Infection Prevention and Control

Best Practice Guideline	Bioaerosol Management
Date	May 5, 2020
Reviewed Date	
Revised Date	

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Purpose

To reduce the level of airborne particles through Best Practices for management of bioaerosols.

Background

The potential for airborne transmission of infections is well recognized – via both large and small droplets (bioaerosols). In general, the amount of virus or bacteria in air is affected by:

- The concentration of particles generated (source/patient control).
- The quality of the HVAC (heating, ventilation and air conditioning) system.
- Relative humidity (RH).
- The proportion of the supply and exhaust air relative to the space.
- The level of filtration applied to the air.
- Movement in the space.

Procedure

Bioaerosol Spread

- Bioaerosol spread is affected by the airflow patterns in the HVAC system as well as local exhaust ventilation, air exchange rates, room pressurization, airflow distribution, and relative humidity.
- Controlling bioaerosols includes dilution of room air around the patients, directional airflow, room pressurization, increasing the relative humidity, and removing infectious agents by filtration.
- The relative value of each strategy is unknown and bioaerosol management *should consider all the above factors.* It should be emphasized that the percent bioaerosol reduction to achieve a reduction in disease transmission is unknown.

  - Controlling the relative humidity (RH) is a very important strategy in controlling airborne transmission. Dry air predisposes to shrinking of infectious aerosols to become droplet nuclei capable of traveling great distances and remaining aloft for longer periods of time. When they encounter a secondary host, the particles rehydrate and become infectious. Increasing the relative humidity not only causes more rapid fallout of particles below the respiratory zone, but also has been documented to be beneficial for clearing respiratory secretions and hydrating mucous membranes with associated improved outcome. Increased RH decreases viral survival.
  - The most unfavourable survival for bioaerosols is a RH between 40% and 60% and attention should be directed to maintaining an optimal RH particularly during cold and flu seasons.
  - Excessive movement in a space disrupts airflow patterns, can decrease relative humidity and predisposes to accidental surface contamination. To mitigate excessive movement, limit the number of personnel in the room and minimize door openings.
  - Negative air pressurization (inward directional flow from hallway into patient room) with direct to the outdoors or HEPA filtered exhaust support efficient movement of airborne contaminants from the patient (source) to safety.
  - In any room where there is concern for infectious bioaerosols, the door to the room should be kept closed regardless of what air pressure is achieved.
  - Air settle time refers to an approximation of time until the room air has cleared of airborne contaminants to varying degrees of efficiency, refer to appendix B. This measure supports decision making around when it is safe to re-enter the space without using a respirator.
- Facilities and Maintenance Operations (FMO) are responsible for commissioning and maintaining the HVAC system to Canadian standards that reflect the infection control requirements for bioaerosol management. **Clinical areas are encouraged to understand their HVAC system and work with FMO and Infection Control in optimizing bioaerosol containment**.

REFERENCES

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Appendix A:

Air Settle/Clearance Times

The table below was adapted from a 1973 NIOSH article where a mathematical formula was devised for clearance of particles in enclosed spaces. It has been used since then as a guideline for room clearance with no updates. As such, it is a general guideline only particularly as air handling systems have become more sophisticated since the formula on which this table was predicated was developed.

In general, a clearance of between 90% and 95% would be in alignment with the goal of N95s which are designed to filter 95% of aerosolized particles.

Table 1. Air changes per hour and time in minutes required for removal efficiencies of 90%, 99% or 99.9% of airborne contaminants

Air exchanges per hour	90%	99%	99.9%
1	138	276	414
2	69	138	207
3	46	92	138
4	35	69	104
5	28	55	83
6	23	46	69
7	20	39	59
8	17	35	52
9	15	31	46
10	14	28	41
11	13	25	38
12	12	23	35
13	11	21	32
14	10	20	30
15	9	18	28
16	9	17	26
17	8	16	24
18	8	15	23
19	7	15	22
20	7	14	21
25	6	11	17
30	5	9	14
40	3	7	10
45	3	6	9
50	3	6	8

This table is prepared according to the formula t = (in C2/C1)/(Q/V) = 60, which is an adaptation of the formula for the rate of purging airborne contaminants (100-Mutchler 1973) with t1 = 0 and C2/C1 = 1 – (removal efficiency/100). Adapted from CDC Guidelines for preventing the transmission of Mycobacterium tuberculosis in health-care facilities 1994