# Homemade cloth face masks as a barrier against respiratory droplets - systematic review

Máscaras de tecido na contenção de gotículas respiratórias - revisão sistemática

Mascarillas caseras para contener gotas respiratorias: revisión sistemática

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## Abstract

**Objective:** To identify, systematically review, and summarize the best scientific evidence available on the efficacy and safety of homemade cloth face masks for the community.

**Methods:** The search was conducted using the Cochrane, PUBMED, EMBASE, and LILACS databases, as well as grey literature, using *Opengrey*. A search was also conducted using references from primary and secondary studies that were found. No language or time period restrictions were applied. All papers that objective was to check efficacy and safety of the use of cloth face masks as protection against viral transmission were included, as well as laboratory studies assessing barriers against particles. We excluded studies approaching the use of face masks by healthcare providers. Two independent reviewers selected the studies, and discrepancies were decided by a third reviewer.

**Results:** No randomized clinical trials involving cloth face masks for the general population were found. Seven studies assessing different types of cloth to prevent the penetration of droplets at a laboratory level and a review study were included.

**Conclusion:** Using cloth face masks provides a barrier against droplets when compared with not using any face masks. The face mask is an additional preventive mesuare and must be used along with respiratory etiquette, hand hygiene, social distancing, and isolation of cases.

## Resumo

**Objetivo:** Identificar, avaliar sistematicamente e sumarizar as melhores evidências científicas disponíveis sobre a eficácia e a segurança das máscaras de tecido para a comunidade.

**Métodos:** Foram consultadas as bases de dados Cochrane, PUBMED, EMBASE, LILACS e literatura cinzenta por meio do *Opengrey*. Também foi realizada busca nas referências bibliográficas dos estudos primários e secundários identificados. Não houve restrição de idioma, nem período de tempo. Foram incluídos todos os artigos que tenham como objetivo verificar a eficácia e segurança do uso de máscaras de tecido como proteção contra a transmissão viral, bem como estudos laboratoriais que avaliassem barreiras de contenção de partículas. Foram excluídos os estudos que envolvessem o uso de máscaras por profissionais de saúde. Dois avaliadores independentes selecionaram os estudos e as discrepâncias foram resolvidas por um terceiro avaliador.

**Resultados:** Após o processo de seleção, não foram localizados estudos clínicos randomizados envolvendo máscaras de tecidos para a população em geral. Incluímos sete estudos que avaliaram diferentes tecidos no bloqueio de gotículas de nível laboratorial e um estudo de revisão.

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**Competing interests:** Despite being Associate Editor for Acta Paulista de Enfermagem, Taminato E was not involved in peer review.

Conclusão: O uso de máscara de tecido possibilita uma barreira às gotículas quando comparada a nenhuma máscara. A máscara é um recurso adicional na prevenção e deve sempre ser associada à etiqueta respiratória, higienização das mãos, distanciamento social e isolamento dos casos.

## Resumen

Objetivo: Identificar, evaluar sistemáticamente y resumir las mejores evidencias científicas disponibles sobre la eficacia y la seguridad de las mascarillas caseras para la comunidad.

Métodos: Se consultaron las bases de datos Cochrane, PUBMED, EMBASE, LILACS y literatura gris por medio de Opengrey. También se realizó búsqueda en las referencias bibliográficas de los estudios primarios y secundarios identificados. No hubo restricción de idioma ni período de tiempo. Se incluyeron todos los artículos que tuvieran como objetivo verificar la eficacia y seguridad del uso de mascarillas caseras como protección contra la transmisión viral, así como estudios de laboratorio que evaluaran barreras de contención de partículas. Se excluyeron los estudios que abarcaran el uso de mascarillas por profesionales de la salud. Dos evaluadores independientes seleccionaron los estudios y las discrepancias fueron resueltas por un tercer evaluador.

Resultados: Luego del proceso de selección, no se localizaron estudios clínicos aleatorizados que incluyeran mascarillas caseras para la población en general. Incluimos siete estudios que evaluaron diferentes telas para el bloqueo de gotas de nivel de laboratorio y un estudio de revisión.

Conclusión: El uso de mascarillas caseras permite una barrera para las gotas al compararlo con ninguna mascarilla. La mascarilla es un recurso adicional en la prevención y siempre debe estar asociada a la etiqueta respiratoria, higienización de manos, distanciamiento social y aislamiento de casos.

## Introduction

The World Health Organization (WHO) is constantly updating the number of COVID-19 cases around the world. The number of deaths and the overall data is alarming. WHO informs that research and development efforts are advancing quickly around the world.[1] The Head of WHO reiterates the need for seeking possibly alternative actions and strategies to reduce the impacts of the pandemic, mainly among underserved populations and the general community.[2] In the face of the pandemic, there is a relentless search for strategies that may guide and minimize contamination levels within the population and allow the rational use of personal protective equipment by frontline providers. Minimizing the spread of the pandemic within the community is paramount.

Considering the conditions caused by the coronavirus (i.e., severe acute respiratory syndrome, SARS, and Middle East respiratory syndrome, MERS) and the containment and prevention experiences observed so far, evidence points out to the transmission person-to-person of COVID-19 by droplets and contact. It can also be transmitted by aerosol-generating procedures, including but not limited to swab sample collection, intubation, and aspiration.[3]

The indications for the use of face masks by the population are based on previous experiences in dealing with respiratory syndromes. However, this measure must be combined with hygiene measures, especially hand washing, disinfecting of frequently touched surfaces, cough etiquette, and avoiding touching face. Together, all these measures seem to be effective against the human-to-human spread of 2019-nCov.[4] The use of face masks by the general population has been seen to potentially hinder the spread of influenza during a pandemic outbreak and reduce infection attack rate, therefore, allowing the reducing of transmission enough to stop the contamination.[5]

Evidence indicates that the use of face masks by the general population during a pandemic of respiratory disease may minimize the spread of this respiratory disease and its economic impact; if worn properly and consistently, face masks are an effective non-pharmaceutical intervention to contain the spread of the disease.[6] The indication for wearing of cloth face masks applies to pandemics and emerging infections, especially in low to mid-income countries.

Due to the increased risk of contamination in a pandemic such as COVID-19, and also considering the reach of saliva droplets and the worldwide limited supplying of personal protective equipment, it is crucial to identify strategies that may provide barriers against droplets, and minimize the risk of respiratory infections in the general population. The use of cloth and disposable face masks is especially significant to symptomatic patients at home, caregivers, and those living with multiple people, skilled nursing facilities, and crowded spaces, such as public transportation.

To identify the efficacy and safety of cloth face masks for this population is of the utmost importance.

This study sought to identify scientific evidence for the efficacy of the community using cloth face masks as a non-pharmacological measure to contain the COVD-19 infection.

## Methods

### Study design and site

This was a scoping systematic review developed by researchers of the Brazilian Cochrane Centre, the CNPq research group on Epidemiology, Systematic Review, and Health Policies of the Escola Paulista de Enfermagem, CNPq research group on Evidence-based Practices, Graduate Program on Evidence-based Health of the Federal University of Sao Paulo, and by the Professional and Academic Master's Degree Program of Armed Forces Hospital's Health Sciences Academy (ESCS). The review was registered on Open Science Framework on April 4, 2020.

### Eligibility criteria

**Types of participants**

Studies involving adults, children, and older people within the general community were included.

**Types of Interventions**

Studies involving masks with different types of fabric (that could be adapted to cover the face, mouth, and nose area) were considered eligibility criteria.

**Types of studies**

Considering the limited number of studies on cloth face masks in the general community, the objective of this brief review is to map existing knowledge on the subject and identify study designs by the level of evidence.

**Types of outcomes**

The following outcomes were selected as primary: barriers against droplets, the incidence of respiratory infections, and adverse events. The following were selected as secondary outcomes: hospital admission, the growth curve for new cases, and mortality.

### Search for studies

Searches were conducted using medical subject headings in the following databases: Cochrane Library (Wiley); Embase (Elsevier); the VHL Portal; Medical Literature Analysis and Retrieval System Online (MEDLINE, PubMed); CINAHL; Web of Science; Scopus; and the Opengrey (https://opengrey.eu) for the grey literature. A manual search was conducted using the references for the primary and secondary studies found in the electronic search. Search strategies developed and used for each electronic database are shown in Appendix 1; searches were conducted on April 20, 2020, and there was no restriction on language or type of publication.

### Study selection

The process of study selection was conducted by two independent reviewers, and any divergences were resolved by a third reviewer. Studies were selected in two steps. The first step consisted of reviewing titles and abstracts of references found with our search strategy; potentially eligible studies were selected. The second step consisted of reviewing the full text of pre-selected studies for confirming eligibility. The selection process took place using the Rayyan platform (https://rayyan.qcri.org; Appendix 2).

## Results

Search strategies returned 1,237 references. During the selection process, we found 383 duplicated references (identical references), and 820 references that did not meet the inclusion criteria upon reviewing of title and abstract (first step) were eliminated. The 34 selected references were then read to confirm eligibility (second step). Figure 1 shows a flowchart of the selection process. After the selection process was completed, seven studies were included.

Reviewing the 34 selected full-text references resulted in the exclusion of 27 studies that did not meet our inclusion criteria. The results of the 10 remaining studies are presented below in a descriptive fashion, as the nature of these studies does not allow any other type of analysis.

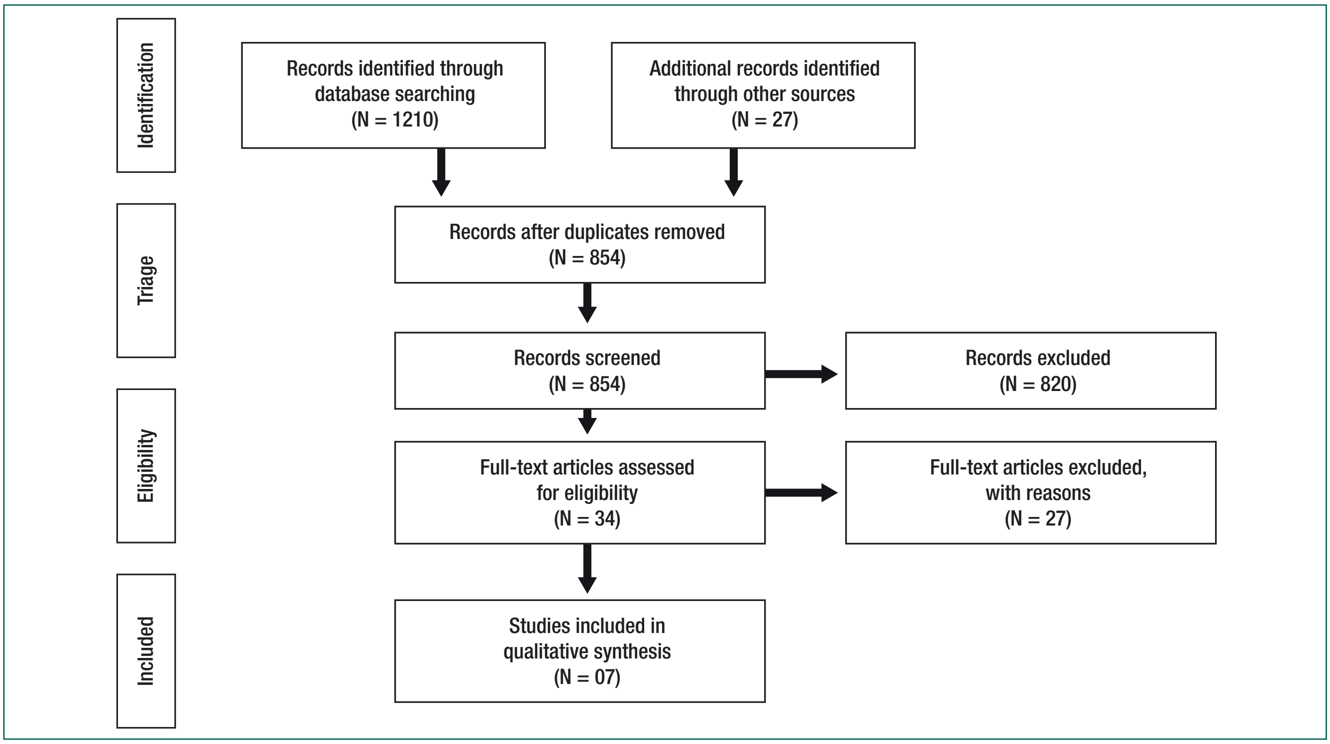


**Figure 1.** Flowchart of paper selection

## Characteristics of the studies included

The seven studies included in this review were published in the years 1983, 2008, 2010 (2), 2013, 2016, and 2020. Among their countries of origin, one takes place in the United Kingdom, four take place in the United States, and two in the Netherlands. Regarding study type, five are laboratory studies, one is experimental, and one is a review study (Chart 1).

Laboratory studies were included in this brief review to verify the efficacy of incorporating this kind of material as a barrier against droplets for the general population. All studies assessed the efficacy of cloth compared to N95 and surgical face masks; the results point to the superiority of face masks indicated for use by healthcare providers and verify that depending on the kind of fabric — and even in the case where these kinds of fabric show lower efficacy —, face masks are capable of acting as a barrier for over 90% of dispersed droplets.

The first study (1983) tested different kinds of materials on a manikin connected to a breathing simulator to determine the fraction of a 2-micron diameter aerosol and the efficacy of materials. Cotton (shirt material), handkerchief material, toweling cloth, and a surgical mask were tested. At a breathing rate of 37 liters per minute, mean leakages for the materials ranged from 0% to 63%, and mean penetrations of particles ranged from 0.6% to 39%. The use of nylon to hold the handkerchief material or the disposable face mask to the face was found to be very effective in preventing leakage. Such a combination could be expected to reduce leakage around the handkerchief to about 10% or less in practice, and around the mask to less than 1%.[(7)]

Van der Sande (2008)[8] conducted an experiment comparing three types of face masks: a filtering facepiece against particles (FFP)-mask, a surgical mask, and a homemade mask. Twenty-eight adults and 11 children between 5 and 11 years of age were included. In the standard protocol, the volunteers were asked to perform five successive tasks of 1.5 minutes of duration each: no activity (sit still), nod head (“yes”), shake head (“no”), read aloud a standard text, stationary walk. Throughout this exercise, the concentration of particles was measured on both sides of the mask through a receptor fixed on the face and on the external side. The study points to the superiority of FFP2 masks, followed by surgical masks, and lower efficacy of homemade

**Chart 1.** Description of the studies included

| Paper | Study design | Methods | Results | Conclusion |
|---|---|---|---|---|
| 1. Cooper DW, Hinds WC, Price JM, Weker R, Yee HS. Common materials for emergency respiratory protection: Leakage tests with a manikin. Am Ind Hyg Assoc J. 1983;44(10):720–6..[7] | Laboratory | Tests conducted on a manikin connected to a breathing simulator to determine the fraction of a 2-micron diameter aerosol and the efficacy of different kinds of materials. Cotton/polyester shirt material, cotton handkerchief material, toweling, a surgical mask, and a disposable face mask were used. | At a breathing rate of 37 liters per minute, mean leakages for the materials ranged from 0% to 63%, and mean penetrations of particles ranged from 0.6% to 39%. The use of nylon to hold the handkerchief material or the disposable face mask to the face was found to be very effective in preventing leakage. | The use of nylon hosiery material ("pantyhose") to hold the handkerchief material or the disposable face mask to the face was considered to be very effective in preventing leakage. Such a combination could be expected to reduce leakage around the handkerchief to about 10% or less in practice, and around the mask to less than 1%. |
| 2. van der Sande M, Teunis P, Sabel R. Professional and home-made face masks reduce exposure to respiratory infections among the general population. PLoS One. 2008;3(7):e2618.[8] | Laboratory | Three different types of masks were tested, two of them professional masks and a homemade mask made of teacloths. Individuals were instructed to perform specific tasks while particle concentration was measured on both sides of the mask. | The study points to the superiority of FFP2 masks, followed by surgical masks, and lower efficacy of homemade masks; it also shows the time of use and Humidity as significant factors for decreased efficacy. | All masks afforded protection against transmission, thus reducing exposure during all types of activities in both children and adults. |
| 3. 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. Annals of occupational hygiene. 2010;54(7):789-98.[9] | Laboratory | The study assesses different types of fabric materials including sweatshirts, T-shirts, towels, scarves, and compares them to the N95 mask for the capacity for filtering particles at different velocities. | Towels and scarves: 60–66% and 73–89% for both velocities. Sweatshirts: 30–61% for 20 nm particles, increasing to 80–93% for 1000 nm particles. T-shirt: 56–79% for 20 nm particles and 89–97% for 1000 nm particles. Towels and scarves: 9–74% for 20 nm particles (9). | Results show that sweatshirt and towel masks may provide lesser penetration levels when compared to other kinds of fabric materials; all analyses showed inferior results to the filtering capacity of an N95 mask. |
| 4. Brienen NC, Timen A, Wallinga J, van Steenbergen JE, Teunis PF. The effect of mask use on the spread of influenza during a pandemic. Risk Anal. 2010;30(8):1210-8.[5] | Review | Reflection on the need for implementing pharmaceutical (vaccination and antiviral drugs) and non-pharmaceutical countermeasures for pandemic preparedness purposes. | Masks have traditionally been used for centuries. Retrospective case-control studies showed that mask use by the general population may have afforded significant protection against SARS. | Face mask use at a population level can delay an influenza pandemic and decrease the infection attack rate, thus reducing transmission sufficiently to contain a pandemic. The effect on the final size of the epidemic depends on features of virus transmission, mask efficiency, and coverage of mask use in the population. |
| 5. Davies A, Thompson K, Giri K, Kafatos G, Walker J, Bennet A.T Testing the efficacy of homemade masks: would they protect in an influenza pandemic? Disaster Med Public Health Prep. 2013; 7(4):413-8.[10] | Laboratory | Twenty-one healthy volunteers were requested to make homemade face masks using 100% cotton fabric. Microorganisms were isolated using various air sampling techniques, and the use of homemade cotton face masks was compared to the use of surgical masks, or the use of no masks. The capacity to filter and block microorganisms was evaluated. | The study's main result was the capacity shown by different types of fabric to block microorganisms. The study shows the use of homemade masks is adequate for the population, but they should not be worn by healthcare providers. | All three different types of fabric were able to block microorganisms; the surgical mask performed up to three times better. The use of homemade masks is adequate for the population, but they should not be worn by healthcare providers. |
| 6. Shakya KM, Noyes A, Kallin R, Peltier RE. Evaluating the efficacy of cloth facemasks in reducing particulate matter exposure. J Expo Sci Environ Epidemiol. 2017;27(3):352-7.[11] | Laboratory | Comparative study on the retention of particles by different types of masks. The study assessed three types of cloth masks and one type of surgical mask. Five monodispersed aerosol sphere sizes and diluted whole diesel exhaust were used in testing. | Among the three cloth mask types, the cloth mask with an exhaust valve performed best. An N95 mask was used as a control and compared to the cloth face mask results; results suggest that cloth face masks are only marginally beneficial in protecting individuals from particles<2.5 μm. | N95 masks performed better in particle removal, despite other cloth face masks also showing marginal percentiles of particle removal. Compared with cloth masks, disposable surgical masks are more effective in reducing particulate exposure. |
| 7. Konda A, Prakash A, Moss G, Schmoldt, Gregory D. Grant, Guha M. Aerosol filtration efficiency of common fabrics used in respiratory cloth masks. ACS Nano. 2020 Apr 24:acsnano.0c03252.[12] | Cross-sectional study | Tests different kinds of fabrics for face makes; 15 different fabrics. | Three variations were measured: one layer of 600 TPI combined with two layers of silk, two layers of chiffon, and one layer of flannel. The results are compared with the performance of a standard N95 mask. | Two layers of 600 TPI cotton is clearly superior, showing >65% efficiency for >300 nm and >90% efficiency for >300 nm.<br>The quilt also provided excellent filtration across the range of particle sizes (>80% for <300 nm and >90% for >300 nm).<br>The performance of a four-layer silk composite offers >80% filtration efficiency across the entire range, from 10 nm to 6 μm. |

masks; it also shows the time of use and humidity as significant factors for decreased efficacy. All masks afforded protection against transmission, thus reducing exposure during all types of activities in both children and adults. Within each category of face masks, the degree of protection varied with age range and, to a lesser degree, with activity. No differences were seen between men and women.[8]

The next study (2010) focused on assessing different types of fabric materials including sweatshirts, T-shirts, towels, scarves, and comparing them to the N95 mask. Results show that sweatshirt and towel masks may provide lesser penetration levels when compared to other kinds of fabric materials; all analyses showed inferior results to the filtering capacity of an N95 mask. Towels and scarves: 60–66% and 73–89% for both velocities. Sweatshirts: 30–61% for 20 nm particles, increasing to 80–93% for 1000 nm particles. T-shirt: 56–79% for 20 nm particles and 89–97% for 1000 nm particles. Towels and scarves: 9–74% for 20 nm particles.[(9)]

The fourth study (2010) reflects on the need for implementing pharmaceutical (vaccination and antiviral drugs) and non-pharmaceutical countermeasures for pandemic preparedness purposes. As adequate pharmaceutical supplies might not be readily available and there might be a lack of scientific evidence, the WHO recommends non-pharmaceutical interventions as additional control measures. Such measures aim to limit the international spread of the virus, reduce spread within populations, reduce the individual risk of infection (through personal protection and hygiene measures), and raise public awareness of the risks. Masks have traditionally been used for centuries. Retrospective case-control studies showed that mask use by the general public may have afforded significant protection against SARS.[5] Face mask use at a population level that can delay an influenza pandemic and decrease the infection attack rate, thus reducing transmission sufficiently to contain a pandemic. The effect on the final size of the epidemic depends on features of virus transmission, mask efficiency, and coverage of mask use in the population. Brienen's findings are based on data in the published literature and mathematical modeling.[(5)]

The fifth study (2013) aimed at assessing homemade face masks as an alternative to commercial masks. Twenty-one healthy volunteers, 12 men and 9 women aged between 20 and 44 years, were requested to make a homemade face mask using 100% cotton t-shirt fabric and sewing machines. Using various air sampling techniques, microorganisms were isolated from the coughs of these volunteers using homemade cotton face masks, surgical masks, or no masks.[10] The different types of fabrics used to make the homemade masks were assessed and compared to surgical masks. Masks were evaluated for the capacity to filter and block microorganisms using microbiological tests. The study's main result was the capacity shown by different types of fabric to block microorganisms; however, the surgical mask was three times more effective in blocking transmission. The study shows the use of homemade masks is adequate for the population, but they should not be worn by healthcare providers.[(10)]

Shakya KM (2016)'s study assesses three types of cloth masks and one type of surgical mask. Five monodispersed aerosol sphere sizes and an exhaust method were used in testing. Among the three cloth mask types, a cloth mask with an exhaust valve performed best. An N95 mask was used as a control to compare the results. N95 masks performed better compared to all three cloth face masks for all particle sizes. At a lower flow rate, the first cloth mask type and the surgical mask were comparable to N95 masks. Efficiency was slightly better for the surgical mask than for the first cloth mask type. Compared to cloth masks, disposable surgical masks are more effective in reducing particulate exposure.[(11)]

In a study by Konda (2020), three variations were measured: one layer of 600 TPI combined to two layers of silk, two layers of chiffon, and one layer of flannel. The results were compared to the performance of an N95 mask, defined as the standard. All three combinations showed good performance, exceeding 80% of efficiency in the range of <300 nm and >90% in the range of >300 nm. Fabric combinations were slightly inferior to the N95 mask. Fabric materials with low porosity are preferable, such as those found in cotton sheets with a high thread count. Materials such as natural silk, chiffon, and flannel can likely provide good electrostatic filtering of particles. Combining layers to form hybrid masks and leveraging mechanical and electrostatic filtering may be an effective approach. The filtration efficiency was >80% for <300 nm and >90% for >300 nm sized particles. In summary, the study shows that the use of cloth masks combining different types of fabric can potentially provide significant protection against the transmission of particles in the aerosol size range.[(12)]

## Discussion

The main contribution this brief review has to offer is subsidizing the Ministry of Health's indications for the use of face masks and synthesizing the best evidence available for this non-pharmacological intervention's indications, associating it with cough etiquette and hand hygiene measures based on the principle of individual protection.[1]

These indications are opportune as a low-cost social measure for the general population, especially at a time when issues of asymptomatic and oligosymptomatic transmission have not been clearly defined and there is a need for an intervention for the low and mid-income countries facing serious social issues, mainly due to precarious living conditions and the non-feasibility of social distancing.[13,14]

The use of face masks as a barrier against droplets has been indicated in the context of other global emergencies, such as in 2009, for the H1N1 pandemic, as a strategic non-pharmacological measure for prevention and mitigation of infections transmitted by droplets. This consideration is significant for the development of policies for the use of non-medical grade face masks in public.[15,16]

The use of cloth and disposable face masks is especially significant to homebound symptomatic patients, caregivers, and those in a living arrangement with multiple people, care homes, and crowded spaces, such as public transportation, for instance.

All of the clinical trials returned by our search assessing the use of surgical masks by the population and their family members to prevent transmission by droplets in the H1N1 pandemic were excluded, as they did not fulfill the inclusion criteria for the type of material. Our study focused on the use of cloth face masks to respond to the global emergency that has become a shortage of personal protective equipment for healthcare providers.

All of the clinical trials evaluated and excluded due to their discussing the use of surgical masks by the population demonstrated an impact on the decrease of transmission between family members and the community when face masks were associated with cough etiquette and hand hygiene.

The use of face masks not only protects healthy individuals, but it also decreases the infection rate of symptomatic and asymptomatic individuals, thus decreasing the number and the efficacy of sources of transmission in the population. Additionally, the use of face masks is expected to influence the behavior of the general population by increasing infection awareness and awareness of the importance of additional preventive behavior, such as washing one's hands frequently, avoiding physical contact, avoiding crowds, and crowded public spaces. There is also the added fact that face masks prevent their users from touching their mouth or nose or other potentially virus-contaminated objects with their hands. However, on the other hand, the use of face masks may generate a false sensation of security and lead to a decrease in the execution of other measures, such as personal hygiene.

A case report on the impact of using face masks in public transportation during the COVID-19 pandemic in China has described the transmission potential of five individuals who did not use face masks.[17]

The Chinese government established several control measures for the pandemic, such as locking down cities, shutting down transportation systems, closing schools, and recommending generalized hand hygiene and face mask use.[18-20] Once the general population started realizing the severity of the outbreak, the purchasing of face masks increased in only a few days, partly due to panic and the lack of information on the new virus, generating a shortage of face masks for healthcare providers.

Given those circumstances, several governments issued recommendations for the use of homemade face masks. The need for randomized clinical trials assessing the effectiveness and adherence to the use of homemade face masks in the community has been identified as a research implication.[21]

As a practical implication, one must consider that studies show that some fabric materials used in a multilayer configuration may serve as a partial barrier against droplets in pandemic settings such as the one the world is currently facing; this resource must be associated with other hand hygiene and social distancing measures.

Thus, any face mask, regardless of filtering efficiency or blocking capacity, will have a marginal impact if not used in connection to other measures, such as isolation of cases, social distancing, respiratory etiquette and good practices, and regular hand hygiene.

## Conclusion

The literature search did not retrieve clinical trials assessing the effectivity of homemade face masks to reduce the emission of particles and preventing respiratory infection. Studies were mainly of laboratory nature and assessed differences in fabric materials as barriers against droplets, compared homemade with professional face masks, usually surgical masks. There are differences in terms of the protection provided by surgical masks and homemade fabric masks, however, there is also a difference in droplet barriers to wearing a face mask versus no face mask-wearing. Studies showed that face mask is an additional preventive measure that must always be accompanied by social distancing, hand hygiene, and respiratory etiquette. Given the risk of transmission by asymptomatic individuals, public health challenges related to social issues, and the need of a progressive and programmed return to social and work activity, the authors suggest that measures to improve hand hygiene and social distancing should be reinforced as a non-pharmacological strategy for the prevention of COVID-19.

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14. Anderson RM, Heesterbeek H, Klinkenberg D, Hollingsworth TD. How will country-based mitigation measures influence the course of the COVID-19 epidemic? Lancet. 2020;395(10228):931–4.
15. Jefferson T, Del Mar CB, Dooley L, Ferroni E, Al-Ansary LA, Bawazeer GA, van Driel ML, Nair S, Jones MA, Thorning S, Conly JM. Physical interventions to interrupt or reduce the spread of respiratory viruses. Cochrane Database Syst Rev. 2011 Jul 6;2011(7):CD006207.
16. Suess T, Remschmidt C, Schink SB, Schweiger B, Nitsche A, Schroeder K, et al. The role of facemasks and hand hygiene in the prevention of influenza transmission in households: results from a cluster randomised trial; Berlin, Germany, 2009-2011. BMC Infect Dis. 2012;12(1):26.
17. Liu X, Zhang S. COVID-19: face masks and human-to-human transmission. Influenza Other Respir Viruses. 2020 Mar. https://doi.org/10.1111/irv.12740.
18. Lancet T; The Lancet. COVID-19: too little, too late? Lancet. 2020;395(10226):755.
19. World Health Organization (WHO). China leaders discuss next steps in battle against coronavirus outbreak [Internet]. Genève: WHO; 2020. [updated 2020 Feb 7; cited 2020 AP 21]. Available from: https://www.who.int/news-room/detail/28-01-2020-who-china-leaders-discuss-next-steps-in-battle-against-coronavirus-outbreak
20. Chinese Center for Disease Control and Prevention (CDC). Chinese center for disease control and prevention (CDC) tips of prevention for COVID-19 [Internet]. 2020 [updated 2020 Apr 21; cited 2020 Ap 21]. Available from: http://www.inacdc.cn/jkzt/crb/zl/szkb_11803/jszl_2275/202003/t20200308_214205.html
21. Leung CC, Lam TH, Cheng KK. Mass masking in the COVID-19 epidemic: people need guidance. Lancet. 2020;395(10228):945.

**Appendix 1.** Tabled of excluded studies

| | |
|---|---|
| 1. Al-Jasser FS, Kabbash IA, AlMazroa MA, Memish ZA. Patterns of diseases and preventive measures among domestic hajjis from Central, Saudi arabia [complete republication] [complete republication]. East Mediterr Health J. 2013;19 Suppl 2:S34–41. https://doi.org/10.26719/2013.19.Supp2.S34 PMID:24673097 | It does not define the type of mask used by pilgrims. |
| 2. Allsopp J, Basu MK, Browne RM, Burge PS, Matthews JB. Survey of the use of personal protective equipment and prevalence of work related symptoms among dental staff. Occup Environ Med. 1997 Feb;54(2):125–34. https://doi.org/10.1136/oem.54.2.125 PMID:9072020 | It does not specify PPE and focuses on dentistry. |
| 3. Sim SW, Moey KS, Tan NC. The use of facemasks to prevent respiratory infection: a literature review in the context of the Health Belief Model. Singapore Med J. 2014 Mar;55(3):160–7. https://doi.org/10.11622/smedj.2014037 PMID:24664384 | Review approaching factors influencing the use of masks in the community. It does not specify the type of mask; masks in general. |
| 4. Lu YT, Chen PJ, Sheu CY, Liu CL. Viral load and outcome in SARS infection: the role of personal protective equipment in the emergency department. J Emerg Med. 2006 Jan;30(1):7–15. https://doi.org/10.1016/j.jemermed.2005.03.011 PMID:16434329 | Healthcare providers. |
| 5. Dato VM, Hostler D, Hahn ME. Simple respiratory mask. Emerg Infect Dis. 2006 Jun;12(6):1033–4. https://doi.org/10.3201/eid1206.051468 PMID:16752475 | Letter to the editor corroborating the use of homemade masks in past epidemics. |
| 6. Chughtai AA, Seale H, Dung TC, Hayen A, Rahman B, Raina MacIntyre C. Compliance with the Use of Medical and Cloth Masks Among Healthcare Workers in Vietnam. Ann Occup Hyg. 2016 Jun;60(5):619–30. https://doi.org/10.1093/annhyg/mew008 PMID:26980847 | Healthcare providers, surgical, and cloth masks. |
| 7. Tracht SM, Del Valle SY, Hyman JM. Mathematical modeling of the effectiveness of facemasks in reducing the spread of novel influenza A (H1N1). PLoS One. 2010 Feb;5(2):e9018. https://doi.org/10.1371/journal.pone.0009018 PMID:20161764 | Mathematical model. |
| 8. Rexroth U, Buda S. Praxismanagement und Arbeitsschutz während der Influenza-Pandemie 2009/2010 - Eine Umfrage unter 1150 Ärzten der Arbeitsgemeinschaft Influenza am Robert Koch-Institut. Gesundheitswesen. 2014 Oct;76(10):670–5. https://doi.org/10.1055/s-0033-1355402 PMID:24165918 | Healthcare providers. |
| 9. Lau MS, Cowling BJ, Cook AR, Riley S. Inferring influenza dynamics and control in households. Proc Natl Acad Sci USA. 2015 Jul;112(29):9094–9. https://doi.org/10.1073/pnas.1423339112 PMID:26150502 | Masks other than homemade cloth masks. |
| 10. Fahdiyani R, Raksanagara AS, Sukandar H. Influence of household environment and maternal behaviors to upper respiratory infection among toddlers. Kesmas: National Public Health Journal. 2016;10(3):120–6. https://doi.org/10.21109/kesmas.v10i3.589. | Healthcare providers. |
| 11. Lo JY, Tsang TH, Leung YH, Yeung EY, Wu T, Lim WW. Respiratory infections during SARS outbreak, Hong Kong, 2003. Emerg Infect Dis. 2005 Nov;11(11):1738–41. https://doi.org/10.3201/eid1111.050729 PMID:16318726 | Respiratory syndrome interventions were other than cloth masks. |
| 12. Cowling BJ, Fung RO, Cheng CK, Fang VJ, Chan KH, Seto WH, et al. Preliminary findings of a randomized trial of non-pharmaceutical interventions to prevent influenza transmission in households. PLoS One. 2008 May;3(5):e2101. https://doi.org/10.1371/journal.pone.0002101 PMID:18461182 | Surgical masks. |
| 13. Suess T, Remschmidt C, Schink SB, Schweiger B, Nitsche A, Schroeder K, et al. The role of facemasks and hand hygiene in the prevention of influenza transmission in households: results from a cluster randomised trial; Berlin, Germany, 2009-2011. BMC Infect Dis. 2012 Jan;12(1):26. https://doi.org/10.1186/1471-2334-12-26 PMID:22280120 | Surgical masks. |
| 14. Larson EL, Ferng YH, Wong-McLoughlin J, Wang S, Haber M, Morse SS. Impact of non-pharmaceutical interventions on URIs and influenza in crowded, urban households. Public Health Rep. 2010 Mar-Apr;125(2):178–91. https://doi.org/10.1177/003335491012500206 PMID:20297744 | Surgical masks. |
| 15. Cowling BJ, Chan KH, Fang VJ, Cheng CK, Fung RO, Wai W, et al. Facemasks and hand hygiene to prevent influenza transmission in households: a cluster randomized trial. Ann Intern Med. 2009 Oct;151(7):437–46. https://doi.org/10.7326/0003-4819-151-7-200910060-00142 PMID:19652172 | Surgical masks. |
| 16. MacIntyre CR, Zhang Y, Chughtai AA, Seale H, Zhang D, Chu Y, Zhang H, Rahman B, Wang Q. Cluster randomised controlled trial to examine medical mask use as source control for people with respiratory illness. BMJ Open. 2016 Dec 30;6(12):e012330. doi: 10.1136/bmjopen-2016-012330. PMID: 28039289; PMCID: PMC5223715. | Surgical masks. |
| 17. 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. 2015 Apr;5(4):e006577–006577. https://doi.org/10.1136/bmjopen-2014-006577 PMID:25903751 | Healthcare providers and surgical masks. |
| 18. Wang M, Barasheed O, Rashid H, Booy R, El Bashir H, Haworth E, et al. A cluster-randomised controlled trial to test the efficacy of facemasks in preventing respiratory viral infection among Hajj pilgrims. J Epidemiol Glob Health. 2015 Jun;5(2):181–9. https://doi.org/10.1016/j.jegh.2014.08.002 PMID:25922328 | Surgical masks. |
| 19. Turnberg W, Daniell W, Seixas N, Simpson T, Van Buren J, Lipkin E, et al. Appraisal of recommended respiratory infection control practices in primary care and emergency department settings. Am J Infect Control. 2008 May;36(4):268–75. https://doi.org/10.1016/j.ajic.2007.08.004 PMID:18455047 | Healthcare providers. |
| 20. Stuart RL, Gillespie EE, Kerr PG. A pilot study of an influenza vaccination or mask mandate in an Australian tertiary health service. Med J Aust. 2014 Feb;200(2):83–4. https://doi.org/10.5694/mja13.10947 PMID:24484101 | No outcome of interest, the mask is not specified. Letter to the editor. |
| 21. Wu J, Xu F, Zhou W, Feikin DR, Lin CY, He X, et al. Risk factors for SARS among persons without known contact with SARS patients, Beijing, China. Emerg Infect Dis. 2004 Feb;10(2):210–6. https://doi.org/10.3201/eid1002.030730 PMID:15030685 | Mask is not specified. |
| 22. Zhang Y, Seale H, Yang P, MacIntyre CR, Blackwell B, Tang S, et al. Factors associated with the transmission of pandemic (H1N1) 2009 among hospital healthcare workers in Beijing, China. Influenza Other Respir Viruses. 2013 May;7(3):466–71. https://doi.org/10.1111/irv.12025 PMID:23078163 | Healthcare providers. |
| 23. Chughtai AA, MacIntyre CR, Ashraf MO, Zheng Y, Yang P, Wang Q, et al. Practices around the use of masks and respirators among hospital health care workers in 3 diverse populations. Am J Infect Control. 2015 Oct;43(10):1116–8. https://doi.org/10.1016/j.ajic.2015.05.041 PMID:26184766 | Masks in hospitals. |
| 24. Shimasaki N, Okaue A, Kikuno R, Shinohara K. Comparison of the Filter Efficiency of Medical Nonwoven Fabrics against Three Different Microbe Aerosols. Biocontrol Sci. 2018;23(2):61–9. https://doi.org/10.4265/bio.23.61 PMID:29910210 | Laboratory study with masks other than homemade cloth masks. |
| 25. Matthews J, Slater K, Newsom SW. The effect of surgical gowns made with barrier cloth on bacterial dispersal. J Hyg (Lond). 1985 Aug;95(1):123–30. https://doi.org/10.1017/S0022172400062355 PMID:4020106 | Unrelated laboratory study. |
| 26. Nagayama A. Inactivation of influenza A virus by gentian violet (GV) and GV-dyed cotton cloth, and bactericidal activities of these agents. J Infect Chemother. 2006 Apr;12(2):73–9. https://doi.org/10.1007/s10156-005-0426-7 PMID:16648946 | Unrelated laboratory study. |
| 27. MacIntyre CR, Chughtai AA. Facemasks for the prevention of infection in healthcare and community settings. BMJ. 2015 Apr 9;350:h694. doi: 10.1136/bmj.h694 | Masks other than homemade cloth masks. |

**Appendix 2.** Search strategies

## PUBMED Strategy

#1 "Respiratory Tract Diseases"[Mesh] OR (Disease, Respiratory Tract) OR (Diseases, Respiratory Tract) OR (Respiratory Tract Disease) OR (Tract Disease, Respiratory) OR (Tract Diseases, Respiratory)
AND
#2 "Respiratory Protective Devices"[Mesh] OR (Device, Respiratory Protective) OR (Devices, Respiratory Protective) OR (Protective Device, Respiratory) OR (Protective Devices, Respiratory) OR (Respiratory Protective Device) OR (Respirators, Industrial) OR (Industrial Respirators) OR (Industrial Respirator) OR (Respirator, Industrial) OR (Gas Masks) OR (Gas Mask) OR (Mask, Gas) OR (Masks, Gas) OR (Respirators, Air-Purifying) OR (Air-Purifying Respirator) OR (Air-Purifying Respirators) OR (Respirator, Air-Purifying) OR (Respirators, Air Purifying) OR "Masks"[Mesh] OR (Mask*)
AND
#3 "Primary Prevention"[Mesh] OR (Disease Prevention, Primary) OR (Disease Preventions, Primary) OR (Primary Disease Prevention) OR (Primary Disease Preventions) OR (Prevention, Primary) OR (Primordial Prevention) OR (Preventions, Primordial) OR (Primordial Preventions) OR (Prevention, Primordial) OR "Secondary Prevention"[Mesh] OR (Prevention, Secondary) OR (Preventions, Secondary) OR (Secondary Preventions) OR (Secondary Disease Prevention) OR (Disease Prevention, Secondary) OR (Disease Preventions, Secondary) OR (Prevention, Secondary Disease) OR (Preventions, Secondary Disease) OR (Secondary Disease Preventions) OR (Relapse Prevention) OR (Prevention, Relapse) OR (Preventions, Relapse) OR (Relapse Preventions) OR (Early Therapy) OR (Early Therapies) or (Therapies, Early) OR (Therapy, Early)

## COCHRANE LIBRARY Strategy

| ID | Search |
|---|---|
| #1 | MeSH descriptor: [Respiratory Tract Diseases] explode all trees |
| #2 | (Disease, Respiratory Tract) or (Diseases, Respiratory Tract) or (Respiratory Tract Disease) or (Tract Disease, Respiratory) or (Tract Diseases, Respiratory) |
| #3 | #1 or #2 |
| #4 | MeSH descriptor: [Respiratory Protective Devices] explode all trees |
| #5 | (Device, Respiratory Protective) or (Devices, Respiratory Protective) or (Protective Device, Respiratory) or (Protective Devices, Respiratory) or (Respiratory Protective Device) or (Respirators, Industrial) or (Industrial Respirators) or (Industrial Respirator) or (Respirator, Industrial) or (Gas Masks) or (Gas Mask) or (Mask, Gas) or (Masks, Gas) or (Respirators, Air-Purifying) or (Air-Purifying Respirator) or (Air-Purifying Respirators) or (Respirator, Air-Purifying) or (Respirators, Air Purifying) |
| #6 | #4 or #5 |
| #7 | MeSH descriptor: [Masks] explode all trees |
| #8 | (Mask) |
| #9 | #7 or #8 |
| #10 | #6 or #9 |
| #11 | MeSH descriptor: [Primary Prevention] explode all trees |
| #12 | (Disease Prevention, Primary) or (Disease Preventions, Primary) or (Primary Disease Prevention) or (Primary Disease Preventions) or (Prevention, Primary) or (Primordial Prevention) or (Preventions, Primordial) or (Primordial Preventions) or (Prevention, Primordial) |
| #13 | #11 or #12 |
| #14 | MeSH descriptor: [Secondary Prevention] explode all trees |
| #15 | (Prevention, Secondary) or (Preventions, Secondary) or (Secondary Preventions) or (Secondary Disease Prevention) or (Disease Prevention, Secondary) or (Disease Preventions, Secondary) or (Prevention, Secondary Disease) or (Preventions, Secondary Disease) or (Secondary Disease Preventions) or (Relapse Prevention) or (Prevention, Relapse) or (Preventions, Relapse) or (Relapse Preventions) or (Early Therapy) or (Early Therapies) or (Therapies, Early) or (Therapy, Early) |
| #16 | #14 or #15 |
| #17 | #13 or #16 |
| #18 | #3 AND #10 AND #17 |

## VHL REGIONAL PORTAL Strategy

#1 MH:"Doenças Respiratórias" OR (Doença$ Respiratória$) OR (Doença$ do Aparelho Respiratório) OR (Doença$ do Sistema Respiratório) OR (Doença$ do Trato Respiratório) OR (Doença$ das Vias Respiratórias) OR (Doença$ do Aparelho Respiratório) OR (Doenças do Sistema Respiratório) OR (Doenças do Trato Respiratório) OR MH:C08$ OR MH:SP4.001.012.143$ OR MH:SP4.046.452.698.904$ OR (Enfermedades Respiratórias) OR (Respiratory Tract Disease$)
AND
#2 MH:Masks OR MasK$ OR Máscara$ OR MH:E07.325.877.500$ OR MH:E07.700.500$ OR MH:E07.858.594.750$ OR MH:J01.637.708.560.782$ OR MH:"Respiratory Protective Devices" OR (Dispositivos de Protección Respiratoria) OR (Dispositivos de Proteção Respiratória) OR (Air-Purifying Respirator) OR (Air-Purifying Respirators) OR (Device, Respiratory Protective) OR (Devices, Respiratory Protective) OR (Gas Mask) OR (Gas Masks) OR (Industrial Respirator) OR (Industrial Respirators) OR (Mask, Gas) OR (Masks, Gas) OR (Protective Device, Respiratory) OR (Protective Devices, Respiratory) OR (Respirator, Air-Purifying) OR (Respirator, Industrial) OR (Respirators, Air Purifying) OR (Respirators, Air-Purifying) OR (Respirators, Industrial) OR (Respiratory Protective Device) OR MH:E07.700.700$ OR MH:J01.637.708.560.937$ OR (Máscaras de Gás) OR (Respiradores Industriais) OR (Respiradores de Ar Purificado)
AND
#3 MH:"Primary Prevention" OR (Prevención Primaria) OR (Prevenção Primária) OR (Disease Prevention Primary) OR (Disease Preventions Primary) OR (Prevention Primary) OR (Prevention Primordial) OR (Preventions Primordial) OR (Primary Disease Prevention) OR (Primary Disease Preventions) OR (Primordial Prevention) OR (Primordial Preventions) OR MH:N02.421.726.758$ OR MH:N06.850.780.680$ OR MH:SP2.026.182 OR MH:"Secondary Prevention" OR (Prevención Secundaria) OR (Prevenção Secundária) OR (Disease Prevention, Secondary) OR (Disease Preventions, Secondary) OR (Early Therapies) OR (Early Therapy) OR (Prevention, Relapse) OR (Prevention, Secondary) OR (Prevention, Secondary Disease) OR (Preventions, Relapse) OR (Preventions, Secondary) OR (Preventions, Secondary Disease) OR (Relapse Prevention) OR (Relapse Preventions) OR (Secondary Disease Prevention) OR (Secondary Disease Preventions) OR (Secondary Preventions) OR (Therapies, Early) OR (Therapy, Early) OR MH:E02.897$ OR MH:N02.421.726.825$ OR MH:N06.850.780.750$ OR MH:SP2.026.187$

## EMBASE Strategy

#1 'respiratory tract disease'/exp OR (airway disease) OR (airway disorder) OR (respiration disease) OR (respiration tract disease) OR (respiratory disease) OR (respiratory disorder) OR (respiratory illness) OR (respiratory tract diseases) OR (respiratory tract disorder)
AND
#2 'gas mask'/exp OR Gasmask OR (respiratory protective devices) OR 'mask'/exp OR mask*
AND
#3 'primary prevention'/exp OR 'secondary prevention'/exp

## CINAHL Strategy

#1 (Respiratory Tract Diseases) OR (Disease, Respiratory Tract) OR (Diseases, Respiratory Tract) OR (Respiratory Tract Disease) OR (Tract Disease, Respiratory) OR (Tract Diseases, Respiratory)
AND
#2 (Respiratory Protective Devices) OR (Device, Respiratory Protective) OR (Devices, Respiratory Protective) OR (Protective Device, Respiratory) OR (Protective Devices, Respiratory) OR (Respiratory Protective Device) OR (Respirators, Industrial) OR (Industrial Respirators) OR (Industrial Respirator) or (Respirator, Industrial) OR (Gas Masks) OR (Gas Mask) OR (Mask, Gas) OR (Masks, Gas) OR (Respirators, Air-Purifying) OR (Air-Purifying Respirator) OR (Air-Purifying Respirators) OR (Respirator, Air-Purifying) OR (Respirators, Air Purifying) OR Mask*

## WEB OF SCIENCE Strategy

#1 (Respiratory Tract Diseases) OR (Disease, Respiratory Tract) OR (Diseases, Respiratory Tract) OR (Respiratory Tract Disease) OR (Tract Disease, Respiratory) OR (Tract Diseases, Respiratory)
AND
#2 (Respiratory Protective Devices) OR (Device, Respiratory Protective) OR (Devices, Respiratory Protective) OR (Protective Device, Respiratory) OR (Protective Devices, Respiratory) OR (Respiratory Protective Device) OR (Respirators, Industrial) OR (Industrial Respirators) OR (Industrial Respirator) or (Respirator, Industrial) OR (Gas Masks) OR (Gas Mask) OR (Mask, Gas) OR (Masks, Gas) OR (Respirators, Air-Purifying) OR (Air-Purifying Respirator) OR (Air-Purifying Respirators) OR (Respirator, Air-Purifying) OR (Respirators, Air Purifying) OR Mask*
AND
#3 (Primary Prevention) OR (Disease Prevention, Primary) OR (Disease Preventions, Primary) OR (Primary Disease Prevention) OR (Primary Disease Preventions) OR (Prevention, Primary) OR (Primordial Prevention) OR (Preventions, Primordial) OR (Primordial Preventions) OR (Prevention, Primordial) OR (Secondary Prevention) OR (Prevention, Secondary) OR (Preventions, Secondary) OR (Secondary Preventions) OR (Secondary Disease Prevention) OR (Disease Prevention, Secondary) OR (Disease Preventions, Secondary) OR (Prevention, Secondary Disease) OR (Preventions, Secondary Disease) OR (Secondary Disease Preventions) OR (Relapse Prevention) OR (Prevention, Relapse) OR (Preventions, Relapse) OR (Relapse Preventions) OR (Early Therapy) OR (Early Therapies) OR (Therapies, Early) OR (Therapy, Early)

## SCOPUS Strategy

#1 (Respiratory Tract Diseases) OR (Disease, Respiratory Tract) OR (Diseases, Respiratory Tract) OR (Respiratory Tract Disease) OR (Tract Disease, Respiratory) OR (Tract Diseases, Respiratory)
AND
#2 (Respiratory Protective Devices) OR (Device, Respiratory Protective) OR (Devices, Respiratory Protective) OR (Protective Device, Respiratory) OR (Protective Devices, Respiratory) OR (Respiratory Protective Device) OR (Respirators, Industrial) OR (Industrial Respirators) OR (Industrial Respirator) or (Respirator, Industrial) OR (Gas Masks) OR (Gas Mask) OR (Mask, Gas) OR (Masks, Gas) OR (Respirators, Air-Purifying) OR (Air-Purifying Respirator) OR (Air-Purifying Respirators) OR (Respirator, Air-Purifying) OR (Respirators, Air Purifying) OR Mask
AND
#3 (Primary Prevention) OR (Disease Prevention, Primary) OR (Disease Preventions, Primary) OR (Primary Disease Prevention) OR (Primary Disease Preventions) OR (Prevention, Primary) OR (Primordial Prevention) OR (Preventions, Primordial) OR (Primordial Preventions) OR (Prevention, Primordial) OR (Secondary Prevention) OR (Prevention, Secondary) OR (Preventions, Secondary) OR (Secondary Preventions) OR (Secondary Disease Prevention) OR (Disease Prevention, Secondary) OR (Disease Preventions, Secondary) OR (Prevention, Secondary Disease) OR (Preventions, Secondary Disease) OR (Secondary Disease Preventions) OR (Relapse Prevention) OR (Prevention, Relapse) OR (Preventions, Relapse) OR (Relapse Preventions) OR (Early Therapy) OR (Early Therapies) OR (Therapies, Early) OR (Therapy, Early)