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The Importance of Masks in Exiting Lockdown

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In recent weeks there has been considerable debate around the use and effectiveness of masks, particularly in the context of developing the right exit strategy from lockdown.

There are many misconceptions around what masks are for and what they can help with.

This paper seeks to set out the lay of the land on masks and makes recommendations for how they can be used as part of plans to restart the economy.

Overview

This paper sets out the key types of masks being discussed as part of the debate on responding to Covid-19: disposable medical masks, N95 masks and homemade masks.

It explains the efficacy of each type: N95 masks give protection to the wearer, while surgical and homemade masks are more effective at protecting others by preventing transmission of the virus.

We set out some of the science behind how SARS-CoV-2 (the virus that causes Covid-19) is transmitted and what role masks can play.

SARS-CoV-2 can be passed through droplets released from an infected carrier's mouth. These droplets are larger initially and then form a fine mist. Breathing in smaller droplets is harder to prevent than inhaling larger ones, through covering the nose and mouth. Any form of mask, even a crude homemade mask, can play a vital role in preventing these larger droplets from spreading from the carrier. This prevents the infection being passed on.

Modelling by HKBU, cited by Professor Trisha Greenhalgh and Jeremy Howard in their work¹, suggests that if everyone wears a mask in public (e.g. in transit, at social venues, at work) the rate of transmission of the virus (R0) can be kept below 1.² This is backed up by mask usage in other countries, including comparisons between US states and the Czech Republic.

The paper challenges some of the arguments against mask-wearing such as “the risk compensation hypothesis” by looking at the use of mass safety devices elsewhere, including bike helmets. It challenges the assumption that mask-wearing will cause a supply problem for frontline workers by advocating the use of mouth coverings, lower- grade medical masks and custom masks.

Alongside other measures we have recommended – particularly mass testing and contact tracing – we believe masks can play a vital role in ending lockdown, helping the economy return to normal and avoiding a second wave of the virus.

We recommend that those working in health-care settings are given N95 masks, while the rest of the public are asked to wear a form of face mask while in public and around large groups of people. This will have a positive impact on the effective R0 rate of transmission.

¹ <https://masks4all.co>

We recommend the government commits to onshoring the manufacturing of both disposable medical masks and high-grade N95 masks with an ambition to develop enough stock to equip the entire nation in the medium-term. We have discussed this with several global manufacturers supplying the UK but with no manufacturing base here, and there is huge interest in doing so. Government should engage with these companies immediately.

² <https://arxiv.org/abs/2003.07353>

Types of Mask

As part of the debate on masks, three types have been the particular focus of discussion:

1. N95 masks
2. Disposable medical masks
3. Custom masks

We give some detail on these below.

N95 Mask

There has been considerable discussion since the outbreak of the virus around N95 masks. These masks are designed to ensure a close facial fit and effectively filter airborne particles. N95 masks are made of special material, which removes at least 95 per cent of even the smallest droplets.³



The edges of the mask are designed so that they form a tight seal around the airways (nose and mouth). These masks are used commonly used in health-care settings.⁴

N95 masks can be reused.

³ <https://www.jhsph.edu/covid-19/articles/the-right-mask-for-the-task.html>

⁴ <https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/n95-respirators-and-surgical-masks-face-masks>

Disposable Medical Masks

Disposable medical masks act as a barrier between the person wearing the mask and the air around them, preventing the wearer releasing potential contaminants into the air. They are comparatively loose fitting and the edges are not intended to form a seal around the airways.



Surgical masks are made of a special material that, despite not forming a seal around the nose and mouth, protects the wearer from larger droplets from coughs and sneezes and prevents the wearer spreading droplets.⁵ Wearing these masks also helps inhibit the outward transmission of larger droplets.

Custom Masks

Custom masks differ from those professionally made models mentioned above. They form a much looser fitting around the mouth and nose. They can also be reused through washing. They may remove some larger droplets and some smaller ones (with a piece of paper towel added) but not as small as those captured by N95 masks.⁶ If worn by those infected by the virus, they can help reduce the spread of large droplets.⁷

5 <https://www.jhsph.edu/covid-19/articles/the-right-mask-for-the-task.html>

6 Jeremy Howard

7 <https://www.jhsph.edu/covid-19/articles/the-right-mask-for-the-task.html>



Major Suppliers

Below we include a list of some of the world's major mask suppliers:

3M

US company 3M is one of the world's largest suppliers of surgical masks, including N95 masks. It is expecting to ramp up monthly US production of N95 masks to 50 million by June.⁸

Honeywell

California-based US company Honeywell is another of the major suppliers. It produces various PPE equipment, including N95 masks.

Prestige Ameritech

Prestige Ameritech is one of the US's largest domestic surgical mask suppliers and one of the largest mask manufacturers in the world. It also produces the "Seal-A-Mask", which is an addition to a basic disposable medical mask that can bring its standard up to around that of an N95 mask.

Kimberly-Clark

Kimberly-Clark is another major mask supplier and also based in the US. It produces a range of PPE, including basic medical masks, N95 masks and face veils.⁹

8 <https://blog.technavio.com/blog/top-10-n95-mask-manufacturers>

9 <https://blog.technavio.com/blog/top-10-n95-mask-manufacturers>

Medicom

Medicom is one of the world's leading manufacturers and distributors of medical-grade PPE (including masks). It is based in Montreal, Canada, and has eight manufacturing facilities in North America, Europe and Asia. Medicom, through its European arm Kolmi-Hopen, is one of the major suppliers of PPE to the French government.¹⁰

Innovation: The “Seal-A-Mask” Upgrades the Disposable Medical Mask

One of the key differences between the disposable medical mask and higher-grade masks, such as the N95, is the lack of a seal on the former. This renders the wearer susceptible to inhaling droplets and particles. We recommend that government onshore the manufacturing of N95 masks (see “Supply Problem?” section below). In the short-term, we have identified an interesting innovation that could improve lower-grade masks.

Created in the US by Prestige Ameritech, but readily available for distribution in large quantities, the Seal-A-Mask is a low-cost addition to a disposable medical mask that introduces a seal. The MD Anderson Cancer Center in Houston is trialing the device now, and the State of Texas has made a significant advance order. Ameritech informed us that half the people tested at MD Anderson passed an N95 fit test wearing nothing but a Level 3 ear loop mask (disposable medical mask) with a Seal-A-Mask fitted.

When an N95 isn't available, a disposable medical mask with a Seal-A-Mask attached to it may be the next best thing. Government should explore the import, and/or possible manufacture of these devices, under licence.¹¹

¹⁰ <https://www.prnewswire.com/news-releases/local-mask-production-a-priority-for-france--president-emmanuel-macron-tours-medicom-facility-301035399.html>

¹¹ www.prestigeameritech.com/seal-a-mask

The Science

In this paper, we have consciously divided the science into two distinct areas – medical and social. This is owed to the debate on the utility of masks being dominated by one evidence base over the other – in the case of masks, that’s medical science.

We argue that in an unprecedented global pandemic where lockdown threatens economic and health outcomes, both streams of thought should carry equal weight.

When it comes to deciding whether masks should be rolled out to an entire population, both the science and behavioural aspects should be considered. Masks have impact on both.

Further, even marginal gains in the reduction of the transmission rate and a reduction in RO should be welcomed.

Medical Science

The key reason for discussing masks in the context of Covid-19 is the role they play in helping limit the transmission of droplets and, therefore, of droplets carrying the virus.

The physics of this are set out by Professor Trisha Greenhalgh and Jeremy Howard. As they explain, when we speak we release “tiny micro droplets” from our mouths. If we are infectious, these particles will contain the virus. Their research draws on that by professor Vladimir Zdimal, head of the Department of Aerosols Chemistry and Physics at the Institute of Chemical Process Fundamentals of the Czech Academy of Sciences. In more detail, he says:

“The key is the relative humidity outside your mouth. If the ambient relative humidity is close to 100%, the evaporation takes much longer time, maybe hundred times more than in case of RH 50%. When we wear a handmade mask, the small volume in front of our mouth is almost saturated with water vapor, so most of droplets we exhale, or expire by speaking, are ejected to an environment that is almost saturated and do not have enough time to evaporate water before they impact on the inner surface of the mask. When the mask is absent, the ambient humidity is usually much lower (speaking about countries as Czechia, we average at 50%). In that case the microdroplets evaporate long before they are able to fall on the ground and stay airborne.

Anyway, the homemade masks are key to be worn by asymptomatic or presymptomatic people, where the flowrates at the mouth opening are high enough to impact most of the droplets on the mask, but low enough not to deform the mask and not to release part of the material at leaks openings.”¹²

Of these droplets only the largest are able to survive for more than 0.1 seconds before they dry out and turn into droplet nuclei. These are between three and five times smaller than the original droplet and some will still contain the virus.

This means that droplets are easier to block just as they are leaving the mouth, compared with trying to stop them from entering the airways of a non-infected recipient.¹³

We are increasingly seeing promising diagnostic tests in development that use swabs of saliva to detect the presence of Covid-19. Indeed, a recent paper¹⁴ suggested that these may in fact be more effective than nasal swabs. This gives rise to a natural conclusion that Covid-19 is present in saliva and is therefore transmissible from droplets leaving the mouth. This

begs the question: Why not encourage the widespread use of mouth coverings?

How Do Masks Help?

The discussion on masks has been based for some time on faulty understanding.

While high-grade masks, such as N95, would afford protection to the wearer from receiving droplets of the virus, this is not their primary purpose in discussions on widespread public use.

We are recommending the use of simple masks and mouth coverings to protect other people who come into contact with the wearer. Masks prevent large droplets passing too far from the mouth – they do not stop smaller droplets getting in. In this regard even homemade cloth masks, worn by infected carriers of the virus, are effective in preventing the spread of the virus to others.

Greenhalgh and Howard note that this is known as “source control” and that this is the key element in the debate on public usage:

“If you have COVID-19 and cough on someone from 8 inches away, wearing a cotton mask will reduce the amount of virus you transmit to that person by 36 times, and is even more effective than a surgical mask. Oddly, the researchers who discovered this fact considered a 36-fold reduction to be ‘ineffective’. We disagree. It means you’ll transmit only 1/36th the amount of virus you would otherwise have done, decreasing the viral load, which is likely to lead to a lower probability of infection, and fewer symptoms if infected.”¹⁵

12 <https://twitter.com/jeremyphoward/status/1252702114469511168>

13 <https://www.fast.ai/2020/04/13/masks-summary/>

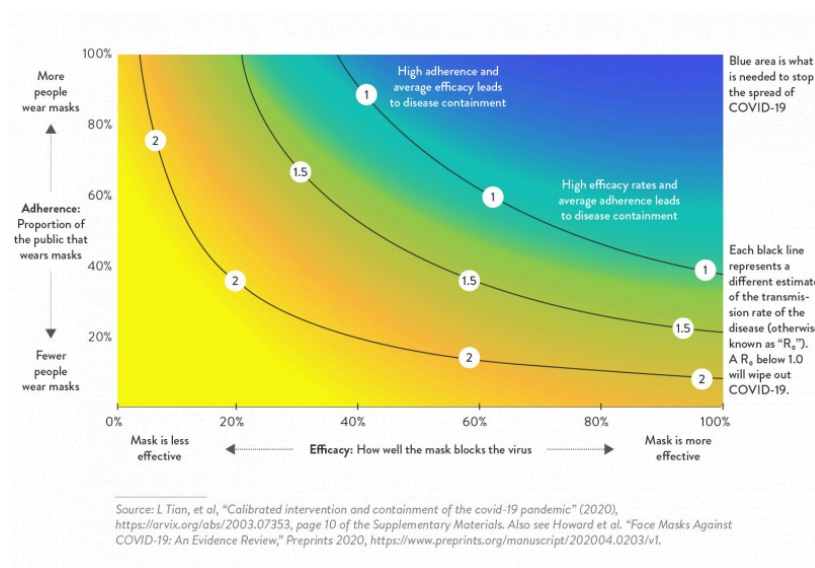
14 Saliva is more sensitive for SARS-CoV-2 detection in COVID-19 patients than nasopharyngeal swabs Anne Louise Wyllie, John Fournier, Arnau Casanovas-Massana, Melissa Campbell, Maria Tokuyama, Pavithra Vijayakumar, Bertie Geng, M. Catherine Muenker, Adam J. Moore, Chantal B. F. Vogels, Mary E. Petrone, Isabel M. Ott, Peiwen Lu, Alice Lu-Culligan, Jonathan Klein, Arvind Venkataraman, Rebecca Earnest, Michael Simonov, Rupak Datta, Ryan Handoko, Nida Naushad, Lorenzo R. Sewanan, Jordan Valdez, Elizabeth B. White, Sarah Lapidus, Chaney C. Kalinich, Xiaodong Jiang, Daniel J. Kim, Eriko Kudo, Melissa Linehan, Tianyang Mao, Miyu Moriyama, Ji Eun Oh, Annsea Park, Julio Silva, Eric Song, Takehiro Takahashi, Manabu Taura, Orr-El Weizman, Patrick Wong, Yexin Yang, Santos Bermejo, Camila Odio, Saad B. Omer, Charles S. Dela Cruz, Shelli Farhadian, Richard A. Martinello, Akiko Iwasaki, Nathan D. Grubaugh, Albert I. Ko

15 <https://www.fast.ai/2020/04/13/masks-summary/>

Transmission

As part of their research, Trisha Greenhalgh and Jeremy Howard draw on modelling by HKBU that suggests that if most citizens wear a mask in public, the transmission rate of the virus (R) can be kept below 1, stopping the spread of the disease.¹⁶

Figure 1 – Modelled Impact of Mask Use on the Reproduction Rate of Covid-19



The effectiveness of the policy rests on three factors:

- How well masks block the virus.
- What proportion of the public wear them.
- The transmission rate of the virus.

In the above graphic, the blue area signifies a level of R below 1. As it shows, this can be achieved through lower usage of very effective masks and and higher usage of less effective masks.¹⁷

Writing in *The Lancet*, Kar Keung Cheng, Tai Hing Lam and Chi Chiu Leung also make clear that, “People often wear masks to protect themselves, but we suggest a stronger public health rationale is source control to protect others from respiratory droplets. This approach is important because of possible asymptomatic transmissions of SARS-CoV-2.”¹⁸

¹⁶ <https://arxiv.org/abs/2003.07353>

¹⁷ <https://www.fast.ai/2020/04/13/masks-summary/>

The authors¹⁹ of the paper Face Masks Against COVID-19: An Evidence Review concluded that: “The preponderance of evidence indicates that mask-wearing reduces the transmissibility per contact by reducing transmission of infected droplets in both laboratory and clinical contexts. Public mask-wearing is most effective at stopping spread of the virus when compliance is high. The decreased transmissibility could substantially reduce the death toll and economic impact while the cost of the intervention is low. Thus we recommend the adoption of public cloth mask-wearing, as an effective form of source control, in conjunction with existing hygiene, distancing, and contact tracing strategies. We recommend that public officials and governments strongly encourage the use of widespread face masks in public, including the use of appropriate regulation.”

Molecular and Cell Biologist Dr Sui Huang has also concluded that, “The latest biological findings on SARS-Cov-2 viral entry into human tissue and sneeze/cough-droplet ballistics suggest that the major transmission mechanism is not via the fine aerosols but large droplets, and thus, warrant the wearing of surgical masks by everyone.”²⁰

In the US, we can already see a gap opening between states in the critical R0 reproduction number²¹. A simple comparison between states mandating masks and those not reveals a 0.05 difference in R0 number. This does not even account for certain outlier states that have smaller population sizes or lower densities.

Table 1 – Comparison of Reproduction Rate of Covid-19 in US States Based on Mask-Wearing

Average R0 of all states	0.89
<hr/>	
Average R0 of states with no masks	0.90
<hr/>	
Average R0 of states with masks	0.85

Even a small difference in the R0 number can have a dramatic impact on what measures a state can introduce to ease lockdown. For example, another paper from our colleagues at the Tony Blair Institute for Global Change²² revealed that opening schools adds an additional 0.2 onto the reproduction number. Further, keeping the R0 number below 1 is key to beating Covid-19.

18 [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)30918-1/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30918-1/fulltext)

Impact on Mortality Rate

Recent analysis²³ of more than 160 regions in which mask usage has been widespread suggests that the mortality rate grows more slowly than in countries where masks aren't widely used. This study includes analysis of Hong Kong, South Korea, Malaysia, Taiwan, Japan, Czech Republic and Mongolia. In a population not wearing masks, the per-capita mortality tended to increase each week by a factor of $100.156 = 1.43$, or 43 per cent. On the other hand, in a population wearing masks, the per-capita mortality tended to increase by a factor of $10(0.156-0.144) = 1.028$, or just 2.8 per cent.

19 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, G.L.; Bax, C.E.; Shaikh, R.; Questier, F.; Hernandez, D.; Chu, L.F.; Ramirez, C.M.; Rimoin, A.W.

20 <https://medium.com/@Cancerwarrior/covid-19-why-we-should-all-wear-masks-there-is-new-scientific-rationale-280e08ceee71>

21 Data taken from rt.live, accurate as of 1st May

22 'A sustainable exit strategy: Managing uncertainty, minimising harm' by Ian Mulheirn, 20th April

23 Leffler, Ing, Lykins, McKeown, Grzybowski, Andrzej, 2020 'Country-wide coronavirus mortality and use of masks by the public'

Social Science

Concerns have been raised about population-level mask usage in terms of behavioural effects.

We do not share these concerns, particularly given we recommend deploying masks alongside other measures such as social distancing and hand-washing, and an effective government-led communications campaign.

Kar Keung Cheng, Tai Hing Lam and Chi Chiu Leung deal with this point well in their Lancet paper: “...there are concerns that mask-wearing could engender a false sense of security in relation to other methods of infection control such as social distancing and handwashing. We are unaware of any empirical evidence that wearing masks would mean other approaches to infection control would be overlooked. It is important, however, to emphasise the importance of this point to the public even if they choose to wear masks.”²⁴

Mask-wearing has a significant societal and cultural impact. It signals readiness for a shift to a “new normal” and makes it easier to “press the button when the pandemic strikes”²⁵. This was evidenced by the widespread usage of masks in Asia and this in turn allows governments to roll out other important measurements quickly and effectively. For example, in Hong Kong, mask-wearing isn’t mandated by law but rather through cultural norms.

There is a fear that face-covering could lead to a sense of invincibility, undermining the important roles of social distancing and social hygiene. We do not recommend that these measures are replaced by mask-wearing but rather that they are complemented – although we do look at the contributions of Jeremy Howard to this debate with interest. It’s important to note that there is no evidence that mask-wearing would cause wearers to get complacent and take unnecessary risks.

We note that the Government’s Science Advisory Group for Emergencies (SAGE) does not currently recommend the use of masks. This sentiment was captured by Sir Patrick Vallance at the daily Covid-19 briefing on 23 April, where he said that the evidence for mask-wearing “has always been quite variable, quite weak and difficult to know.” As set out above, we dispute the scientific base and echo the sentiments of others in the field that “every little helps.” We would go further and call for SAGE to take greater account of the social science in this area – particularly looking at mask-wearing in previous pandemics, such as the SARS and MERS outbreaks – and approach the subject of mask-wearing from the role they would play in protecting society rather than the individual.

Learning From Bike Helmets: The Risk Compensation Hypothesis

There is a growing school of thought that advises against widespread mask usage because of a fear that this will cause wearers to engage in riskier behaviour such as breaching social-distancing rules. This is known as “risk compensation.”²⁶

The risk compensation hypothesis is often found in the world of bike helmets, specifically from those who advocate against wearing them. We’ve done a deep dive into this notion and looked at the world’s first systematic review of bicycle-helmet use and risk compensation²⁷.

From this, 23 studies were identified from self-reported surveys, crash or experimental data, and most studies (n = 18) did not support risk compensation hypothesis. Indeed, 10 studies found helmet use associated with safer cycling behaviour.

One key lesson from this review is that communication plays an important, complementary role to legislation or a directive mandating use of helmets. The same should apply to masks. It seems an oversight by those against mask-wearing because of risk compensation to discount or not consider the role of behavioural science and communications. We would recommend that widespread mask-wearing is complemented by a campaign that does several things, including:

1. Reaffirming the importance of observing social distancing and other complementary measures.
2. Educating wearers on how to use masks properly (e.g. taking into account fitting, use and factors such as facial hair).
3. Making it clear that mask-wearing is a component of a wider mitigation strategy and that wearing one is a positive contribution that a citizen can make to tackling the transmission of Covid-19.

²⁴ [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)30918-1/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30918-1/fulltext)

²⁵ Interview with Professor Sian Griffiths, co -chair of the Hong Kong government’s inquiry into the 2003 SARS epidemic.

²⁶ BMJ 2020;369:m1422

²⁷ (Esmailikia, Radun, Grzebieta and Olivier, 2018)

What Is Happening Elsewhere in the World?

City governments are the primary authorities pursuing requirements for residents to wear masks, but we have seen national governments mandate the same.

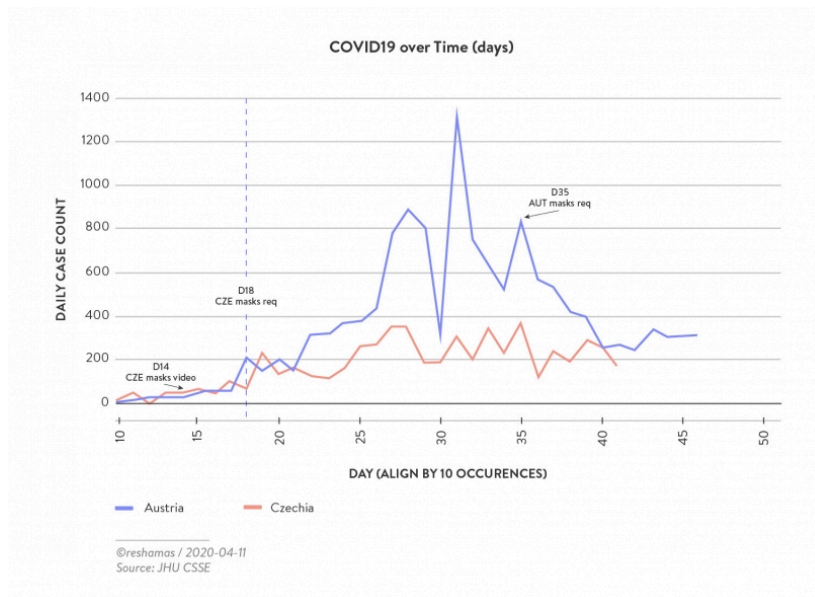
More than 60 governments have made face masks mandatory in public. They include: Indonesia, Israel, the Czech Republic, Slovenia, Bulgaria, Slovakia, Austria, Bosnia, Mongolia, Taiwan, Singapore, Colombia, Poland, Panama, the Philippines, Uzbekistan, Ukraine, Vietnam, Cuba, Morocco, Turkey, Kenya, Zambia, Luxembourg, Ecuador, Chile, Venezuela, Honduras, Ethiopia, Rwanda, Benin, the Bahamas, Liberia, Guinea, North Macedonia, Thailand, Peru, Lithuania, Gabon, Bahrain, Mozambique, Guatemala, parts of China, parts of the USA (New York, New Jersey, Maryland, Pennsylvania, Connecticut, Rhode Island, Hawaii, Colorado: workers only, Puerto Rico, Los Angeles, Miami, Washington DC, San Antonio, Dallas County, San Francisco, Parts of Illinois, Parts of Massachusetts), parts of Russia, parts of Germany, parts of India, parts of Italy, parts of Argentina, parts of Mexico, parts of Cameroon, parts of Pakistan, parts of Democratic Republic of Congo and partial laws in many other countries.²⁸

Case Study: Czech Republic

The Czech Republic was the first country in Europe to mandate face masks in public, on 18 March. This was the same date its European neighbour Austria introduced social-distancing requirements but the Czech Republic also introduced mandatory mask-wearing. The Austrian case rate continued its upward trajectory, while Czech Republic's flattened out. It wasn't until Austria also introduced mask laws weeks later that the two counties returned to similar trajectories.

Figure 2 – Comparison of Covid-19 Cases Between Czech Republic and Austria

²⁸ <https://masks4all.co/what-countries-have-mask-laws/>



Writing in *The Atlantic* on 22 April, Jeremy Howard set out that: “In the Czech Republic, masks were not used during the initial outbreak, but after a grassroots campaign led to a government mandate on March 18, masks in public became ubiquitous. The results took a while to be reflected in the official statistics: The first five days of April still saw an average of 257 new cases and nine deaths per day, but the most recent five days of data show an average of 120 new cases and five deaths per day.”²⁹

Since easing lockdown measures in the Czech Republic – including the staged reopening of shops and services – there has not been a surge in the number of new infections, with new cases staying below 100 per day. According to Czech Health Minister Adam Vojtěch the country has not seen “a negative trend resulting from previous relaxations.”³⁰

Table 2 – Example Measures Around the World

Date	Country
18 March	Czech Republic makes wearing masks mandatory in supermarkets and pharmacies and on public transport.
25 March	Slovakia makes wearing masks mandatory in supermarkets and pharmacies and on public transport.
29 March	Bosnia and Herzegovina made it mandatory for its citizens to wear a face mask or a cloth covering their mouth and nose while walking in the streets or outside their homes.
6 April	Austria made masks mandatory in public spaces.

Date	Country
7 April	Morocco made wearing face masks mandatory. The government warned that anyone who fails to comply faces a prison sentence of up to three months and a fine of 1,300 dirhams (\$130).
7 April	Turkey ordered all of its citizens to wear masks when shopping or visiting crowded public places. The government said it will deliver masks to every family free of charge.
16 April	Poland made covering the face with either a mask or homemade piece of fabric such as a scarf mandatory. This applies to green areas such as parks and beaches as well as public places such as roads, squares, religious facilities, commercial facilities and marketplaces.
21 April	Jamaica imposed a series of new coronavirus restrictions such as a revised curfew and also made it mandatory for citizens to wear a face mask in public spaces.
22 April	Germany became the latest European country to make the wearing of face masks compulsory when on public transport and while shopping in all of its 16 states.

French President Emmanuel Macron recently made clear that wearing a mask in public was “recommended” to minimise the spread of Covid-19. While there is not yet a national requirement to wear them, this may differ at a local level, as regional authorities prepare plans for easing the lockdown. Lyon’s mayor, for instance, said on Thursday 30 April that wearing a face mask out on the street could be made compulsory.³¹ The government has said that by 11 May, when the lockdown eases, there will be enough masks in the country for all citizens.

In the US, the Centers for Disease Control and Prevention (CDC) recommends, “wearing cloth face coverings in public settings where other social distancing measures are difficult to maintain (e.g., grocery stores and pharmacies), especially in areas of significant community-based transmission.

“CDC also advises the use of simple cloth face coverings to slow the spread of the virus and help people who may have the virus and do not know it from transmitting it to others. Cloth face coverings fashioned from household items or made at home from common materials at low cost can be used as an additional, voluntary public health measure.

²⁹ <https://www.theatlantic.com/health/archive/2020/04/dont-wear-mask-yourself/610336/>

³⁰ <https://www.theguardian.com/world/2020/apr/30/danes-and-czechs-say-easing-lockdowns-has-produced-no-covid-19-surge>

“Cloth face coverings should not be placed on young children under age 2, anyone who has trouble breathing, or is unconscious, incapacitated or otherwise unable to remove the mask without assistance.

“The cloth face coverings recommended are not disposable medical masks or N-95 respirators. Those are critical supplies that must continue to be reserved for healthcare workers and other medical first responders, as recommended by current CDC guidance.”³²

The following US states have required citizens to wear masks: Connecticut, Delaware, Hawaii, Illinois, Kentucky, Maryland, Michigan, New Jersey, New York, Pennsylvania and Rhode Island.³³ Similar steps have been taken by every major US airline.³⁴

New York Governor Andrew Cuomo passed an executive order mandating the use of masks in public (in circumstances where social distancing is not possible).

Eight of the largest US cities now also recommend or require masks.

More generally, mask recommendations or requirements now cover 88 per cent of the world population.³⁵

31 <https://www.thelocal.fr/20200430/face-masks-in-france-where-to-buy-and-when-to-wear-them>

32 <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/diy-cloth-face-coverings.html>

33 <https://masks4all.co/what-states-have-mandatory-mask-laws/>

34 <https://www.cbsnews.com/news/face-mask-airplane-passengers-required/>

35 Jeremy Howard

Supply Problem?

Britain currently does not produce large quantities of the disposable face masks that have become common in Asia since the SARS epidemic in 2002-2003 and would struggle to import more in large quantities given a surge in global demand. Because of this, the government is understandably concerned that the widespread use of masks would divert resources from frontline workers.

We recommend that the government commits to onshoring the manufacturing of both disposable medical masks and high-grade N95 masks with an ambition to develop enough stock to equip the entire nation. This is a medium-term ambition, but it is achievable: We have spoken to several of the world's biggest N95 manufacturers who are attempting to engage with the UK government specifically on the matter of bringing "supply chain sovereignty" to mask manufacturing.

We believe concerns around supply to frontline will be addressed in the short-term by:

- Guaranteeing and prioritising supplies of N95 masks for frontline workers and restricting the commercial sale of these to non-frontline workers.
- Moving popular definition of masks for population wear from "surgical grade masks" to "mouth coverings"
- Recommending the use of low-tech masks – still widely available – and custom-made mouth coverings, including homemade masks such as repurposed t-shirts and scarves.
- Communicating the need for surgical-grade masks and face coverings to be prioritised for use by frontline workers.
- Shifting the purpose of mass mask-wearing from protecting the wearer to protecting others.
- Adopt an "encouragement" rather than "enforcement" approach to mass mask-wearing to prevent a run on supplies.

The government must onshore the manufacturing of N95 and disposable medical masks. This is part of a broader discussion around supply-chain sovereignty and the distinction between "just-in-case" manufacturing and "just-in-time" manufacturing. Work on this must start now: The government should proactively engage with suppliers now (we are aware of several who are actively trying to engage) and considers incentives manufacturers through measures such as:

- Logistical support
- Discount warehouse space
- Licence arrangements
- Tax incentives
- Advance order purchases

To reiterate: We know of a number of large PPE manufacturers who are supplying Britain from abroad and who would be interested in setting up a manufacturing facility here in the UK.

As a short-term solution, we recommend a focus on mouth coverings for mass mask-wearing and the use of custom-made masks and face coverings.

Over the medium-term, we recommend supply-chain sovereignty with PPE suppliers. The government should incentivise and encourage them to onshore now, for example by providing logistical support and advance order purchases.

Pressure on Supply of N95 Masks to Frontline Workers

Due to unprecedented demand, there has been significant pressure on the supply lines of N95 masks. This is because these are considered the best masks to wear in a health-care setting. As Covid-19 has placed more and more pressure on global health-care systems, the demand for N95 masks has risen considerably.

We have spoken with the major manufacturers of N95 masks and it is clear there has been greater demand than supply, exacerbated by national-level restrictions on export (for example, in the US). Supply is, however, ramping up and we believe that, through a range of suppliers, coverage of all health-care workers is possible in the short-term.

In any case, this paper does not recommend the deployment of N95 standard masks at population level until a secure and sufficient domestic supply chain is established. This will be achieved by onshoring manufacturing. For now, we do not advocate the use, by the public, of high-grade masks designed to prevent the inward movement of particles into the airways. Such masks should be prioritised for health-care workers. In our view the benefit of population-level mask usage is in preventing

transmission of the virus. In these circumstances, standard disposable medical masks or even homemade masks would be sufficient.

Kar Keung Cheng, Tai Hing Lam and Chi Chiu Leung, in a paper published by the Lancet, make this point clearly: “Another concern is the shortage of mask supply in the community. Medical masks must be reserved for health-care workers. Yet to control the infection source rather than to self-protect, we believe that cloth masks, as recommended by the CDC, are likely to be adequate, especially if everyone wears a mask. Cloth masks can be easily manufactured or made at home and reused after washing. Authorities also worry about correct techniques for wearing, removal, and disposal of face masks, but these techniques could be learned through public education.”³⁶

³⁶ [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)30918-1/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30918-1/fulltext)

Compliance

There is a spectrum of measures for ensuring citizens consistently wear masks. These range from encouragement to enforcement, and we recommend that the government introduce a set of measures in the “encouragement” space but with the option of fines for non-compliance. This would complement the approach taken to lockdown and sit within the window of relative normality for the country.

Encouragement-only can work in countries where there is a culture of mask-wearing. However, for the UK it will be a relative novelty and, therefore, it’s important that alongside clear communications to encourage use, there are disincentives for non-use, such as fines. These disincentives should rise if non-wearing is repeated by an individual.

Finally, it’s important to note that compliance will also be encouraged by measures put in place proactively by business – particularly those in the hospitality and leisure sectors. This is the case in Hong Kong, where the majority of shops and restaurants require masks to enter and the Eurostar, which announced that all passengers would be required to wear a face mask.

Table 3 – Examples of Measures in Place

Encouragement	Enforcement
<p><i>Illinois</i> “People should wear a mask and it should be they should be reminded if they’re not wearing a mask that they’re not.”³⁷</p>	<p><i>Los Angeles</i> People failing to wear masks can be charged with a misdemeanour, risking fines or possibly jail.</p>
<p><i>Hong Kong</i> Socially and culturally enforced (a ban on their use following protests has been upheld³⁸ but usage continues regardless).</p>	<p><i>Morocco</i>³⁹ The country criminalised all violations of public orders, including not wearing a mask.</p>

³⁷ Statement from Governor Pritzker

³⁸ <https://www.theguardian.com/world/2020/apr/09/hong-kong-court-upholds-face-masks-ban-despite-coronavirus>

³⁹ <https://www.moroccoworldnews.com/2020/04/298897/morocco-strengthens-measures-to-enforce-wearing-masks-in-public/>

Recommendations

As we have set out in this paper, it appears clear that masks have a vital role to play in how we exit lockdown.

The science we include indicates that even homemade masks provide an important barrier in inhibiting the spread of the coronavirus by stopping larger droplets.

Modelling indicates that the use of masks, if widespread, can help keep the rate of R below 1 (this is true even of homemade masks).

We recommend that:

1. The government takes advantage of every possible supply channel to ensure our health-care workers have access to N95 masks.
2. The public should be mandated to wear a face covering in public, particularly where normal social distancing is not possible.
3. The government proactively engages with large global manufacturers of N95 and disposable medical masks to onshore the supply of these masks, with an ambition of creating adequate, secure supplies to equip the nation in the medium-term.
4. Mask usage should form part of a wider strategy, including measures such as social distancing, hand-washing and mass community testing.
5. Policy on masks should be accompanied by a communications campaign explaining exactly what masks are being recommended and why.

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