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## Warming Devices May Be Source of Airborne Microbial Contamination, but Fix Is Possible



New research has identified an unexpected source of airborne microbial contamination in the operating room as the Neptune (Stryker) surgical suction system or the Bair Hugger (3M) forced-air warming device, both of which discharge exhaust into the OR environment.

These sources of contamination, the researchers noted, may be mitigated by changing the devices' HEPA filters more regularly, or adding a high-efficiency filter at the end of the Bair Hugger's exhaust hose.

"The CDC recognizes operating room air as a potential source of surgical site infections, and has published several strategies to limit infections resulting from airborne microbes," said Justin Ward, MD, the chief resident, Department of Anesthesiology, at Stanford University, in California. "Both the Neptune surgical suction system and the Bair Hugger forced-air warmer have been staples in operating rooms for many years, and both emit HEPA-filtered air into the OR environment from their exhaust ports.

"We know that HEPA-filtered air should capture at least 99.97% of particles greater than 0.3 microns in size. But it's also true that time and particulate loading can degrade the efficiency of these filters. So we wanted to see if these devices might be contributing airborne microbes to operating room air," Ward said.

To do so, Ward and his colleagues collected 200-L air samples from each device and from OR air inlets in 12 randomly selected ORs, using an industry-standard portable microbial air sampler.

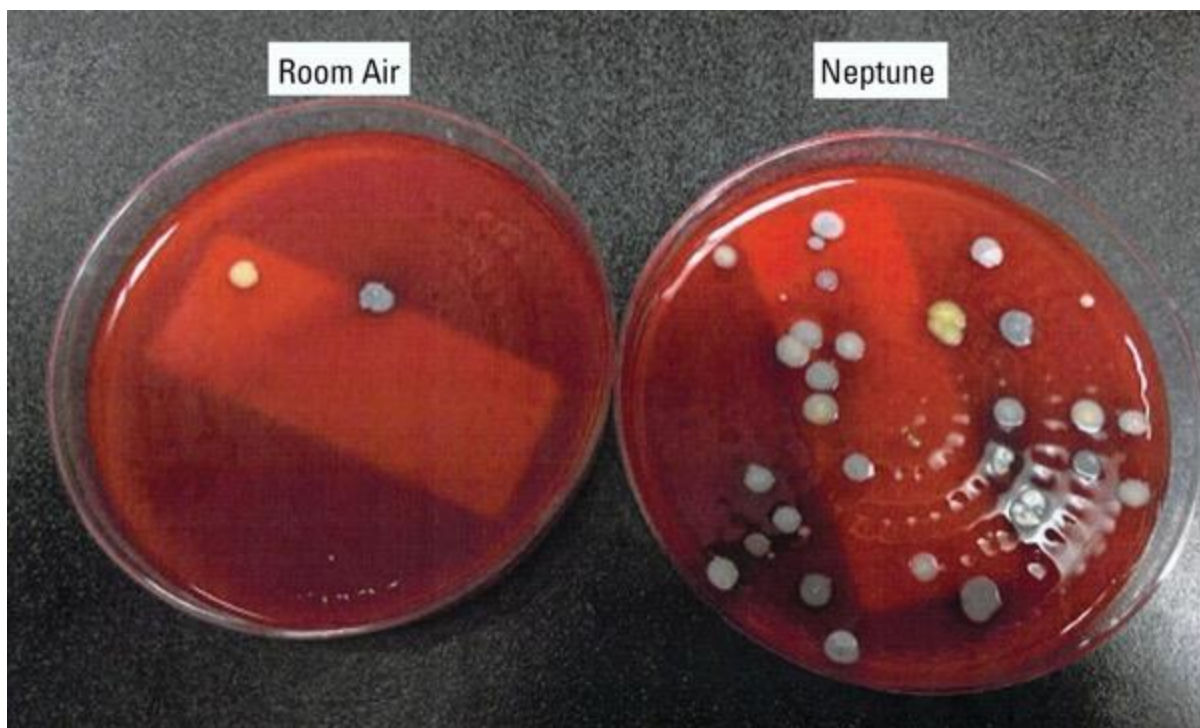
Sample plates were incubated at 30° C to 35° C for three days, followed by four days at 20° C to 25° C, and then interpreted for colony counts. The researchers identified colony organisms using DNA sequencing technology.

“We sampled air coming from the end of the Bair Hugger hose, the Neptune exhaust port and the OR air inlet in the ceiling,” Ward reported in a presentation to the 2020 virtual annual meeting of the American Society of Anesthesiologists (abstract A2011). “The machines we sampled were all within their scheduled maintenance period.”

The study found that the total colony counts (colonies/m<sup>3</sup>) from the exhaust of the Neptune device were not significantly different from those obtained from room air. In contrast, colony counts obtained from the Bair Hugger’s output hose were significantly higher ( $P=0.0005$ ) than in room air.

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“The Bair Hugger emitted over twice the number of colony-forming units as did the Neptune, and four times as many colony-forming units as room air,” Ward said (Figure).



**Figure. Colony counts from room air (left) and the Neptune system’s exhaust port, sampled from one OR in the study.**

Photo courtesy of the investigators.

The study also found extreme variation in colony counts between the two devices. This finding, the investigators said, indicates that some individual Neptune and Bair Hugger units may be significant sources of contamination.

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“The samples from the Neptune and the Bair Hugger were notably more variable than those from room air,” Ward said. “This is important because if all the HEPA filters are performing at the same efficiency, we would expect no difference in variability. But that isn’t what we found. We attribute this to some machines simply inhabiting busier ORs and being used more often.”

In total, four organisms identified as human pathogens were common to all sources and assumed to be present in room air. Three human pathogens were unique to only the Neptune or Bair Hugger, and not isolated from the OR air inlet.

“The Bair Hugger and Neptune both contributed notably more human pathogens into the OR air, although the Bair Hugger was doing so in a statistically significant way. So, we can say with certainty that the Bair Hugger is contributing airborne microbes into the air.”

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### **Manufacturer Disputes Findings**

A spokesman for 3M, Sean Lynch, disagreed with the findings. “For 30 years, the 3M Bair Hugger system has been a safe and effective method of keeping patients warm before, during and after surgery,” he said. “There is no legitimate scientific support for claims that the Bair Hugger system can cause infection. The U.S. FDA, independent institutions including Duke University’s Infection Control Outreach Network (DICON), and federal and state courts that have examined claims of whether the Bair Hugger can cause infection have consistently rejected them.

“Scientific research supports the conclusion that the Bair Hugger system helps patients by maintaining normothermia, which is associated with reducing the risk of infection, shortening recovery time and improving patient comfort,” Lynch said.

The good news, however, is that the investigators proposed a fix: Change the HEPA filters in both devices based on usage instead of time.

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“This could look something like a meter on the machine that shows hours of use,” Ward said. “Then those machines being used more often would be identified before their filters lost efficiency.” Institutions should also consider placing a high-efficiency filter at the end of the Bair Hugger’s exhaust hose, he said.

“Since the Bair Hugger’s HEPA filter is located at the air intake on the bottom of the machine, that leaves the remainder of the machine and the hose open to the OR air and

able to collect particulate matter in the corrugated tubing. This is supported by swab studies of that tubing showing several species of Staphylococcus,” Ward explained.

“When the machine is turned back on, those particulates are ejected back into the operating room. As such, we recommend adding a high-efficiency filter to the end of the hose to prevent particulates from settling in that hose and being redispersed when it’s turned back on,” he said.

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The researchers also suggested that the Neptune system’s exhaust could be routed outside the hospital, via an existing suction system.

“The infrastructure is there, and it would obviate any concern for OR contamination from these devices,” Ward added. Stryker was asked to comment but did not reply to our request.

### **Study an Eye-Opener**

Session co-moderator Katherine Grichnik, MD, found the study’s results compelling. “This study creates an awareness of the sources of contamination that we hadn’t previously considered,” said Grichnik, a cardiothoracic anesthesiologist and physician consultant in Sunrise, Fla. “It hadn’t occurred to me that exhaust from a Bair Hugger would have had such a high contamination rate. It’s interesting, because although we use a new Bair Hugger blanket for every patient, the hoses aren’t changed every time.”

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Nevertheless, Grichnik was encouraged by all of the preventive measures suggested by the authors. “I think they offer some very practical ways that we can prevent infections and make the OR an even safer place,” she noted. “Primarily, though, I think having a heightened awareness about this is important.” Grichnik added that the current findings need to be verified in future studies.

—Michael Vlessides