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REVIEW

Cloth masks as respiratory protections in the COVID-19 pandemic period: evidence gaps

Máscara de tecido como proteção respiratória em período de pandemia da covid-19: lacunas de evidências

Mascarillas de tela como protección respiratoria en el período pandémico COVID-19: lacunas de evidencia

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ABSTRACT

Objective: to identify scientific evidence on the effectiveness of using cloth masks as safe protectors against COVID-19. **Method:** an integrative review of articles available in full obtained at PubMed, CINAHL, and Web of Science. Controlled, non-controlled descriptors and keywords such as "mask", "home-made" and "cloth" or "cotton" and "infection control" or "infection prevention" were used. **Results:** thirty-eight articles were selected; of these, seven studies made up the sample. Evidence shows that cloth masks do not have the same protective characteristics as surgical masks, indicating an increased risk of infection due to humidity, diffusion of fluids, virus retention, and improper preparation. Considering the shortage of surgical masks during the pandemic, cloth masks could be proposed as a last resort. **Conclusion:** cloth masks should be used together with preventive measures, such as home insulation, good respiratory conduct, and regular hand hygiene.
Descriptors: COVID-19; Pandemic; Masks; Security Measures; Nursing.

RESUMO

Objetivo: identificar evidências científicas sobre a eficácia do uso de máscaras de tecido enquanto protetor seguro contra a COVID-19**. Método:** revisão integrativa de artigos disponíveis na íntegra, obtidos nas bases PubMed, CINAHL e *Web of Science*. Foram utilizados descritores controlados, não controlados e palavras-chave "*mask*", "*home-made*" e "*cloth*" ou "*cotton*" e "*infection control*" ou "*infection prevention*". **Resultados:** foram selecionados 38 artigos. Desses, sete estudos compuseram a amostra. As evidências mostraram que máscaras de tecido não apresentam as mesmas características de proteção quanto às máscaras cirúrgicas, indicando risco de infecção aumentado devido à umidade, difusão de líquidos, retenção do vírus e confecção inadequada. Diante da escassez de máscaras cirúrgicas durante a pandemia, elas poderiam ser propostas como último recurso para a população. **Conclusão:** para a população, as máscaras de tecido devem ser usadas em conjunto com outras medidas preventivas, como isolamento domiciliar, boa etiqueta respiratória e higiene regular das mãos.
Descritores: COVID-19; Pandemia; Máscaras; Medidas de Proteção; Enfermagem.

RESUMEN

Objetivo: identificar evidencia científica sobre la efectividad del uso de mascarillas de tela como un protector seguro contra COVID-19. **Método:** revisión integradora de artículos disponibles en su totalidad, obtenidos de las bases de datos PubMed, CINAHL y Web of Science. Se utilizaron descriptores controlados y no controlados y palabras clave "mask", "home-made" y "cloth" o "cotton" y "infection control" o "infection prevention". **Resultados:** se seleccionaron 38 artículos. De estos, siete estudios constituyeron la muestra. La evidencia ha demostrado que las máscaras de tejido no tienen las mismas características protectoras que las máscaras quirúrgicas, lo que indica un mayor riesgo de infección debido a la humedad, la difusión de fluidos, la retención de virus y la preparación inadecuada. Dada la escasez de máscaras quirúrgicas durante la pandemia, podrían proponerse como el último estándar para la población. **Conclusión:** para la población, las mascarillas de tela deben usarse junto con otras medidas preventivas, como el aislamiento del hogar, la buena etiqueta respiratoria y la higiene regular de las manos.
Descriptores: COVID-19; Pandemia; Máscaras; Medidas de Seguridad; Enfermería.

INTRODUCTION

COVID-19 was first detected in the city of Wuhan, China, in December 2019. With the growing number of cases, deaths and the spread of the disease in different countries, the World Health Organization (WHO), on January 30, 2020, declared that the outbreak in China of COVID-19 represented a Public Health Emergency of International Concern[1]. At the end of February 2020, more than 110 thousand cases and 4 thousand deaths were reported in countries on all continents. Therefore, on March 11, 2020, WHO declared the COVID-19 pandemic[2].

Until June 15, 2020, 7,823,289 COVID-19 cases were confirmed, with 431,541 deaths. According to the number of cases, the United States of America leads the world ranking of the country, with the largest number of confirmed cases, 2,057,838, followed by Brazil (850,514), Russia (537,210), and India (332,424)[3].

Faced with the pandemic scenario, researchers and health authorities worldwide began to disclose and disseminate the main forms of protection for health professionals, people with a suspected clinical condition and for those diagnosed with COVID-19, including those undergoing home treatment[4], aiming to interrupt the chain of transmission of infection.

Personal protective equipment (PPE) and collective protection measures (CPE) are the ways indicated and recommended by WHO to control the COVID-19 infection, because, to date, there are no effective drugs and/or vaccines[5]. Among the individual protection measures, mask use stands out. Masks are the respiratory protective equipment indicated to control exposure to saliva droplets, with the objective of reducing the risk of transmission of COVID-19. Considering the high transmissibility of the disease, masks became an indispensable accessory for use by the general population during the pandemic. For health professionals, masks are part of the set of essential PPE, whether surgical, N-95 or PFF-2.

However, increased number of cases, mandatory use of masks in some countries and the population's concern about the risk of contamination have contributed to mask use abuse, leading to their scarcity. Surgical-type masks have been used in an uncontrolled and inappropriate manner, resulting in shortage in health services and endangering the health of people who need to use them, especially health professionals.

In light of the above, alternatives for respiratory protection have been proposed aiming to minimize surgical mask misuse. Cloth masks appear as an alternative to the COVID-19 pandemic, but there are controversies regarding their use. Important implications for resource allocation and communication about cloth masks in this pandemic period are essential[6]. However, there is a lack of data to guide decisions based on scientific evidence to make them an appropriate resource for individual use in pandemic control.

Considering the importance of seeking information on cloth mask use and considering its applicability, this study consists of an integrative review on the effectiveness of using cloth masks.

OBJECTIVE

To identify scientific evidence on the effectiveness of using cloth masks as safe protectors against COVID-19.

METHOD

A descriptive integrative literature review (ILR) was carried out, which followed the essential stages for its development: identification of the theme and selection of the research question; establishment of eligibility criteria; identification of studies on scientific bases; assessment of selected studies and critical analysis; categorization of studies; assessment and interpretation of results; and presentation of data according to the structure of the integrative review[7].

Considering the methodological rigor for review studies and in accordance with Evidence-Based Practice (EBP), which provides for the identification of evidence contained in investigations carried out and that can be inserted in clinical practice, it is recommended to use PICO strategy[8-9]. PICO stands for an acronym - Patient or Problem, Intervention, Comparison, and Outcomes (outcome), which will make it possible to elaborate the research question and search strategies.

Thus, the initial step of this integrative review was to elaborate the guiding question based on the acronym P (pandemic for respiratory infection), I (use of a cloth mask), C (none), and O (effectiveness of the cloth mask): which scientific evidence on the effectiveness of using cloth masks in a pandemic due to respiratory infection, available online, in national and international journals, published in the last ten years?

In view of the emergency in proposing safe alternative measures for protection against exposure to pathogens that cause respiratory infections, represented by the COVID-19 pandemic, systematized search for recent studies that address using cloth masks becomes imperative. Studies involving cloth masks as respiratory protection have been dated to the last ten years, an eligible period for this review, which included studies published from 2010 to 2020.

To compose the corpus of the research, articles were searched on the internet in March 2020. The search in the literature of primary studies was carried out via internet at PubMed, CINAHL (Cumulative Index to Nursing and Allied Health Literature), and Web of Science. To ensure a broad and careful search, the keywords and descriptors were delimited in Thesaurus according to the Medical Subject Headings (MeSH) as well as with the guiding question raised. The AND and OR Boolean operators were used. For search refinement, the classification qualifier (/ CL) was used for the descriptor "mask"; and the symbol* was used to truncate the descriptor mask and the keyword cloth *, as shown in the chart below (Chart 1). In order to avoid bias in the search and selection of articles, two researchers acted independently[10]. Regarding the descriptor "mask" or "*máscara*", it is important to highlight that these are the only terms, whether in English or Brazilian Portuguese, located in both MeSH and DeCS, with an appropriate definition related to a respiratory protection device.

To select the sample, articles from primary sources, indexed in the databases selected for the study, published from March 2010 to March 2020, which addressed the topic in Brazilian Portuguese, English or Spanish and available in full were included in the study. Review articles, which do not include keywords in the title or abstract of selected articles, were excluded. It should be noted that duplicate studies were considered only once.

Chart 1 - Search strategies at Web of Science, CINAHL, and PubMed

Database	Search strategy	Publications identified
Web of Science	Mask* AND (home-made face or cloth*) AND (infection control or infection prevention) [keyword and MeSH]	18
CINAHL	Mask AND cloth AND respiratory infections/ Mask AND home-made face AND infection control [keyword and MeSH]	10
PubMed	Mask/CL AND (cloth or home-made face) AND respiratory infections [keyword and MeSH]	10

The search resulted in 38 articles. Eleven were excluded due to duplication within and between CINAHL, PubMed, and Web of Science; and seven were excluded for not having descriptors in the title or abstract. After reading the full text of 18 articles, 11 were excluded because they did not fit the objectives proposed in this integrative review. Thus, the corpus of this review was composed of seven articles, the potential content of which was dedicated to investigating cloth mask use as respiratory protection for infection control. The search process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) recommendations[11].

After selecting the articles, the texts were read in full, followed by a critical analysis by two researchers, which made it possible to categorize the studies. The results were presented descriptively by means of a synthesis chart aiming to highlight the data collected from the selected studies, considered relevant for analysis, including year of publication; productive institutions and country; level of evidence of articles[12]; target audience; objectives and results found; and analysis and interpretation of results.

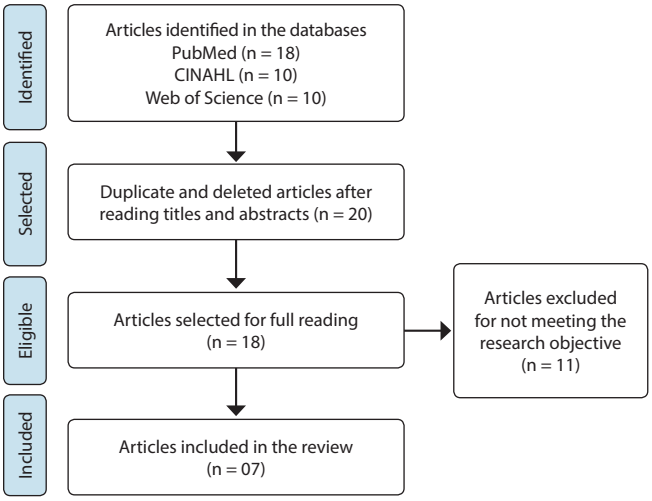

Figure 1 - Flowchart of search and selection of articles adapted from PRISMA[11]

Chart 2 – Synthesis chart of the distribution of selected studies, 2010-2020

Authors Year	Institution Country	Title	Objective	Target audience	Level of evidence	Results
Neupane, Mainali, Sharma, Giri[13] 2019	Tribhuvan University Nepal	Optical microscopic study of surface morphology and filtering efficiency of face masks	To measure the effectiveness of cloth masks in filtering aerosol particles and the effect of washing and drying cycles.	General population	VI	Cloth masks are not effective due to low filtering efficiency. And after washing and drying cycles, efficiency deteriorates.
Mueller, Horwell, Apsley, Steinle, McPherson, Cherrie, et al[14] 2018	Edinburgh Research Institute United Kingdom	The effectiveness of respiratory protection worn by communities to protect from volcanic ash inhalation. Part I: Filtration efficiency tests	To build the first evidence base on the effectiveness of common materials used to protect communities in volcanic crises from ash inhalation.	General population	VI	Standard surgical mask materials can be effective in filtering PM2.5. But other types of masks (single layer not pleated) for use in healthcare environments have performed very poorly against volcanic ash. The fabric materials provided limited filtration.
Shakya, Noyes, Kallin, Peltier[15]. 2017	University of Massachusets USA	Evaluating the efficacy of cloth facemasks in reducing particulate matter exposure	To assess the efficiency of filtering various cloth masks against standard particles of different sizes and particles emitted by combustion of diesel.	General population	VI	Cloth masks are only marginally beneficial in protecting individuals against 2.5 µm particles.
Chughtai, Seale, Dung, Hayen, Rahman, MacIntyre[16] 2016	University of New South Wales, Sydney Australia	Compliance with the use of medical and cloth masks among healthcare workers in Vietnam	To examine factors associated with using surgical and cloth masks and compliance among health professionals and the relationship of compliance with the results of the infection.	Health professionals	II	Compliance rates for medical and cloth masks decreased when continued use was recommended. Adverse events, such as breathing problems and discomfort, were associated with decreased use of masks, while the perceived risk of acquiring a previous infection increased compliance.

To be continued

Chart 2 (concluded)

Authors Year	Institution Country	Title	Objective	Target audience	Level of evidence	Results
MacIntyre, Seale, Dung, Hien, Nga, Chughtai et al[17]. 2015	National Institute of Hygiene and Epidemiology in Hanoi, Vietnan	A cluster randomised trial of cloth Masks compared with medical masks in healthcare workers	To compare the effectiveness of cloth masks with surgical masks in health professionals.	Health professionals	II	Infection rates were higher for cloth masks compared to surgical masks. Particle penetration in cloth masks was almost 97% and in surgical masks, 44%. Moisture retention, reuse of cloth masks and insufficient filtration can result in an increased risk of infection.
Davies, Katy-Anne, Giri, Kafatos, Walker, Bennett[18] 2013	University of Cambridge United Kingdom	Testing the efficacy of homemade masks: would they protect in an influenza pandemic?	To examine homemade masks as an alternative to commercial masks.	General population	VI	The average filtering adjustment factor for home masks was half that for surgical masks. Homemade masks should only be used as a last resort of protection.
Rengasamy, Eimer, Shaffer[19] 2010	National Institute for Occupational Safety and Health, USA	Simple respiratory protection-evaluation of the filtration performance of cloth masks and common fabric materials against 20–1000 nm size particles	To assess the filtration performance of common cloth materials against nano-sized particles, including viruses, in five main categories of cloth materials.	General population	VI	Common cloth materials can provide marginal protection against nanoparticles, including those in the particle size ranges containing viruses in exhaled breath.

RESULTS

After conducting the research in the databases and selecting the studies, seven articles made up the sample, which were presented in Chart 2. Among the published studies, one study was observed each year (2019, 2018, 2017, 2016, 2015, 2013, and 2010). Among the institutions promoting the studies are Tribhuvan University, the University of Massachusetts, the University of New South Wales, and the University of Cambridge, in addition to Vietnan's National Institute of Hygiene and Epidemiology in Hanoi and the USA's National Institute for Occupational Safety and Health, with one publication each. The publications came from studies developed at universities, research institutes and public policy institutes in Nepal, the United States of America (two), Australia, Vietnam and the United Kingdom (two). It was not possible to identify the promoting institution in a study.

Regarding the levels of evidence, five articles have level VI and two level II studies, being descriptive studies and randomized clinical trials, respectively[12]. The target population to whom the studies are directed are health professionals and the general population.

The objectives of the studies are related, in their entirety, to the assessment of the filtration efficiency of particles of masks, including cloth and surgical masks, against respiratory infections.

DISCUSSION

Masks reduce exposure to chemical, biological and mineral dust as well as balance atmospheric oxygen concentrations in specific environments. They are classified according to the agent to which individuals are exposed (biological, chemical, mineral dust) and by the concentration of oxygen in the air; if less than 19.5% and greater than 23%, mask use is indicated[20].

As for exposure to biological agents, N-95 and surgical mask are recommended. They are indicated for use by health professionals and by patients in special situations such as immunocompromised patients, patients in situations of active respiratory infection, among others. Faced with the epidemic caused by COVID-19, cloth masks reappear and, with them, gaps and concerns about their effectiveness[21].

The effectiveness of a mask depends on the type of material[14], the particle size and aerosol charge[15] and can be measured according to its filtering efficiency. A mask is considered effective if its filtering capacity is greater than 95%.

In this context, some aspects should be pointed out in relation to using cloth masks by the population in social isolation, by health professionals and by specific groups mentioned above, specifically in the pandemic situation we are experiencing now.

There are limitations in the knowledge about cloth mask use to protect against respiratory transmission agents. The available evidence shows that they do not have the same protective characteristics when compared to surgical masks and indicate an increased risk of infection due to humidity, diffusion of fluids and virus retention[13].

A study carried out with a group of 21 healthy volunteers, who used surgical masks and cloth masks, concluded that the adjustment factor of cloth masks is inferior to surgical masks. Both masks significantly reduced the number of microorganisms expelled by volunteers, although surgical masks were three times more effective in blocking transmission than cloth masks[16].

The design of fabric masks is important considering the importance of fitting to the face and the need for tight sealing throughout their cover[13]. The conical or tetrahedral shapes that allow the edge to adapt closely to the contours of the face are more efficient[15], and elastic bands must be tied or stretched for a better fit[16].

In addition to the adjustment factor for better filtering performance, the type of fabric, the number of layers of fabrics and the washing cycles of the mask must be considered. Cloth masks are

usually made of cotton (double fabric) and can be reused after decontamination[22].

Some researchers believe that porous tissue fibers capture the virus particles, dry and separate them, and surfaces such as leather and vinyl can be cleaned. However, all types of fabrics can be contaminated by COVID-19; however, so far, studies tell us about the virus's ability to remain on surfaces such as cardboard, steel, copper, and plastic[22].

Regarding the number of layers, filtration efficiency improves significantly with the increase in the number of fabric layers, with the proximity of the fabric threads and with the reduction of the pore size of these threads. The smaller the pore, the greater the filtration capacity. Studies indicate that fabrics with 100% cotton fibers are more recommended[16,19].

However, the reuse of cloth masks can compromise their effectiveness, as the washing and drying processes decrease their filtration capacity. Increasing the washing and drying cycles of the masks leads to a gradual decrease in their filtering efficiency. This process leads to a change in the shape of the fabric threads with an increase in pore size, and five washing cycles can decrease filtering performance by 20%. Researchers assessed fabric masks available on the open market in Nepal for filtering performance and found that these masks had a penetration level of 40% to 90% and filtration efficiency in the range of 3 to 33%. The number of fabric layers, adjustment factor and washing cycles were taken into account[13].

Moreover, aspects related to individual forms of exposure reflect the presence of behavioral and anatomical variations, which may also be present if the general population is asked to wear masks in the event of a pandemic. Variations should be considered when assessing the effectiveness of cloth masks[18].

Available evidence, although scarce, shows that cloth masks are less effective than surgical masks, and their use is not recommended for individual protection in cases of respiratory infections. Cloth masks are not considered to be protective against respiratory viruses. However, in view of the marked shortage of surgical masks, cloth masks could be proposed as the last standard, until the availability of surgical masks is restored[23].

However, caution is recommended when considering this option. Ideally, cloth masks should be used in conjunction with other preventive measures, such as home isolation, good respiratory conduct, and regular hand hygiene. Its use should not exceed two continuous hours. In the case of cotton masks, WHO recommends washing them with household detergent[24]. Furthermore, use of masks by the population conveys a false sense of security, inducing the individual to devalue the set of preventive measures against the pandemic by COVID-19[14-15,22].

Study limitations

The integrative review study was an important strategy to consolidate the scientific production on the effectiveness of cloth masks. However, the scarcity of studies with robust methods to confirm this efficacy through strong evidence is still a gap in scientific production, as there is an absence of experimental studies with microbiological assessment.

Contributions to nursing, health, and public policies

Nursing and health professionals are those who are most exposed in epidemic situations, so they must have their PPE available during their work. Thus, using cloth masks at work is not indicated, and health managers should do their utmost to provide equipment to protect these professionals.

CONCLUSION

This integrative review enabled the search for scientific evidence about cloth mask use as respiratory protection in a pandemic period by COVID-19.

The different types of masks allow for respiratory protection according to their filtration capacity. Cloth masks are less efficient, although individuals are not ideally protected. From the point of view of public health, any type of general use of masks minimizes the risk of viral transmission. However, we refer to the use by the general population. Moreover, it is important not to focus on a single intervention in the event of a pandemic, but to integrate all effective interventions for optimal protection.

REFERENCES

1. World Health Organization (WHO). Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV)[Internet]. Geneva: WHO; 2020 [cited 2020 Apr 28]. Available from: https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meetingof-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)
2. World Health Organization (WHO). Novel coronavirus (2019-nCoV): situation report – 22[Internet]. Geneva: WHO; 2020 [cited 2020 Apr 28]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200211-sitrep-22-ncov.pdf?sfvrsn=fb6d49b1_2
3. World Health Organization (WHO). WHO Coronavirus Disease (COVID-19) Dashboard[Internet]. Geneva: WHO; 2020 [cited 2020 Jun 15] Available from: https://covid19.who.int/
4. European Centre for Disease Prevention and Control (ECDC). Situation update worldwide, as of 2 april 2020[Internet]. 2020 [cited 2020 Apr 2]. Available from: https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases
5. World Health Organization (WHO). Home care for patients with COVID-19 presenting with mild symptoms and management of contacts: interim guidance[Internet]. Geneva: WHO; 2020 [cited 2020 Mar 29]. Available from: https://www.who.int/publications-detail/home-care-for-patients-with-suspected-novel-coronavirus-(ncov)-infection-presenting-with-mild-symptoms-and-management-of-contacts

6. World Health Organization (WHO). Infection prevention and control during health care when COVID-19 is suspected: interim guidance[Internet]. Geneva: WHO; 2020 [cited 2020 Mar 29]. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/infection-prevention-and-control

7. World Health Organization (WHO). Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected: interim guidance, 25 January 2020[Internet]. Geneva: WHO; 2020 [cited 2020 Mar 29]. Available from: https://www.who.int/publications-detail/infectionprevention-and-control-during-health-care-whennovel-coronavirus-(ncov)-infection-is-suspected

8. Whittemore R. Combining in nursing research: methods and implications. Nurs Res [Internet]. 2005 [cited 2020 Mar 29];54(1):56-62. Available from: https://pubmed.ncbi.nlm.nih.gov/15695940/

9. Bernardo WM, Nobre MR, Jatene FB. Evidence-based clinical practice. Part II—Searching evidence databases. Rev Assoc Med Bras [Internet]. 2004 [cited 2020 Mar 29];50(1):104-8. Available from: https://www.scielo.br/pdf/rbr/v44n6/03.pdf

10. Stone PW. Popping the (PICO) question in research and evidence-based practice. Appl Nurs Res [Internet]. 2002 [cited 2020 Mar 29];15(3):197-8. Available from: https://pubmed.ncbi.nlm.nih.gov/12173172/

11. Ursi ES, Gavao CM. Prevenção de lesões de pele no perioperatório: revisão integrativa da literatura. Rev Latino-Am Enfermagem [Internet]. 2006 [cited 2020 Apr 2];14(1):124-31. Available from: https://www.scielo.br/pdf/rlae/v14n1/v14n1a17.pdf

12. Moher D, Liberati A, Tetzlaff J. The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA Statement. PLoS Med [Internet]. 2009 [cited 2020 Mar 29];6(7). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2707599/

13. Melnyk BM, Fineout-Overholt E. Evidence-based practice in nursing and health: a guide to best practice. Philadelphia: Wolters Kluwer; Lippincott Williams & Wilkins Health; 2011.

14. Neupane BB, Mainali S, Sharma A, Giri B. Optical microscopic study of surface morphology and filtering efficiency of face masks. Peer J [Internet]. 2019 [cited 2020 Mar 29];7. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6599448/pdf/peerj-07-7142.pdf

15. Mueller W, Horwell CJ, Apsley A, Steinle S, McPherson S, Cherrie JW, et al. The effectiveness of respiratory protection worn by communities to protect from volcanic ash inhalation. Part I: filtration efficiency tests. Int J Hyg Environ Health. 2018; 221(6):967–76. doi: 10.1016/j.ijheh.2018.03.012

16. Shakya KM, Noyes A, Kallin R, Peltier R. Evaluating the efficacy of cloth facemasks in reducing particulate matter exposure. J Expo Sci Environ Epidemiol. 2017;27:352-7. doi: 10.1038/jes.2016.42

17. Chughtai AA, Seale H, Dung TC, Hayen A, Rahman B, MacIntyre R. Compliance with the use of medical and cloth masks among healthcare workers in Vietnam. Ann Occup Hyg. 2016;60(5):619–30. doi: 10.1093/annhyg/mew008

18. MacIntyre CR, Seale H, Dung TC, Hien NT, Nga PT, Chughtai AA, et al. A cluster randomised trial of cloth masks compared with medical masks in healthcare workers. BMJ Open [Internet]. 2015 [cited 2020 Apr 1];5. Available from: https://bmjopen.bmj.com/content/bmjopen/5/4/e006577.full.pdf

19. Davies A, Katy-Anne T, Giri K, Kafatos G, Walker J, Bennett A. Testing the Efficacy of Homemade Masks: Would They Protect in an Influenza Pandemic? Disaster Med Public Health Prep. 2013. doi: https://doi.org/10.1017/dmp.2013.43

20. Rengasamy S, Eimer B, Shaffer RE. Simple Respiratory Protection - Evaluation of the filtration performance of cloth masks and common fabric materials against 20–1000 nm Size Particles. Ann Occup Hyg. 2010;54(7):789–98. doi: 1.1093/ann0hyg/meq044

21. Horwell CJ, Ferdiwijaya D, Wahyudi T, Dominelli L. Use of respiratory protection in Yogyakarta during the 2014 eruption of Kelud, Indonesia: Community and agency perspectives. J of Volcano Geoth Research. 2017. doi: https://doi.org/10.1016/j.jvolgeores.2017.06.004

22. World Health Organization (WHO). Q&A on infection prevention and control for health care workers caring for patients with suspected or confirmed 2019-nCoV. In: WHO/Newsroom [Internet]. Geneva: WHO; 2020 [cited 2020 Mar 31]. Available from: https://www.who.int/news-room/q-a-detail/qa-on-infection-prevention-and-control-for-healthcare-workers-caring-for-patients-with-suspected-orconfirmed-2019-ncov.

23. Chughtai AA, Seale H, MacIntyre CR. Use of cloth masks in the practice of infection control - evidence and policy gaps. Int J Infect Control [Internet]. 2013 [cited 2020 Mar 29];9:1-12. Available from: https://www.ijic.info/article/view/11366/8308

24. Centers for Disease Control and Prevention. Preventing the Spread of Coronavirus Disease 2019 in Homes and Residential Communities [Internet] 2020 [cited 2020 Apr 2]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-prevent-spread.html