Is It Time to Rethink Air Quality in the OR?

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By admin

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Over the last decade, U.S. healthcare institutions have made significant strides in reducing healthcare-associated infection (HAI) through a combination of vertical strategies, targeted toward the reduction of device or organism specific infection and horizontal strategies aimed at mitigating infection risk across the continuum of care. Strong financial incentives established as part of the Affordable Care Act continue to pressure hospitals to find new ways of reducing HAIs. Despite these measures, HAIs continue to be among the most prevalent and costly adverse events in US healthcare institutions.1

In 2010, Weber, et al. found that in the case of several of the more critical organisms present in hospitals, that patient-to-patient transmission was directly proportional to the level of environmental contamination.2 The emergence of MDROs that persist in the environment, combined with a growing body of evidence correlating contaminated surfaces to HAI, heightened awareness of the environment as a transmission risk in institutions.

As a result, cleaning and disinfection of the patient environment became a core, horizontal infection prevention strategy. The Joint Commission and CMS require hospitals to have rigorous environmental cleaning policies and procedures in place which are subject to routine audit for accreditation. And with this new standard of care, a virtual tsunami of products and services emerged to support these efforts.

Today, the hospital surface disinfectant market alone is projected to be worth $1.2 billion by 2024.
Up to this point, however, infection prevention efforts and investment aimed at reducing the risk of environmental transmission have focused almost exclusively on hard surfaces. With the exception of isolation of patients with serious respiratory infection, hospital air quality has received comparatively little attention. This can be explained, in part, by several factors: Sampling and measurement of viable aerosolized bacteria has been both costly and burdensome. And until recently, there has been an absence of innovation in technology for hospital air quality management. With limited evidence and no new solutions on the horizon, it is understandable that other infection prevention concerns took priority over air.

In the U.S., the importance of airborne transmission to HAI generally is a matter of considerable debate. However, in the case of SSI, there are many reasons why healthcare institutions should consider air quality the next frontier for reduction.

SSIs are complex and multifactorial, yet 30 years of studies demonstrate the contribution of aerosolized bioburden to SSI. As far back as the 1980s, Lidwell found that most bacteria contaminating surgical wounds are likely to have reached it by the airborne route. Whyte found that 98 percent of bacteria in patients' wounds after surgery in a conventionally-ventilated operating room came directly or indirectly from the air.3-4 The recent outbreak of M. chimaera found to be epidemiologically linked to aerosolized bacteria from contaminated heater-cooler units used in cardiac surgery is a more recent reinforcement of the airborne route in SSI.5

While progress has been made in SS reduction, the Agency for Healthcare Research and Quality (AHRQ) reported no decrease, between 2014 and 2017, in a core group of SSIs subject to reporting to NHSN.1 SCIP, SIP and other initiatives aimed at standardization of best practice yielded improvement and new evidence may lead to identification of additional process improvement opportunities, however, the low-hanging fruit in process and practice has likely been harvested.

So, where do we go from here? Rethinking air quality in the OR may be the place to start. Sweden and the Netherlands have promulgated standards in the last two years which limit bacterial colony forming units (CFUs) in key areas of the hospital based on patient risk.6 In the OR, air quality must be maintained at no greater than 10 CFUs per cubic meter (<10CFU/m3). Additional European nations and Australia are considering similar requirements, and the WHO recently issued a conditional recommendation that laminar airflow ventilation systems should not be used to reduce SSI risk for patients undergoing total arthroplasty surgery.7

Requirements for air quality management date to the 1970s and focus on the mechanism of air management not the efficacy of those controls. This is understandable given the absence of innovation in air quality management technology. Since the 1970s, architectural controls have been the only viable approach; however, there is a steady flow of research which calls the efficacy of these controls into question. For example, studies have demonstrated that air exchanges and positive air pressure are easily thwarted by door openings and traffic.9-11

Rethinking OR air quality may be particularly important as the population ages and demand for surgery with implants increases. A recent study predicted exponential growth in total hip and knee arthroplasty (THA/TKA) procedural volume between 2020 and 2030. With no abatement in the rate of infection, by TKA/THA prosthetic joint infections will increase by 14 percent.12

A postoperative infection in a clean surgical wound requires a microbial burden of 105 CFUs, whereas when a foreign body, such as an implant, is present an infection can occur with as few as 10 to 50 CFUs.13-14 A prospective randomized multicenter study showed that joint replacements in rooms with over 50 CFU bacteria were 2.6 times as likely to have postoperative infection than those with 10-20 CFU.15

Infection prevention strategy begins with a risk assessment. Bacterial levels as high as 150 (CFU)/m3 have been documented in U.S. ORs, yet despite the known risk of infection, there is no requirement for bacterial testing or particulate counts in the nation's operating rooms.16 We have little understanding of the risk or the extent to which air may be undermining our efforts to reduce SSI. New, less costly and easier to use air quality measurement technology is entering the market which will help make routine assessment of aerosolized bioburden viable.

Is it time for the US to consider more rigorous standards of care for air quality in the operating room? While there are considerable open research questions, aerosolized bacteria is a known contributor to SSI. And with process and practice measures exhausted, infection prevention stakeholders must look to other ways of mitigating risk. Ten years ago, environmental disinfection was the new frontier in infection prevention, but air was absent from the scope of that effort. In light of new evidence, new technology and the challenge of achieving further reductions in SSI, infection prevention stakeholders may want to consider broadening the scope of environmental disinfection strategy to OR air quality, gain a better understanding of the level of contamination and relative risk their ORs and embrace the potential of enhanced air management strategies to further protect patients from SSI.

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