MANAG WATER SAF

Essential for life, water can also be responsible for deaths if it is not managed properly to ensure it is safe and not distributing bacteria around the building and to vulnerable patients. Pulse finds out about some of the latest technology for maintaining water safety, monitoring water temperature and testing for bugs.

Earlier this year, HTM 04-01, the guidance for safe water in healthcare premises, was updated to make it easier for sites to test thermostatic mixing valves (TMV). Essentially, however, the advice around maintaining water safety across the hospital has not changed.

Horne Engineering supports the industry's traditional thermal regime as the recommended method of pathogen control for waterborne organisms. Keep hot water hot (above 60ºC); cold water cold (below 20ºC); ensure good cold water turnover; and minimise system deadlegs - especially dead-ends - that cool to the ambient temperature, which is favourable for bacteria proliferation.

Managing water in old buildings

"One of the problems with old systems is that they were designed for a specific demand of warm and cold water, and it is likely that, with recent efforts to conserve water, greatly reduced flow rates will have been retrospectively applied to such systems. The result? Reduced turnover and flow rate encourages greater development of biofilm on the internal pipe walls," says Hannah Berry, Marketing Manager of Horne Engineering.

Hans Curt-Flemming, a German scientist specialising in the study of biofilm, determined that 95% of the biomass load in water systems resides on the walls of the system and only 5% is planktonic, or carried in the water flow. If left unchecked, the wall biofilm will grow and periodically disperse downstream as bits break off into the passing stream, thus contaminating other parts of the system.

Horne has always been an advocate of high velocity flushing - this means flushing the system to drain from an integral drain point just upstream of Horne TMVs, showers and the Optitherm tap. "This is generally recommended practice during the commissioning of new installations; for removal of any pipework debris, swarf and other construction contaminants, but we also recommend periodic flushing, at higher velocity, to remove excess biofilm to drain. The changed velocity increases shear forces at the liquid-solid boundary, mechanically scouring the biofilm off the wall and into the flow ... and to drain."

Reduced flow rates also increase the build-up of biofilm within the basin trap as there is not enough pressure behind the flow to sufficiently clear the fouling. This can exacerbate the situation, as the trap is a well-identified source of contamination for retrograde colonisation of the water system via the tap terminal fitting.

Retrograde contamination

An increasing problem today is posed by pathogens that enter the hospital water system from the ward environment. *Pseudomonas Aeruginosa*, for instance, predominantly inhabits the last two metres of pipework before the tap terminal fitting/outlet. "Isolates from the water system typed as being resistant to a specific antibiotic or, increasingly, as being multi-drug resistant (MDR), can only have arrived there as a result of retrograde contamination (RC)," explains Berry.

There are a number of causes of RC, including splashing during hand washing, poor cleaning practices or misuse of the (dedicated) hand washing facilities. The outcome is that the water system - the part proximal to the outlet fitting - becomes a reservoir of potential further infection. Unmanaged, that contamination can extend up the cold pipework to other parts of the system.

The outlet fitting on the tap also has a crucial part to play with respect to reducing contamination. "It is inherently

Water temperature monitoring LinkThru system from Cistermiser

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"AN INCREASING PROBLEM TODAY IS POSED BY PATHOGENS THAT ENTER THE HOSPITAL WATER SYSTEM FROM THE WARD ENVIRONMENT"

vulnerable - not because of its structure or composition - but because it is situated at and serves as the interface between two phases: the non-sterile air of the ward environment and the hospital water system. It will inevitably be subject to contamination as well as evaporation. Therefore, the interface itself, the surface area of that phase boundary, needs to be an optimal size."

In the case of Horne's Optitherm thermostatic tap, the phase interface is reduced to the diameter of the outlet's flow conditioner (which is also designed specifically to reduce splashing). Its design intentionally exploits the water's natural surface tension and stops the spout draining down. "This is important: all a drain-down spout can do is intake air - to replace the displaced water - that is invariably contaminated, and significantly increase the surface area of the air/water phase boundary. Throw in the agreeable temperature and the moist darkness and, hey! It's party time!"

In-line thermal disinfection

A hospital is a complex environment and it is almost inevitable that at some point in its operational lifetime, any tap or shower fitting will be identified as a reservoir of infection for a particular pathogen. *Pseudomonas Aeruginosa* might be grabbing the headlines, but the water system could feasibly become contaminated with just about any hydrophilic pathogen that is present in the ward environment. Recognising this and putting processes in place to manage RC is all that is required.

Hannah Berry outlines the benefits of in-line thermal disinfection.

"The Horne ILTDU (in-line thermal disinfection unit) cannot prevent RC but it does allow for it to be effectively managed. The ILTDU facilitates straightforward thermal disinfection utilising the locally available hot water supply, and does so from a point that is some distance from the outlet, thus covering the more susceptible cold water pipe drop. Everything downstream: the cold water pipe drop, strainers, check-valves, TMV, all the way to, and beyond, the outlet fitting can be routinely raised to system temperature and disinfected.

"Horne recommends routine disinfection using the ILTDU at a temperature no less than 60ºC for a minimum of 10 minutes. To conserve hot water the flow rate can be throttled back slightly, but full immersion of the outlet fitting or the shower spray pattern must be achieved for the full 10 minutes. Tests at participating hospitals have shown that when this advice is followed the ILTDU is capable of resetting *P. Aeruginosa* counts to zero.

ILTDU thermal disinfection should be paired with high velocity flushing to remove excess biofilm and optimise the quality of water entering and exiting the tap or shower fitting.

"This combination of HV flushing and thermal disinfection is the only truly workable solution for minimising the risk of the water supply becoming a reservoir of infection and, with the growing global threat of MDR bacteria, reducing reservoirs of infection will become increasingly important.

"According to HTM 04-01, when a water outlet is identified as being contaminated, point-of use filters are allowed as a temporary protective measure until an engineering solution can be implemented. Where no workable solution exists,

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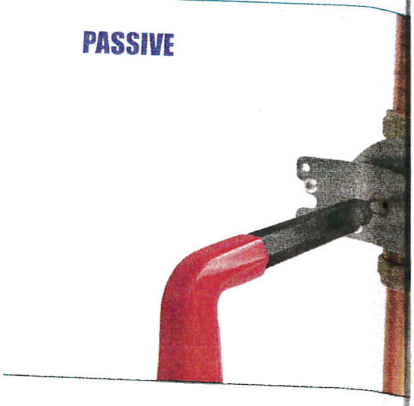
HTM 04-01 Part B, Page 44, Paragraph 7.45 states continuous long-term use of POU filters is not recommended, except where there is no effective alternative.

"There is now, however, a completely workable and significantly more cost-effective solution in the patented ILTDU. There are some obvious limitations with POU filters: they are only effective for a finite period, generally 30 days, and changeover for new is required. This can represent a significant and ongoing cost burden to a resource-limited NHS. Not only that, the filter is just as susceptible to RC and biofilm formation on its outer surfaces as the original outlet fitting. Meanwhile, it allows planktonic and waterborne pathogens to congregate on the upstream side of the filter, form a biofilm and proliferate under likely perfect conditions (favourable temperature, good oxygen supply and, perhaps, nutrient-rich fresh water flowing through it). This may actually exacerbate the contamination of the system.

"ILTDUs compare favourably from a cost point of view. Taking the cheapest POU filter as around £30 - so looking at the worst-case comparison - a single ILTDU with its operation key (the number of keys required should match the number of operatives and not the number of ILTDUs installed) will pay for itself in just over five and a half months. Scale this up and the savings are substantial. With an ILTDU there are no further costs, other than the labour for its routine operation. There are additional savings to be had though: once the product and method are proven - by a number of water



ILTDU from Horne Engineering

New testing guidelines: a fresh start for TMV asset planning

New guidance on thermostatic mixing valves (TMVs) for healthcare premises has gone a long way towards simplifying testing of what can be thousands of TMVs in an establishment. It will save time and costs, and reduce the risk of errors and omissions. It removes the requirement to compare with the last audited result and should reduce the incidence of time-consuming false alarms, but it does not solve the underlying financial challenge of a legacy of old and unaudited TMVs.

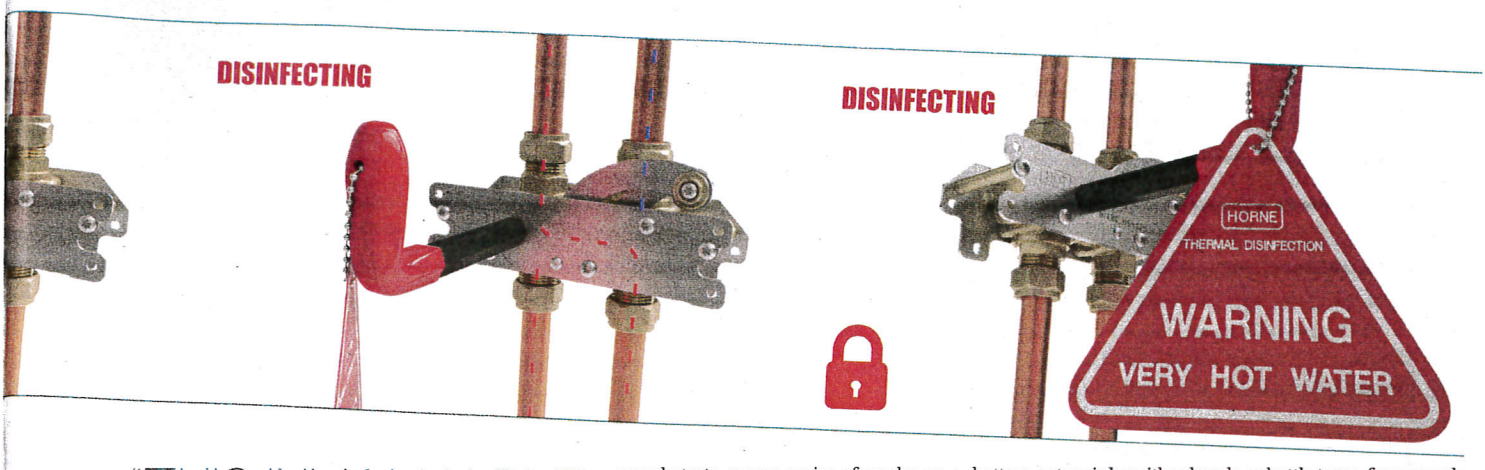
In a nutshell, the old tests involved comparing the supply conditions to those measured when the mixer was originally commissioned or previously audited. That proved to be an issue where there were no records of the initial installation and no history of prior audits.

The Water Safety Group process would be calling for up to date records: but setting up a new audit regime was hard to cost because there might be no record of what valves were installed. Catching up with best practice was a bit like writing an open cheque. The old test procedures were more likely to red flag a valve for further investigation in error, only for contractors to find it is so old that there are no longer service kits on the market. Estates managers were being faced with the costs of replacing significant numbers of TMVs altogether.

These underlying issues will not go away just because the new tests are easier. They may make false alarms and the need to investigate and replace perfectly functional valves less likely, but that may only be a stay of execution. The new HTM-04 D08 guidance does, however, give estates managers a cleaner slate by removing the need for having previous values to compare with.

Now is time get a comprehensive asset register in place so you can quantify the risk presented by older valves that can no longer be serviced and those that are hard to access.

"TESTS AT PARTICIPATING HOSPITALS HAVE SHOWN THAT WHEN THIS ADVICE IS FOLLOWED THE ILTDU IS CAPABLE OF RESETTING P. AERUGINOSA COUNTS TO ZERO"



"THIS INVALUABLE 'REAL-TIME' DATA SUPPORTS ESTATE PERSONNEL'S WATER MONITORING AND PROVIDES ALERTS TO HIGH RISK WATER TEMPERATURES"

sample tests, over a series of weeks or months, showing PA reset to zero - then the frequency of water testing can also be reduced."

The case for POU

Mike Hemingway, UK Sales Director of Aqua *free* argues that there is a strong case for using point of use filters for improving patient safety and that this is common practice in many countries.

"In the UK, point of use filtration is seen as a necessary evil and will be most commonly specified as a temporary risk management solution, until the outbreak or identified pathogen can be permanently engineered out. Compare this to the continent, in countries such as Germany and Austria, where point of use filtration is considered the norm, especially in wards caring for particularly vulnerable patients such as haematology, neonatal and post-operative care facilities.

"The skewed perception here in the UK is largely fuelled by ill-conceived cost drivers, with many procurement departments considering point of use filtration units a cost-hungry solution. The truth, however, is that there is a clear case for offsetting the cost of a potential infection by frequently occurring waterborne pathogens such as *Stenotrophomonas, pseudomonas* and *klebsiella*, with the cost of continuous, properly managed, POU filtration.

"It has been estimated that the average financial cost of a nosocomial infection is around £13,500 per infected patient. The cost of using POU filters on a permanent basis in very high-risk wards could be significantly lower compared to the cost of even one such infection incident.

"The UK has a substantial ageing healthcare building stock, with many hospitals retaining historic systems and building design features. Money is tight, and transforming legacy systems is costly and disruptive. Whilst these improvements are inevitable at some point, the most important factor in the short to medium term must be patient safety.

Until the long-term refurbishments are complete, point of use filtration products can be used to protect vulnerable patient profiles from harmful waterborne bacteria such as *Legionella, Pseudomonas* and *Klebsiella*, no matter how old or complex the water system.

"Many older buildings still have traditional bottom entry sinks with u-bends or bottle traps, for example. These are slowly being designed out or retrofitted with back exit sinks to combat the potential for infection from the washbasin waste.

"The HygieneSiphon from Aqua *free* was developed to fit a traditional sink by simply replacing the plug-hole and is designed specifically to prevent bacteria from the waste entering the room environment and causing infection.

"Effective flushing of the water system is of key importance in older buildings too, to prevent water stagnation and the growth of potentially fatal pathogens. Consider an automatic flushing system, like Aqua *free*'s FLUSH 2.0, which can typically be fitted in a matter of minutes and provides flushing for the prescribed duration and frequency without consuming valuable staffing resources.

"When it comes to augmented care environments, it is important to remember that despite the point of use filtration market being awash with products claiming longer and longer operating times, a responsible supplier of medical grade filters will consider how filters are actually used in clinical care settings when specifying a realistic operating time.

"To maximise resources, look for a manufacturing partner that can offer a comprehensive after sales package, which can include the full management of a filter change programme, including all logistics, qualified technicians to carry out the filter change, documentation of all change activities and training of staff in the correct use and cleaning of the filter.

Consider also filters that can be reprocessed, which reduce waste to zero for carbon conscious healthcare environments looking to deliver a 50% reduction in filter usage related carbon consumption."

Temperature monitoring

Cistermiser has developed a new water temperature monitoring platform, LinkThru, for hospitals and other healthcare sites. The platform automatically checks the water temperature and flow events in pipework systems every five seconds with the results accessed via a user-friendly portal. This invaluable 'real-time' data supports estate personnel's water monitoring and provides alerts to high risk water temperatures, which can be a critical indicator of the potential for growth of waterborne bacteria.

Trialled in major hospitals in London and Birmingham, it saves estates personnel having to record readings manually at multiple sentinel locations, which can be resource heavy and time consuming. Instead it relays the results to 'the cloud' from where they can be accessed via the portal on the user's computer, tablet or smartphone.

Cistermiser Technical Director David Meacock says: "Our new system raises an alarm only when there is an exception to be checked. This avoids swamping the user with unmanageable volumes of data but full reports can be drawn off at any time, for example, for presentation to a regulator."

The platform was developed over two years following extensive consultation with maintenance and engineering personnel. It can be used in a single building or a group of buildings and no matter how large the site is the overarching data remains easily viewable. "At any juncture, you can see how many outlets are being monitored and how many are presenting a high, medium or low risk temperature or flow event," confirms Meacock.

Rapid testing

IDEXX has announced the introduction of Legiolert, a new culture testing method that enables building owners and facility managers to simplify water testing and reduce the risk posed by Legionnaires' disease. Legiolert is a highly sensitive method for the confirmed detection of *Legionella pneumophila* (*L. pneumophila*) in water. It was launched in North America in 2016 and is now available for use across Europe, the Middle East and Africa.

Legiolert improves public health response times by accurately and sensitively quantifying *L. pneumophila* in water, providing a confirmed result in seven days, versus up to 14 days with traditional culture methods. The new test does not require laborious colony counting or confirmation steps which reduces the need for training and the risk of interpretation errors and frees up time for laboratory staff.

Leading water microbiology consultant David Sartory recently concluded that the IDEXX Legiolert™/Quanti-Tray® test is superior to the standard method for quantifying *L. pneumophila*. His assessment was part of a peer reviewed study, 'Evaluation of a most probable number method for the enumeration of *Legionella pneumophila* from potable and related water samples', published in the April 2017 issue of Letters in Applied Microbiology.

The Legiolert test is based on a bacterial enzyme detection technology that signals the presence of *L. pneumophila* through utilisation of a substrate present in the Legiolert reagent. *L. pneumophila* cells grow rapidly and reproduce using the rich supply of amino acids, vitamins and other nutrients present in the Legiolert reagent. Actively growing strains of *Legionella pneumophila* use the added substrate to produce a brown colour indicator.

Though the disease is largely preventable, diagnosed cases of Legionnaires' disease in Europe reached their highest rate ever in 2014, with 13.5 notifications per million inhabitants, according to the European Centre for Disease Prevention and Control. For hospitals, nursing homes, hotels and other high-risk buildings, testing drinking water, cooling towers and other building water systems is the only way to ensure an effective risk management plan against *Legionella pneumophila*.