

# Do Face Masks Increase the Rate of Staphylococcus Aureus Infection as Secondary Infection during Covid-19?

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## Abstract

Nowadays due to the coronavirus disease 2019 (COVID-19) and to save our lives, we have to use masks in a wider range. Since masks are now considered a protective device to prevent some bacterial or viral diseases, especially COVID-19, and the advice is that we should use them to save our lives and the lives of others. It is true that masks have many benefits, but maybe they are also harmful. It seems that is possible in long-term masking, itself cause side effects or even other diseases. Therefore, since masks are now more widely used, its advantages and even disadvantages are important to us. We think, maybe there are harms that may cause other bacterial diseases as secondary bacterial infection that may be confused with COVID-19 because they may have similar symptoms or may increase the severity of it. In this article, we review Staphylococcus Aureus that may be exacerbate or cause infectious diseases and increase the risk of infection. We may be able to prevent them with some recommendations.

**Keywords:** staphylococcus aureus; face mask; Covid-19; infectious diseases; SARS; MERS; ARDS; WHO; FFR, symptoms; pneumonia

## Introduction

### Coronavirus and secondary bacterial infections

In December 2019, a group of acute respiratory disease, nowadays known as novel coronavirus-infected pneumonia (NCIP), occurred in Wuhan, China [1]. The disease has quickly spread from Wuhan to different regions and got pandemic.

Three bronchoalveolar-lavage samples were collected from Wuhan Jinyintan Hospital on 30 December 2019. The novel coronavirus was identified when, Genome sequences were checked and have 86.9% nucleotide sequence of bat SARS-like CoV that also shows the typical betacoronavirus organization and was confirmed as the cause of the NCIP [2].

Analysis had shown that 2019-nCoV is a distinct from betacoronaviruses associated with human severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). The 2019-nCoV is very similar to bat coronaviruses, and it has been presumed that bats are the primary source [2]. While the origin of the 2019-nCoV is still unknown, recent evidence proposes spread to humans happened via transmission from wild animals illegally sold in the Huanan Seafood Wholesale Market. Case reports proofed human-to-human transmission of NCIP [3].

First clinical symptoms included decreased leukocyte counts, dyspnea, fatigue, fever, myalgia, nonproductive cough, normal and pneumonia. Organ dysfunction i.e., acute cardiac injury, and acute kidney injury,

acute respiratory distress syndrome [ARDS], shock and death can happen in severe cases [4]. In addition, the difference in clinical characteristics between severe and non-severe cases has not been reported yet.

Globally, as of 4 June 2021 approximately 171,782,908 confirmed cases of coronavirus disease 2019 (COVID-19) caused by the 2019 novel coronavirus (SARS-CoV-2) including an estimated 3,698,621 deaths have been reported to world Health Organization (WHO).

The focus is needed on prevention and treatment of this viral infection.

Since coronavirus disease 2019 (COVID-19), using of face masks has become ubiquitous [5]. Using face masks by healthy population in the community to minimize risk of spread of respiratory viruses stays disputable. The effect of community-wide mask usage in order to control COVID-19 has been evaluated. Community-wide mask wearing may contribute to the control of COVID-19 by minimizing the amount of emission of infected saliva and respiratory droplets from persons with subclinical or COVID-19 [6].

Using masks is part of a comprehensive package of the prevention and control measures that can limit the spread of COVID-19. Masks can be used either for protection of healthy persons, worn to protect oneself when in contact with an infected individual or for source control, worn by an infected individual to prevent onward transmission [7]. Face mask is critical for protecting health care workers in hospitals and clinics and reduces the spread of the COVID-19.

Pulmonary diseases of viral origin are often followed by the manifestation of secondary infections, may leading to more clinical complications and negative disease results [8]. Then, investigation of secondary infections is important. Data was provided for COVID-19 patients, a mortality rate is higher due to secondary bacterial infections [9]. Quinolones, cephalosporins and macrolides are commonly prescribed, but also the glycopeptide vancomycin [10]. Several bacterial pathogens appear to be common causes of secondary infections, including antibiotic-resistant strains of *Staphylococcus aureus* and *Klebsiella pneumoniae* [8].

### Staphylococcus aureus

*Staphylococcus aureus* is an aerobic that can also, can live in anaerobic conditions and is Gram-positive coccus. *S. aureus* is found in the environment, also in normal human flora, located on the skin and mucous membranes (most often the nasal area) of most healthy individuals. *S. aureus* does not normally cause infection on healthy skin; however, if it enters the bloodstream or internal tissues, these bacteria may cause a variety of serious infections [11]. One of major risk factors for *Staphylococcus aureus* infection is nasal carriage around 25% of adults carry this bacterium [12]. The percentages are higher for people who are patients in a hospital or who work there. *Staphylococcus aureus* is a leading cause of life-threatening infections [13]. Paradoxically, it also asymptotically colonizes approximately 20%–30% of healthy adults. Nasal carriage of *S. aureus* has been shown to be a major risk factor for ensuing *S. aureus* infection [14].

Local skin humidity and temperature are highly conducive to the growth of *S. aureus* [15]. Increases in humidity as well as temperature have been both associated with significantly higher culturable bacteria in indoor air [16].

Different individual factors, including loss of the normal skin barrier, existence of some illnesses such as acquired immunodeficiency syndrome, defects in neutrophils function and diabetes put at risk of infection [17,18]. The primary way of transmission of *S. aureus* is by direct contact, commonly skin-to-skin contact with infected persons or those who have it, also by contacting with contaminated surfaces and stuffs could play a role. Antibiotic-resistant strains of *S. aureus* leads to infection that have become global epidemic. Staphylococcal disease, especially that caused by methicillin resistant *S. aureus* strains (MRSA), is increasing. *S. aureus* is a remarkable compatible pathogen with a proofed ability to provide and develop resistance. Of particular concern is beta-lactam antibiotics diminishing impacts. Resistance is often seen as consequence of gene transmission that is prevalent in hospitals and healthcare institutions. Although the discovery and development of new antimicrobials is essential, the problem of drug resistance seems unlikely to be solved for a long time [19]. To prevent the emergence of the post-antibiotic era, new technologies are needed that lead to faster and faster diagnosis, better understanding of the pathogenicity of *S. aureus* and non-antimicrobial approaches to prevention and treatment of infection [20].

As we mentioned earlier one the most common bacterial infections in humans, is *S. aureus* which may cause human infections including: bacteremia, infective endocarditis, skin and soft tissue infections e.g., impetigo, folliculitis, furuncles, carbuncles, cellulitis, scalded skin syndrome, and others, osteomyelitis, septic arthritis, prosthetic device infections, pulmonary infections e.g., pneumonia and empyema, gastroenteritis, meningitis, toxic shock syndrome, and urinary tract infections [11].

### Is it a problem as a secondary infection in covid-19 patients?

In COVID-19 patients, *Staphylococcus aureus* is one of the common bacteria isolated during secondary infections [21]. During active viral infections, the course of the infection, proximity of infection and

virulence factors vary between bacterial strains, resulting in different outcomes.

Effective treatment of viral and secondary bacterial infection(s) is a vital importance. Deployed antiviral therapies do not initially treat secondary bacterial infections [22].

The preferred treatment for bacterial infections is normally broad-spectrum antibiotics, but this can lead to adversely affect the natural microflora of the host [23]. To reduce severe disease progression or fatal outcomes, alternative methods are needed to alleviate the effects of secondary bacterial infections and eliminate bacterial pathogens while maintaining host immunity.

### Face mask

Masks have been used more than 100 years to minimize some bacterial or viral infections [24,25]. Also, it has been showed that dual respiratory virus or bacterial-viral infections can be reduced by the use of N95 respirators [26]. In addition, masks can consider respiratory protection devices. Because they filter out fine airborne particles from reaching the respiratory system and prevent interpersonal infection, the protective effect of face mask is important [27].

After exposure to masks for hours, hot and humid environment in the facial region that covered by masks, makes discomfort such as change in physiological function of nasal cavity and hyperthermia [28]. The high temperature also, high moisture content of the exhaled breath can make moisture to condense in filtering face piece respirators (FFR) due to difference of temperature between ambient air and that in the FFR dead space. The amount of moisture retained within FFR is impacted by the breathing volume, ambient temperature and humidity. It is possible that more water retention and added impact on breathing resistances could occur with use over an 8-h period. The amount of water vapor present in saturated air depends on the air temperature [29]. Some data suggest that exhaled breath temperatures may be 1–2°C higher in healthy adults. Each 1°C rise in temperature increases water vapor pressure 6–7.5% so that the absolute increase in expelled moisture (and resultant retained moisture in the FFR) at the higher temperature would be increased proportionally [30]. One study indicated that fitting a surgical mask or respirator during 1 h of continuous wearing led to an increase in facial skin temperature under the face mask, while removing the face mask tended to rapidly decrease it after 1 min, returning to the baseline after 5 min [31]. Wearing a face mask may increase the oral temperature in healthy persons [32]. A high increase of humidity and temperature at the end of inspiration was found in the prior nasal part [33].

Wearing masks for a long time causes a lot of physiological and psychological loads and can reduce work efficiency. The activity cannot be performed as much or as efficiently while wearing the mask as when the masks are not worn. In addition, when you can continue an activity, it decreases when using the mask. Prolonged use of N95 and surgical masks can cause physical side effects such as acne, difficulty breathing, headaches, impaired cognition, rashes, and skin breakdown. It also interferes with vision, communication, and thermal balance [34].

Also pain behind the ear and on nose which are possibly due to the tightfitting masks. Some people experience shortness of breath or trouble breathing on exertion when using mask, possibly due to the tight mask that causes hypercapnic hypoxic atmosphere and leads to number of physiological changes, including cardio-respiratory stress and metabolic changes. Other symptoms such as dry mouth, halitosis, and sore throat are most likely due to insufficient water intake during long-term usage of facemask [35]. Also, small proportion of people have been observed with symptoms of odor change, sense of nasal stuffiness, nasal obstruction, cracking sensation, nasal scab [35].

## Recommendation

Survey respondents have recommended to prevent headaches and impaired cognition, it is recommended to take short and continuous breaks, neck massage, increased hydration, alternate surgical masks and N95 masks (if possible) because Continuous use of N95s resulted in significantly lower rates of bacterial colonization [36] and have more protective advantages [37], wearing an N95 mask with a filter for better ventilation, and wearing a mask that fits person's face.

To prevent skin breakdown, it is recommended to use an ear protection, so that earplugs are placed on those protective items instead of behind the ears. Also recommended to use a clean and fresh mask for each shift to remove broken skin. As a precaution such as using moisturizers, emollients, and barrier creams to prevent skin damage. It should be noted that dressings, moisturizers, and lotions do not interact with mask seal, thus causing decreased protection against COVID-19 particles. At the end, to prevent acne, avoiding facial makeup, moisturizing skin, and using facial cleanser wipes to cleanse the skin and Wash your face in the morning and at the end of the day with a gentle, fragrance and non-medicated cleanser [38]. Also recommended to improved mask design with a focus on safety, comfort, and tolerability [34].

We suggest everyone that uses face mask for long period of time, should remove it periodically for regulating temperature and humidity and preventing *S. aureus* infection. And at the end our other suggestion is to design safe and comfortable mask without side effects that can cause other infections or design mask with special substances like dehumidifiers or cooling the air that is inside of mask.

## Conclusion

We have to use mask because it has lots of benefits more than harms. The use of face mask may play a major role in causing significant discomfort to most of persons during long-term use, which can limit the effective use of face mask and reduce protection. On the other hand, face masks are essential to protect us from COVID-19 and some certain strategies can be followed to reduce risks of using mask. Based on abovementioned points, we think that using face masks may increase the rate of *S. aureus* infection. As one of the symptoms of *S. aureus* is pneumonia, could be considered as corona not *S. aureus* that has to be checked.

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