CORE
Metadata, citation and similar papers at core.ac.uk
Provided by kashan university of medical sciences

Le Infezioni in Medicina, n. 2, 185-191, 2020

Protection and disinfection policies against SARS-CoV-2 (COVID-19)

Hadis Fathizadeh[1], Parham Maroufi[2,3], Mansooreh Momen-Heravi[4], Sounkalo Dao[5], Şükran Köse[6], Khudaverdi Ganbarov[7], Pasquale Pagliano[8], Silvano Espsoito[8], Hossein Samadi Kafil[9]

[1]Department of Microbiology and immunology, Kashan University of Medical Sciences, Kashan, I.R. Iran;
[2]Department of Orthopedy, School of Medicine, Tabriz University of Medical Scienences, Tabriz, Iran;
[3]Biotechnology Research Center, Tabriz University of Medical Sciences, Tabriz, Iran;
[4]Infectious Disease Research center, Kashan University of Medical Sciences, Kashan, Iran;
[5]Faculté de Médecine, de Pharmacie et d'Odonto-Stomatologie (FMPOS), University of Bamako, Bamako, Mali;
[6]Department of Infectious Diseases and Clinical Microbiology, University of Health Sciences, Tepecik Training and Research Hospital, İzmir, Turkey;
[7]Department of Microbiology, Baku State University, Baku, Republic of Azerbaijan;
[8]Department of Medicine, University of Salerno, Italy;
[9]Drug Applied Research Center, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran.

SUMMARY

In late December 2019, reports from China of the incidence of pneumonia with unknown etiology were sent to the World Health Organization (WHO). Shortly afterwards, the cause of this disease was identified as the novel beta-coronavirus, SARS-CoV-2, and its genetic sequence was published on January 12, 2020. Human-to-human transmission via respiratory droplets and contact with aerosol infected surfaces are the major ways of transmitting this virus. Here we attempted to collect information on virus stability in the air and on surfaces and ways of preventing of SARS-CoV-2 spreading.

Keywords: SARS-CoV-2, Covid-19, prevention, disinfection, transmission, droplet.

INTRODUCTION

Coronavirus includes of a large family of viruses that are common to both humans and animals (cattle, camels, cats and bats). Sometimes animal coronaviruses can infect humans, such as SARS-CoV, MERS-CoV, and now SARS-CoV-2. Acute respiratory tract infection due to SARS-CoV-2 is currently spreading rapidly worldwide and has become a public health concern. This infection is now officially called the novel coronavirus disease (COVID-19) [1, 2]. COVID-19 is characterized by high fever, difficul breathing, dry cough and atypical pneumonia and is usually confirmed by positive RNA test or computed tomography (CT) of lung [3]. COVID-19 is spreading rapidly in the world and on 11 March 2020, WHO announced the outbreak a global pandemic [4, 5]. There are currently few studies on the pathogenic properties of SARS-CoV-2 and its spreading mechanism, and the present knowledge is largely based on the characteristics of similar coronaviruses. The genomic similarities of SARS-CoV-2 to SARS-CoV, which is known to cause a major outbreak of Severe Acute Respiratory Syndrome (SARS) with 8098 cases, 774 deaths and a final mortality rate of 9% in 2002-2003, can explain the structural and pathogenic features of the SARS-CoV-2 [6, 7]. The strategy of isolating cases and contacts in the fight against SARS-COV-2 has been implemented from the beginning, but it has had a different effect on different countries. After the first major outbreak in Wuhan, China in Jan-

Corresponding author
Hossein Samadi Kafil
E-mail: kafilhs@tbzmed.ac.ir

uary, South Korea, Iran and Italy in late February and early March 2020 became involved in this epidemic [8]. Many countries are currently combating COVID-19 and trying to prevent its further spread and to reduce morbidity and mortality rates, and thereby to diminish the overall stress and tention in their health-care system [9]. Since there is no definitive cure and specific vaccine for SARS-CoV-2, all measures to supplying public health rely on preventing the spread of the virus by droplets and close contact and contaminated surfaces [1]. The person-to-person transmission and spreading from dry surfaces contaminated with nose, mouth and eyes secretions of infected person has been proven about SARS-CoV-2 [10, 11]. Given the severity of this major outbreak and the importance of prevention and protectection against the spread of SARS-CoV-2, we summarize and review the latest findings by scientists about the SARS-CoV-2 persistence outside the body and strategies to prevent further its spread.

PERSISTENCE SARS-COV-2 IN AIR

The transmission of pathogens through aerosols have been proven in closed spaces. There are several respiratory diseases that spread through airborne route, such as tuberculosis [12]. Based on the results of a retrospective cohort study after the 2003 SARS epidemic, airborne transmission could play a significant role in the spread of disease [13]. SARS-CoV-2 can be released when coughing, talking and sneezing of infected person. Droplets containing the virus can infect others if they do not follow the safe distance [14]. Moriyama et al. have stated that low humidity and temperatures increase the viability of SARS-CoV-2 in the droplets, and since the receptor of this virus, angiotensin converting enzyme II (ACE2), appears in a small number of type II alveolar cells, SARS-CoV-2 defects ciliary clearance and defense innate immunity for greater access to deep lung tissue [15, 16]. According to a recent study published in the The New England Journal of Medicine, SARS-CoV-2 can persist for 3 hours in aerosols [17]. Given this finding, safety considerations in the infected sectors and ICU where infected patients are under surveillance are important to prevent the spread of contamination by aerosols. One of these is to prevent high traffic in the infected sections and to inhibition the virus spreading through the airflow. Careful regulation and inspection of air conditioning systems is very important, as air conditioning in polluted areas must be done under negative pressure (Figure 1). A negative pressure room uses lower air pressure to allow outside air into the segregated environment. This traps and keeps potentially harmful particles within the negative pressure room by inhibition of internal air from leaving the space [18]. A study in Chi-

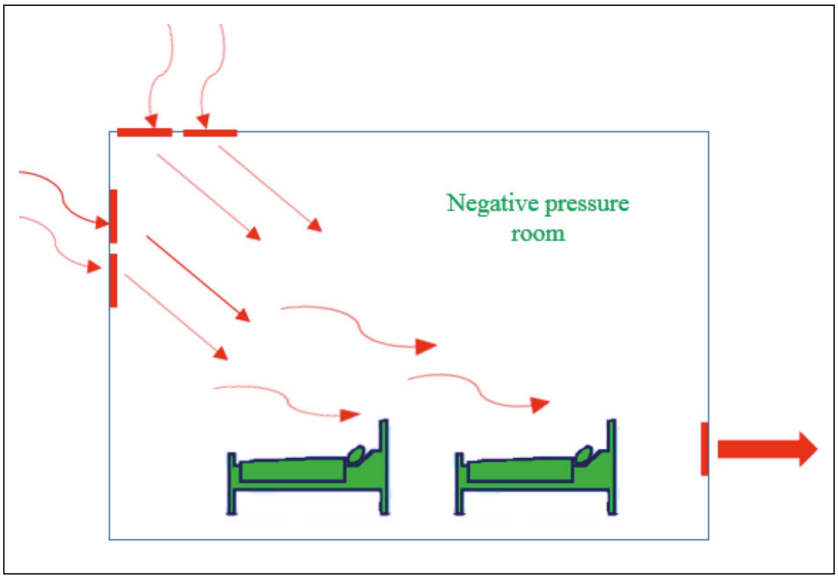

Figure 1 - Airflow movement in infected Room.

na showed that negative pressure ventilation and high air exchange levels within CCU, ICU and ward room of Renmin Hospital were effective in reducing SARS-CoV-2 airborne [14]. To reduce the risk of airborne contamination, early detection of asymptomatic carriers for treatment or quarantine, avoiding crowded communities, use of face masks in places where pollution is high, such as in hospitals and also when using public transportation equipment is recommended [14].

SARS-COV-2 ON THE SURFACES

SARS-CoV-2 spreads mostly through respiratory droplets and then through contaminated surfaces. Recent studies have shown that SARS-CoV-2 can persist on a variety of surfaces from hours to days (Figure 2) [17, 19]. Kampf and his colleagues stated that human coronaviruses can persist for up to 9 days at room temperature. This time can be up to 28 days for veterinary coronviruses, and the interesting thing is that with increasing the temperature to 30 degrees or more, coronavirus persistence was shorter [19]. This indicates that the person may get the virus and become infected after touching the infected objects. Although the load of SARS-CoV-2 on inanimate surfaces at the time of its outbreak is unclear, it does appear that can reduce the load of viruses on the surfaces by disinfectants, especially the surfaces touched by the patient and the space around the patient where have the highest viral load. WHO recommends to ensure that disinfection and environmental cleaning procedures are performed correctly and consistently. Environmental surfaces must be thoroughly cleaned with water and disinfectant. Using hospital disinfectants such as sodium hypochlorite can be an effective method [20]. Disinfection and cleaning of frequently touched surfaces such as doors, toilets, desks, switches and sinks should be carried out with household disinfectants. Different types of biocidal agents such as alcohols, hydrogen peroxide, benzalkonium or sodium hypochlorite chloride are applied worldwide for disinfection [19]. It has been proven that disinfectants with 62-71% ethanol or 0.1% sodium hypochlorite can reduce coronavirus contamination on surfaces within one minute of exposure [19]. Cleaning should be done after disinfection for contaminated surfaces. Examples

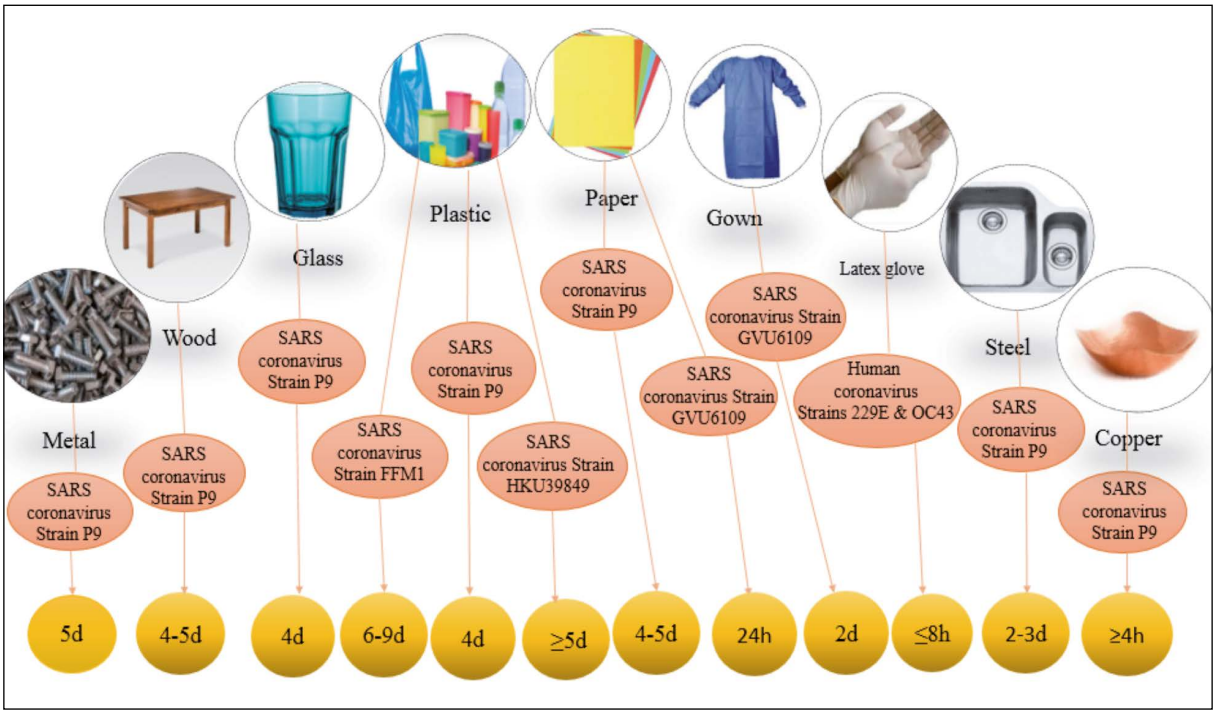

Figure 2 - Persistence of SARS-COV-2 on surfaces [19].

Table 1 - Inactivation of SARS coronavirus Strain FFM1 by different types of biocidal agents.

Virus	*Biocidal agent*	*Reduction of viral infectivity (log_{10})*	*Exposure time*	*Ref*
SARS coronavirus Strain FFM1	Ethanol 95%	≥ 5.5	30s	[21]
	Ethanol 78%	≥ 5.0	30s	[21]
	2-Propanol 75%	≥ 4.0	30s	[22]
	2-Propanol 70%	≥ 3.3	30s	[23]
	Formaldehyde 1%	>3.0	2min	[23]
	Glutardialdehyde 0.5%	>3.0	2min	[23]
	Povidone iodine 0.23%	≥4.4	15s	[24]

of disinfectants and necessary duration for their effect on SARScoronavirus are shown in Table 1.

PREVENTION OF SPREADING SARS-COV-2

Lifestyle (quality sleep, eating healthy and exercise) and health observance play a major role in controlling and preventing the virus spreading (Figure3) [25, 26]. According to CDC recommendations, the main strategies for preventing the spread of the virus include:

- Avoiding contact with symptomatic persons.
- Covering sneeze or cough with a tissue and discarding the contaminated tissue in a contained trash.
- Avoiding travel to high risk areas.
- Wash hands with soap and water for at least 20 seconds.
- If soap was unavailable, use a disinfectant that contains at least 60% alcohol.
- Avoiding hand contact with facial components
- Cleaning and disinfecting repeatedly touched surfaces [27].

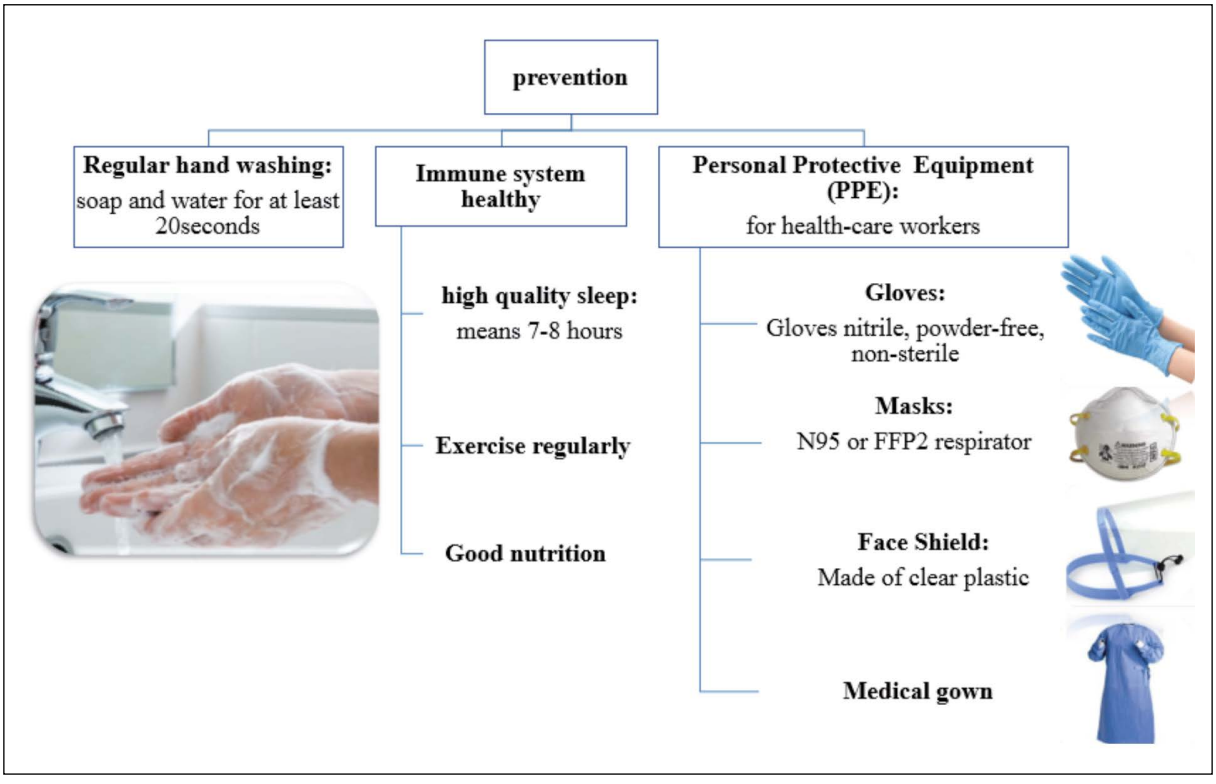

Figure 3 - Preventive and protective measures against COVID-19

PERFORMANCE OF FACE MASKS AGAINST SARS-COV-2

The size of the coronavirus-shaped spherical particles is estimated to be about 0.125 microns (125 nm) using an electron microscope. The smallest of them are 0.06 microns and the largest are 0.14 microns [3]. The most common masks used by health care workers and the general public include:

Surgical mask:
Surgical masks are generally created to protect vulnerable patients from doctors and health care professionals can protect the wearer against large droplets and sprays [28]. Although these masks have been widely used by the public, there is no evidence that these masks are protective against SARS-CoV-2, but may slightly reduce the spread of the virus from the infected patient [29].

N95 respirator
An N95 mask is a type of respirator which filter out at least 95% of very small particles (0.3 micron). N95 masks should be used in health care center where health-care workers are in straight contact with patient [30]. Although experience has shown that these masks are used continuously or intermittently for 8 hours, they are usually used at health centers by health concerns (such as loss of performance due to contamination) or practical considerations (e.g., the need to Resting or using the toilet) is indicated [31].

FFP2 respirator
A filtering face piece 2 (FFP2) respirator out at least 94% of very small particles (0.3 micron). FFP2 or N95 are the gold standard to protection against very small particles [32, 33]. Figure 4 shows the types of masks based on the filter capacity, the ability to capture particles with a diameter of 0.3 microns or larger.

IS THE MASK NECESSARY FOR EVERYONE OR NOT?

Despite the consensus that there is a need to use masks in symptomatic patients and staff in med-

Figure 4 - Types of face masks (removing power of 0.3 micron particle)

ical centers, disagreements have been observed for the general population [34]. According to health recommendations in Germany and the UK, evidence supporting the effective protective effect of face masks for members in the community is extremely rare. However, the use of the mask as a precautionary measure when caring for patients with respiratory infections is on the agenda of health-care workers [35]. It is wise for vulnerable people to avoid crowded areas and use surgical masks when exposing in high risk regions [36]. Currently, WHO recommend using the mask only to people with respiratory symptoms and to healthy people who are caring for someone with respiratory symptoms [37]. However, given the recent findings by scientists that the virus survives in the air for 3 hours [17], it is necessary to discuss the need to use the face masks for people in the community in addition to the medical staff.

CONCLUSION

COVID-19 is now a global health threat and the number of confirmed reports of new cases and deaths is increasing every day. Since the SARS-CoV-2 can remain in the air and on surfaces for several hours to several days, in addition to observing individual hygiene tips such as regular hand washing and avoiding contact, use of negative pressure ventilation in hospital sectors, open space, the face mask wearing in the crowded areas, disinfection of frequently touched surfaces is required to reduce SARS-CoV-2 spreading through of aerosol. however, it is clear that hand hygiene compliance and isolation or quarantine alone cannot prevent the spread of SARS-CoV-2. Therefore, further research needs to be done to increase knowledge about the structural and pathogenic features of SARS-CoV-2 and to find effective therapies and vaccines to control this disease.

Conflict of Interest
None to declare

Acknowledgment
This study was supported by Tabriz University of Medical Sciences with grant number 65174. We thank all staff of hospitals for all they did during Covid-19 pandemic and in memorial of all our colleagues lost their life during this pandemic.

REFERENCES

[1] Whitworth J. COVID-19: a fast evolving pandemic. *Trans R Soc Trop Med Hyg*. 2020.
[2] Liu C, Zhou Q, Li Y, et al. Research and Development on Therapeutic Agents and Vaccines for COVID-19 and Related Human Coronavirus Diseases. *ACS Cent Sci.* 2020. In press.
[3] Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. *New Eng J Med*. 2020. In press.
[4] Bialvaei AZ, Kafil HS, Asgharzadeh M, Aghazadeh M, Yousefi M. CTX-M extended-spectrum beta-lactamase-producing Klebsiella spp, Salmonella spp, Shigella spp and Escherichia coli isolates in Iranian hospitals. *Braz J Microbiol*. 2016; 47, 706-11.
[5] Yuen K-S, Ye ZW, Fung S-Y, Chan C-P, Jin D-Y. SARS-CoV-2 and COVID-19: The most important research questions. *Cell Biosci*. 2020; 10, 40.
[6] Kuiken T, Fouchier RA, Schutten M, et al. Newly discovered coronavirus as the primary cause of severe acute respiratory syndrome. *Lancet*. 2003; 362, 263-70.
[7] Guan Y, Zheng BJ, He YQ, et al. Isolation and characterization of viruses related to the SARS coronavirus from animals in southern China. *Science*. 2003; 302, 276-8.
[8] Niud Y, Xu F. Deciphering the power of isolation in controlling COVID-19 outbreaks. *Lancet Glob Health*. 2020; 8:e452-e3.
[9] Flahault A. COVID-19 cacophony: is there any orchestra conductor? *Lancet*. 2020. In press.
[10] Chan JF, Yuan S, Kok KH, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet*. 2020; 395, 514-23.
[11] Otter JA, Donskey C, Yezli S, Douthwaite S, Goldenberg SD, Weber DJ. Transmission of SARS and MERS coronaviruses and influenza virus in healthcare settings: the possible role of dry surface contamination. *J Hosp Infect*. 2016; 92, 35-50.
[12] Escombe AR, Oeser C, Gilman RH, et al. The detection of airborne transmission of tuberculosis from HIV-infected patients, using an in vivo air sampling model. *Clin Infect Dis.* 2007; 44, 1349-57.
[13] Yu IT, Qiu H, Tse LA, Wong TW. Severe acute respiratory syndrome beyond Amoy Gardens: completing the incomplete legacy. *Clin Infect Dis.* 2014; 58, 683-6.
[14] Liu Y, Ning Z, Chen Y, et al. Aerodynamic Characteristics and RNA Concentration of SARS-CoV-2 Aerosol in Wuhan Hospitals during COVID-19 Outbreak. *bioRxiv.* 2020. In press.
[15] Moriyama M, Hugentobler WJ, Iwasaki A. Seasonality of respiratory viral infections. Annu Rev Virol. 2020. Mar 20 [Online ahead of print].
[16] Zhao Y, Zhao Z, Wang Y, Zhou Y, Ma Y, Zuo W. Single-cell RNA expression profiling of ACE2, the putative receptor of Wuhan 2019-nCov. *BioRxiv*. 2020. In press.

[17] van Doremalen N, Bushmaker T, Morris DH, et al. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *New Eng J Med.* 2020. Mar 17[Online ahead of print].
[18] Khalil EE. Air-conditioning systems' developments in hospitals: comfort, air quality, and energy utilization. Proceedings Clima Med. 2005, 85.
[19] Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and its inactivation with biocidal agents. *J Hospit Infect*. 2020. In press.
[20] Asgharzadeh M, Mazloumi A, Kafil HS, Ghazanchaei A. Mannose-binding lectin gene and promoter polymorphism in visceral leishmaniasis caused by Leishmania infantum. *Pak J Biol Sci.* 2007; 10, 1850-4.
[21] Rabenau H, Kampf G, Cinatl J, Doerr H. Efficacy of various disinfectants against SARS coronavirus. *J Hosp Infect.* 2005; 61, 107-11.
[22] Siddharta A, Pfaender S, Vielle NJ , et al. Virucidal Activity of World Health Organization–Recommended Formulations against enveloped viruses, including Zika, Ebola, and Emerging Coronaviruses. *J Infect Dis*. 2017; 215, 902-6.
[23] Rabenau H, Cinatl J, Morgenstern B, Bauer G, Preiser W, Doerr H. Stability and inactivation of SARS coronavirus. *Med Microbiol Immunol*. 2005; 194, 1-6.
[24] Eggers M, Koburger-Janssen T, Eickmann M, Zorn J. In vitro bactericidal and virucidal efficacy of Povidone-Iodine gargle/mouthwash against respiratory and oral tract pathogens. *Infect Dis Therapy*. 2018; 7, 249-59.
[25] Besedovsky L, Lange T, Haack M. The Sleep-Immune crosstalk in health and disease. *Physiol Rev*. 2019; 99, 1325-80.
[26] Warren-Gash C, Fragaszy E, Hayward AC. Hand hygiene to reduce community transmission of influenza and acute respiratory tract infection: a systematic review. *Influenza Other Respir Virus*. 2013; 7, 738-49.
[27] Bialvaei AZ, Kafil HS, Asgharzadeh M. Role of treatment cost on transmission of multidrug-resistant tuberculosis into Iran. *Clin Infect Dis.* 2015; 61, 1029-30.
[28] Sandaradura I, Goeman E, Pontivivo G, et al. A close shave? Performance of P2/N95 respirators in health care workers with facial hair: results of the BEARDS (Adequate Respiratory DefenceS) study. *J Hosp Infect*. 2020. In press.
[29] Xiao Y, Torok ME. Taking the right measures to control COVID-19. *Lancet Infect Dis*. 2020; Mar 5 [Online ahead of print].
[30] Sadreddini S, Safaralizadeh R, Baradaran B, et al. Chitosan nanoparticles as a dual drug/siRNA delivery system for treatment of colorectal cancer. *Immunol Lett*. 2017; 181, 79-86.
[31] CDC, Recommended Guidance for Extended Use and Limited Reuse of N95 Filtering Facepiece Respirat Healthcare Sett. 2020. In press.
[32] Loeb M, Dafoe N, Mahony J, et al. Surgical mask vs N95 respirator for preventing influenza among health care workers: a randomized trial. *J Am Med Assoc*. 2009; 302, 1865-71.
[33] Radonovich LJ, Simberkoff MS, Bessesen MT, et al. N95 respirators vs medical masks for preventing influenza among health care personnel: a randomized clinical trial. *J Am Med Assoc.* 2019; 322, 824-33.
[34] Feng S, Shen C, Xia N, Song W, Fan M, Cowling BJ. Rational use of face masks in the COVID-19 pandemic. *The Lancet Resp Med*. 2020; Mar 20 [Online ahead of print].
[35] Gholizadeh P, Aghazadeh M, Asgharzadeh M, Kafil HS. Suppressing the CRISPR/Cas adaptive immune system in bacterial infections. *Eur J Clin Microbiol Infect Dis.* 2017; 11, 017-3036.
[36] Adams JG, Walls RM. Supporting the Health Care Workforce During the COVID-19 Global Epidemic. *JAMA.* 2020; Mar 12 [Online ahead of print]
[37] WHO. Coronavirus disease (COVID-19) advice for the public: when and how to use masks. 2020.