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HEALTHCARE DESIGN

Hot Water use in Hospitals

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In general, there is a perception that hot water for washing hands results in reduced infections. However, evidence shows that all things being equal, within the temperatures practical for handwashing, hot water is no more effective than cold water to prevent infections.

The need for effective infection control drives much of how hospitals use water, particularly heated water. In U.S. hospitals, hot water systems generally supply shower/bathing functions, process functions (such as dishwashing equipment), or handwashing. These systems typically consist of a heating source that heats the water to a temperature that will kill most Legionella bacteria, then cooled to a temperature that will avoid scalding humans, and then continuously circulated through the building and to fixtures, where it mixes with cold water to match a particular user's preference—a fairly complicated design that consumes a relatively large amount of first cost and ongoing energy.

In general, there is a perception that providing hotter water for washing hands results in reduced infections. But, evidence shows that all things being equal, within the temperatures feasible for handwashing, hot water is no more effective than cold water to prevent infections. Rather, the primary impact that hot water may have is in improving the comfort of the person washing their hands so as to lead to longer, or more effective handwashing. If, therefore, handwashing water could be delivered to the fixture at a single temperature that was warm enough to provide user comfort but cold enough to discourage Legionella growth then the system could effectively combine the hot and cold water distribution systems into a single system that required no initial heating and cooling, and that saved both first cost, energy consumption, and energy costs. Such a system is technically feasible, but not yet allowed by most relevant building codes.

Walter N. Vernon, CEO and Principal, and Andrew Flanagan, PE, LEED AP, mechanical engineer of engineering and consulting firm, both from the firm Mazzetti Nash Lipsey Burch (M+NLB) spoke on the topic with Shandi Matambanadzo, associate editor, *HEALTHCARE DESIGN.*

Walter Vernon: I first had the idea for this system when observing healthcare delivery in various developing countries. What I observed was that these hospitals provided handwashing water at whatever temperature it was delivered to the facility, without wasting energy on heating it. I started talking to various U.S. infection control professionals about this, and the potential infection control implications. When I started to learn that there were no infection control implications, and that Legionella growth would also be inhibited by lower temperature water, the idea for a single lower-temperature water distribution water system to save costs and energy became obvious. However, one problem is that the regulatory environment, at present, doesn't yet recognize in all cases that these systems are valid for healthcare. So part of what we are after is to change the regulatory regime to allow these kinds of systems, which are a "triple winner."

Andrew Flanagan: With domestic hot water in healthcare there area lot of synergies that can give us the triple win for success. For example, in a healthcare setting, handwashing uses a very large percentage of a facility's domestic hot water, and it particularly utilizes a lot in regard to how standard plumbing design is implemented. This greatly oversizes systems, which then builds in other inefficiencies: energy loss; capital costs up front; maintenance costs; and larger concerns for Legionella and other pathogens. Those all creep in when you start oversizing systems and our goal should always be to right-size the system. Handwashing that doesn't require high water temperature is a big opportunity for hospitals to save lots of energy right now.

Changing the mindset

Flanagan: There is definitely an appetite out there from facility owners to look for these triple bottom line wins with interest in efficiencies. It is a bit of a push to get them to understand the concept, but there are a lot of people in the industry—not only on the owners' side but also on the vendors' side—that have started to promote this idea and have started to build momentum. The bigger adjustment is going to be on the user side. In some cases they are already using room temperature water to wash their hands but there is an old stigma that still has to be worked through.

Vernon: Regulations do not yet permit single-temperature handwashing fixtures, although M+NLB did include it as one of our strategies in our winning design for Kaiser Permanente's "Small Hospital, Big Idea" competition recently. We have not yet implemented this for any clients, at least partly because of the regulatory barriers.

If we were to approach a client at this point and suggest this kind of system, it would require that we work with that client within their regulatory regime to achieve whatever code authorization was needed. As a company and as engineers, however, we are working to change various model codes to recognize healthcare's ability to operate in this way.

Flanagan: While we have not

yet designed with this within the US, we are designing a system like this in a hospital in Africa. In the developing world, the constraints of energy costs and energy supply are such that it's the obvious design in healthcare facilities.

Getting users onboard

Vernon: I think we are going to need to be working with Association for Professionals in Infection Control and Epidemiology (APIC) and some of the other infection control organizations to develop partnerships and education materials for building users. There is a comfort factor to consider in these systems, and while it is true that the heat of the water, all things being equal, does not affect the germicidal activity of handwashing, it is also true that if a nurse avoided washing her hands because the water was uncomfortable, there would be an impact on infection control. This is mostly an issue of cultural change.

The shift away from manually operated toward automatic faucets is a parallel. There was a time when we started making that change within healthcare organizations and it was resisted by a lot of people who felt that they could not control the temperature or flow. They felt, therefore, that there was a risk of poor infection control and handwashing procedures. However, I think it was somewhat of a generational issue and over time, as a newer generations of caregivers have come into medical delivery and as these systems have become more widespread in other settings, they are much more acceptable within the healthcare setting. I think we may see a very similar sort of behavior with hospital handwashing water systems; initial resistance and then transformation over time. We are already seeing single-temperature handwash stations in many venues, notably public restrooms. An alliance with the various medical societies, particularly APIC, will be very important to the educational process as we expand this notion to other handwash facilities inside of healthcare facilities.

Mechanical benefits

Flanagan: These systems open up a lot more synergy with other mechanical systems and how we generate energy. We do not have to rely on fossil fuels or electricity to maintain as much hot water up at high temperatures. Instead, we can start to utilize heat rejection that currently goes to cooling towers or comes from heat pumps and have synergies with other mechanical systems within the building to create that hot water. We can efficiently use energy that we would otherwise have to discard.

Infection control

Vernon: The American Society of Healthcare Engineering (ASHE) has a number of excellent publications on Legionella control. These papers and others explain that there are many strains of the Legionella organism which can grow at different temperatures and at different rates. It is a fairly complex science, but as a gross generalization, the organisms that we are concerned with do not grow as well in the cooler water temperatures. In the aggregate, it appears that this single, lower temperature can provide an improved environment to reduce the risk of growth of the Legionella organism.

On-demand systems

Vernon: Obviously, if we were to replace the current system of hot and cold water mixed at a fixture with a system of single-temperature water at a relatively low temperature, the system would require strategically located on-demand hot water systems, particularly for shower facilities. We do hear anecdotally from clients that the showers in patient rooms are used infrequently. This provides a hidden opportunity for water and energy savings, as well as energy savings in right-sizing systems.

We are also considering the use of these systems in outpatient facilities.

These facilities are even better candidates since they have fewer showers, and, therefore, less need for point-of-use heating systems. And, because of healthcare reform and other economic pressures, the healthcare industry is likely to be focused on development of outpatient facilities and so, there is a tremendous energy opportunity looming for the industry

Conclusion

Vernon: In the developed world in general, and in the United States in particular, we often think of ourselves as the source of knowledge when it comes to green building ideas. What I have learned, though, is that by watching what people do who have few resources and are, therefore, by necessity already green, we can learn a great many lessons about how to live in closer harmony with the natural world. It has been very enlightening to do that and to ask why we do things the way we do. We have a lot to learn from the rest of world, in terms of how we can streamline operations, and this is just the first of many examples.