C19 National Foresight Group: Intelligence Briefing Paper

PPE Summary

25/06/20

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The following areas came up relating to PPE within our literature search for NHS Capability and Capacity from April 2020 and we have updated and extended that this week. A rapid summary of the literature was completed including grey and academic literature. Please note a lot of this literature was modelled on SARS or pandemic experiences and is predominantly restricted to hospital use not social care.

We provided the following feedback in Mid-April:

PPE calculation systems, challenges and solutions

Providing solutions for the shortages in supply chain for one-time-use PPE is extremely complex. Preference would always be for usage of single-use items as described by the manufacturers as ensuring the safety of our healthcare workers is paramount. Logical first step solutions would be to improve communication lines for better stock management of PPE that exploits webpage and mobile phone app development along with dual bespoke production of PPE using medical grade materials where gaps are identified, such as ventilators. However, a pandemic imposes untold and unexpected demands on society that includes provision or contingency planning for reprocessing PPE. Under such situations, it is imperative to follow closely advice from original manufacturers of PPE on material composition and design features with a view to making reprocessed PPE (where possible), fit for purpose. This also includes adhering to close advice provided by regulators, such as FDA. The majority of existing in house hospital, external terminal sterilization and adjacent minimal processing technologies (as used in food industry) will not be effective for reprocessing PPE. However, a review of best evidence suggests that preferred candidate methods for meeting this gap appears to be use of vaporised hydrogen peroxide (VHP) and UV irradiation technologies, which are likely be deployed in the Republic of Ireland.

The Ask: We are trying to establish a better understanding of why concerns have been raised about a possible shortage of PPE *specifically* about the global supply chain of face masks. This briefing explores academic knowledge of PPE use and modelling/forecasting and shares survey data on mask wearing trends for sub sections of the UK populations (UCL survey data). The C-19 team at NTU were asked to review this on the 16th of June, this is our rapid analysis so far, on the 24th of June. Older conclusions are contained further down in this paper.

Additions, as of 23/06/2020 and 24/06/2020

These are the highlighted areas of concern, both from a practitioner's perspective and the academic and grey literature, that all those working in procurement need to be considering.

Practitioners Insights

- Legitimacy of PPE goods being received (identified during quality management checks on arrival), and the supply chain itself.
- Competing with other countries, such as the US and private buyers to get supplies to the UK (gazumping).
- Discontinued orders due to links with slave trade/cheap labour.
- Lack of raw materials and membranes to make PPE, and the consequential spike in costs as a result of this.

- Affordability of minimum quantity orders (bulk buying), and the need to alter procurement procedures and systems to accommodate payment upfront terms.
- Lockdown of countries that would/were manufacturing the products stilted the supply chain.
- PPE attrition rates – local and government decisions about the usage of PPE varies, there is higher level of attrition rates on some products. A clear message has been given about not overusing scarcer PPE products.
- Lead time for ordering products varies. For example, two-week lead times versus three-four months.
- Effective forecasting of PPE is taking place and products are being shared locally; however external factors, such as the embargoing of manufactured products in China has impacted upon this. The ongoing relationship with China is challenging in terms of the management of the supply chain given most of the UK population has little influence over the international relations between countries.

Team reflections:

Public attrition rates
The LRFs are clearly dealing with more complexities around the use of different types of PPE for various purposes than the public will necessarily be dealing with but the public need to be clear about how/when to use it.
Fake PPE products (not up to UK Health and Safety standards)
It may be helpful to know what has happened to this stock and whether it can be repurposed. For example, with countries having differing health and safety requirements it may be that others could repurpose it.
Avoid PPE expiration dates
Ties in with the coordination of PPE with other regions/counties, when the world is nearing the end of the pandemic (vaccination permitting) it would be beneficial to share the remaining stocks with other areas that still require it or have depleted limited stocks left. In this way it mitigates against an abundance of national stock becoming outdated over time, as opposed to those areas placing more orders for stock. The cross-charging of unwanted stock between areas would enable those regions with overstock to recoup money to use on other resourcing activities. As well as working closely with suppliers to reduce the volume of products as need for them dispels.

Academic Insights

Face masks versus face coverings
You asked us whether we could differentiate between facemasks and face coverings (particularly about public use the of face protective equipment).

Distinguishes between face masks and face coverings
Terminology within the literature seems to be used interchangeably (face masks/coverings/face shields), with only differentiations being made between the use of surgical face masks for healthcare workers and face masks/coverings/face shields being used by the public:

‘The World Health Organization, for example, recommends masks only for those with symptoms suggestive of Covid-19, stating that masks should otherwise be reserved for healthcare workers. However, elsewhere WHO acknowledges that the wearing of masks by the general public has a place in severe pandemics, since even a partial protective effect could have a major influence on transmission’

'… 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.’

A rapid search of the literature on the wearing of masks by the general public during epidemics or pandemics by a team at the University of Galway (E Toomey, personal communication, 29 March 2020) found five peer reviewed systematic reviews. They summarise these below (direct quote):

- An “empty review” published on 27 March 2020. That is, a review showing no randomised trials of masks so far during the Covid-19 pandemic
- A 2020 systematic review comparing standard surgical masks and respirator masks, which included a single small trial from 2009 of respirator masks, standard masks, and no masks among the general public during an influenza epidemic in Australia. That trial, which was considered robust, showed a benefit of masks over no masks, but no benefit of respirator masks over standard ones, and also showed that masks were worn less than 50% of the time
- A 2011 Cochrane review covering physical interventions and including 67 studies (many of poor quality), in which the main relevant study was the 2009 trial described above
- A 2010 systematic review of face masks in influenza epidemics, which included standard surgical masks and respirator masks. Found some efficacy of masks if worn by those with respiratory symptoms but not if worn by asymptomatic individuals.
- A 2007 systematic review and expert panel deliberation, which acknowledged the difficulties in interpreting evidence and stated: “With the exception of some evidence from SARS, we did not find any published data that directly support the use of masks … by the public.” The evidence from SARS was not set out in the paper (so we assume it was expert opinion on the panel).

Two further systematic reviews have since been released as preprints. Xiao and colleagues reviewed non-pharmaceutical measures for prevention of influenza. They identified 10 randomised controlled trials published between 1946 and 2018 that tested the efficacy of face masks (including standard surgical masks and commercially produced paper face masks designed for the public) for preventing laboratory confirmed influenza. A pooled meta-analysis found no significant reduction in influenza transmission (relative risk 0.78, 95% confidence interval 0.51 to 1.20; I2=30%, P=0.25). They also identified seven studies conducted in households; four provided masks for all household members, one for the sick member only, and two for household contacts only. None showed a significant reduction in laboratory confirmed influenza in the face mask arm. The authors concluded: “randomized controlled trials of [face masks] did not support a substantial effect on transmission of laboratory-confirmed influenza” (bmj, Face masks for the public during the Covid-19 crisis, 09/04/2020).

Effectiveness and usability of face masks/coverings

References in terms of their effectiveness and usability are noted as follows:

‘Both masks significantly reduced the number of microorganisms expelled by volunteers, although the surgical mask was 3 times more effective in blocking transmission than the homemade 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.'

‘To our knowledge, there are no trials of cloth masks in the general public. A three arm trial of cloth masks versus surgical masks versus “standard practice” in preventing influenza-like illness in healthcare staff found that cloth masks were the least effective, but “standard practice” usually involved a surgical face mask and there was no true control arm with no masks.’

‘Results revealed that the practice of wearing face masks amongst male adults was poorer than that amongst females. This study supports earlier studies, which reported that male adults were less likely to wear face mask. Generally, male adults hold beliefs related to masculinity and perceive themselves as strong with a lower chance of acquiring illnesses. They are less likely to engage in health-related preventive measures. Conversely, female adults, who are more likely to adopt a caregiving role, may consider themselves to have a high risk for illnesses. Thus, females are more likely to adopt health-related preventive measures’.

‘Despite demonstrating a significant difference in their practice of using face masks, male and female adults did not demonstrate any difference in their technique in using face masks. Findings indicated that practice and technique are different concepts. Assuming that people who maintain a satisfactory practice in using face mask can also demonstrate a satisfactory technique in using face mask is illogical. Therefore, teaching and reinforcing the public about the proper technique in using face mask, even to people with good practice, are necessary approaches.’

A number of the literature sources outline the need for public education and gives guidance and recommendations on the types of face masks/coverings and how they should be utilised:

‘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.'

'CDC advice on use of face masks by the general public: Cover your mouth and nose with a cloth face cover when around others. Everyone should wear a cloth face cover when they have to go out in public—for example, to the grocery store or to pick up other necessities. Cloth face coverings should not be placed on children under age 2 or on anyone who has trouble breathing or is unconscious, incapacitated, or otherwise unable to remove the mask without assistance. Do not use a face mask meant for a healthcare worker. The cloth face cover is not a substitute for social distancing'.

‘Moreover, face mask designs vary amongst manufacturers and are confusing to users. For example, several face masks have a coloured side, which is supposed to face outward, whereas others have the same colour, often white, on both sides. This problem is further compromised as most of the packaging of face masks do not provide clear instructions regarding its proper use.’

Increase demand from the volunteering community for PPE (Face masks)
You asked us whether we foresee an increase in demand from the volunteering community for face PPE?

There is very little literature in relation to the following search terms. Therefore, whilst the Market Share by PPE Product and Region [data], 2018, which was shared with the NFG last week, provides insight into the numbers of face masks being ordered and illustrates the complexity of the global market. We recommend this as a read for those in procurement. How these quantities have increased following Covid-19. How much of these products are being procured for volunteers, given volunteer data (before and post-Covid) is not easily discoverable. Our team conclude the following:

'Develop and make available risk communication on: information on the use of face coverings and medical masks', WHO's guidance regarding volunteers at mass gatherings/sporting events.

‘Largely depends on voluntary groups’ requirements for volunteers to wear masks, the types of roles being undertaken by volunteers in the coming months’.

BAME Community (the public) access to PPE
You asked us do we have any intelligence around the access the BAME community (in the public sphere) have to access to PPE?

There is little literature to inform if members of the BAME community have sufficient access to PPE, the UCL dataset does not include ethnicity data. An article entitled ‘Submission of evidence on the disproportionate impact of Covid-19, and the UK government response, on ethnic minorities and women in the UK, 2020’ acknowledges that there is ‘A strong relationship exists between ethnicity, socio-economic status and complications arising from asthma. This cross references the advice above on covering your mouth and nose with a cloth when around others. One study of hospital admissions in the West Midlands, for example, found that BAME groups, particularly those of lower socio-economic status, had higher asthma-related hospital admission rates than the white population.’ There are two points that could be inferred from this, firstly BAME groups (as well as other members of the public in the lower socio-economic group) may not have the financial capabilities to prioritise regular access to PPE themselves unless it is provided for them within their workplaces or by a government initiative.

‘Due to a shortage of sufficient and appropriate PPE across the country, all staff are potentially working in unsafe environments; however, frontline staff from ethnic minority backgrounds carry a great risk. Reporting on lack of PPE and a safe working environment currently relies on individuals speaking out on issues of concern, and reporting shortages to superiors. This may be more difficult for staff from BAME groups, as previous work by the BMA has found that BAME doctors are twice as likely not to speak out about workplace safety concerns, as they do not feel secure enough to do so, further compromising the safety of this already potentially at-risk group.’

Previous additions, as of 16/06/2020 and 17/06/2020

This article has a Market Share by PPE Product and Region pre Covid-19 (2018) (revenue $ million, %) which should highlight by way of context, where the demand is for individual PPE products. There are other statistics that may be of use: https://www.adb.org/sites/default/files/publication/579121/ppe-Covid-19-supply-chains-bottlenecks-policy.pdf

What has caused PPE shortages concerns?

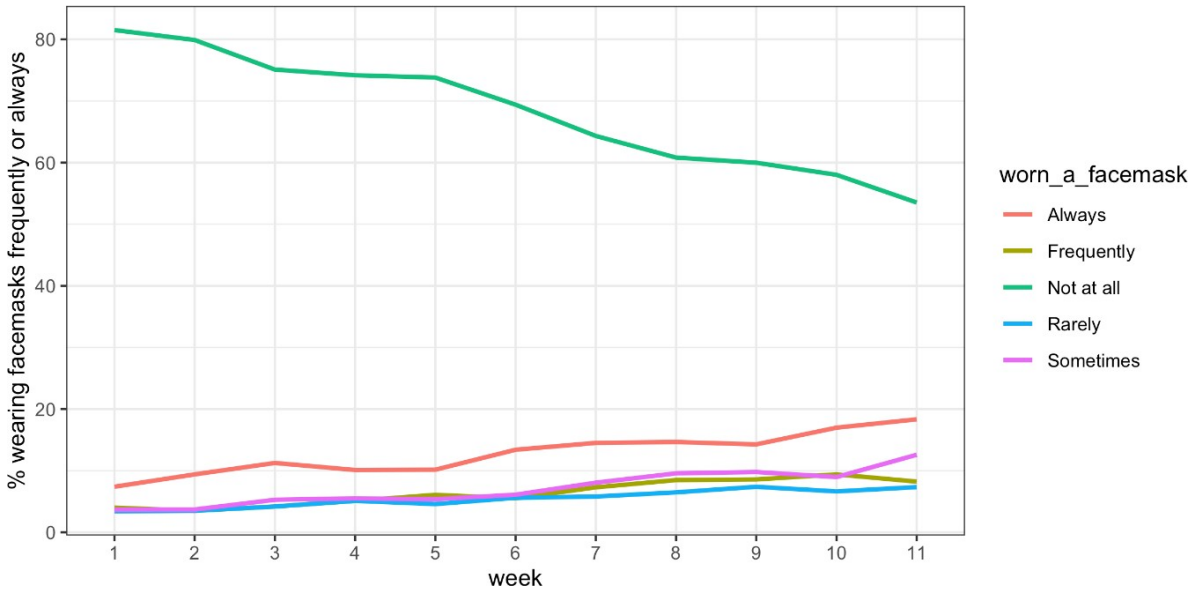
- Second wave in Beijing raises legitimate concerns about the disruption this will/would cause to supply chains due to closure of production and preserving for local use. China is the major producer of PPE and despite some increase in local production (70 million masks to be produced by Honeywell in the UK) concerns are of course related to the potential use of PPE in China
- General concern over the continuation of the first global wave, whilst those countries who have had their first wave enter another wave of COVID-19 affecting global demand for PPE
- As the economy begins to open up in the UK and messages from central government to return to work increase more people will be returning to a new normal (with additional access to workplaces, shops and health/hospitals) there is concern how this may impact on mask availability (more people needing/buying masks)
- Mass gatherings (raves, BLM demonstrations and far right demonstrations), increases attrition rates of PPE stocks as public services engage with these events
- LAs, LRFs and service leaders, may now be having more time to think about this issue as we move into recovery and make slower time strategic planning decisions
- Misuse and overuse of PPE, and a need to find solutions for reprocessing PPE for COVID-19 given its one-time-use (most sterilisation technologies are unsuitable)

Mask wearing trends data

Data from UCL Covid-19 survey has been tracking respondent's use of facemasks in the UK. Data in this briefing represents views from 10th June release (week 11 of lockdown) This data highlights that almost 50% of people are wearing a facemask at least rarely (sum of all but not all data). Therefore assuming that the biggest impact on facemask demand will be those using them always or frequently.

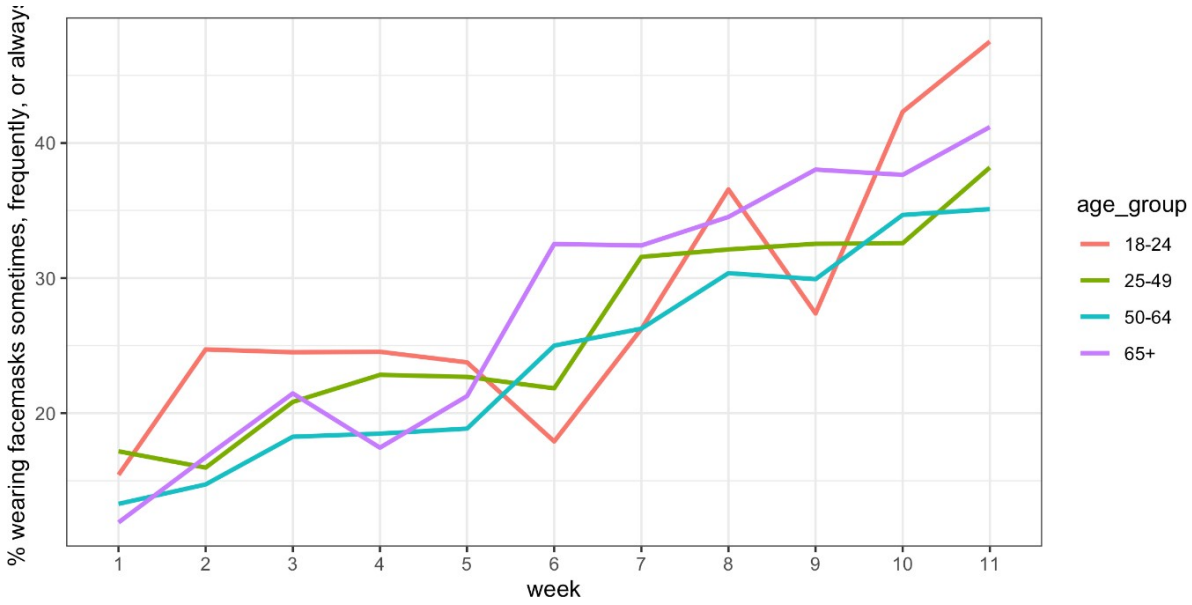
Please note: Preceding charts below highlight response of always or frequently unless otherwise stated.

Figure 1: Face mask wear by age



There is a general increase in facemask use, with approximately 20% of people using a facemask frequently or always. Older adults (65+) and 18-24 are increasing in face mask wearing, with 1/3 of the 65+ age group wearing them always or frequently.

Figure 2: Percentage of times worn a face mask by age group



In terms of pressure points, one assumption could be that use of public transport and increases in hospital visits for elective and non-elective procedures may cause an increase in demand for masks due to stipulations/recommendations on their use in hospitals and public transport use. These SitReps have previously highlighted the link between older adults (one of the highest increasing wearers) and public transport. A review of elective and non-elective procedures below highlights that in normal years there might be an expected increased hospital visits in the autumn.

Figure 3: The graph below shows non-elective inpatient admissions (FFCEs) and outpatient referrals and attendances for first consultant outpatient appointments (averaged across 2008 – 2020 with black line highlighting 95% confidence).

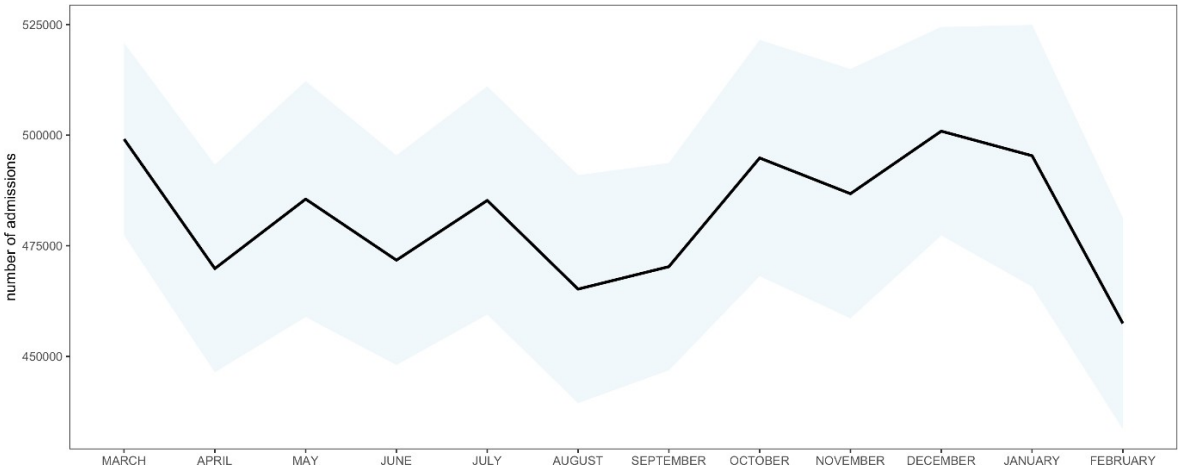
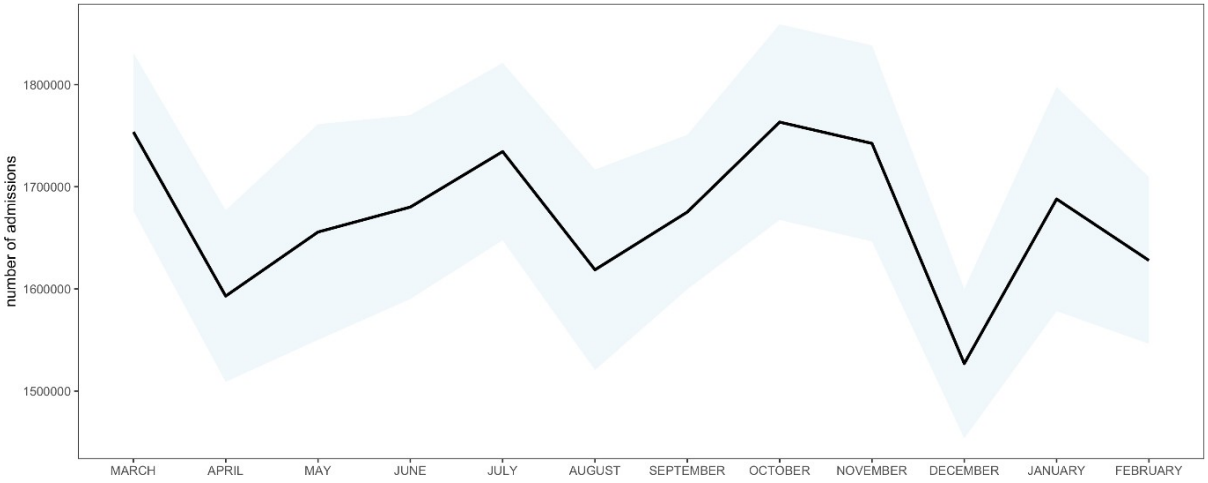


Figure 4: Elective inpatient admissions (FFCEs) and outpatient referrals and attendances for first consultant outpatient appointment (averaged across 2008 – 2020 with black line highlighting 95% confidence).



In employment status (figure 5), students are showing the fastest growth in facemask use, and are now the most likely to wear facemasks. This suggests that returning to university may create a pressure on demand, with students possibly seeking facemasks for F2F content. This is shown especially in the age_sometimes figure 2, which shows that younger adults are most likely to sometimes, frequently, or always wear a facemask (therefore showing the relative increase in 'sometimes'). If students are being more selective about 'when' they use facemasks, this may again point to University (or college) returns as being a pressure point for demand.

Figure 5: Employment status and face mask wear

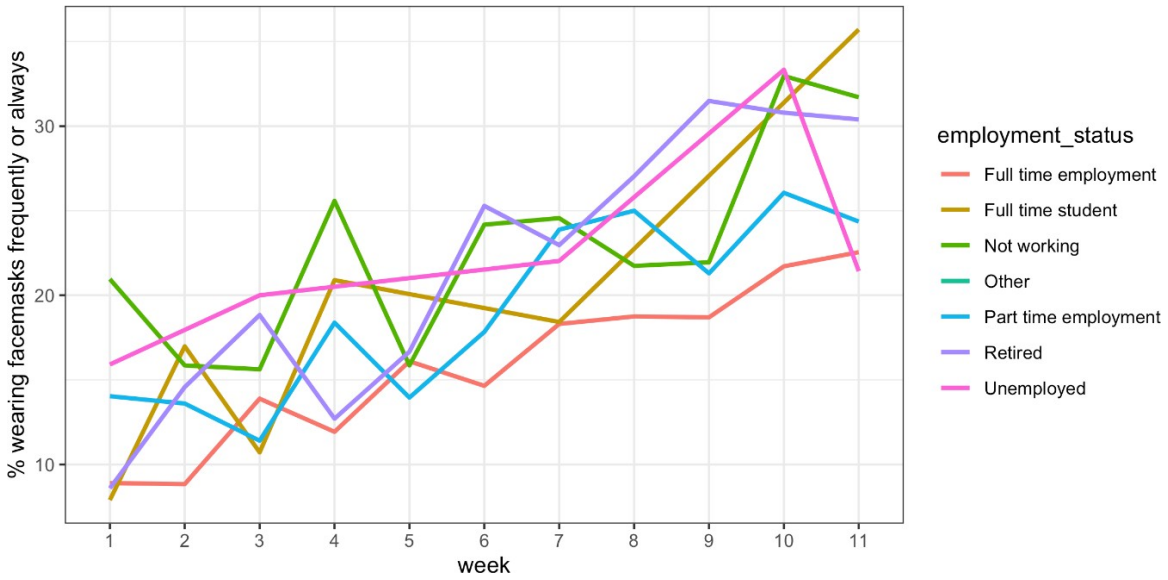
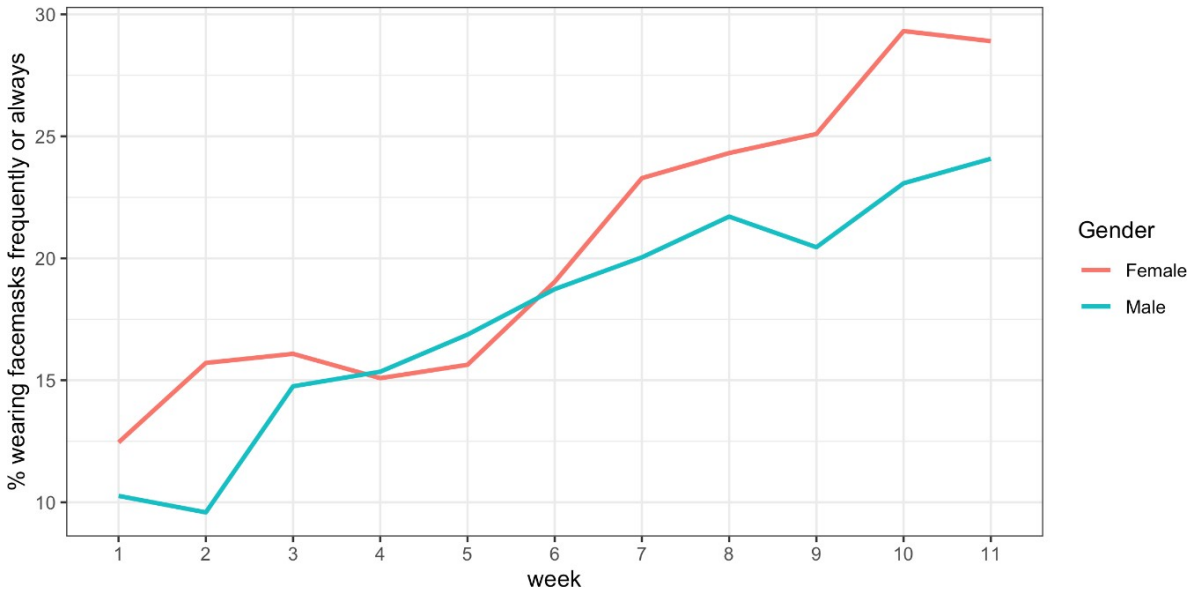


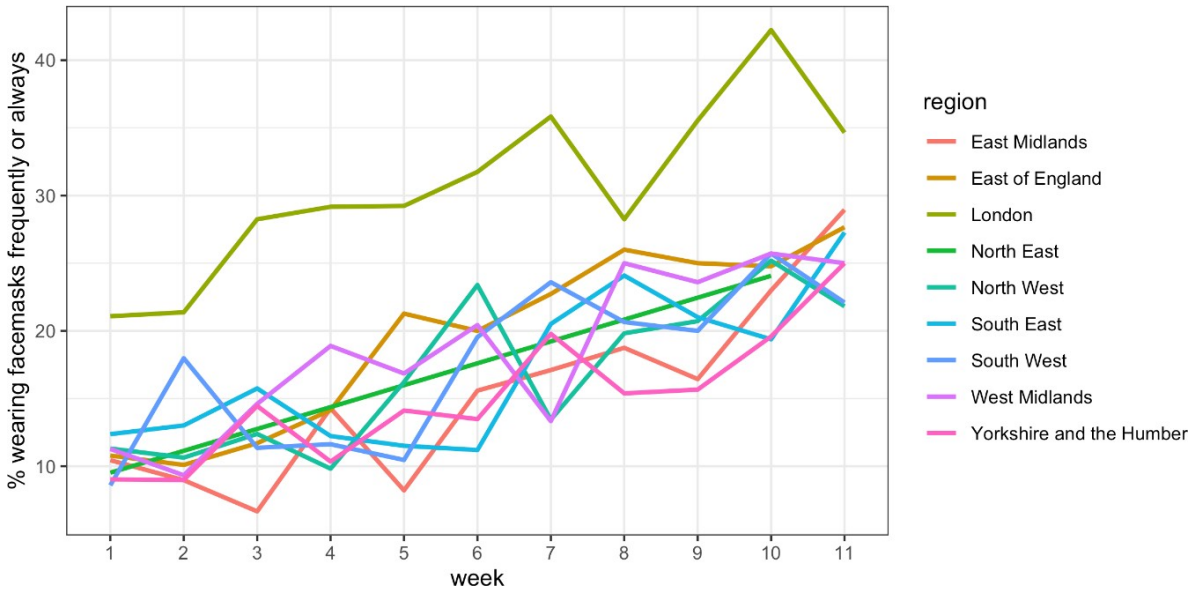
Figure 6: Face Mask wear by gender



Overall females report using facemasks more than men, but both have reported a steady increase.

Regional data are a bit more varied as shown below. This week saw a drop for London. However, Londoners are still much more likely to use facemasks frequently, than other regions of the UK, though there is a general (though not consistent) increase for other regions. Note the declines in the NW and West Midlands.

Figure 7: Face mask wear by region



This data highlights self-reported public use of facemasks. It is a useful measure to explore how particular policy changes or regional spikes may affect public use and a sense of safety. This data has a minimum of a week lag.

Solutions/Recommendations for mitigating against PPE shortages

'Make your own [cloth] masks' ('Despite uncertainty, the potential for benefit, the lack of obvious harm, and the precautionary principle lead us to strongly recommend as close to universal (homemade, unless medical masks can be used without diverting healthcare supply) mask use by the general public as possible.') and 'Encouraging production of cloth masks may help counteract and discourage medical mask hoarding; this can include homemade production and perhaps industrial production'

Government campaign to encourage 'make your own mask' using cloth. This already seems to be happening, revisions to guidance as appropriate need to be made in line with current advice. Particularly in terms of how and when to reuse/dispose/recycle.

Use of 3D printers
This is already occurring for face shields with hobbyist through to universities developing, distributing and promoting their work for local and regional contacts.

Conserving and managing PPE
Import, reclaim, reuse, repurpose, create supply, extend supply, reduce non-essential services, reduce patient contact, use non-human services, stratify use by patient risk, employ immune workers.

Coordination of sharing PPE required within countries
'… repurposing them from areas that are past the peak to areas that are at an earlier phase and operational planning'. There is an OSL Operations, mentioned in WHO's April update, which is establishing and managing a global supply chain hub by actioning countries requests and coordinating the urgent supplies. Noted that 'organised shipments of critical supplies from Dubai to Addis Ababa, …, for onwards dispatch to 34 African countries. A plan to distribute 340 million surgical masks to 120 countries has been developed, and discussions are underway with WFP to prepare the distribution strategy'.

Smart communication software and distribution channels
Northern Ireland considered this to be a positive contributing factor in improving and safeguarding their supply chain and the bespoke production of PPE when planning for PPE shortage. An Australian journal article referenced using a system called SPECTRUM to aid with preparedness decision-making, whilst WHO (08 April 2020) provided a link to a COVID-19 Essential Supplies Forecasting Covid-19 Essential Supplies Forecasting Tool to assist governments and stakeholders in contingency planning for essential PPE supplies.

Improve JIT (Just-in-time) delivery of PPE
According to a case study, Northern Ireland repeatedly chartered non-stop return flights to China to collect vital PPE order, using a team of volunteer pilots (rota). On return to NI the stock was then distributed quickly amongst its healthcare trusts, facilities and care homes. Although costly, this would also help mitigate against the hijacking/interception of PPE during transportation to ensure it meets the intended destination on time and in full. To support with matters such as this, the WHO announced on 8 April 2020 that they will be establishing a Covid-a19 Supply Chain Task Force (COVID-19 Supply Chain System (CSCS)) to provide countries with essential supplies for their COVID-19 response by aiming to: 'Establish and implement a global strategy to ensure access to critical and life-saving supplies, as identified by WHO, bring together the collective capabilities of public and private actors to meet these needs and ensure the flow of vital supplies and essential cargo'.

Modelling face mask usage
One article wrote about categorising the public into two groups to help with supply chain requirements and demand: 'those that habitually do and do not wear face masks' ('To mask or not to mask: Modelling the potential for face mask use by the general public to curtail the Covid-19 pandemic').