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The Secretary
HA Review Panel on SARS Outbreak
Hospital Authority
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Fax: 2199 9644
By Fax and Post

Dear Sir,

Air Conditioning and Air Circulation in Infectious Isolation Wards

During SARS epidemic, it was heart-breaking to see those gallant and selfless doctors, nurses and support staff sacrificed their lives to save others. They represent the greatest value of humanity and love.

But it was frightening to learn, from daily SARS press briefing, of the number of new cases of infected healthcare workers being added continuously to the SARS patients list.

More than 400 health care workers (HCWs) had been infected through cross-contamination, causing alarming questions like what 'holes' in the hospitals were leading to HCWs being continuously infected with SARS.

It has long been suspected that the circulating air, from the ventilation system, was the culprit.

Most common air conditioning airflow found in wards is cold air, from the ceiling, which is returned back to the grille in the ceiling. Up and down drafts can be felt from all directions. If the speed of the air-conditioner is increased to enhance air changes, turbulence is formed; one can even see dust unsettled on the floor. It was these uncontrolled air currents that widely dispersed the droplet nuclei and dust particles containing the infectious agent from patient/s to patients and HCWs in the ward, causing cross-infection.

The following are suggestions to improve the airflow and to minimize nosocomial transmission:-

1. The airflow shall be controlled with flow movement from top to bottom, clean and cold air supplied from the ceiling down to the less clean area of the room where the air will be exhausted at the floor level by flushing all dust and contaminants out through filtration or sterilization.

2. SARS patient is both immunosuppressed and highly contagious. Incoming and discharging air should be germfree.

   All filtration of air conditioning systems shall at least be equipped with high-efficiency particulate air (HEPA) filters at 99.97% efficiency on 0.3 microns particles, or even better with ultralow penetration air (ULPA) filters at 99.999% efficiency on 0.1- 0.12 microns particles. As the size of coronavirus is only 0.06- 0.12 microns, ULPA filters are more efficient to remove this micro virus than HEPA.

3. To carry out the above modifications in existing wards could be difficult, costly, time-consuming and inconvenient to routine operations caused by construction work. Many hospitals have simply added portable air cleaners in their SARS wards, as supplement to their air conditioning system to achieve the desired top-down unidirectional airflow, increase air changes and eliminate swirling dangerous respiratory emissions and dust.

   Some of these so called portable air cleaners can be 2m tall, fitted with ULPA filter, and also with ultraviolet germicidal irradiation (UVGI) lamps. These machines help to obtain optimum air management, to reduce concentration of infectious agents without altering the existing air conditioning system. UVGI, in addition to sterilize the contaminated air, also serves as back up in case the filter has leakage or been damaged. Some machines have features that can convert an ordinary ward into a negative pressure ward with simple ducting work.

   During the second SARS outbreak in Toronto, nearly all SARS clinics and wards were installed with specified ULPA filters plus UVGI portable air cleaners for air infection control. Also, many of these air cleaners were used to convert wards into negative pressure isolation wards, and the exhaust air was also filtered and sterilized by these machines.

4. SARS is a communicable disease. Exhaust fan expelling untreated air to outside, in order to create negative pressure in an infection isolation ward, could cause contamination in other areas of the hospital.

   In mid-May, investigation into the Queen Mary Hospital had found that oxygen treatment on SARS patients could have been the source of cross-contaminations. Each of the three patients received 15 litres of oxygen per minute during the treatment. Every minute 45 litres of used air were pumped out to the corridor without knowing the danger, especially this very infectious respiratory illness. As reported in the newspaper, Prof. Kenneth Tsang Wah-tak, a respiratory and critical-care medicine professor of Hong Kong University, said that like a nebuliser, oxygen masks provided a medium by which infected droplet/s could spread in a room causing serious contamination.

   Therefore, any air, discharged to outside from a SARS ward, must be treated by either ULPA filtration or UVGI, or by both.

We must realize all precautionary measures are passive, can only reduce, not eliminate the risk, if only one SARS patient is constantly producing droplet nuclei, the ward will never be completely clean. Our dedicated HCWs not only deserve our highest respect, but also the very best protection we can provide to minimize any possible risk in their working environment while carrying out their admirable duty.

The SARS incident is over, and let it remain only as a chapter of Hong Kong's history. To learn and share other countries' experience and knowledge in the fight against SARS would definitely prepare Hong Kong to better deal with possible disastrous events in the future.

I hope my suggestions will receive your consideration in planning actions to prevent the repetition of SARS incident or any other epidemic.

With best regards,

Dr. Nancy B.S. Chan