Novel ventilation strategy for reducing the risk of airborne cross infection in hospital rooms

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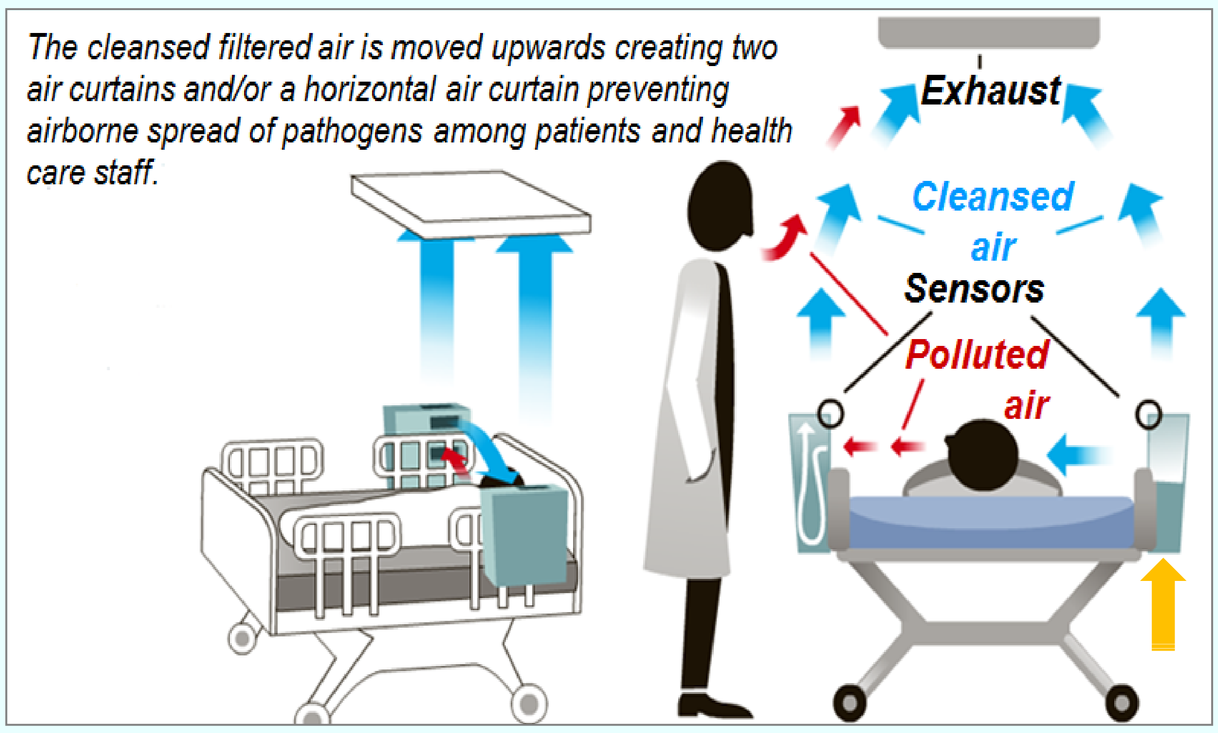
NOVEL BED INTEGRATED VENTILATION

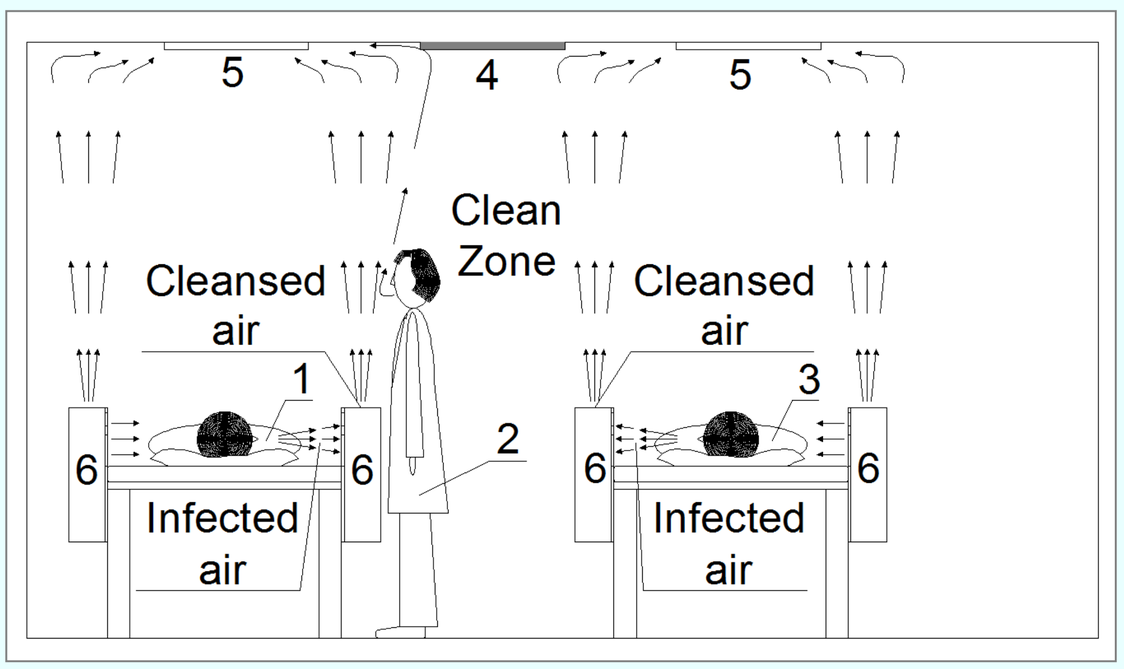
Two devices, named Hospital Bed Integrated Ventilation and Cleansing Units (HBIVCU), are attached to patient's bed. Polluted room air is sucked, cleaned (HEPA & UVGI) and discharged horizontally to guide the polluted exhaled/coughed air (can be infected) from the patient in the bed to be extracted through the second device facing the patient before it is mixed with the room air. The air is cleaned in the device and then is either discharged upwards towards the ceiling exhaust by means of air curtain between the patient and the person standing next to the bed or in the room (the device cleans the room air), or is recirculated through the two units. The "plug and operate" principle can be applied, i.e. patients in beds with HBIVCU can be moved from one room to another together with their personal ventilation units.

The cleansed filtered air is moved upwards creating two air curtains and/or a horizontal air curtain preventing airborne spread of pathogens among patients and health care staff.



METHOD

Tests in air distribution test room: 4.6 x 4.6 x 2.6 m^3

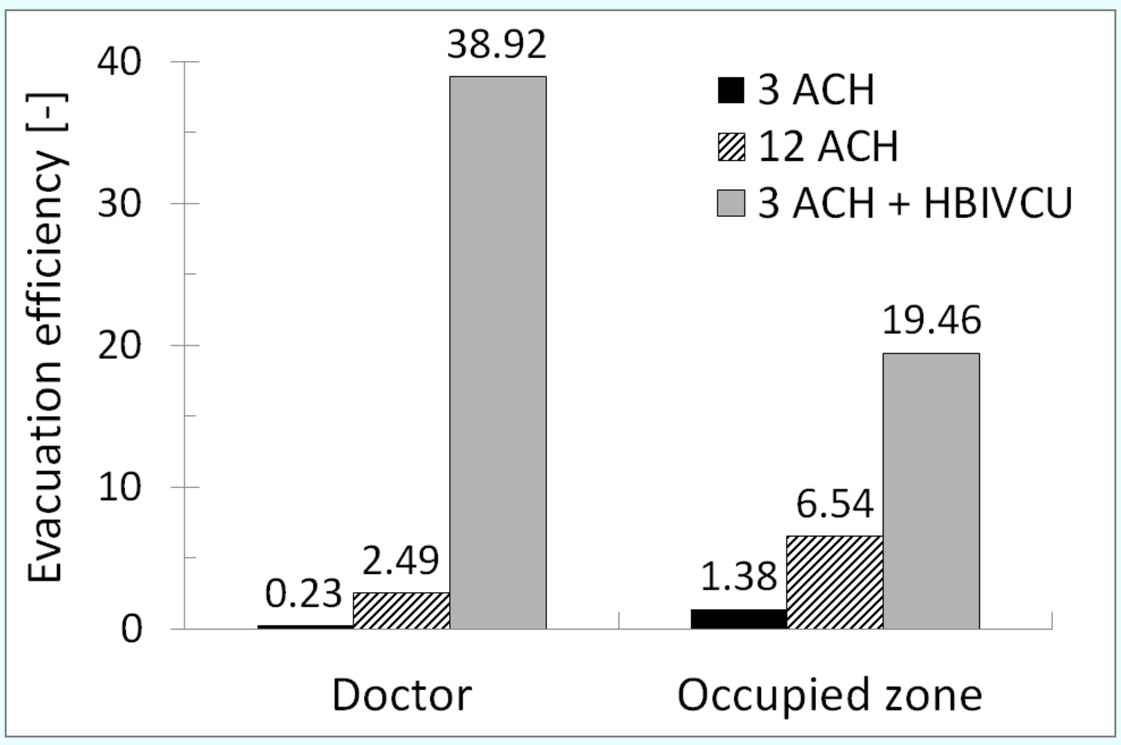


1 – infected patient; 2 – doctor; 3 – second patient; 4 – ceiling air supply; 5 – exhaust; 6 – HBIVCU

t_a = 22 °C; 3, 6 and 12 ACH
Breathing: 2.5 s inhalation, 2.5 s exhalation, 1s break,
Respiration flow: 0.24 l/s, Exhalation: mouth
Exhaled air mixed with tracer gas (refrigerant R 134a)

Evacuation efficiency is defined as tracer gas concentration at exhaust without HBIVCU at 3 ACH devided by tracer gas concentration at measured point with or without the HBIVCU.

RESULTS



Measurements in the air inhaled by the doctor as well as in the occupied zone show dramatic increase of the evacuation efficiency, i.e. decrease of tracer gas concentration when the HBICVU is used compared to the case without the HBIVCU.

Use of HBIVCU combined with mixing ventilation at 3 ACH led to 15 times lower tracer gas concentration in the air inhaled by the doctor in comparison with mixing ventilation alone at 12 ACH.

CONCLUSIONS

- The use of the HBIVCU unit in conjunction with mixing air distribution may lead to substantial lowering of the background ventilation rate (down to 3 h^{-1} from the recommended 12 h^{-1}) and thus to plausible energy saving.
- Mixing ventilation alone is not able to reduce substantially the exposure of medical staff to exhaled air by sick occupant when standing close.