Protection against Cross Infection in Hospital Beds with Integrated Personalized Ventilation

by

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The Prince of Wales Hospital 8A Ward SARS outbreak

Wong et al, EID, 2004
Li et al, Indoor Air, 2005
Yu et al, CID, 2005

Students assigned to examine this patient and did not develop SARS
Students assigned to examine this patient and developed SARS
Personalized Ventilation

It is usual to supply an amount of air which is 1-5 times the volume of the room per hour, but a person only needs about 0.6 m³ per hour. Theoretically it should be possible to supply a much smaller amount when the air is supplied direct to the breathing zone.

PV gives the possibility of having individual control of the thermal comfort. Also it makes it possible to have both cold air in the breathing zone and warm surroundings.

By supplying the air direct to the breathing zone it is ensured that the air has not been contaminated by other persons. This minimizes e.g. cross infection and passive smoking.
The Principle

The personalized ventilation system (LVPV)) utilizes the situations where the head or the body is in natural contact with surfaces as: **beds, pillows, mattresses, clothing, headrests, blankets, etc.**

Chronic obstructive lung illness and sudden infant death syndrome
Effectiveness

The effectiveness of personalized ventilation

If the concentration in the inhalation is $c_{PV}$

$\varepsilon_{PV} = 1.0$

If the concentration in the inhalation is $c_p$

$\varepsilon_{PV} = 0.0$
Pillow around the Head
PV System combined with Vertical Ventilation

SARS room, Hong Kong University

Source patient. Face towards the target patient. Exhalation flow 18 l/s.

Local "Archimedes number"

\[ \sim \frac{(T_{PV} - T_{1.1})}{q_{PV}^2} \text{ (K s}^2\text{/m}^6\text{)} \]
The level of the concentration has been reduced at the target manikins’ breathing zone. The local concentration, $\frac{C_{\text{exp,}PV}{C_{\text{exp,}o}}$, has been **reduced by a factor of 0.6.** This reduction is larger elsewhere in the room.
PV System combined with Vertical Ventilation. One pillow at Source patient and one pillow at target patient

Effectiveness at target patient versus flow rate and supply temperature

Effectiveness at target patient versus "Archimedes number"
PV system Combined with Displacement Ventilation

Very efficient, but displacement ventilation without the PV system can not be recommended for minimizing of airborne cross infection.

Thank you!