water
HYGIENE CENTRE

Water Safety; what does the future hold?

Daniel Pitcher, Managing Director and Authorising Engineer [Water] at Water Hygiene Centre, considers future developments and changes for water safety

Legionnaires' disease was first identified in 1976 due to a large outbreak of pneumonia at a hotel in Philadelphia. Over the last 43 years knowledge of the legionella bacterium has developed, including its ecology and means of control. There has also been an increased awareness of other waterborne pathogens such as Pseudomonas aeruginosa, following an outbreak at a neonatal unit in Belfast in 2012 when three premature babies died due to infection. News of other waterborne pathogens was reported in the journal of the Water Management Society 'Waterline' [winter 2014/2015] in an article titled 'Emerging pathogens of concern in healthcare settings' otherwise referenced as 'ESKAPES' [Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa and Enterobacter spp.]

Taps have changed

- Over the last 43 years there have been fundamental changes in the design of outlets and water system components:
- The introduction of Thermostatic Mixing Valves [TMVs] to help control the risk of scalding. Those who may be at risk include very young, very elderly, infirm, significantly mentally or physically disabled people or those with sensory loss.
- The introduction of filters, strainers and flow straighteners into water distribution systems, taps and tap outlets. Devices are used for a number of reasons such as protection of mechanical components within the TMV from particulates within the water system, to ensure the flow of water from the tap does not cause excessive 'splashing' when the outlet is operated and water is drawn off and for restricting the flow for water conservation.
- The internal finish on the body of the tap has changed, instead of rough cast finish they are now a smooth cast on the side to reduce the accumulation of biofilm on the rough surface. This includes the materials used, such as the introduction of copper.
- The redesign of outlets to include an integral TMV, this facilitates ease of access for servicing and maintenance of the components within the TMV. Some of these designs allow the tap to be taken apart for cleaning and disinfection and some designs allow the flow of hot water through to the cold side for thermal disinfection.
- Touch-free taps, where a motion sensor activates the flow of water when hands are presented beneath the outlet. Some designs, known as 'intelligent' taps, are able to flush automatically in the event of a period of inactivity as well as providing data about the frequency and duration of use!

This very broad overview of the changes charts the development from a simple tap, to a safe tap, to an intelligent tap in this time. The concept of 'getting things right at the design stage' isn't a new one, however, when it comes to water safety there is still a clear need for those who are responsible for water safety, e.g. Water Safety Groups, to be more proactively involved with the design of the systems.

For one client, a scald risk assessment completed during the design stage of a new building resulted in the removal of numerous TMVs from outlets around the building. This could be justified based on the end-user determining who will have access and use of the outlets in each location as opposed to a designer, who maybe risk averse and include TMVs where they are not required. As such changes to tap design, interaction and mode of use will continue through manufacturers advancements and feedback from end users.

Intelligence

There is another trend that has gathered pace in recent years; which is the use of remote monitoring systems. Currently we can see Building Management Systems (BMS) that record various perametres such as hot water generator temperatures, cold water cistern temperatures and maybe the sentinel points / end of line temperatures. The use of these electronic systems is evolving and their use is on the increase, where the assets, i.e. outlets, TMVs, showers etc, that comprise the water system are all uniquely identified and their routine monitoring and maintenance is automatically recorded and tracked on the electronic system. This data is evidence for reporting the state of compliance to Water Safety Groups – as long as the data is accurate.

This means that all risk systems and assets must be known and captured in the system and that operatives undertaking the monitoring and maintenance and those interrogating the system should have been suitably trained. In a recent survey by Forbes it suggests a high majority (90%) of businesses recognise the importance of equipping workers with the best technologies to fulfil their roles. It highlighted this as a positive opportunity, with 43% of respondents believing it empowers workers and allows them to focus on 'higher-value' tasks. Yet too often it remains overlooked.

Thinking about equipping workers with the best technologies to fulfil their roles, a time will come when the manual monitoring of water temperatures will be replaced with remote monitoring sensors.

With the issue of the HSG274 Technical Guidance Part 2 in 2014 the HSE introduced a need to complete return loop temperature monitoring. The location of these 'loops' around a building will invariably be in places that are difficult to access but the use of remote monitoring sensors can remove, or significantly reduce, the need to physically access these parts of the system as part of a manual monitoring excericse.

Development in monitoring using remote sensing technology is starting to reshape what is possible through real time data; which is an example of how modern technologies can provide Water Safety Groups with opportunities to transform compliance data and provide more robust evidence on system performance. The ability to respond to automated critical alerts, such as failures in temperature control, in a timely fashion is paramount for continued system safety. The use of remote monitoring will mean that workers can focus on the 'higher-value' task i.e. responding to failures quickly with less impact on the resources available for the preventative maintenance that reduces failures in the first instance.

It makes sense to partner with a technology specialist who can support the monitoring processes previously completed manually and potentially improve the strength of your compliance data.

Faster Testing

Taking a sample of water from a tap, sending this to a lab for legionella analysis and waiting on the final result [>10 days] is a slow process that can be thwarted if processes are not properly followed i.e. methods of sampling, handling and transportation can significantly impact on the reliability of the results and as such sampler & laboratory competence is hugely important.

The plate-culture method detailed in guidance documents for the enumeration of legionella bacteria is seen as the 'gold standard' and is used by UKAS accredited laboratories. There are limitations to this method that were detailed in the Waterline Journal [winter 2015-16]:

- Length of time taken to obtain a reportable result;
- Poor sensitivity and poor recovery;
- Inability to detect 'viable but non-culturable' cells [VBNC];
- Inhibition from other competing flora.

This article from Waterline went on to introduce:-

- PCR [polymerase chain reaction] testing for the rapid detection of legionella in environmental samples. The benefit of PCR testing is that a result is returned within 24 hours. PCR still has some hurdles to clear before it can be fully embraced, such as interpreting the results returned in 'genomic units' that are not directly comparable to the widely understood colony forming units [CFU/L] used in the culture method. PCR detects target DNA whether it is damaged, dead, dying or viable-but-non-culturable whereas the culture method detects viable cells only. In tests completed by Public Health England PCR achieved 100% negative predication values, so its use as a negative screen within 24-hours is a huge benefit over culture method. PHE and HSE continue to develop culture / PCR data to provide understanding and aid users with possible future guidance.

- Immunomagnetic Separation [IMS] is another rapid detection method for legionella. The process of using microscopic magnetic particles that have been coated with antibodies for the target microorganism, in this case Legionellae. These beads are blended with a sample, the coating of antibodies allows the particles to bind with the cell surface antigens. The beads do not bind well with dead cells [so detection of dead cells i.e. false positives is not an issue]. The next stage is the addition of colour marker antibody to the captured cells. The colour presented is proportional to the number of cells. Use of quantitative colorimetry provides an accurate cell count. The exact identity of the microorganism can be confirmed with PCR.

- There are other rapid testing methods such as MALDI-TOF and Most Probable Number [MPN] which are also developing at a pace.

Closing Thoughts

Attending conferences, seminars and routinely reading journals and papers there are always interesting developments in water safety such as rapid microbiological testing, developments with outlets, developments with pipework, advances in control strategies, water safety plans and water safety groups.

There is very little news when it comes to advances in water monitoring technology and data management systems for capture and analysis of this data. Published articles seem to focus more on the outcome and ways to fix problems with water systems. Where is the emphasis on data? It is the data that is needed to make an informed decision on risk control, such as the need to sample or the need to carry out remedial alterations. Looking at HSG274 Part 2 and HTM04-01 Part B, both detail temperature monitoring and the need for return loop temperatures to be monitored. It is not the easiest task to identify the position of the loops and then devise an efficient approach to routine monitoring. I expect a few readers will now be nodding in agreement that loop monitoring is still a 'nettle to be grasped'.
The world is changing – and some organisations are going to be left behind – being left behind will increase the gap to achieving and demonstrating compliance with legislation & guidance.

Water systems and the chosen control strategies need to be monitored, to prove systems are compliant. The degree of monitoring required and how best to achieve that data capture is the key change to be observed. We live in a digital age, in the next decade the millennial generation will take the reins of leadership and as such, the electronic handling of compliance data is the way forward. The means of water analysis will have moved on too: rapid microbiology technologies will be better understood and optimised for practical use. Consequently, when electronic monitoring systems report failures, rapid testing of water samples will follow and the two together will enable quicker response times all round.

It's time to shake hands with the future – prevention is better than cure!