitals Programme

The construction of new hospital facilities in England will now come under the auspices of the NHS New Hospitals Programme (NHP). This is a joint programme between the Department of Health and Social Care (DHSC) and NHS England (NHSE) that operates in a sponsor-delivery model, with NHSE holding responsibility for the delivery element of the model.

The NHP is said to represent the biggest hospital building programme in a generation, with a "dramatic shift in the way we deliver major healthcare projects in England, building hospitals that will transform the health sector and set new standards for the way we build future social infrastructure."

The NHP aims to:

- Standardise design, through the use of modular modern construction methods to allow quicker manufacturing and assembly and to build better and more efficiently;
- harness digital transformation to make the use of the latest technology for the benefit of staff and patients;
- be sustainable in order to contribute to net zero carbon across the NHS; and
- incorporate learning from the pandemic to ensure hospitals can adapt to changing health needs.

A team of experts has been appointed to advise the NHP. The Programme will represent £20 billion of investment in new hospital infrastructure, although spending on the NHP was updated in November 2023 by a further £685 million to prioritise the rebuilding of seven hospitals affected by Reinforced Autoclaved Aerated Concrete (RAAC).

Hospital 2.0

The standardised approach to design enshrined by the NHP is known as Hospital 2.0, and has been described

as providing the scope for "doing things across the NHS infrastructure in a completely different, or better way."[1]

The guiding principles of Hospital 2.0 include, significantly in this context: improving clinical outcomes and reducing patient safety risk; and supporting clinically appropriate design for adaptable and flexible spaces, optimal flow and safety.

Water safety strategy — the challenges

In relation to water safety, NHS Scotland has put a strategy in place towards achieving exactly these aims — by consulting closely, at an early stage, with experts on healthcare facility designs that put patient safety at their heart. Will the NHP adopt a similar approach?

For example, recommendations from the 2018 Hackitt Report[2] noted that:

- Those who procure, design, create and maintain buildings are responsible for ensuring that those buildings are safe for those who live and work in them
- That building safety risks [should] be managed so far as is reasonably practicable
- That there should be a more effective testing regime with clearer labelling and product traceability
- That poor procurement practices need to be tackled.

In relation to the latter, there will clearly need to be effective feedback and engagement with industry to encourage the best development of the most effective equipment for the NHS. Guidance and compliance may no longer provide all the answers — there needs to be a move to a risk-based approach.

In addition, innovative approaches are needed to deal with the rising challenges of wastewater from hospitals and antimicrobial resistance. The competencies of all those involved will be critical to make this happen.

However, as yet there does not appear to be any information available to clarify how the NHSE and the DHSC will approach these concerns.

This is clearly a subject to be revisited. In the coming months we hope to gain some useful insight from both Government departments so that the next issue of Looking Deeper can present some solid details on how the NHP will address these issues.

References

1. https://content.yudu.com/web/1u0jl/0A1umgt/HEJ-January-2024/html/index.html?page=56&origin=reader
2. https://assets.publishing.service.gov.uk/media/5afc50c840f0b622e4844ab4/Building_a_Safer_Future_-_web.pdf

HOSPITAL DESIGN: PUTTING AN OPTIMAL INFECTION CONTROL ENVIRONMENT AT ITS HEART

Dr Shanom Ali

Susan Pearson talks to Dr Shanom Ali on how designs for new healthcare facilities must consider strategies to minimise infection control issues.

Dr Shanom Ali is the lead for the Environmental Research Laboratory (ERL) — a multi-disciplinary microbiology diagnostics and research facility based in London, an associate professor at University College London and the London School of Hygiene and Tropical Medicine and a trustee for the Healthcare Infection Society.* He is also Director of a UKAS accredited microbiology testing laboratory at the ERL, that performs over 50,000 tests annually from various hospitals in and around London to keep patients safe from acquiring infection.

Dr Ali discusses how well-informed thinking on infection prevention and control (IPC) should impact on design to reduce risks behind the very serious IPC issues that can occur in new facilities — and also reflects on how design that improves the overall patient experience can be achieved without compromising patients' safety. Dr Ali is quoted in this article in a personal capacity.

How has your work at the ERL informed your thoughts on the infection prevention and control (IPC) considerations needed when new hospitals are designed?

The ERL, which comprises a team of healthcare scientists and academics, provides academic research and

consultancy to address anti-microbial resistance (AMR) and infection control management, as well as exploring novel antimicrobial therapeutics (medicines and treatments) and diagnostics. For the last 15 years the ERL has also been providing an environmental screening and surveillance service, developing considerable experience in investigating infection control outbreaks and "looking for the unusual."

How you design, build and test new hospitals is currently being widely discussed. However, there is not much of a focus on the patient environment, hospital building and environmental monitoring until there's an IPC issue.

"We have some guidelines such as 'Health Building Notes (HBN)' to guide the design of hospitals and wards and the Health Technical Memorandums (HTMs) to support how we test (air, surfaces and water) to monitor the patient environment. However, I don't think we've got it right for existing buildings. There is little consultation with IPC in the early design stages for new hospitals."

In clinical settings, when it comes to training and development, most of the clinical interest is in patient to patient transmission and the clinical side of microbiology, as opposed to the environmental microbiology aspect, i.e. the influence of air, water and surfaces.

"There is an assumption that you can swab a surface or extract some air and a result comes out and it's as easy as that..."

There needs to be an understanding that the matrix being tested (air, surface, water) will determine what kind of test is used: for example, swabs shouldn't be used for testing water samples. When sampling surfaces, the swab needs to be the correct one for the type of surface being tested and the target organism. A swab that works for *E. coli* may not work for MRSA or *Clostridioides difficile.*

Looking at other considerations, for example, in water sampling: 100 mL samples are usually taken for routine water monitoring for *Pseudomonas aeruginosa*, however, monitoring of *Legionella* is more difficult. These require 1 litre samples, with a mass of 1 kg per bottle to be collected. Logistically these add up to a huge weight across the thousands of samples that might be generated from numerous outlets across many wards. While swabs are small, the size of *Legionella* samples makes for complex logistics around storage and transport — and this needs consideration in planning design.

In the meantime, as NHS England's New Hospitals Programme[1] is rolled out, a new standardised hospital design has been proposed, designated 'Hospital 2.0': *"we have to consider what can be built now that will [both] cover enough of the infrastructure [and allow us to] add new tech and new innovations and new ways of working with it."*

How do the latest design trends to improve patients' experiences impact on IPC?

Rooftop gardens

Mental health and mental wellbeing are increasingly, quite rightly, under discussion, particularly for long term patients who may feel trapped between their four walls. The idea 'to bring the outdoors in' in the form of rooftop gardens and other greenery is therefore very welcome, especially in cancer hospitals where patients can walk on grass, breathe the air, see the trees and sit amongst 'nature'.

However, this vegetation brings infection control risks with it: soil, compost and the plants themselves may harbour pathogenic microorganisms that can be particularly dangerous for immuno-compromised patients. This can pose a number of challenges.

Hospital roof garden, Erasmus Medical Centre, Rotterdam, The Netherlands. Credit: ID 119955427 © Frans Blok | Dreamstime.com

Alongside the plants, garden taps in rooftop gardens can also be problematic as they could become colonised with *Pseudomonas.* These outlets may be used by cleaners and porters to fill their buckets, potentially spreading contaminated water around the hospital.

"I work with the hospital IPC, estates and microbiology teams to survey and test these areas to assure no risk or harm to patients ever occurs."

With regards to 'Hospital 2.0', these changes to how hospital buildings are used will need to be reflected in the way we test and monitor patient spaces.

"As well as routine testing of outlets for bacterial contamination across our client hospitals, we also design new and innovative ways of testing, particularly if a hospital has an outbreak of something outside of the usual routine screening. My team is the only NHS-based team in the country that monitors these types of events and applies innovation and research and development to further our knowledge and expertise.

"Because we have academic interests in learning how pathogens transmit and the behaviour of both staff and patients, you build an idea of what is good and what is not.....Just because something looks clean, or has been looked after, doesn't [necessarily] mean it is sterile."

Wood

Wood surfaces are now being considered to enhance the patient environment, inspired by Scandinavian design in particular. Wood can have anti-microbial properties, although this is very low and the properties of different types of wood vary. Most wood is treated and coated with a varnish or resin to make it more durable, which creates a barrier between bacteria on one side and the anti-microbial properties of the wood on the other. There are some synthetic products and coatings on the market that have some anti-microbial activity, as a means to "self-clean", but these are often trialled in a best case scenario.

If the new Hospital 2.0 standards integrate antimicrobial surfaces and coatings, these products will need to be tested and trialled robustly to ensure they provide safety to patients and healthcare providers, as there is always the scope for transmission of bacteria between surfaces via the hands of healthcare staff, patients and visitors.

Water v. waterless

There are increasing discussions about whether to reduce the number of outlets in various healthcare settings. For example, in single patient rooms, is it necessary to have a hand wash basin (HWB) in both the room and the bathroom? Or a HWB beside each bed in a four-bed ward, as well as a clinical HWB and another HWB in the ward bathroom?

The obvious advantage of taking away water is that this removes the inherent risk that water brings in terms of waterborne pathogens. However, we do know that for patients to be able to bathe and clean themselves in a shower or bath helps their general wellbeing. The question is — how do we still allow that for them and maintain IPC? Using alcohol gels in hand-rubs is one way to disinfect some pathogens from hands, but over time these can damage the skin and the gel component of some rubs becomes a sticky coating on the hands.

We also have to think about how to maintain good infection control if we remove water, as well as how we audit and educate staff to maintain high standards. The main pathogens that need to be tackled in hospitals in the context of hand washing are *P. aeruginosa* and *Clostridioides difficile. C. difficile* produces robust spores that can persist for years and are resistant to alcohol, UV radiation and many disinfectants — hand washing is the primary option to remove it.

Solutions

Innovation: monitoring

In order for patients to be able to use rooftop gardens where there is an inherent risk to themselves or others, extensive monitoring with regular testing is needed to alert for risks as they happen. However, most settings do not have the budget to test more, which opens up a space for innovation, for products that monitor and detect water contamination in real time. An example would be utilisation of remote monitoring devices attached to pipe work to constantly monitor water flow and temperature.

"From a research profile, we're always trying to engage with industry... if they have new ideas that would help healthcare... we try to scientifically trial them in wards... Without innovation, you can't enhance or go forward with better healthcare."

Innovation: cleaning

We need better surfaces that are easier to clean, and we also need better products for cleaning them. And we need to develop better methods to clean the hospital surfaces effectively. Although the cleaning and

decontamination solutions from industry vary, there is a niche for automated whole-room disinfection and decontamination. For example, robots are available that can move around, scan patient rooms and calculate the optimal cleaning cycle. These automated decontamination technologies may utilise means such as hydrogen peroxide vapour (HPV) or UVC radiation to disinfect rooms. However, these have pros and cons. HPV is good at killing pathogens from heavily contaminated surfaces, but a cycle can take up to 5-6 hours of cleaning time. UVC on the other hand can kill moderate levels, but cycles are very short (minutes) and can be used to target surfaces. However, all technologies are improving and advancing.

Education

Better knowledge and support around cleaning is needed because the people who do the cleaning are often short-term entry-level cleaning staff on their way to another role. Training — and empowerment allowing operatives to understand why their role is so important — are crucial to ensure cleaning products are used correctly.

Conclusion

However we build and whatever materials we use, we need to ensure that the water is safe, surfaces are easy to clean, or self-clean, and that we have good quality air.

Monitoring is the key. When we think about new hospitals, Hospital 2.0 and futuristic design, we need to start thinking of future technology: alongside material innovation and routine validation, the way forward points to real time data, in-line monitoring, biosensors and real-time feedback.

Reference

1. www.linkedin.com/company/new-hospital-programme/about/

**** Role of Dr Ali and the Healthcare Infection Society (HIS) in solutions to address the 'New Hospitals' landscape:***

In his additional current role as guest editor of the Journal of Hospital Infection, a HIS journal, Dr Ali is chairing a special issue: ***"Infection prevention risks associated with healthcare water systems and wastewater disposal – considerations for planning of hospitals for the future".*** *This issue will curate high-quality original research, innovations, solutions and clinical perspectives into the planning, building and infection control aspects for future healthcare buildings.*

Also in response to the NHP, ahead of the Hospital 2.0 framework, Dr Ali and colleagues, in partnership with the HIS, as part of the HIS's "Water safety in healthcare" course, are developing training aimed to prepare and inform all key members of the scientific, medical, IPC and estates communities.

Dates for diaries...

Water Management Society AGM and Conference
17-18/06/2024 Bedfordshire, UK & Online
wmsoc.org.uk/events

HIS Annual Conference 2024
24-25/06/2024 London, UK
his.org.uk/event/book?id=AC2406

World Congress on Infectious Diseases: Infection 2024
24-26/06/2024 Paris, France & Online
infectiouscongress.com/

8th Eurobiofilms 2024 Congress
26-29/06/2024 Copenhagen, Denmark
eurobiofilms@mci-group.com

International Biennial Pseudomonas Conference
01-05/09/2024 Copenhagen, Denmark
microbiologysociety.org/event/society-events-and-meetings/international-biennial-pseudomonas-conference.html

WMSoc Scotland Conference
24/09/2024 Glasgow, UK
waterlinepublication.org.uk/events/

9th International Conference on Legionella
26-30/09/2024 Rome, Italy
info@legionella2017.com

Healthcare Estates Conference and Exhibition
8-9/10/2024 Manchester, UK
healthcare-estates.com/

FIS/HIS International Conference 2024
20-24/11/2024 Liverpool, UK
his.org.uk/training-events/fis-his/fis-his-2024/

INSTALLING SAFE HEALTHCARE WATER — COMPETENCY EQUALS KNOWLEDGE

In relation to water safety, one of the pillars of NHS Scotland Assure's mission to improve the management of risk in new hospital buildings and refurbishments is the expectation that contractors will provide a construction phase water safety plan (WSP).

Having outlined this framework in the last issue of 'Looking Deeper' (pp 5-7), and now referred back to on p 5 of this issue, alongside an equivalent WSP for England, there also needs to be a focus on the competency of plumbing contractors installing water systems in healthcare — to ensure that in England, plumbers have the training to understand the complexities of plumbing in hospitals and other facilities and the implications of getting it wrong.

In our Spring 2023 issue (13), we discussed what is meant by 'competency' when applied to health sector Authorising Engineers (p13) — here, in discussion with Paul Millard, Technical Manager of Water Regs UK,* we look at what the equivalent 'competency' would look like in plumbing.

WaterSafe

The best 'go-to' source to find 'competent and qualified' plumbers and water services specialists across England, Wales, Scotland and Northern Ireland is WaterSafe, a free on-line search facility launched in 2013 by the water industry, which then encompassed seven approved contractor schemes. Celebrating its ten year anniversary last year, this national accreditation body now brings together around 7500 qualified contractors from the six existing approved contractors' schemes across the UK (see box) — of whom 2000 are based in Scotland — and is supported by the UK's key water regulatory bodies: the Drinking Water Inspectorate in England and Wales, the Drinking Water Inspectorate (Northern Ireland), and the Drinking Water Quality Regulator in Scotland.

Contractors approved through WaterSafe have specific training in the Water Fittings Regulations and Byelaws to ensure they meet the strict legal requirements for installing water pipes and fittings. The regulations and byelaws are outlined on the WaterSafe website. All NHS hospital Trusts are advised to use WaterSafe-approved contractors in order to safeguard public health.

Yet, over ten years on, has much improved? In domestic scenarios, only three in ten customers were found to be happy with plumbing work carried out and many plumbers are employed to fix others' bodge jobs. Clearly, there is still a way to go.

> *"The combination of training, skills, experience and knowledge that a person has and their ability to apply them to perform a task safely."*
>
> ***Health and Safety Executive definition of competency***

Competency

But what about in healthcare? For example, in Scotland 'competency', namely understanding the conditions that cause *Legionella* growth in water systems, is now required all the way down the sub-contracting pyramid.

While problems are often blamed on plumbers, in the initial planning phase layouts for pipes and water outlets are often specified by architects — yet this should really be a team effort between all knowledgeable parties, which should include plumbers.

However, whatever happens at the design stage, even the best planned water system needs to be installed properly, and this is a stage where problems can arise. For example, in healthcare, incorrectly bonded pipes can be a source of microbial growth: in this context 'competency' would include knowing that substance 'X' would be acceptable, while substance 'Y' may well

WaterSafe
LOCAL APPROVED CONTRACTORS

- The Water Industry Approved Plumbers' Scheme (WIAPS)
- Association of Plumbing and Heating Contractors (APHC)
- Chartered Institute of Plumbing and Heating Engineering (CIPHE)
- Scottish and Northern Ireland Plumbing Employers' Federation (SNIPEF)
- Anglian Water's APLUS
- Severn Trent's Watermark

Credit: Water Regs UK

be cheaper, but can lead to water contamination that would be dangerous in a healthcare setting.

WaterSafe is helpful in this context; despite many different schemes, e.g. Checkatrade, which does check that plumbers' qualifications are up to Level 2, there is still no guarantee that a contractor will be knowledgeable enough. While most plumbers will be qualified to Level 2, this training doesn't cover the water fittings regulations. Although Level 2 is a sufficient qualification for most types of building work, for work in healthcare plumbers' understanding needs to go further than just outlining the legislation — it also needs to explain the consequences of not following these rules. However, there are expectations that those qualified to Level 2 would have some level of supervision by a Level 3 qualified person to check standards and legal compliance, which would make Level 2 qualifications acceptable provided there is oversight.

Contractors also need to understand that usage of the wrong materials would be breaking the law — and used wrongly could cause dire consequences, with the potential to lead to infection and fatality.

Paul Millard commented: *"Everyone on the WaterSafe register, whether they're level 2 or 3, will have that knowledge of the regulations [in addition to] their craft qualifications....I would be concerned employing someone without water fittings training as they may not understand the impact of using inappropriate materials or failing to install adequate backflow protection to safeguard public health."*

Water fittings training has to meet learning objectives agreed by water companies in order to be recognised by approved contractor schemes. There are a number of different training organisations that deliver this training (see: https://www.watersafe.org.uk/about/installer_area/qualifications_water).

**Water Regs UK supports water companies in their role to supply safe, resilient water supplies in the UK by promoting the Water Fittings Regulations and Byelaws to protect public health by helping to keep water safe in premises. Works with 27 UK water companies to safeguard drinking water quality, reduce leakage, encourage water efficiency and support developers with new connections.*

Water efficiency labelling

As part of Defra's push to reduce water consumption, with specific targets laid out — see Looking Deeper, Issue 14, p 8 — consultation has now been completed on a mandatory water labelling scheme for fittings.[1] However, minimising water usage in hospitals is essentially problematic due to the need for system flushing to prevent water stagnation and microbial build-up.

Water Regs UK has advised that efficiency labelling for taps should not replace, but must run alongside, existing water fittings testing to ensure they meet the regulations. In future the government have confirmed that all fittings will need to be compliant with Regulation 4 in order to meet the criteria for a mandatory water efficiency label.

However, while water fittings will increasingly be designed to reduce flow, yet still producing a sufficient volume for users, there may be knock-on implications when introducing 'lower flow' outlets. For example, the introduction of new 'low-flow' taps is likely to alter the dynamic of the original pipe work, which will be fitted with bores designed for much greater flows rates.

Legislation for this new mandatory labelling scheme should be put in place this summer, with implementation for a specific list of product types, including taps, WCs and showers by 2025.

"This is a very commendable first step and Water Regs UK fully supports the label. People need water efficiency information to make informed choices. We welcome confirmation that products displaying the label must also be compliant with the regulations as well as being efficient.

"[Which] takes us back in a circle on competency — making it even more important that plumbing contractors understand the consequences of reducing water consumption."

Reference

1. www.gov.uk/government/consultations/uk-mandatory-water-efficiency-labelling

A CLINICAL APPROACH TO SAFER HAND WASHING

The safe delivery of water is critical within any areas where there are vulnerable patients, for example, in augmented care units.

The Markwik 21+ Basin thermostatic basin monobloc shown here with the Contour 21+ back outlet basin. Notably, the basin waste and trap have been designed to be concealed discreetly behind the basin to eliminate the possibility of contaminants or debris accumulation in an overflow. Additionally, the mixer is equipped with sequential thermostatic control to ensure that both hot and cold supplies are drawn, and that operation is intuitive and user-friendly.
This design is compliant with HBN 00-10.

'Safe delivery' can mean a number of things depending on the perspective. It can mean taps that provide optimum warm water for most effective hand washing without the danger of scalding — however, it could also mean water supplied at the very hot temperatures least likely to encourage growth of harmful bacteria. This might suggest a lack of thermal control. As neither route addresses both requirements, neither seems to really offer a 'safe' solution.

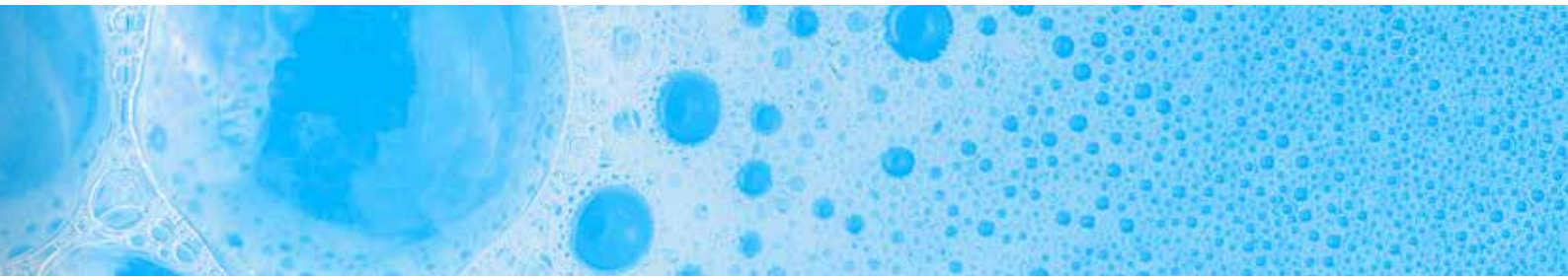
So, is there a way of achieving optimum water temperatures for hand washing that are less likely to lead to the growth of dangerous pathogens?

One solution is a thermostatic basin monobloc that incorporates a built-in thermostat for consistent water temperature, whilst incorporating a number of design features aimed at reducing the risk of dangerous bacterial growth. For example, the Armitage Shanks Markwik 21+ range has been designed to discourage microbial biofilm by: increasing the amount of brass materials utilised to promote the natural antimicrobial properties of brass wherever possible; and building in features such as narrow-bore pipes that increase water velocity, making it difficult for pathogens to stick to surfaces, as well as minimising water stagnation due to low static water volumes.

Of course, no hospital mixer can be totally safe from contamination — but this type of basin monobloc, that is very easy to remove and disinfect, allows engineers the option of removing the spout for sterilisation, or removing the complete fitting from the top of the basin and replacing it with a clean mixer while the original body is being disinfected.

This type of mixer is typically paired with a back outlet wash basin that has a hidden trap and a waste designed to quickly remove water and avoid pooling, so reducing

The tap mechanism is built into the basin, allowing the body to be removed quickly, using an Allen key, and then disinfected



The tap also has a removable spout that can be sterilised. Keeping a stock of spare clean spouts allows the tap to remain operational

the chance of bacteria growing anywhere near the area in which the user washes their hands. In effect, the basin and mixer combination applies a clinical approach to hand washing for patient areas as well as staff areas.

There are several applications where this hand washing solution is likely to be particularly effective: patient en-suites would benefit from having optimum control of hand washing water temperatures coupled with a strict replacement body disinfection programme; any heavy use areas, such as doctors' surgeries, walk-in centres or veterinary centres, with their multiple different users all carry high infection risks; while care homes could also incorporate the combination for their residents to ensure safe and effective hand washing.

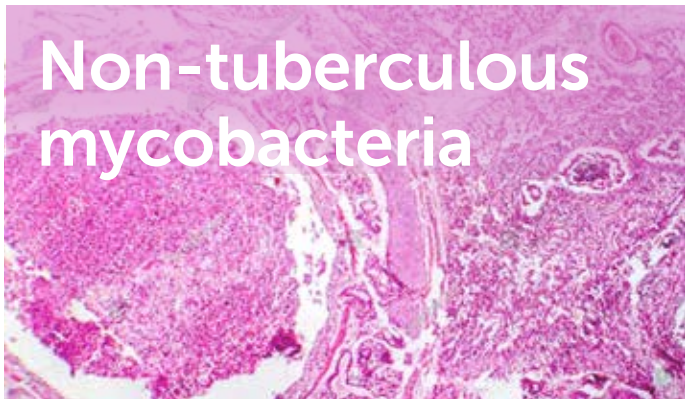
While this wash station combination comes at a higher cost compared to a traditional standard basin and tap, it may not be essential for every setting. However, in environments with elevated infection risks and vulnerable patients, this solution offers a thought-out and effective 'safe' hot water delivery solution.

The tap is stripped down allowing all the components to be thoroughly disinfected

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**

Non-tuberculous mycobacteria



Photomicrograph of bronchopneumonia, illustrating inflammation and consolidation of lung tissue due to bacterial infection.

Non-tuberculous mycobacteria, or NTM, are a group of bacteria that may cause health problems for people with an underlying lung problem or a weak immune system. They are part of the same family of bacteria that cause tuberculosis (TB), but manifest as very different infections. Although NTM infections have previously been considered rare, their prevalence is now increasing at a rate of 5% per year with 15 out of 100,000 individuals currently affected in the US. However, NTMs are difficult to detect with microbial culture techniques, and are highly resistant to the chemicals used in traditional water treatment technologies.

Although NTMs have been detected in clinical samples for many years, their environmental links with water were highlighted in 2015 when numerous infections (specifically related to *Mycobacterium chimaera*) were associated with the use of water containing heater-coolers used in cardiac surgery. These incidents were encountered across many countries.

A Pub-med search looking back over just one year, 2023, has identified that waterborne NTM infections are increasingly being seen in patients in haematology and oncology units, and are also inextricably linked with cystic fibrosis patients. Equipment such as ice machines, bronchoscopes and infusion heating devices have been contaminated with NTMs, while a further cluster associated with cardiac surgery, this time of *M. abscessus*, was linked to a commercial water purification system.

Water stagnation in buildings is yet another risk factor for growth of opportunistic pathogens, including NTMs. Two deaths due to *M. abscessus* post lung-transplant were reported in the new-build at Papworth Hospital, Cambridge, in 2019 (see: royalpapworth.nhs.uk/mycobacterium-abscessus). This was linked to the hospital supply and is now managed by multiple control measures. The following papers provide further detail on the latest research — but there are many more!

Infect Control Hosp Epidemiol.

2023 Dec;44(12):2056-2058. doi: 10.1017/ice.2023.101. PMID: 37272469

A bronchoscopy-associated pseudo-outbreak of *Mycobacterium chelonae* and *Mycobacterium mucogenicum* associated with contaminated ice machine water and ice

Engers DW *et al*

A pseudo-outbreak of bronchoscopy-associated *Mycobacterium chelonae* and *M. mucogenicum* was traced to contaminated ice machine water and ice. A non-sterile ice bath was used to cool uncapped, sterile, saline syringes used to slow procedural bleeding. Joining the growing evidence of bronchoscopy pseudo-outbreaks, this investigation describes several lessons for future prevention.

J Hosp Infect.

2023. Aug:**138**:60-73. doi: 10.1016/j.jhin.2023.05.011 PMID: 37290689

Waterborne infections in haemato-oncology units — a narrative review

Inkster T, Walker J and Weinbren M

Bone marrow transplant and haemato-oncology patients are at risk of healthcare-associated infections due to waterborne pathogens. This narrative review was taken of waterborne outbreaks in haemato-oncology patients from 2000 to 2022. Databases searched included PubMed, DARE and CDSR, and were undertaken by two authors. The review analysed the organisms implicated, sources identified and infection prevention and control strategies implemented. The most commonly implicated pathogens were *Pseudomonas aeruginosa*, non-tuberculous mycobacteria and *Legionella pneumophila*. Bloodstream infection was the most common clinical presentation. The majority of incidents employed multi-modal strategies to achieve control, addressing both the water source and routes of transmission. This review highlights the risk to haemato-oncology patients from waterborne pathogens and discusses future preventative strategies and the requirement for new UK guidance for haemato-oncology units.

Infect Control Hosp Epidemiol.

2023, Dec 15:1-11. doi: 10.1017/ice.2023.250. PMID: 38099453

Bronchoscopy-related outbreaks and pseudo-outbreaks: a systematic review

Kakoullis L *et al*

This review aimed to identify and report the pathogens and sources of contamination associated with bronchoscopy-related outbreaks and pseudo-outbreaks in inpatients and outpatients. PubMed/Medline databases were searched according to Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, using the search terms "bronchoscopy," "outbreak," and "pseudo-outbreak" from inception until December 31, 2022. From eligible publications, data were extracted regarding the type of event, pathogen involved, and source of contamination. Pearson correlation was used to identify correlations between variables. In total, 74 studies describing 23 outbreaks and 52 pseudo-outbreaks were included in this review. The major pathogens identified in these studies were Pseudomonas aeruginosa, *Mycobacterium tuberculosis*, nontuberculous mycobacteria (NTM), *Klebsiella pneumoniae, Serratia marcescens, Stenotrophomonas maltophilia, Legionella pneumophila* and fungi. The primary sources of contamination were the use of contaminated water or contaminated topical anaesthetics, dysfunction and contamination of bronchoscopes or automatic endoscope reprocessors, and inadequate disinfection of the bronchoscopes following procedures. Correlations were identified between primary bronchoscope defects and the identification of *P. aeruginosa* (r = 0.351; *P* = .002) and *K. pneumoniae* (r = 0.346; *P* = .002), and between the presence of a contaminated water source and NTM (r = 0.331; *P* = .004) or *L. pneumophila* (r = 0.280; *P* = .015). It was concluded that continued vigilance in bronchoscopy disinfection practices remains essential because outbreaks and pseudo-outbreaks continue to pose a significant risk to patient care.

Ann Intern Med.

2023, March 7. doi.org/10.7326/M22-3306

***Mycobacterium abscessus* cluster in cardiac surgery patients potentially attributable to a commercial water purification system**

Klompas M *et al*

Descriptive study describing the analysis and mitigation of a cluster of *Mycobacterium abscessus* infections in four cardiac surgery patients at Brigham and Women's Hospital, Boston, Massachusetts, US. Commonalities among cases were sought, potential sources were cultured, patient and environmental specimens were sequenced, and possible sources were abated. Whole-genome sequencing confirmed homology among clinical isolates. Patients were admitted during different periods to different rooms, but on the same floor. There were no common operating rooms, ventilators, heater-cooler devices or dialysis machines. Environmental cultures were notable for heavy mycobacterial growth in ice and water machines on the cluster unit, but little or no growth in ice and water machines in the hospital's other two inpatient towers or in shower and sink faucet water in any of the hospital's three inpatient towers. Whole-genome sequencing confirmed the presence of a genetically identical element in ice and water machine and patient specimens. Investigation of the plumbing system revealed a commercial water purifier with charcoal filters and an UV irradiation unit leading to the ice and water machines in the cluster tower, but not the hospital's other inpatient towers. Chlorine was present at normal levels in municipal source water, but was undetectable downstream from the purification unit. There were no further cases after high-risk patients were switched to sterile and distilled water, ice and water machine maintenance was intensified, and the commercial purification system was decommissioned. Limitation: Transmission pathways were not clearly characterised. Conclusion: Well-intentioned efforts to modify water management systems may inadvertently increase infection risk for vulnerable patients.

J Hosp Infect.

2023 Nov:**141**:9-16. doi: 10.1016/j.jhin.2023.08.007. PMID: 37604277.

How clean is your ice machine? Revealing microbial amplification and presence of opportunistic pathogens in hospital ice-water machines

Cazals M *et al*

Ice machines in healthcare facilities have been suspected and even linked to outbreaks and pseudo-outbreaks. Guidelines exist for maintenance of these devices, but there is no clear independent infection control standard, and little is known about their microbial contamination. This study aimed at evaluating the microbial contamination, amplification, and presence of opportunistic pathogens in ice-water machines in a healthcare facility. Concentrations of general microbial indicators (heterotrophic plate counts (HPC), total and intact cells), faecal indicators (enterococci) and opportunistic pathogens (*Pseudomonas aeruginosa*, non-tuberculous mycobacteria, *Candida* spp.) were measured in 36 ice-water machines on patient wards of a 772-bed hospital. Profile sampling was performed on five ice-water machines and adjacent taps to identify sites of microbial proliferation. *Candida* spp. were found in half of ice-water samples while enterococci and *P. aeruginosa* were present in six and 11 drain inlets respectively. NTM were measured in all ice-water samples and 35 out of 36 biofilms. Pre-filters and ice machines are sites for additional amplification: NTM densities were on average 1.3 $\log_{10}$ higher in water of ice machine flushed 5 min compared to adjacent flushed tap water. Conclusion: Ice machine design needs to be adapted to reduce microbial proliferation. Cleaning and disinfection guidelines of ice machines in healthcare facilities need to be improved.

J Hosp Infect.

2023 Nov:**141**:49-54. doi: 10.1016/j.jhin.2023.06.018. PMID: 37385452

Bacterial contamination of water used as thermal transfer fluid in fluid-warming devices

Schnetzinger M *et al*

Recent reports implicated heater-cooler units (HCUs), which are used for warming infusions, blood or in extracorporeal membrane oxygenation devices, as a possible origin of healthcare-associated infections with potentially pathogenic bacteria, such as non-tuberculous mycobacteria. This represents a source of contamination in a usually sterile setting. This study aimed to analyse water from infusion heating devices (IHDs) for bacterial contamination, and to determine if IHDs are a potential source in the transmission of HAIs. Thermal transfer fluid (TTF; 300-500 mL) was collected from the reservoirs of 22 independent IHDs and processed on different selective and non-selective media for colony count and identification of bacteria. Strains of *Mycobacterium* spp. were analysed by whole-genome sequencing. Bacterial growth was observed in all 22 TTF samples after cultivation at 22°C and 36°C. *Pseudomonas aeruginosa* was the most frequent pathogen identified, present in 13.64% (3/22) of samples at >100 colony-forming units/100 mL. Colonisation with *Mycobacterium chimaera, Ralstonia pickettii* and *Ralstonia mannitolilytica* was detectable in 9.09% (2/22) of samples. Primary sequencing of the detected *M. chimaera* suggests a close relationship with a *M. chimaera* strain detected in an outbreak in Switzerland which led to the death of two patients. Contamination of TTF represents a germ reservoir in a sensitive setting. Handling errors of IHDs may lead to the distribution of opportunistic or facultative bacterial pathogens, increasing the risk of transmission of nosocomial infections.

Ann Am Thorac Soc.

2023, May 1:**20**(5): 677–686. doi: 10.1513/AnnalsATS.202209-779OC. PMID: 36656594

Molecular epidemiologic investigation of *Mycobacterium intracellulare* subsp. *chimaera* lung infections at an adult cystic fibrosis programme

Gross JE *et al*

Outbreaks of non-tuberculous mycobacteria among people with cystic fibrosis (pwCF) have been reported at CF centers, with conflicting conclusions. The occurrence of NTM at the UVMC (University of Vermont Medical Center) adult CF program was investigated. The HALT NTM (Healthcare-associated Links in Transmission of NTM) toolkit was used to investigate the healthcare-associated transmission and/or acquisition of NTM among pwCF having genetically similar NTM isolates. Whole genome sequencing of NTM isolates from 23 pwCF was conducted to identify genetically similar NTM isolate clusters (30 or fewer single-nucleotide polymorphism differences). The epidemiological investigation, comparison of respiratory and healthcare environmental isolates, and home residence watershed mapping were analysed. Whole genome sequencing analysis revealed two clusters of NTM isolates (*Mycobacterium avium* and *M. intracellulare* ssp. *chimaera*) among pwCF. The epidemiologic investigation demonstrated opportunities for healthcare-associated transmission within both clusters. Healthcare environmental *M. avium* isolates revealed no genetic similarity to respiratory isolates. However, *M. intracellulare* ssp. *chimaera* respiratory isolates revealed greater genetic similarity to a hospital water biofilm isolate than to each other. Neither cluster had all subjects residing in the same watershed.

This study suggests the healthcare-associated transmission of *M. avium* among pwCF is unlikely at UVMC, but supports the healthcare-associated environmental acquisition of *M. intracellulare* ssp. chimaera. The presence of genetically similar isolates alone is insufficient to confirm healthcare-associated transmission and/or acquisition.