

Best evidence topic report

Title	Do homemade facemasks work as a preventive measure for virus transmission?	
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Clinical scenario	Since the outbreak of COVID-19, we are facing an imminent shortage of surgical facemasks and respirators to protect patients and healthcare workers. Inspired by the widespread use of cloth masks in Asia, alternatives out of cotton and old bras are on the rise in Belgium. This raises the question whether these homemade facemasks are effective in the prevention of virus transmission. And if so, which materials are most suitable.	
Answerable question (PICO)	P: General population I: Homemade facemasks crafted from common materials C: Medical/surgical facemasks or respirators (N95, FFP2) or no mask O: Preventing further spreading of respiratory viruses	
Search terms	We searched through Pubmed, Embase, Cochrane and the specific COVID-19 database LitCovid by using terms such as: "Masks"[Mesh], "Viruses"[Mesh], "Coronavirus"[Mesh], infection, "Respiratory Protective Devices"[Mesh], "Developing Countries"[Mesh], "Masks"[Mesh], "Influenza, Human"[Mesh], 'surgical mask'/exp, 'mask'/exp, 'coronavirinae'/exp, 'droplet infection'/exp, 'cloth mask', virus, 'cotton'/exp, 'respiratory tract infection'/exp, 'cotton'/exp, 'face mask'/exp, 'coronavirinae'/exp, 'face mask'/exp, 'influenza virus'/exp, Mask, droplet infection, coronavirinae, "homemade protection masks", "Pandemics"[Mesh], "Masks/statistics and numerical data"[Mesh], "Respiratory Protective Devices"[Mesh], "Cotton Fiber"[Mesh], cotton, nanofabric, microfiber, muslin, influenza, respiratory infection, "cloth masks"	
Search date	17/03/2020 – 20/03/2020	
Search outcome	848 articles	
Selection criteria	<p><u>Inclusion criteria</u></p> <ul style="list-style-type: none"> - Concerning facemasks and virus transmission - Concerning materials and particle penetration - Patients: General population or healthcare workers - Any study type - Time window: none - Language: English 	<p><u>Exclusion criteria</u></p> <ul style="list-style-type: none"> - No mention of either selfmade masks, facemasks or cloth masks - Insufficient quality or no added value - Full free text unavailable

Relevant Papers (Final inclusions)	7
Flow chart	<pre> graph TD subgraph Database_search [Database search] P[Pubmed (n = 436)] E[Embase (n = 320)] C[Cochrane (n = 76)] L[LITCOVID (n = 13)] R[Reference tracking (n = 3)] end P --> S[Records after title and abstract screening (n = 18)] E --> S C --> S L --> S R --> S S --> F[Full text review (n = 18)] F --> I[Full-text articles included (n = 7)] F --> D[Did not meet inclusion/exclusion criteria (n = 11)] </pre>

Evidence table

Author, date and country	Patient characteristics	Study type	Intervention	Key results	Study weaknesses/bias	Conclusion
MacIntyre et al. 2015, VIETNAM (1)	<ul style="list-style-type: none"> - 1607 healthcare workers (HCW) > 18 y/o (nurses and doctors) - 14 secondary/tertiary - Hospitals in Hanoi 	<p>Randomised controlled trial</p> <ul style="list-style-type: none"> - Cluster randomisation by using Epi info V.6 for allocation of 74 wards (emergency, infectious/respiratory disease, intensive care and paediatrics) containing 1607 HCW. - Daily follow-up - Labo testing and results were blinded. Clinical end points unblinded. - Compliance monitored by a self-reporting mechanism. - ITT analysis, yet no withdrawals. 	<ul style="list-style-type: none"> - HCW randomised in 3 groups: medical mask or cloth mask or control group (usual practice of mask). - Continuous mask use every shift during 4 consecutive weeks + 1 week follow-up for appearance of symptoms. - Outcome parameters: clinical respiratory illness (CRI), influenza-like illness (ILI), laboratory confirmed viral infections, compliance. 	<ul style="list-style-type: none"> - Rates of all infection outcomes highest in the cloth mask arm: ILI (relative risk (RR) =13.00, 95% CI 1.69 to 100.07) - ILI (RR = 6.64; 95% CI 1.45 to 28.65) and confirmed viral infections (RR = 1.72; 95% CI 1.01 to 2.94) significantly higher in cloth mask group. - Penetration: cloth masks 97%, medical masks 44%. 	<ul style="list-style-type: none"> - No allocation bias - No withdrawal bias - No attrition bias - No reporting bias - Ascertainment bias due to unblinded clinical end points, since a facemask is a visible intervention. - Lack of a no-mask control group: high rate of mask use in the controls through standard practice mask use impedes interpretation. - Recall bias: compliance was measured through a self-reporting mechanism. - Quality of cloth masks varies, not generalizable. 	<p>No evidence homemade masks play a role in the reduction of transmission of respiratory viral infections, instead the moisture retention, reuse of cloth masks and poor filtration may result in increased risk of infection.</p> <p>Cloth masks should not be recommended.</p>

MacIntyre et al. 2015, AU (2)	- People in community setting and healthcare setting	Review (not SR) of 9 cluster RCT's, of which 3 concerning cloth facemasks: - Larson et al. 2009 (open label) (3) - Cowling et al. 2010 (single blind) (4) - Suess et al. 2012 (single blind) (5)	Comparison of the effectivity of surgical masks, face masks and respirators for droplet and airborne viruses.	- Community setting: people in high risk settings could benefit from facemasks. - Healthcare setting: only medical masks and respirators offer enough protection. - cloth masks only when no other option. - Compliance is a determinant of protection.	- Confounding effect due to pooled analysis with medical masks or simultaneous use of hand sanitizer. ^{3,4,5} - Low compliance ^{3,4,5} - Self-reporting bias ^{3,4,5} - Performance bias: use of masks in control group. ⁴ - Suboptimal fit of the masks ⁴	No evidence cloth masks play a role in the reduction of respiratory viral infections, yet widespread use in developing countries because of the lower cost and reusability. Further research on cloth masks is needed.
Davies et al. 2013 ENG (6)	- Healthy volunteers - 12 men, 9 women (20-44 y/o)	In-vitro and in-vivo observational study	Materials tested on penetrance of 20nm particles. Air sampling 5min after healthy volunteers cough in closed box, thereafter bacteria are cultivated on settle plates.	- Household materials have a filter efficiency of 50-89% against 20nm particles. - No difference in forming of bacterial colonies.	- Not enough power - Higher than realistic compliance - Suboptimal fit of the mask - Population sampling error possible	Homemade facemasks are not recommended as they offer minimal protection.
Van der Sande et al. 2008 NL, USA (7)	- 1 st exp: 28 adults and 11 children (5-11y/o) - 2 nd exp: 22 adults (10 men en 12 women) - 3 rd exp: artificial in-vitro	In-vitro and in-vivo observational study	Testing inward and outward protection of FFP2 masks, surgical masks and homemade masks out of tea cloth, worn for variable amounts of time and while performing tasks of varying intensity.	- Protection mainly depends on type of mask. - Tea cloth masks still offer some degree of protection.	- Not enough power - Higher than realistic compliance - No data on coughing - Population sampling error	Homemade masks offer some degree of protection, however significantly less than the FFP2 masks.

				- Protection decreases over time.	possible	
Rengasamy et al. 2010 USA (8)	NA	In-vitro observational study	Penetration of household materials are tested for 20-1000nm particles.	Penetration: - Cloth 74-90%. - Cotton/polyester T-shirt 40-% depending on composition. - Cotton T-shirt > 85%. - Towel 60-66%. - Scarf 73-89%.	- Not enough power - Use of nanoparticles, not viruses - Sampling error of fabrics possible	Homemade masks are not recommended as materials are > 50% penetrable by small particles.
Shakya et al. 2010 USA (9)	NA	In-vitro observational study	Penetration of 3 cloth masks obtained from street vendors are tested for 30-500nm particles compared to surgical masks and 2 types of N95 respirators.	Penetration of regular cloth mask is 60-80% by particles < 100nm.	- Not enough power - Use of nanoparticles, not viruses - Sampling error of fabrics possible	No evidence homemade masks play a role in the reduction of respiratory viral infections.
Golanski et al. 2009 FR (10)	NA	In-vitro observational study	Particle flow through cotton and industrial fabrics of 40nm and 80nm graphite particles with low velocity.	- Cotton has a penetrance of 27% at low velocity particle flow. - Industrial fabrics are significantly less penetrable.	- Not enough power - Use of nanoparticles, not viruses - Sampling error of fabrics possible - Velocity of particle flow is not representative for airflow when breathing or coughing.	Non-woven industrial fabrics are less penetrable for nanoparticles than cotton.

Main results

None of the in-vivo studies recommend the use of cloth facemasks as they offered poor protection against viruses. In-vitro studies showed that household materials such as cotton and cotton-polyester blend are mostly permeable for virus-sized particles.

The level of protection provided by homemade facemasks is mainly determined by the used material, compliance and correctness of fit.

Conclusion

The majority of studies caution against the use of cloth masks made of fabrics such as cotton or cotton-polyester blend, for the prevention of virus transmission, especially for health care professionals. Infection rates have shown to be much higher in cloth masks compared to disposable medical masks. Hence, most of these masks are over 50% permeable to nanometer-range particles, and therefore provide very little protection to the COVID-19 droplet particles which range from 50 to 200 nm.

Heavy materials such as towels and tea cloths perform slightly better compared to T-shirts, yet have to compromise on respiratory comfort, which reduces the compliancy of use. Furthermore, due to a poor fit, leakage of viral particles reduce their protective effect.

However, if respirators or surgical masks are not available in a pandemic, cloth masks may be used on the principle that 'something is better than nothing'. Nevertheless, this strategy is highly discouraged for healthcare workers, who are at a higher risk of exposure, given that a cloth mask won't provide enough protection.

Comment

Scientific data are sparse. Other than one RCT, no studies have been conducted concerning the efficacy of cloth masks, due to the introduction of disposable medical masks and respirators. Consequently, it is difficult to determine whether these homemade cloth masks offer any clinical protection. Further profound research and international guidelines are needed.

Clinical bottom line

Homemade face masks provide insufficient protection against viruses. Therefore, their use is cautioned in any health care setting.

References

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- 2) MacIntyre C Raina, Chughtai Abrar Ahmad. (2015). Facemasks for the prevention of infection in healthcare and community settings *BMJ*; 350 :h694
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- 10) Golanski L, Guiot A, Rouillon F, Pocachard J and Tardif F. (2009). Experimental evaluation of personal protection devices against graphite nanoaerosols: fibrous filter media, masks, protective clothing, and gloves. *Human & Experimental Toxicology*, 28(6–7), 353–359. <https://doi.org/10.1177/0960327109105157>

Supplementary table of search strategy:

Database	Search terms	#Hits	# publications after title and abstract screening
PUBMED			
Pubmed	("Masks"[Mesh] AND "Viruses"[Mesh] AND infection	89	1
Pubmed	("Respiratory Protective Devices"[Mesh] AND "Coronavirus"[Mesh]	3	0
Pubmed	((masks[MeSH Terms] OR respiratory protective devices[MeSH Terms]) AND respiratory virus[MeSH Terms]	105	0
Pubmed	home made protection masks	11	1
Pubmed	("Masks/standards"[Mesh] AND "Pandemics"[Mesh]	2	2 (1 double)
Pubmed	("Masks/statistics and numerical data"[Mesh] AND "Respiratory Protective Devices"[Mesh])	28	2
Pubmed	("Respiratory Protective Devices"[Mesh] AND "Cotton Fiber"[Mesh]	0	0
Pubmed	"Masks"[Mesh] AND cotton	22	7 (1 double)
Pubmed	((("Masks/standards"[Mesh]) AND "Cotton Fiber"[Mesh]) AND "Viruses"[Mesh]	0	0
Pubmed	"Masks"[Mesh] AND nanofabric	0	0
Pubmed	"Masks"[Mesh] AND microfiber	0	0

Pubmed	"Masks"[Mesh] AND muslin	1	0
Pubmed	("Respiratory Protective Devices"[Mesh]) AND "Developing Countries"[Mesh]	2	1
Pubmed	(("Masks"[Mesh]) AND "Influenza, Human"[Mesh])	173	3 (all doubles)
EMBASE			
embase	('surgical mask'/exp OR 'mask'/exp) AND ('coronavirinae'/exp OR 'droplet infection'/exp)	115	0
Embase	'cloth mask':ab,ti AND virus:ab,ti	1	1
Embase	'cotton'/exp/mj AND 'respiratory tract infection'/exp/mj	9	0
Embase	('cotton'/exp OR 'face mask'/exp) AND 'coronavirinae'/exp	77	2
Embase	'face mask'/exp AND 'influenza virus'/exp	118	0
COCHRANE			
Cochrane	mask in Keyword AND droplet infection in Keyword	0	0
Cochrane	mask in Title Abstract Keyword AND coronavirinae in Title Abstract Keyword	1	0

Cochrane	mask in Title Abstract Keyword AND "respiratory protective device" in Title Abstract Keyword AND "respiratory infection" in Title Abstract Keyword	4	0
Cochrane	mask in Keyword AND influenza in Keyword OR respiratory infection in Keyword	62	0
Cochrane	facemask in Title Abstract Keyword AND droplet infection in Title Abstract Keyword	1	0
Cochrane	face-mask" in Keyword AND influenza in Keyword	8	0
LITCOVID	cloth masks	13	0
REFERENCE TRACKING		3	1