Technoleg Iechyd Cymru
Health Technology Wales

Rapid summary: Face coverings to reduce COVID-19 transmission

Rapid summaries are designed to provide evidence-based answers to a question about a health technology. They may also highlight gaps and uncertainties in the existing evidence. They aim to provide a balanced overview of the evidence base, but they are not underpinned by exhaustive literature searches due to the short timescales in which they are produced.

Question:	What is the effectiveness of face coverings used in the community to reduce rates of COVID-19 transmission and infection, and what guidelines exist on their use?
Summary of findings:	The widespread use of face coverings by healthy people in the community setting is not supported by high-quality or direct scientific evidence, and there are potential benefits and harms to consider regarding use of face coverings in the community. A range of systematic reviews, meta-analyses and primary studies, mainly investigating protection against influenza, have come to differing conclusions about the value of using face coverings to reduce disease transmission in community settings. Low-reliability evidence from observational studies suggests that face coverings support a protective effect in the community, but evidence from randomised trials is inconclusive. There are indirect data and weak direct evidence that use of face coverings by symptomatic individuals may reduce COVID-19 transmission. The effect of face coverings for source control in asymptomatic individuals is less well studied: retrospective studies suggest their use may reduce COVID-19 transmission, but these findings have very low reliability and did not specify the type of face covering used. Many countries, supported by WHO advice, now recommend wearing cloth face coverings in public settings where other social distancing measures are difficult to maintain. Most guidance states that the use of face coverings alone is insufficient to provide an adequate level of protection or source control, and other personal and community level measures should also be adopted to suppress transmission of COVID-19. The extent of any protection will depend on how face coverings are made and used, and how face covering use affects the behaviour of the user and those around them. There is not enough evidence to draw quantifiable conclusions about public acceptance of face coverings, adherence to their use, or any potential harms arising from their use. Further high-quality trials are needed to assess when wearing a face covering in the community is most likely to be protective.
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The health problem/intervention

Introduction
The SARS-CoV-2 virus, which causes COVID-19, is likely to be transmitted mainly by droplets. Relatively large droplets emitted from the respiratory tract, by coughing, sneezing and speaking, quickly turn into aerosols (smaller microdroplets). Face coverings may protect the wearer work by blocking tiny aerosolised particles. In contrast, source control face coverings protect other people from the larger droplets emitted by the wearer of the face covering. Evidence suggests that a significant portion of individuals with COVID-19 are asymptomatic, and that even those who are pre-symptomatic can transmit the virus to others before showing symptoms. This means that the virus can spread between people interacting in close proximity, even if those people are not exhibiting symptoms.

Definitions
Face masks are typically used in certain work environments (e.g. healthcare settings) and classified as filtering facepiece respirators (e.g. N95, FFP2/3) or medical/surgical masks. These are required to comply with regulations and standards. Face coverings (also known by terms such as non-medical/non-surgical, community, home-made, cloth or fabric, etc.) are usually not standardised or intended for use in healthcare settings. Cloth face coverings typically are reusable, washable items, and include common household items, such as scarves, bandanas, handkerchiefs, hand-sewn masks, and commercially available masks, such as biking masks and pollution masks. The unlimited combination of fabrics and materials of non-medical face coverings results in variable filtration and breathability.

Scope of report
Health Technology Wales researchers searched for evidence on how the use of face coverings affects rates of community-based transmission or infection. We looked for evidence specifically on COVID-19 but also evidence on transmission/infection of other respiratory viruses. We looked for evidence on both surgical/medical masks and community face coverings, but focussed on community face coverings as these are more likely to be used by the general population. Respirators were included where they were used as a control for another type of face covering.

Evidence overview

Secondary evidence

Published UK guidance
Guidance from the UK Government states that the general public should wear a face covering in enclosed public spaces where physical distancing isn't possible and where there will be contact with people they do not normally meet. The guidance states that it is compulsory for all passengers on public transport, and all hospital visitors and outpatients in England to wear a face covering at all times. The guidance refers to an evidence base which suggests that wearing a face covering does not protect the wearer of the face covering, but it may protect others if the wearer is infectious (Cabinet Office. 2020). A Press release from the British Medical Association states that masks "should not be restricted to public transport but to all areas where physical distancing is not always possible" (British Medical Association. 2020). From 24 July 2020, face coverings were made mandatory in shops, supermarkets, shopping centres, transport hubs, banks/building societies, post offices, and when buying food and drink to take away from cafes and shops in England (Department of Health and Social Care. 2020).

UK Government advises that a face covering is not the same as the surgical masks or respirators used by healthcare professionals and other workers, as part of personal protective

equipment. These should continue to be reserved for those who need them to protect against risks in their workplace (Cabinet Office. 2020).

The Scottish Government made face coverings mandatory in shops, on public transport and in some public transport premises. The advice states that people in Scotland should wear a face covering in enclosed spaces where physical distancing is difficult and where there is a risk of close contact with multiple people who are not members of the same household. They note that there is no evidence to suggest there might be a benefit outdoors from wearing a face covering, unless in a crowded situation (Scottish Government. 2020).

The Government in Northern Ireland advises that the general public consider using face coverings outside of the home in enclosed spaces where physical distancing is not possible. It was mandatory to wear a face covering on public transport in Northern Ireland from 10 July 2020 (NIdirect government services. 2020).

Published international guidance

The World Health Organization (WHO) published interim guidance on 5 June 2020 where they advised that to prevent COVID-19 transmission effectively in areas of community transmission, governments should encourage the general public to wear fabric face coverings where there is widespread transmission and physical distancing is difficult, such as on public transport, in shops or in other confined or crowded environments. WHO advises that medical masks should be reserved for health workers and at-risk individuals when indicated (World Health Organization. 2020).

Recommendations on cloth face coverings during the COVID-19 outbreak vary across countries. In Europe, countries including the Czech Republic, Germany, Slovakia, and Bosnia-Herzegovina have mandated the compulsory use of surgical face masks or cloth face coverings in the general population. Asian countries such as China, South Korea, and Japan have adopted use of surgical masks or cloth face coverings in public areas as a common hygienic practice. In Africa, Morocco made wearing face masks in public mandatory and encouraged textile factories across the country to produce cloth face coverings (ECRI. 2020).

The Centers for Disease Control and Prevention (2020) in the US recommends wearing cloth face coverings in public settings and when around people who are from a different household, especially when other social distancing measures are difficult to maintain.

The Government of Canada (2020) recommends wearing a homemade face covering in the community for periods of time when it is not possible to consistently maintain a two-metre physical distance from others, particularly in crowded public settings, such as stores, shopping areas and public transportation. In some jurisdictions, the use of face coverings in many indoor public spaces and on public transit is now mandatory.

Systematic reviews and other evidence reviews

Evidence for effectiveness against COVID-19

Low-certainty evidence from a meta-analysis of 10 adjusted observational studies (n = 2,647) investigating the association between use of various types of face masks, respirators and face coverings by health-care workers, patients, or both, with virus transmission of severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERs) or COVID-19 showed that the use of face protection resulted in a reduction in risk of infection (pooled adjusted odds ratio [OR]: 0·15, 95% confidence interval [CI]: 0·07 to 0·34, risk difference: −14·3%, 95% CI: −15·9 to −10·7). There was a stronger association with reduced infection risk with N95 or similar respirators compared with disposable surgical masks or similar (e.g., reusable 12–16-layer cotton face coverings). Although the data showed that either disposable surgical masks or reusable 12–16-layer cotton face coverings were associated with protection of healthy

individuals within households and among contacts of cases, there were limitations: only one of the included studies investigated COVID-19, all studies were non-randomised, there was limited information about the situations when respirators were used and about how exposure was measured, and most were conducted in healthcare settings in which aerosol-generating procedures were performed (Chu et al. 2020).

One non-peer-reviewed systematic review by Marasinghe (2020) searched for evidence that investigated the effectiveness of medical or surgical masks, or N95 respirators, in limiting the spread of COVID-19 among those who are not medically diagnosed with COVID-19. No relevant studies of any design were identified, although the review only considered evidence published up to mid-March 2020 and may now be outdated.

A peer-reviewed living rapid review (Chou et al. 2020) did not identify any studies evaluating masks or face coverings for the prevention of COVID-19 in community settings. Two cohort studies (530 participants) evaluated mask use and risk for COVID-19 in the health care setting. One of the studies found that N95 respirators were associated with a decreased infection risk versus no mask. The other study evaluated health care workers with inadequate personal protective equipment during exposure to a patient with unrecognised COVID-19: three out of 37 health care workers reported cases of COVID-19.

The Scientific Advisory Group for Emergencies (SAGE) commissioned and considered two rapid reviews produced by the Usher Network for COVID-19 Evidence Reviews. One review looked at whether the use of face masks and coverings in the general population make a difference to the spread of infection, and the other review investigated whether homemade face coverings are effective at reducing transmission of COVID-19 in community settings. Both reports found 11 articles looking at homemade face coverings. They concluded that the quality of the evidence available was very low. The reports state that homemade masks are not effective at filtering respiratory aerosols, but they can reduce transmission by mitigating aerosol dispersal and reduce transmission through droplets. Whilst the reports suggest that homemade face coverings can reduce the risk of transmitting or acquiring COVID-19 through reducing environmental (surface) contamination, they note that encouraging the use of face coverings may have some negative consequences, such as giving people a false sense of security and encouraging behaviour that puts people at increased risk of infection. The reports suggest that better quality research in community settings in the UK is needed (Usher. 2020).

Evidence for effectiveness against other respiratory viruses

We identified numerous recent systematic reviews investigating the effectiveness of face masks and face coverings against respiratory viruses other than COVID-19. The studies typically involved surgical masks or the type of face protection was not specified. The infection control measures to which face masks/face coverings were compared were not always clear but included no background infection control measures or use of hand hygiene alone (to our knowledge, no studies included a control group that used social distancing measures). The findings of the systematic reviews are summarised below.

A meta-analysis by the WHO (2019) pooled ten studies to quantify the efficacy of community-based use of face masks in the reduction of influenza virus infection. The findings indicate uncertainty in whether addition of face masks reduces the number of influenza cases (risk ratio: 0.78, 95% CI: 0.51 to 1.20, I^2 = 30%, p = 0.25 for face masks only; risk ratio: 0.92, 95% CI: 0.75 to 1.12, I^2 = 30%, p = 0.40 for face masks with or without hand hygiene).

A meta-analysis by The Royal Society and The British Academy (2020) investigated cloth (including ≥12-layer gauze masks) and paper face coverings for the protection of wearers in healthcare settings in China. Three of the studied provided statistics for SARS cases and one for influenza H1N1. They found that for SARS and H1N1 infections, the use of both cloth/≥12-layer gauze and paper face coverings is associated with a statistically significant reduction of the infection risk (pooled risk ratio = 0.49, 95% CI: 0.30 to 0.78, n = 888). However, there was considerable heterogeneity in the findings.

Aggarwal et al (2020) conducted a systematic review and meta-analysis of RCTs studying face masks for the prevention of viral respiratory infections in community settings. They found no significant reduction in influenza-like illness either with face masks alone (n = 5, pooled effect size: −0.17; 95% confidence interval [CI]: −0.43 to 0.10; P = 0.23; I^2 = 10.9%) or face mask with handwash (n = 6, pooled effect size: −0.09; 95% CI: −0.58 to 0.40; P = 0.71, I^2 = 69.4%).

Liang et al (2020) conducted a systematic review of 21 studies studying the use of medical and surgical masks, N95 respirators, and cotton and paper face coverings by healthcare workers and non-healthcare workers. Meta-analyses suggested that mask use provided a significant protective effect (OR: 0.35, 95% CI: 0.24 to 0.51). Data showed that masks worn by non-healthcare support workers can reduce the risk of virus infection by 56% in non-household settings. The authors concluded that face masks/face coverings could serve as an adjunctive method of protection regarding the COVID-19 outbreak.

A systematic review of 10 RCTs did not find evidence that surgical-type face masks are effective in reducing laboratory-confirmed influenza transmission, either when worn by infected persons (source control) or by persons in the general community to reduce their susceptibility (Xiao et al. 2020).

A rapid systematic review of RCTs studied the efficacy of facemasks and respirators for reducing transmission of respiratory viruses in healthcare workers, patients and the general public. Eight RCTs were set in the community, six in healthcare settings and five as source control. In the community, facemasks appeared to be effective with and without hand hygiene, and both together were found to be more protective. Medical facemasks in healthcare settings were not effective, and cloth face coverings were even less effective (MacIntyre and Chughtai. 2020).

Perski et al (preprint.2020) conducted a rapid evidence review using a Bayesian statistical approach to analyse experimental and observational studies conducted in non-UK community-dwelling children and adults that assessed the effectiveness of face mask wearing (versus no face masks) on viral respiratory infections (not COVID-19). They reported that the available

evidence from RCTs is equivocal as to whether wearing face masks in community settings results in a reduction in viral respiratory infections.

A non-peer-reviewed systematic review of 31 studies of the transmission of influenza-like illness linked to the use of mainly surgical face masks worn by non-health professionals found that wearing a face mask did not statistically significantly reduce the odds of developing influenza-like illness or respiratory symptoms. The authors concluded that that the evidence was too uncertain to support the widespread use of face masks as a protective measure against COVID-19, but that there is enough evidence to endorse the use of face masks for short periods of time by vulnerable individuals when in transient higher risk situations, such as on public transport or visiting shops (Brainard et al. 2020).

Bakhit et al (2020) conducted a non-peer-reviewed systematic review and meta-analysis of 11 RCTs and observational studies evaluating the downsides of face masks or face coverings and other challenges to their use such as adherence to their use. Community and healthcare settings were included. The most commonly reported outcomes were difficulties breathing and facial irritation/discomfort, which increased with duration of continuous wear. Compared to the control group, 47% more people wore face masks, and adherence was significantly higher in the surgical/medical mask group than in the N95/P2 group. No evidence was found that reported on face covering/mask contamination or risk, or whether risk compensation behaviours were associated with their use. The review authors conclude that there is insufficient data to quantify all of the adverse effects that might reduce the acceptability, adherence and effectiveness of face masks, and it recommends that new research on face masks should assess and report the harms and downsides.

Another non-peer-reviewed systematic review and meta-analysis of eight RCTs studied the efficacy of wearing face masks to prevent influenza-like illness in the community setting. They reported that participants wearing face masks had a significantly lower risk of developing influenza-like illness than those not wearing face masks (pooled risk ratio: 0.81, 95% CI: 0.70 to 0.95). The decreased risk of influenza-like illness was more pronounced if everyone wore a face mask irrespective of whether they were infected or not (Wei et al. 2020).

A Clinical Evidence Assessment by ECRI (April 2020) found that evidence for cloth face coverings worn by public to reduce transmission of viral respiratory infection (COVID-19) is inconclusive.

We identified a narrative review (Howard et al. 2020), which discussed the available evidence relating to the effectiveness of face coverings to protect against COVID-19. The review states that although no randomised controlled trials on the use of face coverings as source control for SARS-CoV-2 have been published, a number of studies have attempted to indirectly estimate the efficacy of face coverings. Based on the available evidence, the authors recommend the adoption of public cloth face covering-wearing, as an effective form of source control, in conjunction with existing hygiene, distancing, and contact tracing strategies.

A Cochrane evidence review found "moderate certainty evidence shows that the use of handwashing plus masks probably reduces the spread of respiratory viruses, but results for masks alone were inconclusive, and reviewers rated the evidence as very low certainty" (Burch and Bunt. 2020).

Other sources

Evidence for effectiveness against COVID-19

A rapid expert consultation on the effectiveness of fabric face coverings for the COVID-19 pandemic, did not identify studies of individuals wearing homemade fabric coverings during their typical activities. The evidence identified was indirect evidence, primarily laboratory studies testing the effectiveness of different face covering materials. They concluded that, overall, the available evidence is inconclusive about the degree to which homemade fabric face coverings may suppress the spread of infection from the wearer to others (National Academies of Sciences, Engineering, and Medicine. 2020).

A non-peer-reviewed update to a report by the Data Evaluation and Learning for Viral Epidemics (DELVE), a group convened by the Royal Society, suggests that face coverings can reduce the risk of transmission and provide protection to the wearer. This is based on observational and modelling data in humans, on the effectiveness of masks in intercepting droplets and aerosols and on controlled studies of experimental animals (Edelstein and Ramakrishnan. 2020).

A second non-peer reviewed report by the Royal Society's Science in Emergencies Tasking (SET-C)–COVID-19 group looked at the effectiveness of different face mask types and coverings and highlights behavioural factors that have limited adherence, such as public understanding of the virus transmission, risk perception, trust, effectiveness of public messages and perceived barriers to wearing a mask (Royal Society and The British Academy. 2020).

Wang et al (2020) conducted a retrospective cohort study of households in China and found support for the efficacy of face masks (unstated type) in prevention of the transmission of COVID-19 from asymptomatic/pre-symptomatic individuals in indoor settings. Face mask-use by the primary case and their family contacts before the primary case developed symptoms was 79% effective in reducing transmission in comparison to controls. In a multivariable regression logistic model, four factors were significantly associated with household transmission: one of these was ≥ 1 family member wearing a mask at home before disease onset in index case (odds ratio: 0.21, 95% CI: 0.06 to 0.79).

A recent study from Hong Kong supports the role of masks in preventing indoor transmission. Of the 14 case clusters occurring over the first 100 days of the pandemic, all of them were indoor settings and 11 of them (113 cases) occurred in recreational mask-off settings (bars, restaurants, gyms). There were three clusters (11 cases) in workplace mask-on settings ($p = 0.04$). The authors also surveyed mask-wearing compliance of 10,050 pedestrians and found that 97% of them were wearing masks. They make the argument that universal mask wearing is one of the reasons why Hong Kong has had sustained control over transmission (Cheng et al 2020).

Mitze et al (2020) compared the COVID-19 incidence in a German city which had early adoption of a universal public face mask (unspecified type) requirement, to other German cities and regions, using a 'synthetic control' method in a natural experiment that attempted to control for the influence of other variables on infection rates. They estimated that the face mask-wearing policy resulted in a 40% to 60% decrease in the daily growth rate of the epidemic.

An observational study of a COVID-19 outbreak on a US Naval aircraft carrier found that a face use of a face covering was significantly associated with a decreased risk of becoming infected (odds ratio: 0.3, 95% CI: 0.2 to 0.5). This study suggests that face coverings can also provide protection to the wearer (Payne et al. 2020).

An ecological study by Kenyon et al (2020) found an association between whether countries advocated face mask use and the number of diagnosed cases of COVID-19 ($p = 0.02$). However, this study is subject to major biases and considerable residual confounding variables.

A number of modelling studies support the use of face masks in reducing transmission of COVID-19 (Stutt et al 2020; Ngonghala et al 2020; Eikenberry et al 2020). A non-peer-reviewed mathematical model by Tian et al (2020) suggests that a face covering that is 60% effective at blocking viral transmission and is worn by 60% of the population will reduce R_0 to below 1.0. A preprint of an epidemic model by Worby and Chang (2020) stated that distribution of relatively ineffective masks to 10% of the population could reduce mortality rates by 5%.

Evidence for effectiveness against droplet emission/other respiratory viruses

We identified several relevant primary studies not included in the systematic reviews mentioned above.

Viola et al (2020) used the Schlieren optical technique to examine airflows associated with quiet and heavy breathing, while coughing, and with different face masks and face coverings. They found that all face masks and face coverings without an outlet valve reduced the front flow through the jet by more than 90%, but that surgical masks, face coverings and face shields generate several leakage jets.

Ma et al (2020) conducted a breath simulator study using a nebuliser through face coverings and reported that the percentage of avian influenza virus particle (used as a surrogate for COVID-19) blocked by two homemade polyester cloth face coverings (95.15%, 95% CI 90.97% to 97.39%) was lower than that blocked by N95 respirators (99.98%, 95% CI: 99.98% to 99.99%) but similar to that blocked by surgical masks (97.14%, 95% CI: 94.36% to 98.55%).

Anfinrud et al. (2020) used sensitive laser light-scattering procedures to detect droplet emission while people were speaking. The authors found that a damp homemade cloth face covering reduced droplet emission to background levels. In an unpublished follow-up experiment, Anfinrud et al. repeated their study with a variety of dry cloths, including a standard workers dust mask (not certified N95) and a face covering rigged from an airline eye covering. They found that all of these masks/face coverings reduced droplet emission generated by speech to background level (National Academies of Sciences, Engineering, and Medicine. 2020).

Davies et al (2013) evaluated capacity to block bacterial and viral aerosols in homemade cotton face coverings compared to surgical masks and no masks. Both the surgical mask and cotton face covering significantly reduced the number of microorganisms expelled, although the surgical mask was three times more effective in blocking transmission than the homemade face covering.

Rengasamy et al. (2010) tested the filtration performance of five common household fabric materials: sweatshirts, T-shirts, towels, scarves, and cloth face coverings in a laboratory setting. The study projected the particles at face velocities, typical of breathing at rest and during exertion. For the five common household fabric materials, penetration ranged from about 40 to 90%, indicating a 10 to 60% reduction. The authors concluded that common fabric materials may provide a low level of protection against nanoparticles.

Van der Sande (2008) examined the extent to which respirator masks, surgical masks, and tea-cloth face coverings would reduce tiny particle counts on one side of the mask/face covering compared to the other. They used burning candles in a test room to generate particles. N95 masks provided 25 times the protection of surgical masks and 50 times the protection of cloth face coverings. The study also tested the effectiveness of the three masks/face coverings at reducing emissions from a simulation dummy head that produced uniform “exhalations.” It found that cloth face coverings reduced emitted particles by one-fifth, surgical masks reduced it by one-half, and N95-equivalent masks reduced it by two-thirds.

A study by Konda et al (2020) investigated the performance of various commonly available fabrics used in face coverings. They found that a hybrid material of (cotton-chiffon, cotton-silk, cotton-flannel) performed the best at >80% (particles <300 nanometres) and >90% (for particles >300 nanometres). They concluded that this enhanced performance of hybrids was likely related to the combination of mechanical and electrostatic-based filtration. They noted that the effectiveness of all face masks and coverings were seriously reduced when a gap was introduced, suggesting the importance of proper fit and usage.

An in-silico study that modelled the utility of cloth face coverings concluded that they should provide source protection from coughing or sneezing. They predicted two different effects depending on droplet size, completely stopping those four microns or greater, while reducing the velocity of the air carrying the smaller ones (Kumar et al. 2020).

A number of older studies on the efficacy of surgical masks from a time when they were made of cloth and reused support the use of cloth face coverings for source control and protection of the wearer. Two of these studies showed that reusable cloth surgical face masks were 90 to 95% efficient at filtering outward oral-origin aerobic bacterial particles in the one to 10 micron diameter range (Greene and Vesley. 1962; Quesnel. 1975). One study used an aerosol of a bacterial suspension in saline, and found that cotton surgical face masks had filtration efficacies of 43% to 94%, depending on the weave (Furuhashi. 1978).

Gaps in the evidence

We did not identify any high-quality, direct evidence on the effectiveness of face coverings to protect against COVID-19 in the community setting. The most well-established evidence is from other respiratory diseases or other pandemics: evidence studying face coverings specifically for reducing community COVID-19 transmission is emerging but is currently limited to retrospective studies of very low reliability; none of these studies studied community-type face covering specifically. Indeed, most research has been undertaken in the context of surgical masks in healthcare workers and considers the extent to which the face coverings protect the wearer, not the protection of other people from droplets emitted by the wearer. Most of the primary evidence identified investigated the transmission of larger respiratory droplets. There is little evidence regarding the transmission of small aerosolised particulates of the size potentially exhaled by asymptomatic or pre-symptomatic individuals with COVID-19.

WHO urges countries that have issued recommendations on the use of both medical masks and non-medical face coverings by healthy people in community settings to conduct research on this important topic. Such research needs to look at whether SARS-CoV-2 particles can be expelled through face coverings of poor quality worn by a person with symptoms of COVID-19 while that person is coughing, sneezing or speaking. Research is also needed on face covering-use by children and other medically challenging persons and settings (WHO 2020).

Ongoing trials

We identified several ongoing studies:

- Darlyane Torres, Milena Santos, Paula Cardoso, Nikolaos Pandis, Carlos Flores-Mir, David Normando. Are Cloth Masks an effective option to substitute Manufactured Medical Masks? A Systematic Review. PROSPERO 2020 CRD42020178417 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020178417 Anticipated completion date: 1 June 2020
- Darlyane Torres, Milena Santos, Paula Cardoso, David Normando, Nikolaos Pandis, Carlos Flore-Mir. Efficacy of homemade and commercial cloth facemasks in preventing COVID-19 contamination. A systematic review. PROSPERO 2020 CRD42020178007 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020178007 Anticipated completion date: 31 May 2020

- Aidan Tan. Comparison of reusable cloth facemasks against surgical facemasks for filtration efficacy and clinical outcomes. PROSPERO 2020 CRD42020178117 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020178117 Anticipated completion date: 4 May 2020
- Syukri Rahim, N Nazurah A Wahid, Ibnu Ayyub Mohammad, Mizah Rahim, Nazhrah Mostapha, Farid Metussin, Ahmad Ibrahim, Caroline Tan, Adli Souyono. Evaluating the protective effect of home-made or cloth face mask against viral respiratory illness: a systematic review. PROSPERO 2020 CRD42020179821 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020179821 Anticipated completion date: 31 May 2020
- Daniela Coclite, Antonello Napoletano, Greta Castellini, Silvia Gianola, Primiano Iannone. The effectiveness of wearing face masks in the community for reducing the spread of COVID-19: a systematic review. PROSPERO 2020 CRD42020184963 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020184963 Anticipated completion date: 6 June 2020
- NCT04337541: An RCT of 6,000 adult participants in Denmark, investigating reduction in COVID-19 infection using surgical facial masks versus no masks/coverings. The experiment will take place outside the healthcare system: participants will be instructed to use the face mask consistently when outside their home (and at home when receiving visits from others). Participants will perform antibody screening at the start and end of the study. Estimated completion July 1 2020: https://clinicaltrials.gov/ct2/show/NCT04337541?term=NCT04337541&draw=2&rank=1
- NCT04415879: An RCT of 20 participants assessing exercise capacity (through estimated peak oxygen consumption, oxygen saturation and level of perceived exertion during treadmill based exercise) while wearing a cloth face covering compared to exercising without a cloth face covering to determine if subjects can exercise safely. Estimated completion date August 1 2020: https://clinicaltrials.gov/ct2/show/NCT04415879?term=NCT04415879&draw=2&rank=1

WHO is collaborating with the scientific community to facilitate a better understanding of the effectiveness and efficiency of face coverings and urges countries that have issued recommendations to conduct research on this topic (WHO. 2020).

Key references and resources

- Aggarwal N, Dwarakanathan V, Gautam N, Ray A. 2020. Face masks for the prevention of viral respiratory infections in community settings: a systematic review and meta-analysis. Indian Journal of Public Health; 64(supplement):S192-S200. DOI: 10.4103/ijph.IJPH_470_20
- Anfinrud P, Bax CE, Stadnytskyi V, Bax A. April 2020. Preprint. Could SARS-CoV-2 be transmitted via speech droplets? https://doi.org/10.1101/2020.04.02.20051177
- Bakhit M, Krzyzaniak N, Scott AM, Clark J, Glasziou P, Del Mar C. 2020. Preprint. Downsides of face masks and possible mitigation strategies: a systematic review and meta-analysis. https://doi.org/10.1101/2020.06.16.20133207
- Bartoszko JJ, Farooqi MAM, Alhazzani W, Loeb M. 2020. Medical masks vs N95 respirators for preventing COVID-19 in healthcare workers: A systematic review and meta-analysis of randomized trials. Influenza and Other Respiratory Viruses, 14, 365-373. doi:10.1111/irv.12745
- Brainard JS, Jones N, Lake I, Hooper L, Hunter P. April 2020. Preprint. Face masks and similar barriers to prevent respiratory illness such as COVID-19: A rapid systematic review. doi: https://doi.org/10.1101/2020.04.01.20049528
- British Medical Association. June 2020. Press release. Face covering measures are important now and should not be restricted to public transport, says BMA: https://www.bma.org.uk/news-and-opinion/face-covering-measures-are-important-now-and-should-not-be-restricted-to-public-transport-says-bma
- Burch J and Bunt C. March 2020. Cochrane Clinical Answers. Can physical interventions help reduce the spread of respiratory viruses? https://www.cochranelibrary.com/cca/doi/10.1002/cca.2965/full
- Cabinet Office. June 2020. Staying safe outside your home: https://www.gov.uk/government/publications/staying-safe-outside-your-home/staying-safe-outside-your-home#face-coverings
- Centres for Disease Control and Prevention. April 2020. Recommendation regarding the use of cloth face coverings, especially in areas of significant community-based transmission: https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover.html
- Chan, JF-W., Yuan, S., Zhang, A., Poon, VK-M., Chan, CC-S., Lee, AC-Y. et al. 2020. Surgical mask partition reduces the risk of non-contact transmission in a golden Syrian hamster model for Coronavirus Disease 2019 (COVID-19). Clin Infect Dis. doi: 10.1093/cid/ciaa644
- Cheng, VC-C., Wong, S-C., Chuang, VW-M., So, SY-C., Chen, JH-K., Sridhar, S. et al. 2020. The role of community-wide wearing of face mask for control of coronavirus disease 2019 (COVID-19) epidemic due to SARS-CoV-2. J Infect. doi: 10.1016/j.jinf.2020.04.024
- Chou R, Dana T, Jungbauer R, Weeks C, McDonagh MS. June 2020. Masks for prevention of respiratory virus infection, including SARS-CoV-2 in health care and community settings. Annals of Internal Medicine: M20-3213 doi: 10.7326/M20-3213
- Chu DK, Duda S, Solo K, Yaacoub S, Schünemann HJ. June 2020. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. The Lancet. https://doi.org/10.1016/S0140-6736(20)31142-9
- Davies A, Thompson KA, Giri K, Kafatos G. May 2013. Testing the Efficacy of Homemade Masks: Would They Protect in an Influenza Pandemic? Disaster Medicine and Public Health Preparedness, 7(4): 413-418. DOI: https://doi.org/10.1017/dmp.2013.43

- Department of Health and Social Care and the Rt Hon Matt Hancock MP. Press Release. Face coverings mandatory in shops, supermarkets, shopping centres and enclosed transport hubs from Friday. https://www.gov.uk/government/news/face-coverings-mandatory-in-shops-supermarkets-shopping-centres-and-enclosed-transport-hubs-from-friday
- ECRI. April 2020. Clinical evidence assessment. Cloth face coverings worn by public to reduce transmission of viral respiratory infection: https://assets.ecri.org/PDF/COVID-19-Resource-Center/COVID-19-Clinical-Care/COVID-ECRI-HTA-Cloth-Face-Coverings-Worn-By-Public.pdf
- Edelstein P, Ramakrishnan L. 2020. Report on Face Masks for the General Public - An Update. DELVE Addendum MAS-TD1. Available from http://rs-delve.github.io/addenda/2020/07/07/masks-update.html.
- Government of Canada. June 2020. Non-medical masks and face coverings.
- Eikenberry, S., Mancuso, M., Iboi, E., Phan, T., Eikenberry, K., Kuang, Y. et al. (2020) To mask or not to mask: Modeling the potential for face mask use by the general public to curtail the COVID-19 pandemic. Infect Dis Model. doi: 10.1016/j.idm.2020.04.001 https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/prevention-risks/about-non-medical-masks-face-coverings.html
- Furuhashi, M. (1978) A study on the microbial filtration efficiency of surgical face masks–with special reference to the non-woven fabric mask. Bull. Tokyo Med Dent Univ. 25(1):7-15. PMID: 343940
- Greene, V. and Vesley, D. (1962) Method for Evaluating Effectiveness of Surgical Masks. Journal of Bacteriology, 83(3):663-7. PMID: 13901536
- Howard J, Huang A, Li Z, Tufekci Z, Zdimal V, van der Westhuizen H, von Delft A, Price A, Fridman L, Tang L, Tang V, Watson GL, Bax CE, Shaikh R, Questier F, Hernandez D, Chu LF, Ramirez CM, Rimoin AW. Face Masks Against COVID-19: An Evidence Review. *Preprints* 2020, 2020040203: doi: 10.20944/preprints202004.0203.v1
- Kenyon C. April 2020. Preprint. Widespread use of face masks in public may slow the spread of SARS CoV-2: an ecological study. https://doi.org/10.1101/2020.03.31.20048652
- Konda A et al. 2020 Aerosol Filtration Efficiency of Common Fabrics Used in Respiratory Cloth Masks. ACS Nano. 14, 6339–6347 doi:10.1021/acsnano.0c03252
- Kumar, V., Nallamothu, S., Shrivastava, S., Jadeja, H., Nakod, P., Andrade, P., et al. (2020) On the utility of cloth face masks for controlling ejecta during respiratory events. arXiv. Available from: https://arxiv.org/abs/2005.03444
- Liang M,Gao L, Cheng C, Zhou Q, Uy JP, Heiner K, Sun C. May 2020. Efficacy of face mask in preventing respiratory virus transmission: A systematic review and meta-analysis. Travel Medicine and Infectious Disease: 101751. https://dx.doi.org/10.1016%2Fj.tmaid.2020.101751
- Ma QX, Shan H, Zhang HL, Li GM, Yang RM, Chen JM. Potential utilities of mask-wearing and instant hand hygiene for fighting SARS-CoV-2 [published online ahead of print, 2020 Mar 31]. Journal of Medical Virology. 2020;10.1002/jmv.25805. doi: 10.1002/jmv.25805
- MacIntyre CR, Chughtai AA. August 2020. A rapid systematic review of the efficacy of face masks and respirators against coronaviruses and other respiratory transmissible viruses for the community, healthcare workers and sick patients. International Journal of Nursing Studied. 108. https://doi.org/10.1016/j.ijnurstu.2020.103629
- Marasinghe KM. April 2020. Preprint. Concerns around public health recommendations on face mask use among individuals who are not medically diagnosed with COVID-19 supported by a systematic review search for evidence. DOI: 10.21203/rs.3.rs-16701/v3

- Mitze, T., Kosfeld, R., Rode, J., Wälde, K. (2020) Face Masks Considerably Reduce COVID-19 Cases in Germany: A Synthetic Control Method Approach. IZA – Institute of Labor Economics, Contract No.: IZA DP No. 13319.
  Available at: https://www.iza.org/publications/dp/13319/face-masks-considerably-reduce-covid-19-cases-in-germany-a-synthetic-control-method-approach
- National Academies of Sciences, Engineering, and Medicine. 2020. *Rapid Expert Consultation on the Effectiveness of Fabric Masks for the COVID-19 Pandemic (April 8, 2020)*. Washington, DC: The National Academies Press. https://doi.org/10.17226/25776
- NIdirect government services. 2020. Coronavirus (COVID-19): overview and advice: https://www.nidirect.gov.uk/articles/coronavirus-covid-19-overview-and-advice
- Ngonghala, C., Iboi, E., Eikenberry, S., Scotch, M., MacIntyre, C., Bonds, M. et al. (2020) Mathematical assessment of the impact of non-pharmaceutical interventions on curtailing the 2019 novel Coronavirus.
  doi: 10.1016/j.mbs.2020.108364
- Payne, D., Smith-Jeffcoat, S., Nowak, G., Chukwuma, U., Geibe, J., Hawkins, R. et al. (2020) SARS-CoV-2 Infections and Serologic Responses from a Sample of U.S. Navy Service Members - USS Theodore Roosevelt, April 2020. Morbidity and Mortality Weekly Report.
  doi: 10.15585/mmwr.mm6923e4
- Perski O, Simons D, West R, Michie S. 2020. Preprint. Face masks to prevent community transmission of viral respiratory infections: a rapid evidence review using Bayesian analysis.
  https://www.qeios.com/read/1SC5L4
- Quesnel, L. (1975) The efficiency of surgical masks of varying design and composition. Br J Surg, 62(12):936-40.
  doi: 10.1002/bjs.1800621203
- Rengasamy S, Eimer B, Shaffer RE. October 2010. Simple Respiratory Protection—Evaluation of the Filtration Performance of Cloth Masks and Common Fabric Materials Against 20–1000 nm Size Particles. The Annals of Occupational Hygiene, 54 (7): 789–798 https://doi.org/10.1093/annhyg/meq044
- Scottish Government. Advice and guidance. Coronavirus (COVID-19) Phase 3: staying safe and protecting others.
  https://www.gov.scot/publications/coronavirus-covid-19-phase-3-staying-safe-and-protecting-others/pages/face-coverings/
- Stutt, R., Retkute, R., Bradley, M., Gilligan, C., Colvin, J. (2020) A modelling framework to assess the likely effectiveness of face masks in combination with 'lock-down' in managing the COVID-19 pandemic. Proceedings of the Royal Society A.
  doi: 10.1098/rspa.2020.0376
- The Royal Society and The British Academy. June 2020. Face masks and coverings for the general public: behavioural knowledge, effectiveness of cloth coverings and public messaging
  https://royalsociety.org/-/media/policy/projects/set-c/set-c-facemasks.pdf?la=en-GB&hash=A22A87CB28F7D6AD9BD93BBCBFC2BB24
- Tian L, Li X, Qi F, Tang QY, Tang V, Liu J, Li Z, Cheng X, Li X, Shi Y, Liu H, Tang LH. Non-peer-reviewed. Calibrated Intervention and Containment of the COVID-19 Pandemic: https://arxiv.org/abs/2003.07353
- Usher Network for COVID-19 Evidence Reviews. Does the use of face masks in the general population make a difference to spread of infection?
  https://www.gov.uk/government/publications/does-the-use-of-face-masks-in-the-general-population-make-a-difference-to-spread-of-infection-7-april-2020
- van der Sande M, Teunis P, Sabel R. 2008. Professional and Home-Made Face Masks Reduce Exposure to Respiratory Infections among the General Population. PLoS ONE 3(7): e2618. https://doi.org/10.1371/journal.pone.0002618

- Viola M, Peterson B, Pisetta G, Pavar G, Akhtar H, Menoloascina F, Mangano E, Dunn KE, Gabl R, Nila A, Molinari E, Cummins C, Thompson G, McDougall CM, Lo TYM, Denison FC, Digard P, Malik O, Dunn MJG, Mehendale FV. 2020. Face coverings, aerosol dispersion and mitigation of virus transmission risk. Medical physics. Cornell University arXiv:2005.10720v1
- Wang, Y., Tian, H., Zhang, L., Zhang, M., Guo, D., Wu, W. et al. (2020) Reduction of secondary transmission of SARS-CoV-2 in households by face mask use, disinfection and social distancing: a cohort study in Beijing, China. BMJ Glob Health. doi: 10.1136/bmjgh-2020-002794
- Wei J, Doherty M, Persson MSM, Swain S, Kuo C, Zeng C, Lei G, Zhang W. 2020. Preprint. Face masks prevent influenza-like illness: implications for COVID-19. doi: https://doi.org/10.1101/2020.05.07.20094912
- Worby C, HH Chang. 2020. Preprint. Face mask use in the general population and optimal resource allocation during the COVID-19 pandemic. https://www.medrxiv.org/content/10.1101/2020.04.04.20052696v1
- World Health Organization. 2019. Non-pharmaceutical public health measures for mitigating the risk and impact of epidemic and pandemic influenza; Licence: CC BY-NC-SA 3.0 IGO. https://www.who.int/influenza/publications/public_health_measures/publication/en/
- World Health Organization. June 2020. Interim guidance. Advice on the use of masks in the context of COVID-19: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/when-and-how-to-use-masks
- Xiao J, Shiu EYC, Gao H, Wong JY, Fong MW, Ryu S, Cowling BJ. May 2020. Nonpharmaceutical Measures for pandemic influenza in nonhealthcare settings—personal protective and environmental measure. Emerging Infectious Diseases, 26(5): 967–975. doi: 10.3201/eid2605.190994

For any non-medicine technology where more detailed guidance is needed on clinical and cost effectiveness, HTW can consider this for fuller assessment underpinned by a rapid health technology assessment. Requests for technologies on which such guidance would be useful can be submitted to HTW here: https://www.healthtechnology.wales/suggest-a-topic