
Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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## Computer keyboards and the spread of MRSA

Madam,

Recent correspondence from Wilson *et al*. regarding computer keyboards and their place in the spread of meticillin-resistant *Staphylococcus aureus* has prompted me to write this letter.[1]

About 1 year ago, my computer keyboard stopped working properly; the contacts inside were obviously dirty. My information technology adviser told me to put it through my dishwasher at home and allow it to dry out before reconnection. I did as suggested, and dried the keyboard out on top of the boiler. Afterwards, the keyboard worked perfectly. Furthermore, as the water had been close to 70 °C for several minutes, most, if not all, of the vegetative bacteria on the keys would have been killed.

Keyboards are made of plastic, rubber and metal contacts. Once they have been disconnected from computers, they are not electrically charged. Consequently, they can then be immersed in hot water and, if allowed to dry out thoroughly, can be used again. Could this not be used as a simple and effective method of disinfection?

The only problem I can see is that the labels on the keys may be washed off with repeated immersion, making it difficult to tell the difference between the letters. However, this problem could be solved easily and keyboards are cheap. When they are worn out, they could simply be replaced. I have not yet tried this on a cordless keyboard.

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## Virus diffusion in isolation rooms

Madam,

We note that Kao and Yang's numerical analysis confirms the generally held opinion that isolation rooms should be negatively pressurized, with a piston ventilation system that promotes horizontal air flow over the patient and away from any healthcare workers (HCWs) present in the room.[1] We also note, with interest, that by off-setting the extract grilles behind the patient, it appears to be possible to concentrate any infectious particles produced to one side of the bed, thus leaving the other side relatively free of contamination. This finding may be of some importance because it would enable a 'safe zone' (or, perhaps more correctly, a safer zone) to be created close to the patient. The creation of such a zone would be a significant advance because it would enable nurses and doctors to attend to the patient's needs in relative safety, provided that they stayed within this area. Perhaps the area of the safe zone could be marked out on the floor?

In order to create a truly safe zone to the side of the patient, it would be necessary to ensure that large respiratory droplets (>50 μm) are removed as well as smaller droplet nuclei (<10 μm). These larger droplets, which may contain infectious virus, tend to fall to the ground within 1–2 m of the patient, whereas the smaller droplets

evaporate rapidly to form nuclei that can remain airborne for many hours.[2] It is unclear from Kao and Yang's work whether or not the movement of these larger droplets was simulated. Being relatively heavy, the effect of room air currents on these larger droplets is much less than that on droplet nuclei, and they tend to be removed from the air by gravitational deposition. They are nonetheless of considerable importance as a number of infections, including severe acute respiratory syndrome, are known to be transmitted by the droplet route. In order to protect HCWs in regions close to the patient, it is necessary to ensure that they are not exposed to these larger respiratory droplets. We would therefore encourage Kao and Yang to consider this issue in their future work.

Notwithstanding our comments above, we believe that computational fluid dynamics is an important tool in analysing the spread of airborne infection. Indeed, our own analysis suggests that the positioning of supply diffusers and extract grilles can have a profound effect on the movement of infectious particles within isolation rooms, and that careful positioning of these can lead to significant improvements.[3]

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### Safe zone in isolation rooms

Madam,

We appreciate the comments of Profs Beggs and Kerr on our work, the main purpose of which was to understand how different airflow patterns affect virus diffusion in isolation rooms.[1] In practice, the risk of virus dispersal is controlled not only by airflow patterns but also by other factors, such as contagious transmissions, changing airflow directions caused by people moving or doors opening, and other hazardous situations including carrying the virus, etc. In our investigation, we simplified the airflow model for the analysis of virus dispersal in isolation rooms by assuming the following to be the normal situation: (1) closed doors; and (2) air flow maintained in a stable state without any movement of people. In our investigation, only coughs producing larger droplets ($\approx 30\,\mu m$) were considered for the requirements of isolation rooms used for non-airborne diseases, e.g. severe acute respiratory syndrome. However, the results provided reasonable physical evidence that the appropriate airflow patterns with suitable operating parameters, e.g. 12 air changes/h, which dominates the average velocity inside the isolation rooms, can create a relative safe zone for staff. The value of 12 air changes per hour is determined by engineering experiments and specified in our national specifications (CDC of Taiwan) for the installation of hospital ventilation systems. In addition, our proposed computational fluid dynamics (CFD) technique is a simple and readily available method for analysing the air within isolation rooms that are subject to coughs producing larger droplets.

Furthermore, in our opinion, CFD still has some difficulty in simulating realistic cases of airborne diseases, such as a cough that produces smaller droplets. Realistic simulations would require complex conditions and physical models, and would be restricted by limitations of numerical models for various situations inside the isolation rooms, e.g. the effect of evaporation for droplets, a long-time computational model for tracing each nucleus (micro-particles), and the problems of mathematical instability for the CFD techniques. The physical mechanism for droplet nuclei drying out during the transition of virus dispersal by airflow patterns inside the isolation rooms is not clear. For coughs producing smaller droplet nuclei, we suggest that alternative approaches are more suitable, i.e. tracer containment testing.[2,3]

As suggested by Profs Beggs and Kerr, in order to mark out the relative safe zone inside an isolation