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RESEARCH

Airborne and Surface Bacteria in ORs: Integration of ASHRAE-Compliant Ventilation and Active UV-C Air Treatment

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ABSTRACT

Bacteria in ORs increase surgical site infection risk. The American Society of Heating, Refrigerating and Air-Conditioning Engineers Standard 170 defines OR ventilation standards, but the added benefit of in-room supplemental ultraviolet C air treatment remains uncertain. We compared bacterial counts before and after installing active ultraviolet C air treatment in an OR with Standard 170–compliant ventilation, using a similar OR as a control with Standard 170–compliant ventilation alone. After installation, the intervention OR showed 80% fewer airborne bacteria and 61% fewer settled surface bacteria. The control OR showed a 219% increase in airborne colony-forming units per cubic meter and a 24% increase in settled surface bacteria over the same period, reflecting potential confounders. Although the intervention was associated with lower bacterial levels in two assays, more evidence is needed given the limited number of ORs tested and the variation in the control OR.

Key words: *ultraviolet C irradiation (UV-C), UV-C germicidal irradiation (UVGI), airborne contamination, surgical site infection (SSI), OR ventilation.*

The presence of airborne microorganisms in ORs contributes to surgical site infections (SSIs), which are especially consequential for patients undergoing implant procedures or at elevated risk of mortality and morbidity.[1-3] Airborne particles carrying microorganisms can settle into the surgical field, making environmental control a critical part of a perioperative infection control and prevention program.[4]

Modern ORs are designed to reduce microbial risk through controlled ventilation systems. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 170 specifies downward unidirectional laminar airflow at 25 to 35 feet per minute (FPM) over the sterile field,[5] while AORN guidelines emphasize directing clean air toward the sterile field and away from contamination sources.[6] These approaches have been foundational to OR design. However, maintaining ideal airflow conditions during active surgical procedures remains challenging. Localized recirculation or stagnant zones can develop during active operations, potentially affecting air cleanliness.[7,8] Staff movement, equipment placement, and

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door openings can disrupt airflows, potentially leading to localized contamination.[9] As a result, there is ongoing concern that ventilation systems alone, even when compliant with current standards, may not fully mitigate bacterial risk in actual operating conditions. This limitation is particularly important in procedures such as joint arthroplasty, where even low levels of bacteria and fungi can result in severe complications. These challenges highlight the potential need for supplemental air-treatment strategies that can dynamically address microbial risk during surgery.

This study evaluates the use of active ultraviolet C (UV-C) air treatment as a supplement to ASHRAE 170–compliant ventilation and assesses the association of this combination of equipment with airborne and settled-surface bacterial loads in the OR.

REVIEW OF THE LITERATURE

The relationship between OR air quality and SSI has been studied for decades. In 1972, foundational work was published focusing on postoperative infection after total hip replacement. Special reference was made to air contamination in the OR, and the principle of *clean air surgery*—the idea that ultraclean-ventilation environments reduce deep infection rates after total hip replacement—was established.[10]

Surgical site infection, particularly after orthopedic procedures, often involves airborne particles carrying microorganisms, predominantly *Staphylococcus aureus*.[11] In an active comparison of three types of OR ventilation (unidirectional, stabilized, and turbulent flow), researchers concluded that 98% of infections are related to airborne particles.[12] The ASHRAE Standard 170 established specifications for health care ventilation design with laminar (unidirectional) airflow for surgical suites.[5] However, recent evidence has challenged assumptions about the relevance of laminar airflow. A 2017 systematic review and meta-analysis searched MEDLINE, Embase, Cochrane Central Register of Controlled Trials, and the World Health Organization's regional medical databases for literature published between 1990 and 2016.[13] Studies included those exploring whether laminar airflow in the OR reduces overall or deep SSI rates among patients of any age. The review found that although laminar airflow ventilation consistently reduced airborne bacterial counts, it did not reduce SSI incidence compared with conventional ventilation.[13] This finding has been corroborated in an exploration using laminar airflow and space suits to reduce early deep infection after total hip and knee replacement using New Zealand Joint Registry Data.[14] Additional corroboration can be found in a study of air samplings taken in 28 ORs supplied with unidirectional, turbulent, and mixed airflow ventilation to determine the index of microbial contamination.[15] Additionally, risk for severe SSI after hip prosthesis implantation was found to be significantly higher in the presence of laminar airflow ventilation in an active SSI surveillance performed across 63 surgical departments representing a total of 99 230 operations.[16] In a cohort study of 6972 patients, the rate of periprosthetic joint infection was similar in procedures performed both with and without laminar airflow.[16]

Computational and experimental studies have identified why inconsistencies in the effectiveness of laminar airflow ventilation may exist. Interruption of the demarcation zone by staff activity may cause inconsistencies in the effectiveness of laminar airflow and influence the RN circulator's work area, anesthesia zone, and equipment borders.[7,8] A study involving 166 air samples collected during arthroplasty procedures confirmed that occupancy and movement in the OR influence contamination levels even within the laminar airflow demarcation zone.[17] Staff movement generates particle dispersion,[9] and mask failure can lead to nasopharyngeal shedding,[18] increasing bioburden levels as procedure duration and staff member counts increase.[19]

Supplemental air-treatment technologies, including UV-C germicidal irradiation (UVGI) and high-efficiency particulate air filtration, have been proposed as adjuncts to primary heating, ventilation, and air-conditioning (HVAC) systems to target pathogen inactivation in specific zones to complement the primary ventilation strategy. The literature supporting their use in active surgical environments remains limited, underscoring a critical research gap that this study seeks to address.

CONCEPTUAL FRAMEWORK

Our study design, sampling locations, and interpretation of findings are grounded in a layered engineering control framework, which holds that no single environmental control is sufficient under real-world conditions, and multiple complementary layers together provide more robust protection than any single intervention alone. Within this framework, ASHRAE 170–compliant laminar-flow ventilation serves as the primary engineering control, designed to protect the sterile field under ideal conditions. However,

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the perioperative environment is dynamic: staff movement, door openings, and equipment placement continually disrupts intended airflow patterns, degrading primary control effectiveness precisely during the active surgical procedure. Cleaning degradation is most pronounced in transitional zones at the periphery of laminar-flow coverage, including the back table, the RN circulator's work area, and the anesthesia area, where airflow momentum is reduced and bioaerosol re-entrainment is most likely. Active UV-C air treatment is applied in this study as a continuous, independent, secondary engineering control that is separate from the ventilation airflow geometry to enhance microbial control in areas where the primary ventilation system is most vulnerable.

RESEARCH QUESTIONS

- Is the addition of active UV-C air treatment to an OR with an ASHRAE 170–compliant ventilation system associated with a change in concentration of reproductive-competent airborne bacteria (colony-forming unit per cubic meter [CFU/m^3]) during orthopedic procedures compared to baseline?
- Is there an association between active UV-C air treatment and a change in settled surface bacteria as measured by the number of CFUs per plate sampled at the back table, RN circulator's work area, and anesthesia zone in an OR during orthopedic procedures?

OPERATIONAL DEFINITIONS

- *Airborne bacterial concentration*: The quantity of reproductive-competent airborne bacteria measured in CFU/m^3 collected using SAS (Surface Air System) 180 air samplers on tryptic soy agar (TSA) supplemented with 5% sheep blood.
- *Settled surface bacteria*: The quantity of reproductive-competent bacteria deposited on a horizontal surface by gravitational settling. Collected using RODAC (Replicate Organism Detection and Counting) contact plates with TSA agar with tween and lecithin.
- *ASHRAE 170–compliant ventilation*: An OR ventilation system designed following *ANSI/ASHRAE/ASHE Standard 170-2021* (American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers/American Society for Health Care Engineering) specifying downward unidirectional (laminar) flow at 25 to 35 FPM over the sterile field.
- *Active in-room UV-C air treatment*: A supplemental air-disinfection approach mechanically drawing air into a sealed unit located on the ceiling containing a high-intensity UV-C lamp (254 nanometers [nm]) irradiated in an enclosed chamber and returned to the room as treated air. This active fan mechanism is distinct from *upper-room UVGI*, also referred to as *germicidal UV*, in which UV fixtures irradiate the upper air zone and rely on passive convective air mixing to expose microorganisms to UV-C energy. Active UV-C units process a defined volume of air per minute (CFM), providing continuous targeted germicidal treatment independent of room airflow patterns, occupancy, or convective mixing. This study used six ceiling-mounted active UV-C units, each operating at 62 CFM with an internal MERV (Minimum Efficiency Reporting Value) 6 filter and positioned outside the sterile field to treat the air in OR A transitional zones where laminar flow is most vulnerable to disruption.
- *Intervention OR* (OR A): The OR equipped with ASHRAE 170–compliant ventilation plus six continuously operating in-room active UV-C air units positioned outside the sterile field.
- *Control OR* (OR B): The OR equipped with ASHRAE 170–compliant ventilation and no in-room active UV-C air treatment.
- *Preintervention*: The 16-hour sampling time frame (over two days) before installing the active UV-C air treatment. Also referred to as *Sampling Round 1*.
- *Postintervention*: The 16-hour sampling time frame (over two days) after the intervention was installed and while the active UV-C air treatment was operating. Also referred to as *Sampling Round 2*.

METHODS

This investigation was conducted at a 560-bed community teaching hospital in southeast Michigan in the third quarter of 2025. A multidisciplinary team at the facility selected two ASHRAE 170–compliant ORs for evaluation: OR A (intervention) and OR B (control). Both rooms were identical in dimensions, placement of lighting and booms, and with ASHRAE- design laminar flow ventilation for orthopedic operative procedures.

This study involved microbiological sampling of OR air and settled surfaces. No patient data, patient identifiers, or patient specimens were collected. No human subjects

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were enrolled, and no protected health information was assessed. This was an environmental quality improvement investigation. Formal Institutional Review Board review was not required under applicable regulations. The study was conducted in accordance with facility infection control and environmental monitoring protocols with approval of a multidisciplinary facility team.

Ventilation equipment in OR A included six active UV-C (254 nm) air treatment units (Clean Air; UV Angel Partners). Each UV-C unit operated at a nominal 62 CFM, as represented by the UV-C unit (Figure 1). The units provide shielded UV-C for UVGI of the air. These units were positioned outside the sterile field in areas where bacteria may enter. These units have an internal MERV 6 filter and high-intensity sealed UV-C chambers integrated into a 2 × 2-ft light fixture installed on the ceiling (Figure 2). Active UV-C air treatment was not installed in OR B, and this room served as a control.

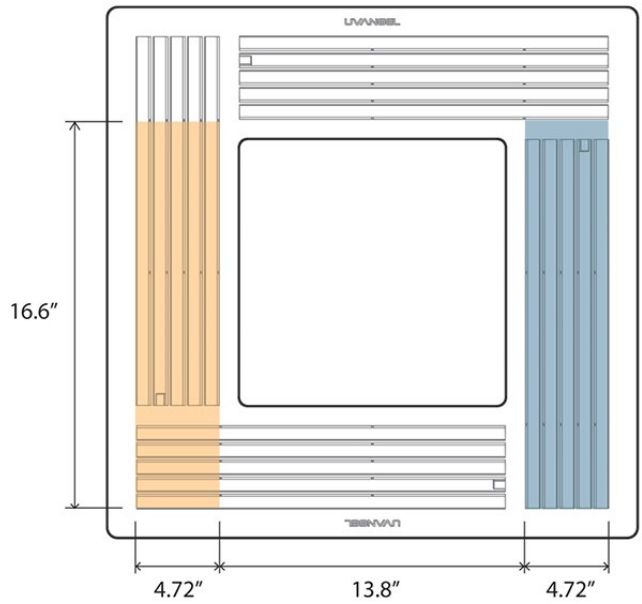


Figure 1. Diagram of the 2 × 2-ft active air treatment unit.

Data Collection

Sampling locations were those identified by the perioperative staff as critical to maintaining sterile technique; specifically, the back table (sterile instrument) area, RN circulator's work area, and the anesthesia zone in both OR A and OR B. Two sampling rounds were performed by two environmental sampling personnel from UV Angel and monitored by the hospital's infection prevention staff in both OR A (with UV-C intervention) and OR B (control). Sampling round 1 took place before the installation and operation of the UV-C units in OR A. Sampling round 2 took place after UV-C units were installed and operating in OR A. During both rounds, sampling personnel remained in each OR for the full shift duration, collecting one air and one settled surface sample once per hour in each sampling location, resulting in a total of 192 air and surface samples—96 from OR A and 96 from OR B. Sampling occurred during routine orthopedic procedures in each room; staff occupancy, movement, door openings, and normal clinical flows were maintained during the sampling. The sampling personnel recorded activity in the room (eg, the number of staff, exact number of door openings and closings) and shared the information with the perioperative team, who determined that no patterns outside normal operations were observed.

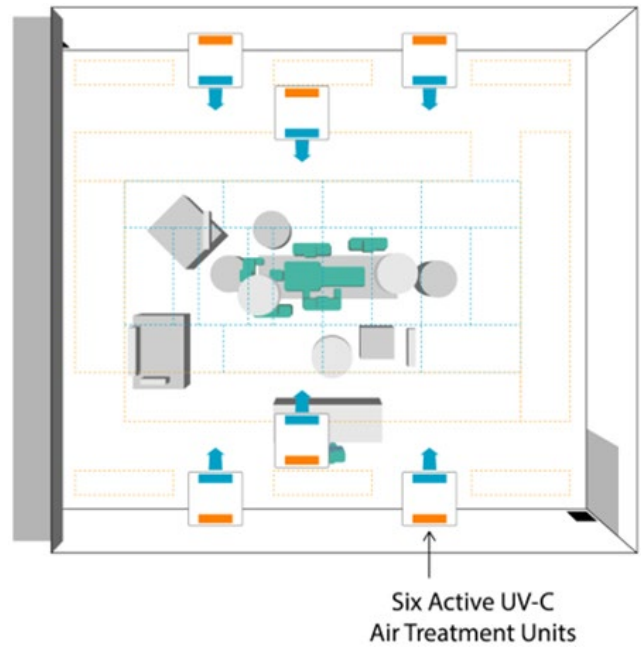


Figure 2. Operating room A representation with equipment, air treatment units, and sterile field locations. UV-C = ultraviolet C.

To capture the changes in bacterial concentration during active surgical schedules, we collected air samples following standard American Industrial Hygiene Association and American Conference of Governmental Industrial Hygienists bioaerosol impact sampling methods using SAS 180 impaction samplers (Biosciences International). We collected 1000 L of air per air sample on TSA supplemented with

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5% sheep blood. We collected settled surface samples on RODAC contact plates with TSA agar supplemented with tween and lecithin to neutralize residual disinfection and facilitate bacterial recovery.

Settled surface reproductive-competent bacteria reflect airborne particle load, size, and gravitational settling dynamics, where larger aggregated microbiological particles settle faster onto surfaces. This results in increased surface contamination independent of changes in cleaning or room activity.

Samples were analyzed by an independent laboratory (EMSL Analytics Inc) that was blinded to room for assignment and intervention status. The laboratory incubated all bacterial samples at 35 °C (95 °F) for 48 hours and recorded colony counts as CFU/m^3 (adjusting for correction hole factor) for the air samples and CFU per plate for the settled surface contact samples. Sample size was determined based on feasibility and operational constraints rather than a power analysis to reflect the exploratory nature of this environmental study and previously published studies.

Data Analysis Procedures

Data were analyzed using paired nonparametric tests appropriate for nonnormally distributed data and modest sample sizes as is typical in environmental infection control studies. An exact sign test was applied to all paired comparisons, and a Wilcoxon signed-rank test was also used for settled surface samples, with a 2-sided significance level of α = 0.05 (XLSTAT 2025, Addinsoft). Effect size was calculated using the *r* correlation coefficient, and 95% confidence intervals (CIs) were reported where appropriate. Missing pairs and missing observations were excluded from analyses. Only culturable bacteria were measured; viral, fungal, and nonculturable microorganisms (including their speciation) were not assessed. No deviations from the planned sampling protocol or documented major environmental abnormalities occurred during the study.

RESULTS

Operating room A, in which UV-C air treatment was added to the existing laminar flow ventilation, underwent sampling before and after installation of the UV-C equipment. Operating room B sampling occurred on the same days as OR A, although it did not have UV-C air treatment installed.

OR A: Active UV-C Air Treatment

In the intervention OR A, airborne bacterial concentrations were 80% lower after the UV-C air treatment was installed, showing a mean of 93.4 CFU/m^3 before installation and a mean of 18.5 CFU/m^3 after installation. This difference was statistically significant ($P < .0001$) The correlation between our application of in-room active UV-C air treatment in OR A and airborne bacterial counts was significant and negative ($r = -0.92$). The 95% CI for this correlation was −0.95 to −0.54 (Table 1).

Settled surface bacteria showed a similar pattern. The installation of UV-C air treatment was associated with 61% lower mean settled bacterial counts ($P < .0001$). Plate counts from the back table showed a 59% lower number of settled surface bacteria compared to counts before UV-C air treatment installation. Lower numbers were consistent

Table 1. Air and Surface Sampling Summary: OR A (Intervention)

	Air Bacteria				Surface Bacteria			
	Sampling Round 1, CFU/m^3	Sampling Round 2, CFU/m^3	% Change	*P* Value	Sampling Round 1, CFU/m^3	Sampling Round 2, CFU/m^3	% Change	*P* Value
Back table	90.94	22.13	−76		36.13	14.81	−59	
RN circulator's workstation	95.88	23.38	−76		33.88	10.81	−68	
Behind anesthesia area	93.38	10.00	−89		31.19	14.00	−55	
Overall average	93.40	18.50	−80	<.0001	33.73	13.21	−61	<.0001

CFU = colony-forming unit.
NOTES. Standard deviation reported for overall average row only (variation across three sampling locations, n = 48 each). *P* values: sign test, 2-tailed, exact method. α = 0.05. Statistical significance $P < .05$.

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across all sampling locations, including the RN circulator's work area and the anesthesia zone. These locations correspond to regions of lower airflow momentum, where the designed laminar airflow pattern was predicted to be less effective.

The number of staff members present, including the environmental sampling team, in OR A and OR B, was counted by the sampling team and recorded in the field notes during each sampling and then averaged. In OR A, the mean number of staff members was 7.3 per hour during preintervention sampling (round 1) and 4.4 per hour during postintervention sampling (round 2). In OR B (control), the mean number of staff members was 7.3 per hour during round 1 and 5.4 per hour during round 2.

OR B: No UV-C Air Treatment

Sampling in OR B showed markedly higher numbers (219%) of airborne bacteria during sample round 2 compared to round 1 ($P < .0001$). Table 2 shows the sampling figures during sampling rounds 1 and 2, including that the numbers of settled surface bacteria were higher (24%) during round 2 of sampling.

Table 3 summarizes the results for air and settled surface samples in OR A before and after installation of UV-C air treatment and OR B (control). For each OR and sample type, the table presents the number of observations (n = 48 per condition), means, ranges, and standard deviations. The change in OR B was not statistically significant ($P = .165$, $\alpha = 0.05$).

Table 2. Air and Surface Sampling Summary: OR B (Control)

	Air Bacteria				Surface Bacteria			
	Sampling Round 1, CFU/m³	Sampling Round 2, CFU/m³	% Change	*P* Value	Sampling Round 1, CFU/m³	Sampling Round 2, CFU/m³	% Change	*P* Value
Back table	130.31	443.56	240		33.50	41.88	25	
RN circulator's workstation	151.44	438.13	189		29.56	40.50	37	
Behind anesthesia area	117.25	393.00	235		39.06	43.75	12	
Overall average	133.00	424.90	219	<.0001	34.04	42.04	24	0.165

CFU = colony-forming unit.
NOTES. Standard deviation reported for overall average row only (variation across three sampling locations, n = 48 each). *P* values: sign test, 2-tailed, exact method. α = 0.05. Statistical significance < .05.

Table 3. Sampling Results Summary

Variable	Minimum	Maximum	Mean	SD
Air sampling, CFU/m³				
OR A round 1	17	209	93.4	44.788
OR A round 2	0	141	18.5	31.303
OR B round 1	17	1308	133	203.992
OR B round 2	42	1308	424.9	478.675
Surface sampling, CFU/plate				
OR A round 1	3	92	33.73	21.873
OR A round 2	0	51	13.21	10.547
OR B round 1	1	201	34.04	37.594
OR B round 2	0	201	42.04	38.486

CFU = colony-forming unit.
NOTE. Each round consisted of 48 samples.

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DISCUSSION

This study sought to assess the association between bacterial counts and the use of supplemental air treatment in addition to laminar flow ventilation in the OR. Operating room A, with active UV-C air treatment, showed statistically significant differences in both airborne and settled surface microbial counts before and after treatment. However, the control OR showed a wide variation between sampling rounds for no reason that is readily apparent.

In each room, air and surface measurements were analyzed separately, and the paired nonparametric tests indicate that operation of the UV-C air treatment was associated with lower microbial levels in OR A over the observation periods. In the intervention OR, these patterns may be consistent with a process in which treatment of recirculating air alters the pool of microorganisms available for deposition onto perioperative surfaces; however, given the wide variation in bacterial load in the control OR and the exploratory design, including the investigation of a single OR, these findings should be interpreted cautiously and viewed primarily as hypothesis generating. The substantial increase in airborne CFU counts in the control OR warrants careful interpretation, as it represents a significant change from baseline conditions. No apparent or reported differences in occupancy, procedure type, or environmental cleaning practices were observed between sampling periods based on technician sampling reports, perioperative staff reports, and facility operations.

The findings of this study on supplemental active UV-C intervention in the OR should be interpreted in the context of recent evidence questioning whether laminar airflow alone is sufficient to prevent SSIs. A systematic review by Bischoff and colleagues[13] found that, despite clear reductions in airborne bacterial counts, laminar airflow ventilation did not reduce the incidence of SSI compared with conventional ventilation. Similar conclusions are reported in multiple large registry and multicenter studies, which found that although laminar flow systems consistently lower microbial counts in OR air, they have not translated into lower infection rates in orthopedic procedures.[13,16]

A substantial body of research suggests that supplemental air-treatment technologies may be necessary to achieve meaningful reductions in infection risk. Traditional assumptions hold that laminar airflow provides cleaner air and better outcomes. The work we have documented here was exploratory in nature and designed to evaluate the association of environmental bacteria with active UV-C treatment rather than clinical outcomes. Additional research is necessary to show this association. Further, to establish a clinically significant relationship between any differences in bacterial load and reductions in the incidence of SSIs requires additional investigation.

Our OR study is relevant to orthopedic and other types of surgical procedures—cardiac procedures, for example, as well as those where SSIs involving nonhuman implants can be catastrophic. The principle of clean air in the operating theater[11] has long been a foundational concept in the prevention of orthopedic infections. However, recent evidence questioning the reliability of laminar-flow ventilation in real-world surgical conditions has raised uncertainty about environmental controls.[12,16] Unmeasured confounders may have influenced bacteria levels and should be considered when interpreting these findings.

For surgeons, the ability to reduce airborne and settled surface bacterial counts in critical areas around the sterile field, particularly on the back table where instruments are maintained, may help bridge the gap between intended ventilation performance and the reality of active surgical conditions, where staff movement and equipment placement inevitably disrupt ideal airflow patterns. Although studies continue to examine the benefits and challenges of SSI and OR design, future research should evaluate the effect of active supplemental UV-C air treatment technology in adjacent high-risk perioperative and procedural environments.

Investigations should include multiple ORs; multiple site evaluations; varied HVAC designs; extended observation periods; comprehensive environmental monitoring, including HVAC performance parameters; implementing prospective SSI surveillance linked to environmental data; and assessing cost-effectiveness and operational feasibility across different facility types. Formal power analyses, systematic capture of operational variables, and prospective links between environmental data and clinical outcomes may further clarify the role of supplemental air cleaning as an infection prevention strategy.

Limitations of the Study

This is an environmental study design, and no claims are made regarding improved patient outcomes or clinical

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Key Takeaways

- Airborne microorganisms in ORs can contribute to surgical site infections (SSIs), and although American Society of Heating, Refrigerating and Air-Conditioning Engineers Standard 170–compliant laminar airflow systems are designed to reduce contamination, real-world factors such as staff movement, equipment placement, and door openings can disrupt airflow patterns. Existing research has shown that laminar airflow can reduce airborne bacterial counts, but evidence linking it to lower SSI rates remains inconsistent.
- Researchers evaluated whether adding active in-room UV-C air treatment to a Standard 170–compliant orthopedic OR was associated with lower airborne and settled-surface bacterial counts. Air and surface samples were collected before and after installation of six ceiling-mounted UV-C units and compared with samples from a similar control OR.
- After installation of the UV-C system, the intervention OR demonstrated an 80% reduction in airborne bacterial concentrations and a 61% reduction in settled-surface bacteria. Reductions were observed across critical perioperative locations, including the back table, the RN circulator work area, and the anesthesia zone.
- Findings should be interpreted cautiously because the study involved only one intervention OR over a short observation period and the control OR showed an unexplained increase in bacterial counts. Supplemental UV-C air treatment may help reduce environmental bacterial burden when used alongside compliant ventilation systems, but larger studies are needed to determine its long-term effect and relationship to SSIs.

significance. The study was conducted in a single OR in a single facility with a short duration of sampling over two days before installation and two days post installation. This limits its generalizability.

Unexplained spikes in bacterial load observed in the control OR limit the interpretation of the results from the intervention OR and imply existing confounders that have not been identified. There was also a limited ability to control the procedure mix (although all procedures were orthopedic), traffic patterns, or other observed operational variables. Although the results show statistically significant reductions in airborne and settled surface bacteria in the intervention OR, these limitations should be acknowledged. The increase in bacteria observed in the control OR cannot be attributed to a single factor, as multiple environmental and operational variables may have contributed. Finally, the potential influence of staff behavior, procedure complexity, and other unmeasured procedural or environmental factors cannot be excluded and may have influenced the observed outcomes.

Implications for Perioperative Nursing

For perioperative nurses, surgical technologists, infection preventionists, and OR managers, the efficacy data from the installation of active in-room UV-C air treatment carry several practical implications. First, reliance on HVAC design compliance alone may be insufficient to maintain optimal microbiological air quality under the dynamic conditions of active surgery. Standard laminar airflow systems are most effective under low disturbance conditions and during routine clinical activity; however, staff movement, door traffic, and equipment handling can degrade their performance, particularly in peripheral zones.

Second, the lower numbers of bacteria observed at the back table where sterile instruments are maintained throughout orthopedic procedures suggest that active UV-C air treatment may offer protection for the back table environment by reducing airborne bacterial levels and, consequently, the risk of instrument and supply contamination. Perioperative nurses and surgical technologists responsible for maintaining sterile technique should recognize that environmental conditions around the back table are influenced by airborne bacteria, and that active air treatment strategies may reduce microbial risk in this critical area.

Third, infection preventionists and OR managers should consider evaluating active UV-C air treatment as part of a comprehensive, layered SSI-prevention strategy, particularly in high-risk procedural environments, such as orthopedic, cardiac, and spine surgery suites where

implant-related infections can be catastrophic. For perioperative teams, infection preventionists, and surgeons, these findings suggest that relying on HVAC design compliance alone may be insufficient, and that active, continuous UV-C air treatment strategies—particularly targeting areas with less effective ventilation—may be an essential adjunct to comprehensive SSI-prevention programs.

CONCLUSION

Adding a supplemental UV-C air treatment in a single OR was associated with a significantly reduced number of airborne and settled surface bacteria in an ASHRAE Standard 170–compliant OR designed for orthopedic surgery. The control OR showed an unexplained increase in bacterial load, and this, along with the short duration and single intervention OR, limits accurate interpretation. The study highlights unmeasured confounding factors but suggests active supplemental air treatment may be associated with lower bacterial counts when used in conjunction with compliant ventilation systems. Additional research involving multiple ORs is needed to confirm whether active UV-C air treatment is associated with lower airborne and settled bacterial loads over time.

These findings warrant additional investigation. Relying on HVAC design compliance alone may be insufficient for reducing bacteria that can lead to SSIs. Active, continuous air-treatment strategies, particularly targeted to areas with less effective ventilation, may be an essential adjunct to a comprehensive perioperative infection control program.

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