

this may have led to increased transmission of multidrug-resistant nosocomial pathogens on the gloved hands of health care workers [5]. Another possible explanation for the paradoxical increase in MRSA rates during the SARS outbreak could be the shunting of limited infection-control resources to SARS case surveillance and epidemiology and away from mainstream infection-control activities, thus compromising the effectiveness of baseline control measures against nosocomial infections.

As our data reinforce, during periods of intense alert for novel emerging pathogens, such as SARS coronavirus and avian influenza virus, it is imperative that “conventional” practices of infection control not be overlooked, because they remain essential for the control of infection with endemic nosocomial pathogens in our midst.

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### Outbreak of Methicillin-Resistant *Staphylococcus aureus* Infection Associated with an Outbreak of Severe Acute Respiratory Syndrome

SIR—We read with great interest the recent article by Yap et al. [1]. The authors report a significant increase in the methicillin-resistant *Staphylococcus aureus* (MRSA) acquisition rate, with a very high rate of ventilator-associated pneumonia—caused mainly by MRSA—in patients with severe acute respiratory syndrome (SARS) in an intensive care unit (ICU) that admitted only patients with SARS. Paradoxically, this increase occurred after infection-control measures (including the wearing of gloves and gowns at all times) were upgraded because of the SARS outbreak and despite a low importation rate of MRSA into the ICU.

Yap et al. [1] provide 3 possible explanations for this observation. First, the practice of wearing gloves at all times may have led to poor compliance with hand hygiene, and the routine wearing of long-sleeved gowns, which were not changed between contact with patients, could also have contributed to cross-transmission of MRSA. Second, the heavy use of antimicrobials active against gram-negative organisms could have promoted the overgrowth of MRSA. Third, the SARS-associated coronavirus (SARS-CoV) may predispose patients to secondary infection with *S. aureus*.

We agree with these hypotheses, but we

disagree with the conclusion that “cross-transmission of MRSA may be increased ... if the [infection-control] measures included excessive use of gloves and gowns” [1, p. 515]. An alternative explanation for the significant increase in the rate of MRSA acquisition may be a viral-bacterial interaction between SARS-CoV and *S. aureus*, leading to an explosive airborne dispersal of *S. aureus* and a very efficient transmission of MRSA from colonized to noncolonized patients (the “cloud phenomenon”). This phenomenon was described by Eichenwald et al. [2], who showed that newborn infants who are nasally colonized with *S. aureus* produce significant airborne *S. aureus* dispersal and become highly contagious after infection with a respiratory virus. These babies caused explosive outbreaks of *S. aureus* infection in nurseries. Because they were literally surrounded by clouds of bacteria, they were called “cloud babies” [2]. We have recently shown that the same mechanism also occurs in certain adult nasal *S. aureus* carriers (“cloud adults”) [3–5]. Reports in the literature describe single health care workers nasally colonized with *S. aureus* who originated nosocomial *S. aureus* epidemics while experiencing a viral infection of the upper respiratory tract. This confirms that “cloud adults” can cause outbreaks [3, 6, 7]. Our data also indicate that clothing contaminated with *S. aureus* can amplify the dispersal of these bacteria into the air [4, 5], in agreement with previous observations [8, 9].

In conclusion, aerial dissemination of MRSA because of the “cloud phenomenon” may be the main reason for the described epidemic of MRSA infection. This may have occurred as a result of direct aerial dissemination or as a result of heavy contamination of the environment of colonized patients (including contamination of patient bedclothes or health care worker gowns). This, in combination with difficulties associated with frequently changing gloves and gowns, may have greatly facilitated MRSA cross-infection during the SARS outbreak.

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## Reply to Bassetti et al.

SIR—We appreciate the comments on our article [1] by Bassetti et al. [2]. We agree that the fourth hypothesis, relating to the “cloud” phenomenon [3–5], may contrib-

ute to the spread of methicillin-resistant *Staphylococcus aureus* (MRSA).

However, we do not think that the cloud phenomenon is the main reason for the MRSA epidemic we describe [1]. During the study period, all staff in the intensive care unit (ICU) wore N95 masks. Because masks are effective in reducing the dispersal of MRSA [5], “cloud” health care workers would be an unlikely explanation for the epidemic. For patients who carry *S. aureus* in the nares, it appears that active breathing, sneezing, nose blowing, or snorting to the open air are important in the formation of airborne bacterial “clouds.” We would like to point out that it is unlikely that our patients performed these activities to a significant extent. Unlike in patients with rhinovirus infection, nasal symptoms are rare in patients with severe acute respiratory syndrome. Furthermore, precautions to control aerosol spread in the ICU were extremely strict during the period of the SARS outbreak. The majority of patients received mechanical ventilation. All circuit connection and disconnection procedures were performed with extreme caution, and all suctioning was conducted in closed-suction systems. A high-efficiency bacterial/viral filter was incorporated into each breathing circuit, and the exhalation port of the ventilator was connected to scavenging systems. Surgical masks were worn by spontaneously breathing patients with nasal cannula or oxygen masks. For patients requiring high-flow oxygen, tight-fitting masks with filters were used. Use of Venturi-type masks, nebulization, and non-invasive positive-pressure ventilation were all avoided. Therefore, “explosive” dispersal of droplets or aerosols would have been unlikely.

During the outbreak of SARS, there was a hospital (Queen Mary Hospital; Pokfulam, Hong Kong) that explicitly banned “gloving all the time” and instead promoted glove use “only when indicated” and meticulous hand washing. This hospital managed a total of 52 cases of SARS, which is a substantially lower number of

cases than were treated at our institution (Prince of Wales Hospital, Hong Kong). There was no change in the rate of MRSA acquisition in the ICU or in the hospital in general (W. H. Seto, personal communication).

In a health care environment, patient contact is the main mode of transmission for MRSA. During the period we reported, gloves were worn at all times by health care workers, and hands were not necessarily always washed between the changing of gloves [1]. These practices—together with the excessive use of antibiotics, including fluoroquinolones—may be the main driving factors underlying the outbreak of MRSA infection. After removal of gloves, hands are commonly contaminated with nosocomial pathogens such as MRSA, with contamination rates of up to 50% [6]. Occult breaks in latex gloves can cause substantial contamination of the hands [7], and it has been reported that 20% of latex gloves that had passed the watertight test allowed penetration of bacteria to the hands [8].

The “cloud” phenomenon is an interesting subject, and its relevance in the nosocomial transmission of pathogens deserves further evaluation. Health care workers should understand that wearing of gloves is not a substitute for hand washing.

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