May 2020

Airborne Infectious Isolation Rooms – A Protective Airflow Verification Solution

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Due to the recent SARS-COV-2 pandemic, the need for additional airborne infection isolation (AII) rooms has become essential. SARS-COV-2, an enveloped RNA virus, has the potential to exist in both droplet and aerosol forms. It has also been studied and confirmed to be infective six to seven feet from the source (1-7). The Center for Disease Control (CDC) recommends that aerosol generating procedures (AGPs) on infected or suspect patients should be performed in an AII room (8). In many hospitals, existing AII rooms are already fully utilized, and this has forced protective environment and operating rooms (normally positively pressurized) or ICUs (with no air pressure requirement) to be converted to AII rooms under COVID surge conditions. In some cases, rapidly developed temporary or permanent structures are being built.

ANSI/ASHRAE/ASHE Standard 170-2017 recommends that AII rooms provide negative pressure, perform 12 air changes per hour (ACH) with two outside air exchanges, and exhaust directly to the outside with no recirculation (9). ASHRAE COVID 19 Guidance (10) outlines possible configurations for converting these spaces to negative pressure AII rooms and describes them as follows:

1. In-room HEPA discharging directly to the exterior. Block-off the in-room exhaust.
2. In-room fan, non-HEPA discharging directly to the exterior. Block-off the in-room exhaust.
3. In room HEPA discharging to exhaust. Don't block in-room exhaust. This configuration may cause down-stream effects to pressure, which can be detrimental to other hospital spaces including positively pressurized environments.
4. When no window is present, in room HEPA in 'scrub' mode, discharge to corridor. Block-off the in-room exhaust. May cause pressure issues in corridor.

(ASHRAE COVID 19 guidance also has additional configurations, but these options do not create a negative environment and utilize in-room recirculation with a HEPA filter and no exhaust.)

Additionally, in AII rooms, ventilation air movement should be from clean to less clean areas, while continuously exhausting potentially contaminated aerosols nearest to their source so that healthcare workers (HCW) and uninfected patients in surrounding areas are protected from accidental exposure. This is achieved through directional flow of filtered supply air that carries infectious particles from their source to an exhaust inlet location (Figure 1).

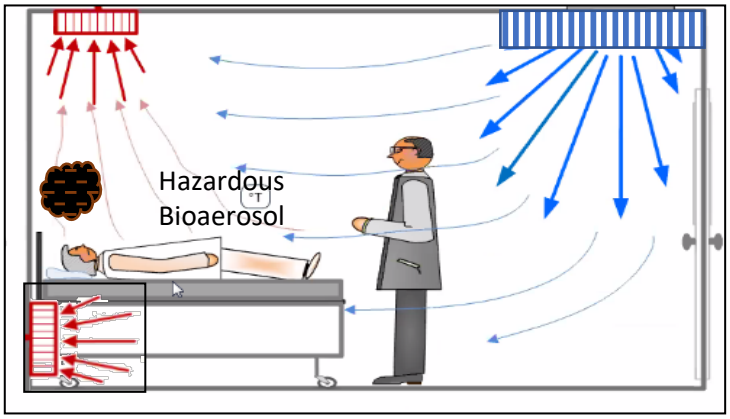

Figure 1: Optimal Air Movement

Since air is invisible, an alternate method is needed for visualizing how the directional air flows within the room, in real time or as frequently as possible. New technology exists to enable safety, facility, or clinical rounding teams to 'visualize' this airflow. AirStatEQI™ Airflow Visualization Device* quickly maps the directional flow in each operating room, to determine if any risks exist for either the surgical patient or the

surgical team members (Figure 1). If risks are identified, clinical teams can then make alterations to work or patient care flows to mitigate these in-room risks. Facilities teams can also check for risks of potentially contaminated air escaping to hallways and adjacent spaces.

This hand-held technology allows the user to input space identification information, room temperature, and specific humidity. It measures the velocity and direction of the air at various points within the AII space, and through a contamination risk mapping algorithm (11), produces a 'risk map'. The numerical risk readings are color coded green (ok), yellow (below target) and red (critical) on the map for easy reference by the team member collecting the data. The risk readings are uploaded to an interactive floor plan of the AII room (Figure 3), indicating location of patient bed, toilet room and anteroom in relation to the team member collecting the readings. In this figure, the AirStatEQI device is depicted in blue and its orientation is indicated for downdraft or cross draft readings at each specific location. Each location (2-10 per room) takes approximately 5 seconds (average 5 one-second readings) minimizing disruptions to patient care processes or procedures. Data from each reading is stored to enable analytics and trending of historical conditions.

Figure 2. AirStatEQI™ Airflow Visualization Device

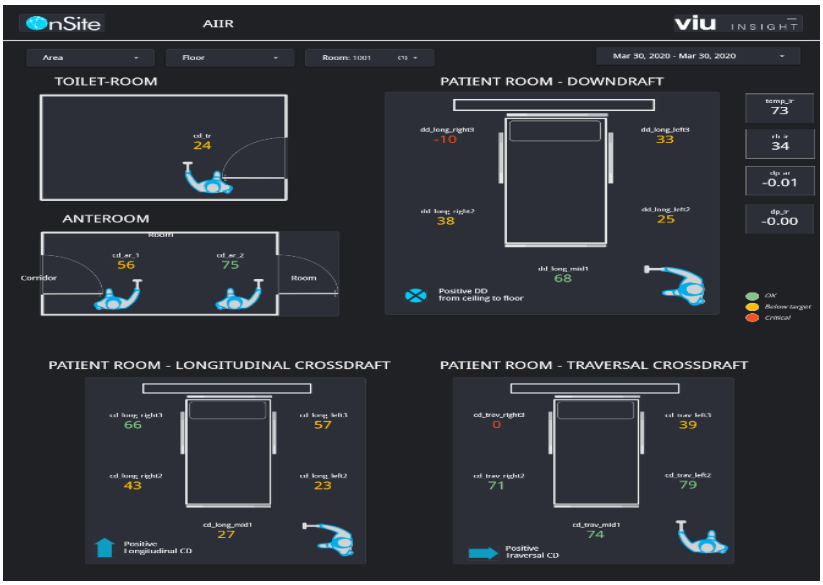

Figure 3: Interactive Room Risk Map Dashboard

The AirStatEQI™ device can also be used as part of the OnSite BEACON™ Comprehensive Environmental Quality Indicator Risk Mapping Toolkit for re-commissioning spaces (11-17). Because many spaces that were re-purposed during this pandemic will eventually be returned to their original intended function, the need for their environmental performance to be evaluated to ensure proper pressure, air flow, humidity, temperature, air change rates, and cleanliness (SARS-COV-2 and mold free) will be required. Validating that these recommissioned spaces are functioning optimally could play a big part in building public confidence in the efforts of healthcare providers to restore safe environments for their patients, visitors, and staff.

*The AirStatEQI™ Airflow Visualization Device is a joint endeavor between OnSite-LLC and VIU Insights, Inc.

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