



# ULTRASONIC CLEANING FOR INFECTION CONTROL

Studies Show Dramatic Results  
in Removing Dangerous Bacteria

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*Editor's note: Michael A. Pinto conducted some of the testing described in this article. He has no ownership connection to Morantz or other manufacturers of mentioned products.*

**D**epending on which statistics you read, the estimates for North America for health care-acquired infections (HCAI) range from a low of 490,000 cases of infections caused by health care practices to more than 1.7 million a year. Anywhere from 48,000 to 100,000 fatalities annually can be tracked back to the development of infections in patients who did not have an infection upon admission.<sup>1</sup> Beyond the loss of life, these infections are expensive. Various researchers estimate that the extra days spent in the hospital lead to \$8.1 billion in added costs.<sup>2</sup>

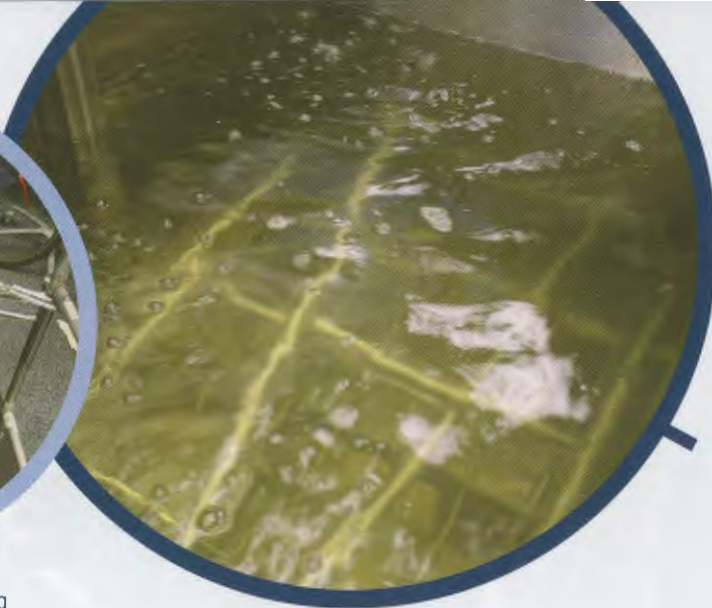
One response to this problem is to move toward stronger and stronger chemicals for cleaning purposes. Although this may provide some short-term relief, the side effects of harsh chemicals and the natural ability of bacteria and other infectious agents to develop a resistance to antimicrobial agents requires a new approach to cleaning in health care facilities.

## A SAFER WAY TO CONTROL INFECTIONS

After more than two years of study, it is now clear that one adaptation from the restoration industry can dramatically enhance normal cleaning procedures in health care facilities: ultrasonics. New studies show that using digital ultrasonic cleaning equipment is very effective in destroying bacteria and other pathogens that are found on hard-to-clean items in medical facilities. Better yet, because removal of the biological contaminants is through physical means rather than by a chemical reaction, the use of ultrasonics to enhance healthcare cleaning does not present the risk of creating drug-resistant organisms. Managers of health care facilities are also attracted to this novel



Flexible templates allowed sampling of irregular surfaces. This photo shows a post-cleaning sample being collected from a walker.



A full-size walker was easily immersed in the ultrasonic cleaner. This allowed cleaning of both the external and internal surfaces.

cleaning methodology because it reduces the dangers of chemical exposure for the cleaning staff.

The Morantz Corporation's ultrasonic machines were used in a series of tests in both the U.S. and Great Britain to determine the effectiveness of the equipment in removing bacterial contamination from items typically used in institutional and residential settings.

Three carefully controlled studies were conducted to test whether the ultrasonic process was deadly to a whole range of microorganisms. Both controlled testing and field testing showed that digital ultrasonic machines were effective in removing gross contamination and microscopic bacterial pathogens.

All three experiments utilized digital ultrasonic equipment without any special enhancements. The first test was completed in two hospitals in the U.K. to determine if the ultrasonic equipment could supplement their normal cleaning procedures to significantly improve infection control without being burdensome or overly expensive. The other two tests were conducted by this author in facilities that did not provide medical services—one at the Morantz facility and the other in the Wonder Makers Environmental lab.

During visits to the U.K. for various trade shows, the digital ultrasonic machines from the Morantz Corporation caught the attention of a microbiologist who works with the National Health Service (NHS) in the U.K. After conducting some preliminary adenosine triphosphate (ATP) testing that yielded impressive results, he worked with Morantz and a local U.K. client who had been using the Morantz SM-200 machines (previously known in the U.K. as the Bio-Cav 40) in a hospital setting to meet with individuals in charge of infection control within the NHS. Ultimately, NHS asked Morantz to provide a Bio-Cav 40 to conduct its own studies on the efficacy of the machine for cleaning and infection control in a health care environment.

In the first trial, the Bio-Cav 40 was used in two hospitals. The NHS was looking at ultrasonics as part of its Healthcare Associated Infections (HCAI) Technology Innovation Program, which "aims to speed up the development and adoption of technologies to further

help combat HCAIs and identify which new technologies provide the best value and will have the most impact."<sup>3</sup>

With the study underway in the U.K., Morantz Ultrasonics President Lisa Morantz determined that it would be wise to conduct similar testing on machines in the U.S. for comparison purposes. Wonder Makers Environmental was hired to conduct two independent tests.

Initial testing was done on a full range of items frequently cleaned by ultrasonic machines as part of a fire or water loss restoration. Both direct-read and laboratory samples were taken before and after cleaning. While those results showed that the ultrasonic cleaning appeared to be effective in eliminating microorganisms, there was a wide range of pre-cleaning contamination levels that made it difficult to validate the promising results.

The next step of testing was designed to address the problem of cleaning items with both low and high levels of contamination by intentionally soiling each object prior to cleaning. To replicate contaminants that could be found in a black water loss, raw sewage was "painted" on each piece. While this ensured that a wide array of pathogens was on each item (including *Enterococcus* and *E. coli* bacteria), the manufacturer wanted to be sure that the process would also be effective in destroying bacteria that pose the greatest concern to health professionals. Therefore, the tested items were also inoculated with a strain of methicillin-resistant *Staphylococcus aureus* (MRSA); this served as a surrogate for such serious strains of microbial contamination. (It is important to note that special engineering controls had to be utilized to obtain and test MRSA bacteria, to the point where the study had to be conducted at a site that met the requirements of a level 1 biosafety facility.)

#### A COMMON-SENSE TESTING APPROACH

In all three studies, both direct read instrumentation and laboratory samples were utilized. Each testing method contributed specific strengths to the evaluation process. The samples were analyzed with ATP testing instruments, providing immediate feedback. Although ATP instruments have a long history of use in



Both the seat and the seat cushion of a wheelchair were tested. Testing showed a substantial reduction of bacterial contamination from the various surfaces.



The pre-cleaning result for the wheelchair cushion was recorded on the BioReveal unit at 182 relative light units (RLUs).

*Photos courtesy of Michael A. Pinto*

food service and health care settings to determine the cleanliness of surfaces related to biological contaminants, they cannot identify the specific type of biological material on the surface. Bacteria, plant debris, skin cells, and other debris from living organisms all produce numerical results known as relative light units (RLU) from the instrument. *(For more information on the growing role of ATP testing in the cleaning industry, see "The Momentum of Measurement for Cleaning" in the March/April 2012 issue of C&R.—Ed.)*

In the U.S. studies, an independent laboratory also analyzed side-by-side surface samples to determine concentrations of specific types of bacteria. While this process takes longer for the information to be received, it does identify the specific types of organisms that were present both pre- and post-cleaning. But even this enhanced sampling system has limitations; cost considerations required that the items be tested for specific contaminants rather than every possible bacteria type. Still, the combination of the broad screening, immediate feedback and later specific results showed just how effective the ultrasonic process was at illuminating invisible pathogens and that the ATP instrument was an effective tool for evaluating cleaning capabilities.

One additional important consideration was whether the digital ultrasonic process was appropriate for both porous and non-porous items. Typically, ultrasonic cleaning is utilized for solid materials, but in these tests, all sorts of material types were intentionally contaminated and then cleaned in the ultrasonic tank. Standard cleaning times (two to four minutes, depending on the object's size, type and material) were used so that results useful in real-world applications could be obtained.

### **STUDIES REVEAL REAL-WORLD BENEFITS**

Ultrasonic cleaning has been effectively used to dislodge dirt, grease and other non-hazardous materials for more than 50 years, making it an indispensable piece of equipment for a variety of residential and commercial contents. Since health care facilities also utilize many

types of contents, an effort was made to identify a variety of materials for testing, including toys, a wheelchair and electronic components.

During the first U.S. test, the sampling data showed the Morantz ultrasonic cleaning system to be extremely effective in removing bacteria from items with heavy contamination. Bacterial reduction of 99.86 percent and 99.98 percent were achieved for items that started with more than 1 million and 259,900 colonies of bacteria, respectively. This was also important because there was a concern about the possibility of cross-contamination if water in the ultrasonic tank was not changed between cleaning each item. The ultrasonic process proved so effective at destroying bacteria that immediately after the tank water was contaminated with highly elevated bacterial concentrations, an item cleaned in the tank had test results below the laboratory's detection limit.

The follow-up study carefully reviewed the applicability of ultrasonic cleaning to the types of pathogens found in restoration situations and health care settings. The sampling data generated when items were intentionally contaminated with raw sewage and live MRSA showed that all of the drug-resistant bacteria were eliminated from contaminated surfaces by the ultrasonic cleaning. The second set of tests also showed a 100 percent reduction for *Enterococcus* and *Escherichia coli* bacteria for every non-porous item tested. In addition, it validated the conclusion about cross-contamination. When the ultrasonic machine was operating, live bacteria counts in the water stayed close to zero, even after intentional contamination with gallons of raw sewage.

### **A POWERFUL SUPPLEMENT TO EXISTING EFFORTS**

With considerable expertise in addressing HCAIs, the NHS understood that a variety of techniques are necessary to combat contamination on surfaces. To this end, they made sure that the use of ultrasonics in the hospital study "...was not intended to, and did not, replace standard cleaning. All equipment continued to be cleaned in the usual way."<sup>4</sup>

In other words, the infection control experts understand that ultrasonic cleaning is a *supplement* to existing infection control efforts, not a process that *supplants* it.

The British study was prompted by their understanding of the benefits of the ultrasonic cleaning process.

"Ultrasonic technology is good at accessing inaccessible areas that normal cleaning cannot reach, for example screw threads and hinges. It is good at cleaning hard substrates. It has been found by researchers to be even more effective than thorough hand scrubbing, often observed in busy work areas. It involves less exposure to cleaning agents and, therefore, contributes to a reduction in skin damage."<sup>5</sup>

The British hospital study was much more comprehensive than the U.S. testing. The NHS evaluated 1,025 measurements from items before and after cleaning. The initial results were so impressive that the three-month trial was moved to the second hospital and extended for an additional three months. The results showed "an average of a 98 percent change in the RLU reading when the average pre-clean reading is compared with the average post-clean 2 reading."<sup>6</sup>

The researchers at NHS were both surprised and impressed by the results. Not only were the findings positive enough to extend the trial, they were strong enough for the researchers to adjust the original goal of the study, which was simply to measure the cleanliness of particular items. The researchers would then use the general association between cleanliness and infection control to decide if the process was worth adopting. Instead, at the conclusion of the trial period, the study authors noted, "The evaluation was not designed to assess the effectiveness of ultrasonics in reducing infection, but was it more effective than normal routine cleaning."

The NHS study even went so far as to make some specific recommendations and conclusions.<sup>7</sup> The British researchers suggested that hospitals should use ultrasonic cleaning for items such as wheelchairs, commodes, IV stands, cabinets, tables, chairs, electrical fans, toys and laundry-sack stands.

The study authors also stated:

"The... ultrasonic system can be used without disruption to staff or patients so long as there is a plan in place to ensure equipment that may be required frequently through the day is cleaned at an appropriate time to allow it to be returned before being required again. The clean appearance of the equipment returned had a lot of support from staff and the RLU values post pre clean [after cleaning] proves equipment was less contaminated."<sup>8</sup>

### IMPLICATIONS FOR THE C&R INDUSTRY

As health care organizations struggle to operate with increasingly scarce dollars, their attention is quickly turning toward minimizing HCAs. Restoration contractors are in a prime position to assist such organizations in a variety of ways. Restorers are seeing detailed cleaning to arrest the outbreak of disease as another type of emergency response they can add to their repertoire. Another potential business approach is to offer contracts for ultrasonic cleaning of large hospital items on a weekly or monthly basis.

A third way to assist health care organizations is to match the cleaning of large, difficult-to-sanitize equipment using ultrasonic technology with the application of surface protectorants, such as BioShield 75, for continuing protection against the spread of biological contaminants.

Both controlled testing and field demonstrations have confirmed that digital ultrasonic cleaning is an important tool that should be utilized to improve cleaning performance in health care settings and other critical-use facilities. This improved cleaning is one of the keys to reducing HCAs and limiting the personal suffering and financial loss that comes from these preventable diseases.

### Footnotes

1. R. Monina Klevens, DDS, MPH, et. al., "Estimating Healthcare-Associated Infections and Deaths in U.S. Hospitals, 2002," *Public Health Reports, Centers for Disease Control and Prevention, March-April 2007, Volume 122.*
2. R. Douglas Scott II, "The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospitals and the Benefits of Prevention," *Division of Healthcare Quality Promotion National Center for Preparedness, Detection, and Control of Infectious Diseases; Coordinating Center for Infectious Diseases; Centers for Disease Control and Prevention, March 2009.*
3. "Showcase Hospitals Local Technology Review Report number 5: Bio-Cav40 Ultrasonic Cleaning," *Calderdale and Huddersfield NHS Foundation Trust, p. 2.*
4. *Ibid.*, p. 10.
5. *Ibid.*, p. 8.
6. *Ibid.*, p. 12.
7. *Ibid.*, p. 7.
8. *Ibid.*, p. 18.

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