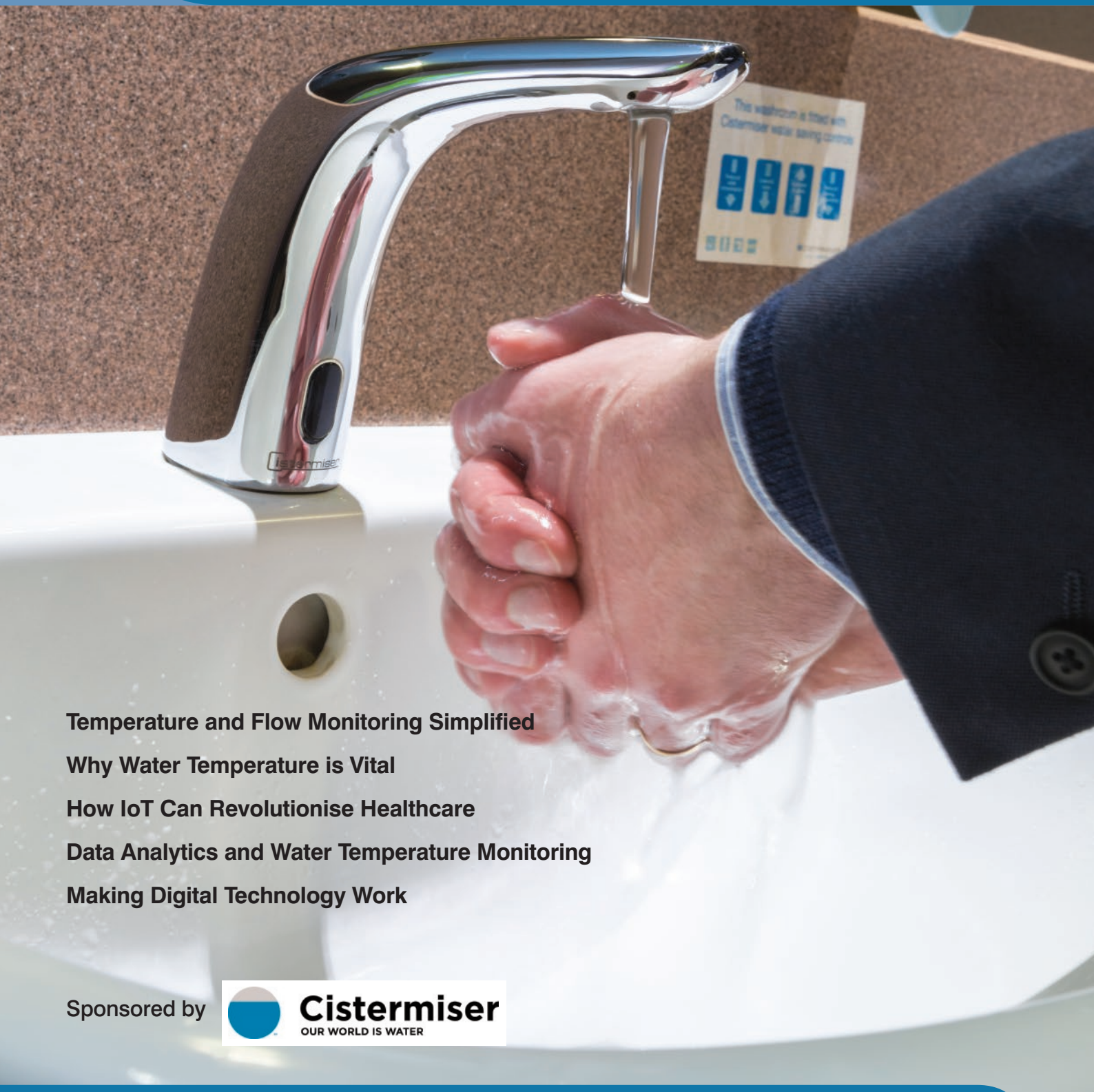
SPECIAL REPORT

Advances in Water Temperature Monitoring Technology



Temperature and Flow Monitoring Simplified

Why Water Temperature is Vital

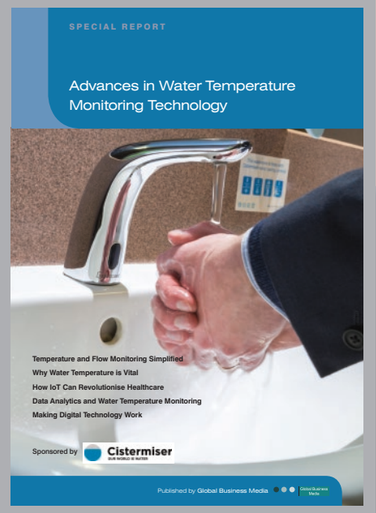
How IoT Can Revolutionise Healthcare

Data Analytics and Water Temperature Monitoring

Making Digital Technology Work

Sponsored by Cistermiser OUR WORLD IS WATER

Published by Global Business Media



Published by Global Business Media

Global Business Media Limited
62 The Street Ashtead Surrey KT21 1AT
United Kingdom

Switchboard: +44 (0)1737 850 939
Fax: +44 (0)1737 851 952
Email: info@globalbusinessmedia.org
Website: www.globalbusinessmedia.org

Publisher
Kevin Bell

Business Development Director
Marie-Anne Brooks

Editor
Tom Cropper

Senior Project Manager
Steve Banks

Advertising Executives
Michael McCarthy
Abigail Coombes

Production Manager
Paul Davies

For further information visit:
www.globalbusinessmedia.org

Contents

Foreword

CONTROLLING THE temperature of water has long sat at the heart of anti-infection strategies in the NHS, but they have often been held back by an inability to gain a truly accurate real-time view of water temperature. That is changing thanks to a new generation of digital technologies which promise to revolutionise temperature control.

A prime example is showcased from Cistermiser. Their LinkThru system delivers up-to-the-minute information on the status of water to a central cloud-based platform. In our opening article, Jonathan Baillie, editor of HEJ magazine, reveals how this technology was developed and how it can deliver many practical benefits to hospitals.

We then look at why water temperature monitoring is so important. To combat infection, hospitals need to keep water out of so-called danger zones where bacteria can thrive. The HSE recommends constant inspections, but these are a drain on resources and are not 100% reliable. Temperatures can stray beyond boundaries without being detected.

Jo Roth then examines one of the key technologies underpinning the next generation of water temperature monitoring. Internet of Things (IoT) technology allows equipment throughout the hospital to be connected, raising alarms when issues arise and giving managers a real-time 24/7 view of the temperature of water.

We then look at the importance of big data and the challenge of securely analysing all the data IoT technology will produce. There are major challenges and perceived risks but, as James Butler discovers in our final article, hospitals are being slow to embrace change. However, with the right approach and by taking adequate security protocols, hospitals can integrate technologies which allow them to reduce running costs while also meeting the demands of the future.

It is an exciting time, and technology will play an important role in the future of the NHS. Just how important will depend on the way in which technology is integrated.

Tom Cropper
Editor

*Over the past 15 years, **Tom Cropper** has produced articles and reports on various aspects of global business. He has also worked as a copywriter for some of the largest corporations in the world, including ING, KPMG and the World Wildlife Fund.*

Temperature and Flow Monitoring Simplified

Jonathan Baillie, *Editor, Health Estate Journal*

This article, titled 'Temperature and flow monitoring simplified', first appeared in the August 2017 issue of Health Estate Journal (www.healthestatejournal.com), the monthly magazine of the UK's Institute of Healthcare Engineering and Estate Management (IHEEM: www.iheem.org.uk), published 10 times per year, and also accessible online.

DESIGNER, DEVELOPER, and manufacturer of washroom control products, Cistermiser, will soon launch a wireless system for the continuous, automatic, and accurate monitoring – with minimal human intervention – of hot and cold water temperatures and water flow events in large pipework systems such as those found in hospitals. As I discovered from technical director, David Meacock, the 'Internet of Things (IoT)'-enabled temperature monitoring system is designed to substantially reduce the workload of healthcare estates teams seeking to minimise the risk of Legionella growth by eliminating the need for frequent manual sampling and flushing of well-used outlets where water temperatures and flow remain stable.

The temperature monitoring unit incorporates an aerial, and two ports to which cables connect, and are then attached at the other end to the pipework or outlet.

In a highly competitive sector, continuing to innovate remains key for Cistermiser – one of the UK's best-known names in washroom controls, whose sister company, Keraflo, operates 'at the other end of the water system', supplying 'maintenance-free' float valves and tank management systems. The latest in a line of innovative products developed over the past five years – with launch scheduled for April 2018 – is an operating platform comprising physical and software components that can enable Cistermiser to add intelligence to its new temperature monitoring unit and connect it to the Internet of Things. This gives the user a system for automatic wireless monitoring, providing real-time temperature readings on their computer screen, in order to track and monitor hot and cold water temperatures in pipework systems – critical to risk assessments.

Cistermiser technical director, David Meacock, said: "Healthcare estates teams are good at undertaking risk assessments and water monitoring, but many large hospitals face a significant resource issue in sparing the staff to go around and take temperature samples."

The system was developed over the past two years in collaboration with 'Internet of Things' solutions provider, SPICA Technologies. Cistermiser has committed to a long-term partnership with SPICA which will see further 'connected device' innovation introduced across its product range, underpinned by SPICA's data analysis solutions. The IoT-enabled temperature monitoring unit was specifically designed to enable maintenance and engineering personnel responsible for large, complex water systems – such as those found in in hospitals – to continuously monitor hot and cold water temperatures within multiple buildings without having to visit sentinel points to temperature sample manually.

In a highly competitive sector, continuing to innovate remains key for Cistermiser – one of the UK's best-known names in washroom controls

The battery-powered units connect quickly and easily to the water pipe, TMV, or outlet, using small clamps.

The 'Internet of Things'-enabled monitoring system is designed to substantially reduce healthcare estates teams' workload.

Instead a network of small 'black boxes' does the job automatically.

The battery-powered units, each incorporating a lithium metal cell battery with a five-year lifespan, connect quickly and easily to the water pipe, TMV, or outlet, using small clamps. Their use eliminates the need for a healthcare engineer to take temperature readings using a probe or thermistor at sentinel points perhaps once weekly, record the data, and then email or manually input the data into whatever monitoring software 'front end' the estates department is using.

David Meacock, who gave me a presentation on the new system at Cistermiser's Reading offices, explained that discussions between the company's salesforce and engineers, and healthcare customers over the past 2-3 years, had confirmed that healthcare estates teams 'spend inordinate amounts of time' manually checking and recording water temperatures.

A Well-Recognised Brand

He explained: "We are fortunate, when developing and launching new products, that Cistermiser is such a well-recognised brand, and indeed really a 'household name', despite most of our products – such as our WC flushing and urinal systems – being destined for commercial applications. We are constantly looking to innovate, and it was with a view to taking Cistermiser in a slightly new direction harnessing wireless technology that I first met SPICA's team about two years ago. Its strength is using sophisticated algorithms to collect data, identify patterns, and present the data in a very user-friendly way. The company had developed a Legionella monitoring product, and in the past year we have undertaken some field trials with it at large acute hospitals. We have strong brand and manufacturing expertise, coupled with excellent contacts at specifier and merchant level, while SPICA is fantastic at writing software and developing IoT solutions."

David Meacock explained that Cistermiser designs all the mechanical and electronic components for its products, moulds all its own plastic parts, and assembles everything on site. Cistermiser, and its sister company, Keraflo, are part of Davidson Holdings, most of whose business interests are associated with washroom controls and water systems.

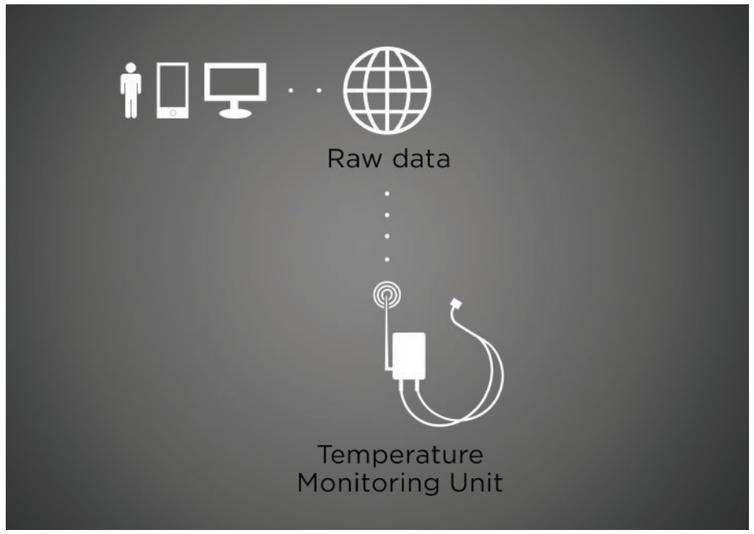
Complementary Expertise

Having considered the background to the new system's development, David Meacock showed me a presentation which firstly emphasised the need for careful monitoring of water temperatures to combat Legionella, as set out in HTM and HSE guidance, before explaining the key features and capabilities of the new automatic monitoring system. He said: "This is all – as HTM 04-01 stipulates – about avoiding water temperatures that favour the bacterium's growth, i.e. maintaining stored cold water temperatures at 20˚C or below, and circulating hot water at around 60˚C.

"In developing the new monitoring system we continually referred to HTM guidelines – for instance in setting the software's recommended default temperature ranges for certain outlet types. HTM and HSE L8 ACoP guidance also emphasises the need to ensure water doesn't stagnate, and of accurate record-keeping; indeed the ability to automatically monitor and record water temperature with minimal human intervention is one of the biggest cost and time-saving benefits cited by the two large hospitals with whom we have recently trialled the new connected temperature monitoring system.

A 'Significant Resource Issue'

"Healthcare estates teams are good at undertaking risk assessments and water monitoring," he continued, "but many large hospitals face a significant resource issue in sparing the staff to go around and take temperature samples, let alone keep really accurate records. How many estates managers could, say, hand on heart, that their water temperature records are 100 per cent accurate,



The temperature monitoring unit collects and transmits raw data to a 'cloud' server. The portal interface then refines that 'big data' into a format that is presented to the user on a dashboard screen.

yet if an issue arises, and they cannot present accurate records to a regulator, they could face prosecution."

"Currently in most large hospitals," David Meacock added, "an estates manager will either direct one of his or her own staff to tour the site, turn taps on and off, and take temperature readings, or may use an outside contractor to do the job. Electronic logging systems are available, but most require somebody taking samples. However, can the estates manager always be sure that the job is being thoroughly carried out?"

David Meacock next showed me one of the temperature monitoring units. He said: "The device is designed to be retrofittable, and to fit onto a washbasin, any pipe with an access point, behind a panel, under a sink, on a sluice, or by your boiler. The unit incorporates an aerial, and two ports to which cables connect, and are then attached at the other end to the pipework or outlet, typically to a 15 mm or 22 mm pipe, using small push-fit connectors. With lagged pipework, using a small Stanley knife will expose the pipework sufficiently to enable a sound connection. The process is very quick and easy." Each port can take two readings, for instance from a hot and cold tap.

'Live and Reading' Immediately

David Meacock continued: "The unit can be affixed using adhesive tape or the integral groove in its base which will fit onto a pipe secured by a zip-tie. Once attached it is live and 'reading' every five seconds." I asked when the second port might be used. He replied: "Typically on a TMV, with a hot feed, a cold feed, and a mixed feed – requiring three connections, or you might have a cold feed and a hot and cold return on your hot outlet, or you could just leave one connector fitted to record your ambient temperatures."

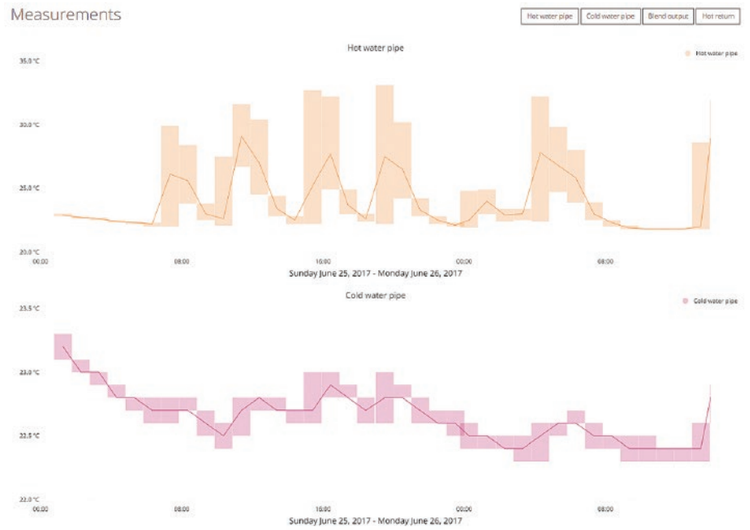
The connected temperature monitoring unit takes a reading every five seconds, and then sends data on the temperature recorded back to 'the cloud' hourly, providing data including the maximum and minimum and the average temperature recorded over that period. David Meacock added: "The sensor also records any flow events, such as the tap being turned on, which will give a spike in temperature. The data is analysed by the device's inbuilt software, batched, and sent back to the 'cloud', and thence to the user interface. The system uses the Sigfox network, a long range, low-power, low-bandwidth wireless technology, already well established across Europe and now being slowly rolled out across the UK. Its principal use to date has been for the transmission of 'Big Data' around smart devices and machine-to-machine intelligence.

Signal Boosters

"Where the local Sigfox signal strength is not adequate," he explained, "we can provide boosters, while the system has both a high and a low fidelity mode, the latter for use should the battery run low (the batteries typically have a lifespan of five years or more). If this happens, the system alerts the user. The sealed units are designed to be replaced at the end of the battery's life. The system is simple to install, and the devices easy to relocate."

I wondered how many of the devices a large acute hospital might require. David Meacock said: "It will always be a balance. The user pays for the hardware, and there is then a monthly

Many large hospitals face a significant resource issue in sparing the staff to go around and take temperature samples, let alone keep really accurate records



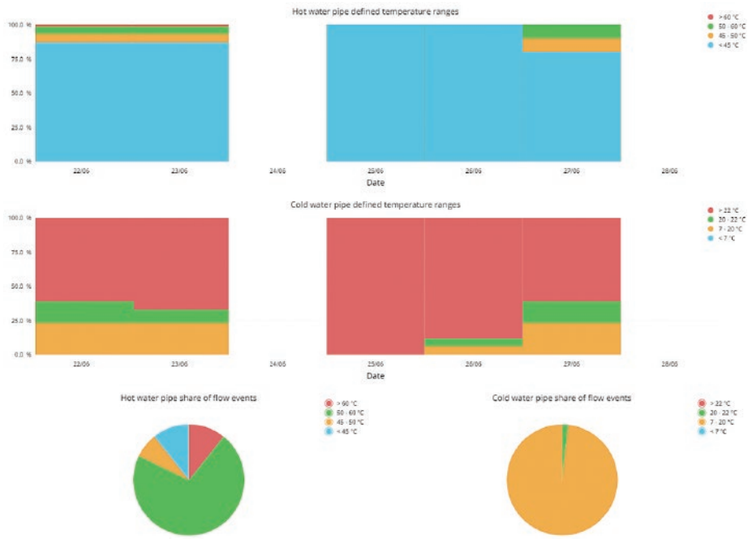
This sample 'dashboard' shows hot and cold water temperatures over a two-day period.

subscription fee to access the software platform to analyse the data. The user – say a Trust's estates team – will need to determine what they are paying for their current solution, and how much value they put on robust data and ease of use, and then identify the best solution. Some sites have told us they want a unit on every outlet; with a large acute hospital this could potentially be tens of thousands, but realistically I imagine many will principally fit them to their higher risk outlets."

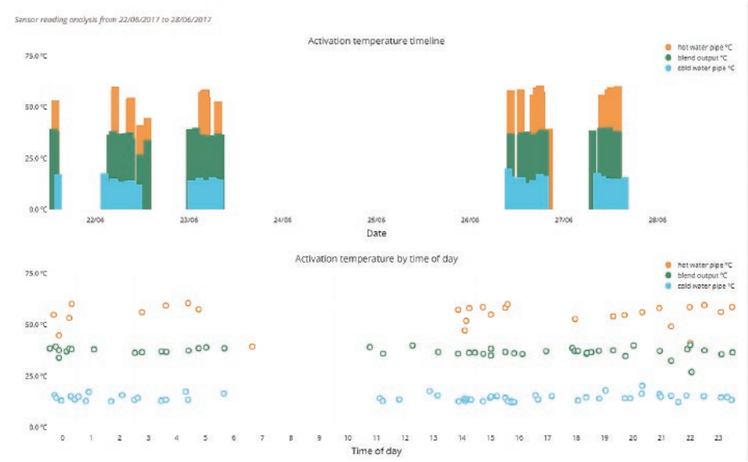
Not Easy to Understand

David Meacock explained that while there were already water temperature control probe systems available that link into building management systems, feedback suggested that some of the interfaces and controls were 'not that easy for the less well-trained to understand', adding: "In fact in our recent trials users said they liked the fact that our new temperature monitoring system was not linked to a BMS, because sometimes making the necessary adjustments can be tricky. Couple this with the ease of installation and removal and relocation of the black boxes whenever required, and the elimination of having to take regular manual temperature readings, and you can see why the trials have generated such positive feedback."

Users are allocated a password and 'log in', with no need to install software on their PC, since all the data is held in the 'cloud' and accessed via a simple web interface. Once each device



Hot and cold water pipe defined temperature ranges and flow events over a period of several days.



A screen shot showing activation temperature timelines from sensor readings.

is registered, they can access data both from individual units and the main interface. David Meacock said: "Traditionally an estates engineer recording data could have thousands of temperature readings to sort through, analyse, and, where necessary, respond to with remedial action each week. Our new system reads temperatures automatically, only alerting the user if there is a problem. The software allows, say, a 'master-user', to create pre-determined rules for different outlets such as sinks or TMVs. The units fitted to sentinel points will then only send an alert – either directly to the user interface, or to designated personnel via email – if the temperature falls outside the set parameters for that type of outlet, or if water flow is low or non-existent over a preset period."

Entering Initial Data

During the installation process the engineer fitting the monitoring device needs simply to enter data on the type of outlet, its location building/floor number etc., and its 'unique ID', into their phone or PDA. The software then registers all this data, enabling a precise record to be maintained of temperatures and flow 'events' at every device. David Meacock said: "Once this is done, monitoring begins immediately, and, provided no alerts are generated for that particular outlet, there is no need for the engineer to re-visit it. We are now working to further simplify the initial data inputting and sending process via the launch of an IOS, Android, and Windows-compatible 'app'."

In addition to enabling efficient, accurate, automatic temperature monitoring, the Internet of Things-enabled temperature monitoring unit also eliminates the need for an engineer, or indeed, say, a designated nurse, to make a point of visiting well-used outlets to undertake flushing, provided that temperatures remain within the preset parameters. David Meacock added: "The automatic temperature monitoring facility not only detects temperatures which could lead to Legionella colonisation, but also those that might pose a scalding risk, or, conversely, see pipes freeze. It will also help users identify under-used outlets or, for example, taps or showers left running. "Once the data is recorded it can be integrated into a BMS or CAFM, and exported in file formats including Word, Excel, and CSV."

At this point – to give me a better 'feel' for the system – David Meacock opened up a series of typical 'dashboards' to show the system's range of functionality, explaining: "The interface – which we have developed – is designed so that no matter how big your hospital site, and how many buildings you have, the overarching data is easily viewable.

At a Glance 'Picture'

"At any juncture you can see how many outlets are being monitored, how many are presenting no risk, a 'high', 'medium', or 'low' risk, temperature or flow-wise, and which are functioning optimally. By clicking on screen where an issue is identified, the user receives a summary of what the issues are. You can, for example, easily bring up a list of all outlets where temperatures or water flows are presenting a potential risk."

The system is entirely web-based; when the user purchases the system, the 'master-user' will log in and assign which other users can access the system, and to what level, and which will receive email alerts. David Meacock said: "Equally, individual users can decide whether, in the event of an alert, it only shows if they access the main dashboard, or is emailed to them via their mobile device. In an ideal scenario – where most outlets pose minimal Legionella risk – you may never get an alert because your system is

The user pays for the hardware, and there is then a monthly subscription fee to access the software platform to analyse the data

functioning perfectly. You might want, however, to log in monthly and export a report which will give you a summary of all activity for the last month."

Timeline Feature

Looking at another 'dashboard', David Meacock pointed to a page incorporating a timeline. He expanded: "When an 'event' occurs – say somebody running a tap for 30 seconds, the system electronically imprints a date and time stamp, and the current temperature, in a little 'cube' of information. By clicking on any event the user can drill down for more detail." Looking at a sample dashboard showing all a user's sites, he explained that here they can view, in real time, the precise number of sites and buildings under their control, and the fact that they might have 61 devices currently operating, with five outstanding 'issues'. He added: "Looking at this site, building, and floor, I can see how many outlets I have, and what type. Looking at the men's toilet on the first floor I can see readings over the past week on the two TMVs there, including those indicating every activation and the temperature at the time. The range of temperatures can also be illustrated via a colour-coded graph. From this page, for example, I can see that most of the activations of this particular TMV are early in the morning or early evening, which might, for example, give an estates manager a good idea on the best times to send cleaners in.

Identifying Potential Problems

"Here," he said, looking at another screen, "is a time/date record – over the preceding week – of the temperature of water at a single hot water outlet, indicating the percentage of readings where temperatures are within the preset range. This graph shows me the times when the hot water temperature at the outlet is falling below 45˚C, so I may need to look out for an issue. Conversely, focusing on the analysis of the cold water temperature at the outlet, the system shows it to between 7˚C and 20˚C, 100 per cent of the time, which affords reassurance." Looking at another page, he said: "This page tells me that on 21 March I had a high alert because the cold pipe got too warm. The subsequent readings identify that this issue resolved itself within two hours, but the software has left me a little tag to acknowledge on screen, which won't disappear until I do so. Had I not acknowledged this, the system would have displayed a bright red flag. These are invaluable tools for a busy healthcare estates team."

Scrutinising an alert page, David Meacock added, "Here you can see the range of preset alerts for, say, cold water pipes, TMVs, and hot water and hot return pipes – by default all based on legislation or guidelines. However, if you have a site with different needs, it is very simple to just drag the sliders along and alter temperatures for individual or groups of outlets. There is also a 'no-usage' alarm to alert you should, for example, a TMV not have been used recently. In the screen we are now viewing, a high alert alarm would be generated given no flow at an outlet for seven days. All the parameters are editable, but as all the default settings concur with HTM and other 'official' guidance, you don't need to alter any of the settings unless you wish to." Standard outlet profiles include a basin, a cold water tap, a tank, a calorifier, a TMV, an incoming mains, a riser cupboard, a shower, and internal pipework.

Regular Reports

Viewing a report page, David Meacock said: "If I wish I can produce a report for every site and building I am responsible for, although I might just want to focus on a particular building or floor. I can produce reports by date or, say, week or month-long periods, and the software will then generate a report on all the events that occurred.

"While the system is designed to be straightforward to learn and use, we will be offering online training (including 'YouTube' clips) and, for early adopters, will visit the customer site and ensure everything is working properly. Over time, however, we believe most users will be able to use the system, and get all the benefits, entirely self-sufficiently. Ease of use will be further enhanced once the 'app' is launched. The aim is for the system to be so user-friendly that anyone can use it.

Site Surveys

"Initially," David Meacock added, "we will need to undertake site surveys to determine the local Sigfox reception, but hopefully we will soon no longer need to do this, since Sigfox – already widely used in mainland Europe – is rapidly being rolled out across the UK. Where reception is 'patchy' we can set up a local private network, if necessary including repeaters. We selected Sigbox for its high range and low power; it also appears to be the leading technology worldwide for this type of sensor-based application."

David Meacock acknowledged that while some healthcare facilities would only purchase the devices to monitor more 'critical' outlets, a large acute hospital might order 'tens of thousands'. He said: "There will clearly be economy-of-scale benefits for those buying large numbers, but the system is designed to be affordable for use across both the NHS and by private healthcare providers. So far we have found that even where estates teams have well-established existing temperature and flow monitoring procedures, having trialled the temperature monitoring units, seen how easy they are use, and how accurate, detailed, and easily accessible and reliable the data is, they typically say: 'This is so good I wish our system was like that, and afforded the same reliability'."

Easy to Install

In addition to offering continuous, automatic temperature monitoring and a user-friendly interface, David Meacock added that, when he was evaluating the system and its potential 'early on', he was conscious that, like all Cistermiser's products, it needed to be easy for a plumber to install. He said: "When I look at something new it has to be easy both for the installer, and for the user, to access. Following the launch, we anticipate the system being available both direct via Cistermiser, and via the national network of builders and plumbers' merchants."

Interestingly, as our discussions ended, David Meacock said: "To date healthcare has never been a major focus for us, although we have sold into the sector – primarily because our products are not specifically designed for the field. However, the launch of this system is very much in line with a determination to be more healthcare-focused. We anticipate very significant interest from healthcare estates teams following the launch."

About Cistermiser

Established in 1970 in Reading – and at its current site in the Berkshire city since 1984 – Cistermiser is – its website emphasises – 'synonymous with urinal control valves', but also offers a range of other products designed to ensure efficient washroom operation and minimise unnecessary water usage. Its Sensazone system, for instance, monitors washroom occupancy, turning off lights and fans when the room is not in use. On the water control front, meanwhile, 'Sensazone controls water flow with solenoid valves. If motion is detected the valves open to supply water to urinals and cisterns. If no movement is detected for a pre-set period (configurable to 15 or 30 minutes), water supply is cut off.' The product description continues: 'As Sensazone controls water at its entry point, the water is prevented from passing uncontrolled through any defective or damaged outlet, eliminating the risk of wastage or flooding during vacant periods. The power supply to the lighting will action when Sensazone detects that the washroom is occupied, and when ambient light falls below a user-configurable level. Power will continue to be supplied for a 0, 15, or 30-minute period, depending on preference. Extractor fan operation can also be configured; users can either use Sensazone to control the fan-run on time, or use the fan's own timer facility (dependent on model selected).'

Cistermiser's range of washroom controls and water management systems also includes its Novatap and Vectatap infra-red taps, both IR sensor-activated. Installing such taps with a 3.5 litre per minute spout can, Cistermiser claims, save up to 6 litres per use, 'saving over 80% over a 12-month period', while the company also offers a comprehensive range of urinal and WC flushing, washroom control, and limescale prevention systems.

The company adds: "It is envisaged that our new technology will eventually enable Cistermiser and sister company Keraflo to add intelligence…" to many of their existing products, for example real-time water tank management data by applying it to Tanktronic, and washroom usage analysis using Sensazone."

Why Water Temperature is Vital

Tom Cropper, *Editor*

Tightening budgets and growing regulatory scrutiny mean that water temperature control becomes a critical issue for healthcare organisations.

One of the key weapons against a disease such as legionellosis is temperature control. The bacteria can only survive in water temperatures between 20°C and 45°C. A straightforward way to eliminate the disease, therefore, is to control its temperature

IT'S A story which would sent a shiver down the spine of anyone in charge of health and safety in a hospital setting. An outbreak of Legionnaires disease in a Lisbon Hospital made 40 people sick and killed another four[1]. It was a clear example of why maintaining safe water should be seen as a high priority for hospitals of all kinds.

Legionnaires, and other forms of waterborne disease, present a clear danger in hospitals. These diseases can be serious for anyone, but can be particularly debilitating for people suffering from other health conditions. Maintaining water quality is crucial, but difficult.

Waterborne Infection

One of the key weapons against a disease such as legionellosis is temperature control. The bacteria can only survive in water temperatures between 20°C and 45°C. A straightforward way to eliminate the disease, therefore, is to control its temperature. The HSE advises ensuring that all stored hot water is kept at 60°C and delivered at 50°C, while cold water should be stored at 20°C. It sounds straightforward, but, in a large and complex environment, ensuring temperatures don't stray into the danger-zone, is difficult.

The HSE recommends a full risk assessment and continuous monitoring of water storage and outlets for signs of blockages or corrosion. Tanks should be inspected and cleaned regularly.

The first problem is the drain on resources. Staffing levels in the NHS have become critical, especially since the Referendum. A report from the Nurses and Midwifery Association found that 35,363 nurses had left the profession between October 2016 and September 2017[2]. Although the Department of Health was at pains to stress that this represented just 0.2% of the total number of nurses working in the UK, this news backs up research from the Kings Fund earlier in the year which predicted that the number of working nurses would fall for the first time since 2013[3].

The talent drain is partly down to uncertainty surrounding the status of EU nationals since the Referendum, but it is also down to a flight of UK nationals driven by stress, and poor pay. Earlier in the year, a report found that nurses were quitting to work in supermarkets because of low pay. An organisation representing NHS Trusts in England said a significant number of hospitals had reported lower paid members of staff leaving to work in supermarkets[4].

"It's worrying that we are seeing a continuing rise in nurses and midwives leaving the register and our data is clear that this is being driven by both UK and EU registrants," said Jackie Smith, Chief Executive and Registrar of the Nurses and Midwifery Association.

"These figures continue to highlight the major challenges faced by the UK's health and care sectors around the recruitment and retention of staff. Nurses and midwives work incredibly hard in very difficult circumstances. Those responsible for workforce matters will no doubt respond to what these trends are showing."

A Question of Cost

Staffing issues go hand in hand with the question of cost. The NHS faces an environment in which demands on its services are increasing exponentially. The population is growing – not just in terms of numbers, but also the average age. According to the Office of National Statistics, the UK population is projected to grow by 4.1 million by 2024. The fastest growing group of people will be the over sixties, which will increase by 20.4% over ten years and by 60% over the next 25 years[5]. That's good news in many ways – and testament to the gigantic strides made by healthcare over the decades. However, it will place an enormous strain on health services as more people will be living with long term and complex conditions.

At the same time, funding has failed to keep pace. The NHSE had said it needed £4bn to meet its key targets. However, only £1.6bn was provided prompting them to warn that these

SPECIAL REPORT: ADVANCES IN WATER TEMPERATURE MONITORING TECHNOLOGY

targets would be missed[6]. In summer 2017, the British Medical Association claimed that the government was deliberately underfunding the NHS to speed up privatisation[7].

The Government refutes this claim, but the undeniable truth is that finances are failing to keep pace with demand. This has two important implications:

1. **Maintaining adequate infection control is more difficult.** As organisations battle to manage shrinking budgets and staffing levels, the risk of infection inevitably rises.
2. **It is more important than ever to avoid infection** – not just to improve safety, but to avoid the impact of financial penalties.

The NHS is struggling under a rising level of legal expenses. Earlier in 2017 a report by the Medical Protection Society found that the £1.5bn annual cost of settling negligence claims could double by 2023[8]. Despite the number of claims falling, the total cost had risen because of the size of claims themselves. An entire industry has arisen dedicated to claiming compensation for medical negligence. Patients are increasingly aware of their rights, and firms are working hard to push up the value of individual claims.

In such an environment, it becomes increasingly important to reduce the likelihood of infection arising and, also, to demonstrate compliance, which is why healthcare organisations are looking to update their temperature control processes.

Using existing approaches, it is difficult to ensure that temperatures remain in the correct zones all of the time. Few managers would be able to say, with 100% certainty, what the temperatures of all water stored was at any given time.

A High Tech Solution

The solution lies in technology. Sophisticated temperature control software can relay the current temperature of water to a central system immediately. This gives managers an instant view of the current state of play and empowers them to make better decisions. They can reduce the resource allocation of inspection and cleaning and correct issues much more quickly.

From a compliance point of view, it is much easier to prove that they are in compliance with the regulations. Clear data about the temperature of water and any remedial action taken can be retrieved quickly and delivered to regulators.

The technology to do this is becoming available, but is not yet widely adopted. Awareness is sporadic and hospitals may be wary of the cost and the process involved with implementation. However, the rewards can be profound. These systems offer wins on multiple fronts – they make it easier to gain a real-time view of water temperatures to ensure compliance and reduce the cost and work involved with monitoring the system. They may involve an initial expense, but these are systems which will pay for themselves rapidly.

The talent drain is partly down to uncertainty surrounding the status of EU nationals since the Referendum, but it is also down to a flight of UK nationals driven by stress, and poor pay

How IoT Can Revolutionise Healthcare

Jo Roth, *Staff Writer*

The internet of things holds the potential to revolutionise healthcare, including water temperature control.

The internet of things market is predicted to reach 250bn by 2020. By 2016, Garner had estimated that there were 6.2bn connected devices in the world and by 2020 experts have suggested the total might reach 30bn

IT'S ONE of the most hyped technologies in the world. Name the business and you will find articles telling you how the internet of things (IoT) is poised to revolutionise it. However, beneath the publicity is a technology plagued by uncertainty and fragility. It can indeed transform the industry for the better, but it continues to suffer from misunderstanding and suspicion.

A Brief History of IoT

Like many much-hyped technologies, the internet of things has been here much longer than most people are aware. As far back as 1932, JB Nash wrote "within our grasp is the leisure of the Greek citizen made possible by our mechanical slaves." It's a glorious vision indeed and one which has not – as yet – come to pass. But it foreshadows the concept of the internet of things. It's a world in which multiple devices are connected, sharing information to the common good of all. In 1982 a Coke machine at Carnegie Mellon University became the first device to be connected to an internet. It was able to share stocking information across a network. However, the phrase was first coined by Kevin Ashton in 1999 who envisaged an internet of things connected by RFID devices.

Today the concept has truly taken off. The internet of things market is predicted to reach 250bn by 2020[9]. By 2016, Garner had estimated that there were 6.2bn connected devices in the world and by 2020 experts have suggested the total might reach 30bn[10]. That trajectory is, however, uncertain. At one time the popular prediction being suggested was 50 billion. The fact that such a transformative technology has undershot predictions hints at one of its core weaknesses. While its potential is enormous it has yet to truly fulfil it.

Enormous Potential

To see why, we can look at the world of financial services and, in particular, insurance. Here IoT technology is predicted to be transformative. Insurers are looking to use connected devices gathering information from multiple sources to help them calculate insurance premiums more accurately. The most high-profile example is the use of black box car insurance policies as promoted by Admiral[11]. They gather information about an individual's driving style and use it to analyse how good a driver they are. It goes beyond old fashioned risk profiling to create a policy which is, in theory, more tailored to the individual and which rewards better drivers. If you're confident of your driving ability, this is a route to cheaper car insurance.

However, there is a problem. Black box has not become the transformative product the insurance industry hoped. Indeed, the internet of things remains a technology in which most of the value lies in its potential, and that's also true of the healthcare sector.

IoT in Healthcare

The potential is enormous. Medical professionals can embed IoT devices in healthcare apparatus allowing them to monitor patients and equipment much more effectively. Remote devices, for example, can help diabetes patients manage their healthcare more effectively from home. They can monitor the location and condition of patients, issuing an alarm if problems arise.

When it comes to infrastructure management there are real gains to be had. Devices can be connected, sharing information and reporting back to a central database. Managers can instantly see real-time information about the status of equipment, scheduling repairs and running maintenance operations only when they are needed.

Temperature Control

A key area can be temperature control. Maintaining a healthy balance of water temperature is a key weapon against infection. But for all the precautions hospitals take, it is impossible to be 100% certain about the temperature of stored and running water all the time. Inspections and manual recording of data is onerous and costs money.

SPECIAL REPORT: ADVANCES IN WATER TEMPERATURE MONITORING TECHNOLOGY

The NHS has developed its Test Beds programme to investigate ways that innovative technology, including IoT, can be integrated into NHS processes. It's an attempt to realise the vision of the Five Year Forward View to create a 'the conditions and cultural change necessary to enable proven technologies to be adopted faster[12].' Among the first trials was a programme to help patients manage diabetes, data analytics to identify older patients at risk and apps to help mental health patients manage their own conditions in the community.

The potential is enormous. A report from MarketsandMarkets suggests that healthcare IoT could be worth $158bn by 2020 – more than three times the $41.22bn in 2017[13]. That's a gigantic leap, and brings us back to our earlier point. The market could be enormous but so too could be the potential for disappointment.

There May be Trouble Ahead

For all its benefits, IoT faces some substantial hurdles. Every new technology does, but these are substantial. The first, and most obvious, is cost. NHS Trusts are struggling to find money for even the most basic expenditure. IoT would represent a substantial technological overhaul and, while evidence suggests it will repay that investment many times over, the initial cost will still present a barrier.

The second issue is existing IT systems. They increase dramatically the amount of data processed by IT systems and many are not in a position to handle it. Harvesting such data is one thing, but managing it is more than many onsite systems are capable of. As a result, many operators are turning to the cloud - but this brings them into contact with another barrier: data security.

Secure Data

We live in a world of big data and all that information – shared across multiple devices – represents a huge opportunity for everyone. For healthcare managers, it's a fantastic chance to make significant improvements in the delivery of care. For cyber criminals it's a lucrative business opportunity. Healthcare organisations are becoming more data hungry and handling vast quantities of sensitive data. At the same time, defences may not be as sophisticated as large corporations or financial services where cyber-crime has become one of life's natural hazards. Embracing technologies comes with a risk, and the fear of security and privacy issues is holding many managers back.

To fulfil their potential, IoT developers must address their key weaknesses. They must overcome the fear of the new and address the very reasonable concerns of managers about security and privacy. It is both a technological and public relations challenge. Systems must be developed which are fool-proof and which can convince potential users that they are safe to use. The question is how they overcome those fears and how healthcare managers harness the power of IoT and digital technology to meet their key objectives.

Data Analytics and Water Temperature Monitoring

Tom Cropper, *Editor*

How hospitals can harness the power of big data to secure a giant leap forward in water temperature monitoring.

Having an effective view of the current water temperature has been shown to be an effective weapon in the battle against water borne bacteria such as Pseudomonas aeruginosa and legionellosis

WE LIVE in a world of big data and it offers something valuable for businesses of all kinds – the ability to monitor the real-time status of systems and equipment. It is helping those NHS Trusts which have already adopted it to make significant gains across the board. However, to make it work, managers must combine it with the correct IT systems and processes. That is a prospect which is putting some trusts off. But systems now exist tailored to the needs of healthcare which are opening up a wealth of opportunities. The challenge for operators is to see exactly what they can do and to quantify the return on investment.

Monitoring Water Temperature

Having an effective view of the current water temperature has been shown to be an effective weapon in the battle against water borne bacteria such as Pseudomonas aeruginosa and legionellosis. If temperatures stray into so-called danger zones, bacteria can flourish and infection can spread. In 2013, Basildon hospital was fined £350,000 after two patients died in an outbreak of legionnaires disease[14]. During the case, it was revealed that the hospital had been battling the disease for more than fifteen years, during which time it had spent more than £3million. The hearing found that shower heads and thermostatic valves had not been properly cleaned, after the budget for cleaning had been cut.

An attempt to control water temperatures with super-heated pipes may have backfired after the pipes inadvertently heated cooler water. Bacteria can survive in a temperature range between 20°C and 45°C. The super heating of pipes was intended to maintain stored water above the top rate temperature, but might also have brought colder temperature into the danger zone.

This is a prime example of how things can go wrong. The budget for cleaning had been cut resulting in more expenditure elsewhere as the hospital battled to arrest the spread of the disease. The attempts to effectively burn it out of existence by heating water backfired because of one simple thing - a lack of data. It was not noticed that temperatures were out of range and so the problem could not be addressed.

Big Data – Big Challenge

This is where data comes into its own. The challenge is for managers to have sensors on the pipes which can deliver real-time information on temperature. Existing processes in which temperatures are measured and recorded by hand are slow and inaccurate. It is difficult to know for certain that temperatures are safe 100% of the time. When that's the case, a hospital will always be at risk as in the example of Basildon.

To capture that data, hospitals need two things: sensor technology which can accurately and reliably record the temperature of water and a data analytics platform capable of delivering real-time readouts. The benefits are enormous.

Managers will receive real time information on the temperature of the water. They can instantly record whether it remains 100% safe and raise an alarm if it strays into the danger area. It creates a valuable data trail which can be used to demonstrate compliance if an outbreak of infection were to occur. Managers can show that they have complied with their obligations by managing temperatures and taking action when problems occur.

Equally, they can make the process of managing temperatures less arduous and expensive. As things stand, hospitals must perform laborious manual inspections; they must record data such as the condition of pipes, the presence of corrosion and the temperature of water. It's out of date and expensive. Crew are routinely deployed when there is no need.

The Power of Data

Data analytics can avoid that necessity. It can constantly monitor the condition of water and raise an alarm if an issue arises. It allows hospitals to take prompt remedial action and address issues before they become critical. This also means that they can reduce the number of man hours they dedicate to the process, as David Peacock of Cistermiser explains.

Managers will receive real time information on the temperature of the water. They can instantly record whether it remains 100% safe and raise an alarm if it strays into the danger area

"Our new system raises an alarm only when there is an exception to be checked," he says. "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."[15]

Cistermiser have developed a ground-breaking system harnessing their existing experience in washroom technology. LinkThru is specifically tailored to the healthcare system and programmed with the correct HSE guidelines. It uses these to issue an alarm quickly and compile ongoing data.

It's a best of both worlds system – one which acts as the guardian, telling humans when there is a problem, and storing detailed information for as and when it is needed, at which time their system can quickly produce a report.

It was developed over the course of two years and consists of three elements:

- **A temperature monitoring unit:** which can be connected to the pipework to monitor temperatures. This has been designed to be retrofitted easily into existing infrastructure.
- **Wireless network:** The sensors take data and transmit it to the cloud.
- **The portal:** An intuitive portal allows data analytics to be accessed quickly. This provides the ability to receive quick updates, as well as drill down into the detail to produce comprehensive reports.

This is, then, a good model for the future. It was initially trialled with success in Birmingham and London hospitals and holds tremendous potential for the water temperature monitoring and infection control.

But… and there is often a but. The use of cloud computing will be controversial. The value of data is its ability to deliver insights and reports which would not previously have been possible – but it also creates a weakness. The more data that is transmitted across multiple partners with shared security responsibilities, the greater its vulnerability. Managers will have to harness data without being controlled by it, and introduce it in the correct way. If they do this they can save money, improve performance and make hospitals a safer place to be. It's a win on many different fronts.

Making Digital Technology Work

James Butler, *Staff Writer*

Digital technology holds the key to the future of the NHS – including the monitoring of water temperature. However, many obstacles stand in its way. Here's how managers can overcome them.

Technology forms a central plank of the future strategy of the NHS. The Five Year Forward View envisages a world in which technology is crucial to the effective delivery of the healthcare system

IN THE summer of 2016, the NHS came under the biggest cyber attack in its history. The Wannacry virus was part of a worldwide attack against organisations of all sizes[16]. It froze staff out of their computers and brought the NHS, temporarily, to a halt. It was the highest profile example of how devastating an attack against NHS systems can be, and pours cold water on those who envisage a bold digital future for the NHS.

Technology forms a central plank of the future strategy of the NHS. The Five Year Forward View envisages a world in which technology is crucial to the effective delivery of the healthcare system. Achieving that is no small matter. Actions often fail to reflect bold ambitions, which was why Jeremy Hunt was recently forced to admit that the NHS was likely to miss its targets to become paperless by 2020[17]. What stands in the way is a heady cocktail of expense, risk and the age-old suspicion of innovation.

Counting the Cost

The frustration for those who would like to see a digital and connected NHS, is that the technology often exists, but is not being used. For water temperature measurements, for example, cloud computing platforms give operators the ability to monitor temperatures in real-time, streamline operations, improve safety and manage finances – but these systems come at a price.

A cash strapped NHS Trust is always likely to ask the question: can we afford it? They are already struggling to manage the basics and often rely on donations and fund raising efforts to buy the latest equipment. The Royal National Orthopaedic Hospital in Stanmore made headlines in 2016 when it revealed that it had been forced to rely on crowdfunding to equip wards[18]. Managers may see the value but often feel that the barrier of the initial cost is too hard to overcome.

Against that, though, they should calculate the savings new technologies can bring. These come in a number of forms.

1. Reduced inspection: Advanced cloud-based platforms reduce the need for teams to organise routine inspection. Instead they can constantly monitor temperatures and use as-needed maintenance operations to reduce the ongoing cost and manpower.

2. Early identification of problems: The ability to flag issues early and take prompt remedial action also delivers savings through lower maintenance requirements and a longer lifespan for key equipment.

3. Regulatory compliance: The ability to gather, store and present real-time data on water temperatures and equipment condition makes it easier to demonstrate regulatory compliance and avoid costly fines.

The initial cost of next-generation water temperature monitoring systems is much lower than many people might assume. Software packages can be relatively affordable and are accessible via the cloud. Hardware can easily be retrofitted to monitor pipes with minimal change to existing infrastructure.

The return on investment, on the other hand, is significant and ongoing. Given the challenges that the NHS faces in a world in which budgets are falling in real terms and demands are growing, that could prove crucial – perhaps even to its very survival. It is being asked to do more with less, and more than a few commentators have questioned how long it can continue. To survive, it must make sizeable gains in efficiency across the board. Systems such as remote water temperature monitoring can offer incremental gains to help the service meet goals which, at first glance, might seem unachievable.

Fear of Failure

Another key consideration is the operational risk of new technologies. These come in two forms. The first is the strain on existing IT infrastructure and the second is the growing menace of cyber security. The Wannacry attack was just one of many ransomware attacks against healthcare

targets around the world. The year 2017 was the biggest yet for ransomware. In May, Kaspersky revealed than ransomware attacks had increased by 250%, with targets in the US being the most severely affected[19]. In 2016 a report warned that 28 NHS trusts may have been hit by ransomware according to a report on the Digital Health Website[20].

Ransomware attackers view the NHS – and other healthcare organisations around the world – as being ripe for attack. They hold a huge amount of personal data and defences may not be as robust as organisations which are used to facing down constant cyber-attacks. The race to embrace digital technology may also make it more vulnerable.

Let's take the idea of how a 'connected hospital of the future' might approach water temperature control. They will move away from old fashioned manual inspection and move towards sophisticated real-time monitoring using wireless connectivity. However, it will be vulnerable to system outage and a ransomware attack. The more data a healthcare organisation stores in the digital realm the more vulnerable it will be to a denial of service attack.

Shared Data

When hospitals turn to the cloud they complicate the issue of security. Data is now shared across more than one platform, which means responsibility for its safety is also shared. By allowing data onto the cloud a hospital surrenders a certain amount of control over how it will be secured. They will be reliant on the security of a third-party provider.

The use of IoT technology also drives managers to consider endpoint security. Multiple connected devices create a security challenge that existing firewalls are not always equipped to cope with. It is imperative that all devices which connect into the central system are as secure as they possibly can be. They must keep all endpoints up to date with the latest security protocols. It takes only one faulty endpoint to allow the attacks to gain a foothold. According to Endpoint Security Provider, Duo, healthcare organisations are logging into twice as many apps as the average user, creating a wide attack vector. They are more likely to choose Internet Explorer 11, while other users will go for Chrome and 22% browse dangerously on unsupported versions of IE. They are also twice as likely to have Flash installed which can be used as a point of vulnerability for hackers[21].

Security, therefore, is an issue that healthcare professionals need to get to grips with and urgently. To do so, they will need to ensure all endpoints are secure and that cyber defences are constantly updated to cope with the latest types of attack. Staff education will be critical. Managers must ensure that all staff follow strict security protocols and that clear guidelines are in place about what devices can and can't be used.

Digital technology, then, is truly transformative. It can reduce the administrative burden on staff; it can cut costs and improve oversight. However, challenges remain, especially surrounding IT and infrastructure, security and awareness. But by adopting the right approach managers can capitalise on the true power of the digital revolution.

References:

1 Death Toll From Legionnaires Up at Four:
https://uk.reuters.com/article/uk-portugal-health-legionnaires/death-toll-from-legionnaires-disease-in-lisbon-hospital-up-at-4-idUKKBN1DA22D

2 Increasing Numbers of Nurses Leaving the Profession: http://bit.ly/2lIFbuL

3 The Number of Nurses Falls for First Time Since 2013:
http://www.independent.co.uk/news/uk/home-news/brexit-nhs-nurses-numbers-drop-first-time-eu-staff-a7995366.html

4 NHS Staff Quitting to Work in Supermarkets:
http://www.independent.co.uk/news/health/nhs-staff-quitting-to-work-in-supermarkets-low-pay-doctors-nurses-hospitals-jeremy-hunt-a7723411.html

5 Office of National Statistics – Population Growth: http://bit.ly/2CfVwgN

6 Row Breaks Out as Jeremy Hunt Says NHS Must Stick to Targets:
https://www.theguardian.com/society/live/2017/nov/30/nhs-leaders-meet-to-discuss-cutting-services-amid-funding-gap-live-updates

7 Senior Doctors Accuse the Government of Deliberately Underfunding the NHS:
http://www.independent.co.uk/news/health/nhs-latest-senior-doctors-hospitals-underfunding-accelerate-privatisation-agenda-conservative-a7808591.html

8 Cost of Negligence Claims to Double:
https://www.theguardian.com/society/2017/jun/23/cost-of-nhs-negligence-claims-is-likely-to-double-by-2023-study-medical-legal

9 Internet of Things Market: http://bit.ly/2Ce2J0J

10 Popular Internet of Things Forecast is Outdated:
https://spectrum.ieee.org/tech-talk/telecom/internet/popular-internet-of-things-forecast-of-50-billion-devices-by-2020-is-outdated

11 First Time Driver Black Box Insurance: https://www.admiral.com/first-time-insurance/

12 NHS Test Beds: https://www.england.nhs.uk/ourwork/innovation/innovation-and-technology-payment-201819/

13 Healthcare IoT Market: http://bit.ly/2ELcTYa

14 Basildon Hospital Fined Over Legionnaires' Diseases Deaths: http://www.bbc.co.uk/news/uk-england-essex-23961487

15 Cistermiser Showcases New Water Monitoring Technology Platform:
https://www.buildingbetterhealthcare.co.uk/news/article_page/Cistermiser_showcases_water_temperature_monitoring_platform/134997

16 Investigation Wannacry Cyber Attack and the NHS: https://www.nao.org.uk/report/investigation-wannacry-cyber-attack-and-the-nhs/

17 NHS Wont be Paperless by 2020: https://www.digitalhealth.net/2017/04/nhs-will-not-be-paperless-before-2027/

18 NHS Trust Relies on Crowdfunding to Equip Wards: http://www.bbc.co.uk/news/uk-england-london-37727426

19 Ransomware Attacks Rise 250 percent: http://www.newsweek.com/ransomware-attacks-rise-250-2017-us-wannacry-614034

20 28 NHS Trust Ransomware Attacks Reported: https://www.digitalhealth.net/2016/10/28-nhs-trust-ransomware-attacks-reported/

21 The current state of Healthcare Endpoint Security: https://duo.com/blog/the-current-state-of-healthcare-endpoint-security

Notes