Reusable Facemask Pilot Trial

A summary of the project and impacts

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Executive Summary

Across the UK, single use facemasks have become the scourge of the Covid 19 pandemic with over a trillion having been consumed since the beginning across the globe.

An opportunity to look at the potential to use reusable facemasks in place of single use facemasks was highlighted through the dramatic increase in waste generated, the shortages of supply and the environmental impact.

The reusable facemasks were trialled by 63 organisations, trialling 1,250 facemasks, all responded with an overwhelmingly positive response. There is a need and a desire to adopt these reusable facemasks widely across the NHS and staff feel passionate that this should be done as fast as possible. The 1,250 facemasks used in this pilot trial replaced 41,920 single use facemasks or the equivalent of 1.467 tonnes of single use facemasks and saved up to 41 tonnes/CO2e of carbon emissions.

For reusable facemask to be adopted across the health care system there needs to be national IPC and PHE guidance as well as buy in. Procurement systems also need to participate in this process as well.

In order for Trusts to implement reusable facemasks, they need to assess their appropriate use, washing procedures, staff assessment and the Trusts need to assess a variety of options, review and update their policies. Measures need to be in place to track the use of the facemasks and ensure that they are taken out of circulation at the end of their tested lifespan.

There are cost savings to be made to Trusts across the UK and healthcare systems across the world by implementing reusable facemasks. The implementation of a reusable Type IIR facemask within the healthcare systems across the world can help to increase reusability, local circular economies, reduction and elimination in healthcare waste and reduce littering. It can also start the process of investigating other reusable products.

Acknowledgements

Thanks must be given to all of the participants, the observers and the manufacturers involved in this trial. Thank you to the team at the Greener NHS at NHS England for supporting this project and helping to drive change within the guidance institutions.

Special thanks should go to the manufacturers: Revolution Zero, Wise Protec, OmniProtect, ANJ Trading Limited and Virustatic Shield who have kindly donated their products for use in the NHS as part of this trial. All of the NHS sustainability and green minded healthcare professionals who have participated in this pilot trial, distributing the facemasks, collating the information from the trial participants and returning it for analysis.

Throughout this trial there have been many challenges to overcome and a steep learning curve in the art of single use products as well as reusables. The road to a reusable Type IIR facemask is not a clear one but between us all we have navigated the challenge and allayed the fears of many, hopefully to transition to a low to zero emission reusable facemask that supports a Net Zero NHS for the future.

1.0 Background

1.1 Reusable Facemask Pilot Trial

The pandemic highlighted the challenges for single use PPE (Personal Protection Equipment) and the role that reusables can play in the reduction of waste and the environmental impact. This pilot project was borne out of the need and demand to look at alternatives to the single use facemask. Yorkshire Ambulance Service NHS Trust commenced the pilot trial to assess the options available on the market to look at reusable facemasks. As the pilot was developed, more Trusts and healthcare organisations wanted to get involved due to the overwhelming desire to look at solutions to the mounting waste being produced by the health system and the inundation of waste providers, no longer capable of coping with the increased demand for waste disposal. Many green minded healthcare professionals are also keen to eliminate single use products and explore the options on the market.

During this pilot, over 60 healthcare organisations have been involved in trialling reusable facemasks across the UK. Different challenges have been raised through the process of assessing them with the details laid out in this report.

1.2 COVID 19

In 2019, a highly transmissible disease was spread across the world and the NHS understood the fragility of the world and the supply chain infrastructure that supports the healthcare system. COVID19, a coronavirus with flu like symptoms that can be transmitted by aerosol particles was born in China and quickly turned into a pandemic as many were infected. As the COVID19 pandemic spread its tentacles across the world, killing many and infecting many millions more, the demand for the methods and products to prevent the spread increased.

1.3 PPE

1.3.1 Supply Chain

The supply chain providing key products to the NHS was put under severe pressure early in the pandemic. The supply of key healthcare products is heavily reliant on the Far East with most manufacturing facilities based in China, Taiwan and Korea. Other manufacturing facilities are located in Turkey and India. During the early stages of the pandemic, these countries faced a complete shut down and there was no manufacturing of products that supplied the entire world. The world had become heavily reliant on the cheap manufacturing of the far eastern supply chain with many countries deeming their own manufacturing chains too expensive due to the cheap products for the Far East. There was no local resilience for PPE.

1.3.2 PPE Crisis

During the pandemic, PPE became a much sought out commodity as many who had never needed or used PPE before were required to or wanted to wear it to protect themselves from COVID19.

The raw product of oil was reduced in production due to the decreased demand for petrol and diesel across the world. Blown plastic, the core raw material for many PPE items stopped being manufactured in the Far East as the countries shut down. This led to additional demands for blown plastic and pushed prices of critical PPE up.

The PPE crisis highlighted the fragility of the supply chain, the fragility of the raw material supply chain and manufacturing, issues associated with modern slavery, shipping and our dependencies on a few suppliers.

PPE costs

Due to the lack of supply and increased demand through global lockdowns, the prices of PPE escalated with many entering bidding wars to secure PPE at higher than normal costs. The cost of Type IIR facemasks increased from around 10-15 pence per facemask (pre pandemic) to over 70 pence per facemask (peak pandemic).

PPE Push Stock

During the coronavirus pandemic, the DHSC (Department of Health and Social Care) needed to expand the PPE supply chain from 226 NHS trusts in England to over 58,000 different settings, including care homes, hospices and community care organisations. The Department of Health and Social Care (DHSC) distributed over 3.5 billion PPE items for use by health and social care services in England. The UK manufacturing capability plays an important role in a more resilient supply chain. The UK manufacturing response to the crisis has been a significant achievement with, on average, UK-based supply anticipated to meet 70% of forecasted demand in England in December 2020 for all categories of PPE excluding gloves. It also has wider benefits, including the potential to create jobs and for the UK to become a centre for innovative products that meet user needs.

PPE ordered from the portal is free of charge. All PPE offered on the portal meets UK government quality standards. The PPE portal can be used by:

- GPs
- residential social care providers
- domiciliary social care providers
- pharmacies
- dentists
- orthodontists
- optometrists
- children’s care homes and secure homes
- all special schools and special post-16 institutes
- community drug and alcohol services
- residential drug and alcohol services

Details of the amount of facemasks available to order to a GP surgery through the PPE portal is presented in the table below:

	Amount that can be ordered per week	Amount that could be ordered per year
GPs - <5000 patients	200	10,400
GPs - 5000 to 7,999 patients	400	20,800
GPs - 8000 to 10,999 patients	700	36,400
GPs – 11,000 to 29,999 patients	1400	72,800
GPs with 30,000+ patients	5000	260,000

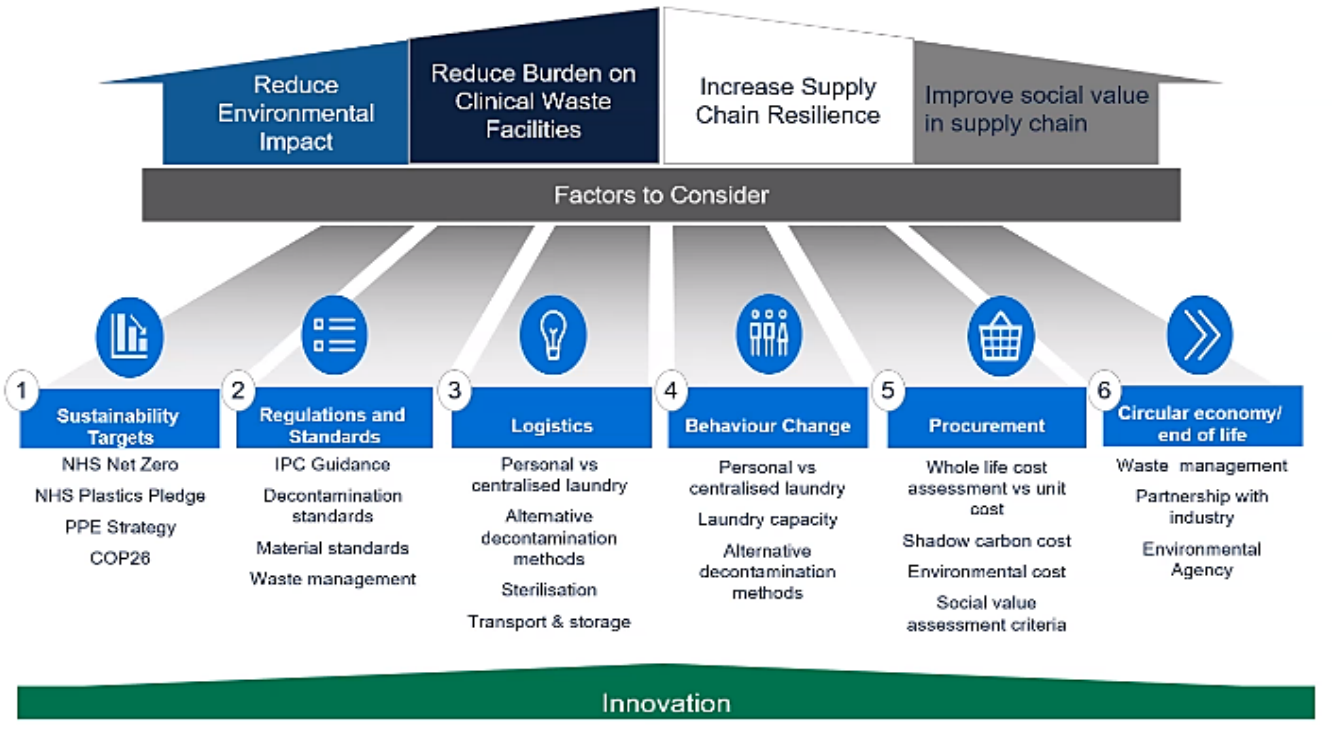
The updated details as to how many items can be ordered by each health care group is presented on the PPE portal: how to order COVID-19 personal protective equipment (PPE).

PPE opportunity

There are great opportunities that can be offered to the NHS in shifting away from single use products. The opportunities include supply chain resilience, cost saving, transportation reduction, UK make, job creation, waste reduction and elimination, second life for the products through circular economy, carbon reduction.

1.4 Shifting to reusable products

The shift to reusable products is complicated and there are many different challenges that need to be overcome in order to achieve the implementation. There are many more benefits to transitioning to reusable products as well.



Source: NHS England Innovation Hub

2.0 Face masks requirements

For the purpose of this report, the following terms are referred to in reference to 'facemasks'.

- **Facemask** – a face covering or facemask that protects the user from air borne infectious agents
- **FRSM** – Fluid Resistant Surgical Masks
- **Face covering** – a facemask that does not comply with legislative requirements
- **Surgical/Medical face mask** – intended use of medical face masks is to minimise transfer of infectious agents (germs) by large particle droplets between healthcare staff and a patient during surgical procedures and other medical/healthcare settings with similar requirements (in the case of Type II masks). Additionally, in certain circumstances it is intended to protect the wearer against splashes of potentially contaminated liquids (in the case of Type IIR masks). A medical face mask with an appropriate microbial barrier may also be intended to be worn by patients and other persons to reduce the risk of spread of infections, particularly in epidemic or pandemic situations (in the case of Type I) (ref. HM Government).
- **Type IIR** – a medical grade fluid resistant surgical mask that complies with BS EN 14683:2019

This report is about the adoption and uptake of reusable Type IIR facemasks.

2.1 Legislation

Type IIR

It is vital that a distinction is made between the evidence pertaining to fluid-resistant surgical face masks (FRSM) (Type IIR) and standard (non-fluid-resistant) surgical face masks (Types I and II). Surgical masks are tested against the safety standard BS EN 14683:2019; this series of tests measures the performance of a surgical mask in bacterial filtration efficiency (BFE), breathing resistance and splash resistance. Type II and Type IIR surgical masks are both tested against this standard with them needing to meet a minimum BFE of 98%; however only Type IIR masks must pass the splash resistance test with a resistance of at least 16.0kPa.

The terms 'fluid resistant' and 'fluid repellent' are often used interchangeably to denote a Type IIR surgical mask, however, terminology may vary internationally and a 'fluid repellent' mask may occasionally describe a mask that does not meet the BS EN 14683:2019 splash resistance standard and which is not suitable for protection against splash or spray i.e. a Type II surgical mask. In the UK, when recommended for infection prevention and control purposes a 'surgical mask' will be a fluid-resistant (Type IIR) surgical mask (quoted from ARHAI Scotland report Rapid review of the literature: Assessing the infection prevention and control measures for the prevention and management of COVID-19 in health and care settings) .

Medical grade Type IIR Facemasks are covered under these British standards:

- EN 14683:2019 – Medical face masks
- ISO 22609 – Synthetic Blood Fluid Pressure
- Compliance with the Class 1 medical device UK Medical Device Regulations 2002 (SI 2002 No 618)
- CE, UKNI or UKCA marked

The technical specifications are laid out in the document Technical specifications for personal protective equipment (PPE)

The EN 14683:2019 standard refers to the following requirements in order to achieve the correct standards.

		EN 14683:2019		
		Type I	Type II	Type IIR
Barrier Tests	Bacterial Filtration Efficiency (BFE) % ASTM 2101/EN14683	≥95	≥98	
	Particle Filtration Efficiency (PFE)% ASTM F2299	Not required		
	Synthetic Blood Fluid Pressure ASTM F1862/ISO 22609	Not required		≥16.0 (kPa)
Safety Tests	Microbial Cleanliness ISO 11737-1	≤30 (cfu/g)		
	Flammability 16 CFR part 1610	Not required		
Physical Tests	Differential Pressure EN 14683 (Pa/cm^2)	< 40		< 60

Further details on PPE standards can be found at Public Health England COVID-19 PPE Hub and NHS guidance on supply and use of Personal Protective Equipment (PPE) and other supplies.

2.2 Regulators

The regulators for the medical grade single use facemasks

- MHRA – Medical devices authority

For Medical grade reusable Type IIR facemasks, a variety of regulators have been involved in the assessment of the process for assessing and approving the use and regulation of the masks. These are:

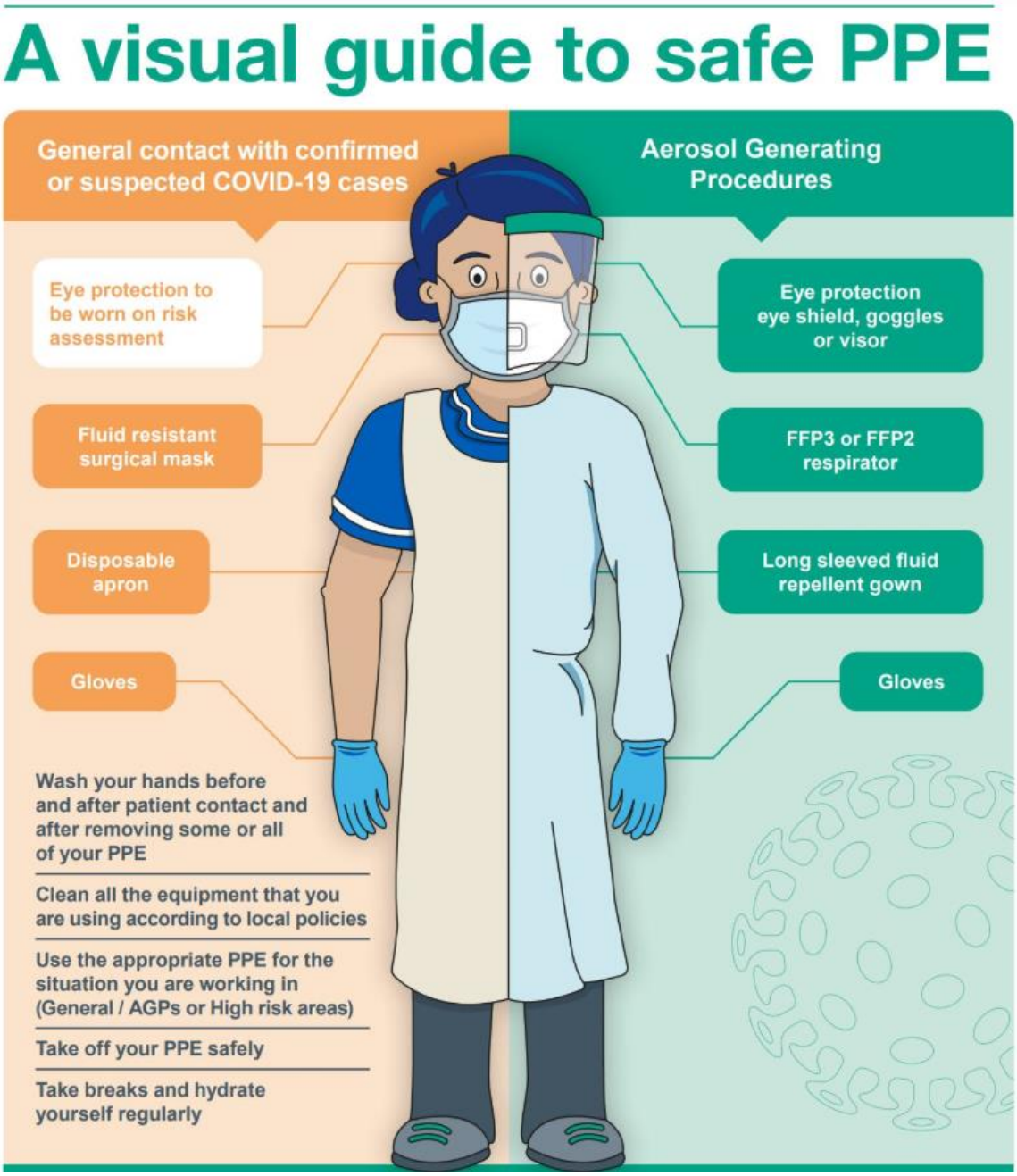
- MHRA
- HSE (Health and Safety Executive)
- OPSS – Office for Product Safety and Standards
- NHS England Technical Assurance team

2.3 Guidance

The guidance supplied to NHS Trusts during the COVID19 pandemic changed regularly.

It was mandated on 22nd September 2020 and came into law on 24th September 2020 that the general public should wear facemasks at all times when in shops. At the same time a mandate came from NHS England that all staff use Type IIR facemasks when on health care sites.

The COVID-19 waste management standard operating procedure was issued in January 2021 providing information on the waste management requirements of waste generated within healthcare systems.



Source: Guidance for Primary Care | HSC Public Health Agency (hscni.net)

The guidance laid out in the COVID-19: Guidance for maintaining services within health and care settings - infection prevention and control recommendations (dated August 2020) and the COVID-19: infection prevention and control (IPC) identified some guidance changes that are required to change the uptake of reusables. This national guidance is a barrier to the uptake of reusable products and is quoted by IPC leads across the board as being their sole or one of several reasons for not allowing the uptake of reusables facemasks. The guidance states:

All PPE should be:

- located close to the point of use (where this does not compromise patient safety, for example, mental health/learning disabilities). In domiciliary care PPE must be transported in a clean receptacle
- stored safely and in a clean, dry area to prevent contamination
- within expiry date (or had the quality assurance checks prior to releasing stock outside this date)
- single use unless specified by the manufacturer or as agreed for extended/sessional use including surgical facemasks
- changed immediately after each patient and/or after completing a procedure or task (unless sessional use has been agreed and local risk assessment undertaken)
- disposed into the correct waste stream depending on setting, for example domestic waste/offensive (non-infectious) or infectious clinical waste
- discarded if damaged or contaminated
- safely doffed (removed) to avoid self-contamination. See here for guidance on donning (putting on) and doffing (removing)
- decontaminated after each use following manufactures guidance if reusable PPE is used, specifically non-disposable goggles/face shields/visors

In reference to Type IIR masks, this guidance is presented that states that it should be disposable:

Fluid-resistant (Type IIR) surgical face mask (FRSM)

A disposable fluid-resistant mask worn over the nose and mouth to protect the mucous membranes of the wearer's nose and mouth from splashes and infectious droplets. FRSMs can also be used to protect patients. When recommended for infection control purposes a 'surgical face mask' typically denotes a fluid-resistant (Type IIR) surgical mask.

2.4 Infection prevention Control

The Standard Infection Control Precautions (SICPs) are the basic IPC measures necessary to reduce the risk of transmitting infectious agents from both recognised and unrecognised sources of infection and are required across ALL COVID-19 pathways. Sources of (potential) infection include blood and other body fluids secretions or excretions (excluding sweat), non-intact skin or mucous membranes and any equipment or items in the care environment that could have become contaminated. The application of SICPs during care delivery is determined by an assessment of risk to and from individuals and includes the task, level of interaction and/or the anticipated level of exposure to blood and/or other body fluids.

Through guidance provided COVID-19 infection prevention and control guidance (publishing.service.gov.uk), the requirements stated that fluid resistant surgical face mask (FRSM Type IIR) masks must:

- be worn with eye protection if splashing or spraying of blood, body fluids, secretions or excretions onto the respiratory mucosa (nose and mouth) is anticipated or likely
- be worn when providing direct care within 2 metres of a suspected/confirmed COVID-19 case
- be well-fitting and fit for purpose, fully cover the mouth and nose (manufacturers' instructions must be followed to ensure effective fit and protection)
- not be touched once put on or allowed to dangle around the neck
- be replaced if damaged, visibly soiled, damp, uncomfortable or difficult to breathe through

PPE required for SICPs when following the low risk pathway is as follows (see table below):

SICPs/PPE (all settings/all patients/in dividuals)	Disposable gloves	Disposable apron/gown	Face masks	Eye/face protection(visor)
If contact with blood and/or body fluids is anticipated	Single use	Single use apron (gown if risk of spraying / splashing)	FRSM Type IIR for direct patient care and surgical mask Type II* for extended use	Risk assess and use if required for care procedure/task where anticipated blood/body fluids spraying/splashes

*sessional/extended use of facemasks apply across the UK for HCWs in any health or other care settings

2.4.1 Trust IPC leads

Those who participated in this trial were asked to contact their Trust infection prevention control (IPC) team in order for them to assess the products and assess where they deemed appropriate use of the facemasks. It was suggested that GPs contacted their regional primary care network IPC lead to involve them in the continuing conversation as well. This was considered an essential part of the process in order to use these products in the appropriate situations as well as to aid the longer term adoption.

Two online sessions were run for the Trust IPC leads to ask questions of the manufacturers about their products. These were closed sessions so that all of the facemask manufacturers would be open and could disclose any potential IP information.

2.5 Face mask consumption

2.5.1 International Assessment

In order to assess the international market to see if there were any viable products available, the HCWH (Healthcare without Harm) group was contacted to see if there was any similar Type IIR accredited facemasks on the market. Some trials had been carried out but there were not accredited masks being used in the Netherland, Spain or Sweden.

A preliminary assessment carried out internationally by NHS England showed that there are no healthcare systems that have adopted reusable facemasks across the world.

2.5.2 Face mask consumption in NHS

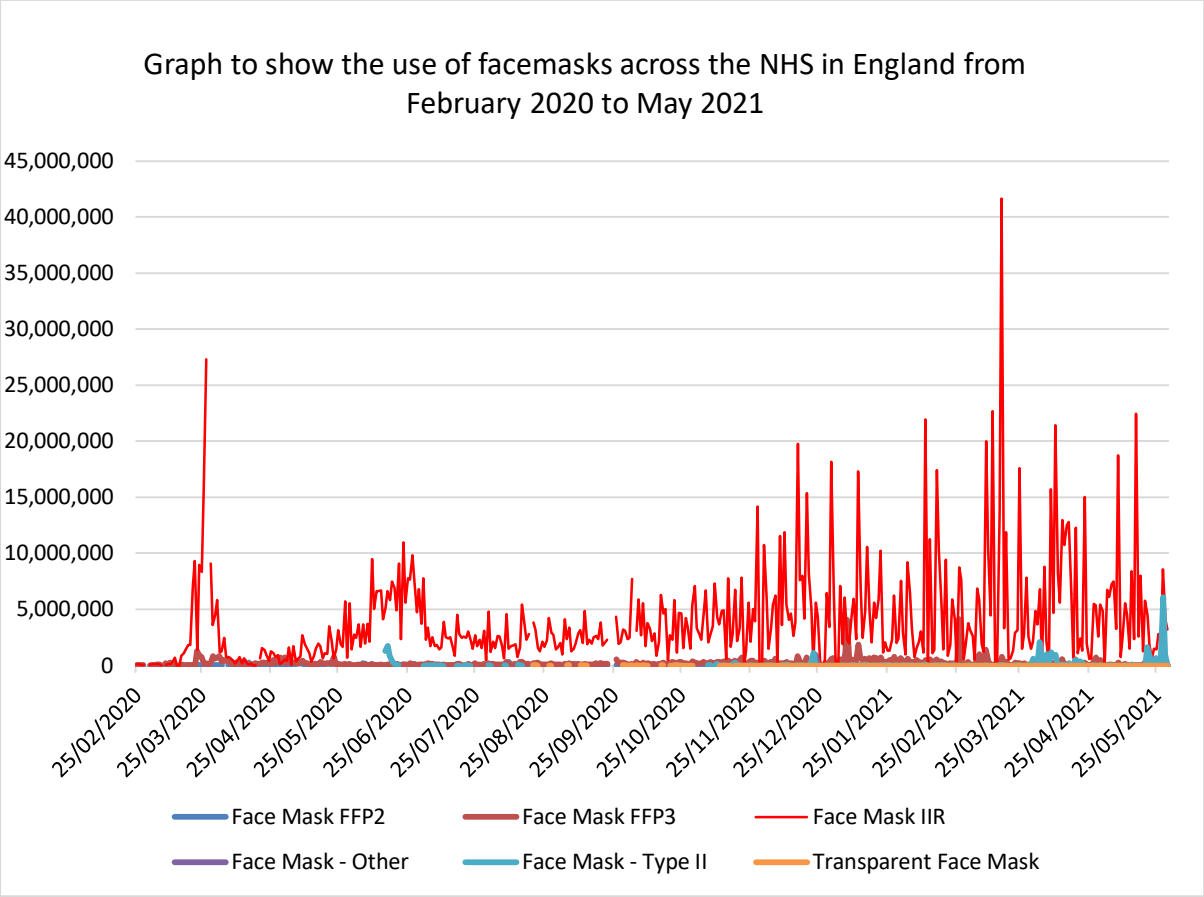
The average consumption of facemasks in the NHS has increased from around 60,000 facemasks used per day (in 2019/20) to 3.8 million single use facemasks used per day[1]. The total number of single use facemasks consumed by the NHS in England in 2019/2020 was 21,864,235. The total amount of facemasks consumed from February 2020 to May 2021 is 1,956,119,784 of which 1,355,965,562 are Type IIR.

Table to show the unrounded PPE distributed statistics for England

PPE item	Cumulative Total (25 Feb 2020 to 30 May 2021)	Full Year Total (25 Feb 2020 to 24 Feb 2021)	Previous Year (1 Jan to 31 Dec 2019)
Aprons	1,630,407,750	1,225,366,100	161,631,850
Body Bags	341,910	301,397	84,944
Cleaning Equipment	81,730,391	81,730,391	383,662,956
Clinical Waste Bags	73,475,072	66,773,766	49,507,575
Clinical Waste Containers	75,360	75,360	305,173
Coveralls	1,287,011	1,065,356	0
Eye Protectors	143,582,662	102,555,683	481,612
Face Mask FFP2	12,384,471	11,769,521	522,600
Face Mask FFP3	101,521,555	82,507,227	2,809,910
Face Mask IIR	1,810,454,908	1,249,970,114	18,531,725
Face Mask - Other	1,086,750	1,085,400	0
Face Mask - Type II	30,672,100	10,633,300	0
Fit Test Kits	27,429	19,136	409
Fit Test Solutions	166,427	139,065	6,762
General Purpose Detergent	76,130,453	65,052,331	37,700,253
Gloves	7,368,401,736	5,492,769,755	1,763,164,310
Gowns	50,502,334	36,593,092	749,250
Hand Hygiene	23,144,338	19,606,965	2,047,548
Paper Towels	1,700,215	1,700,215	10,215,360
Swabs	325,792,988	289,817,277	1,006,300
Other Items	615,928	615,928	6,646
Total	11,733,501,788	8,740,147,379	2,432,435,183

[1] PPE deliveries statistics (England): weekly reports - GOV.UK (www.gov.uk)

The use of facemasks across the NHS in England is shown below with data collected on a weekly basis from February 2020.



Source: https://www.gov.uk/government/collections/ppe-distribution-statistics-england with additional information from the consumption of PPE pre and post Covid - DHSC document from the PPE Strategy (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/921787/PPE_strategy_v4.5_FINAL.pdf)

2.5.3 Face mask consumption by the healthcare systems

Participants of the trial were asked to supply details of their consumption within their healthcare system. The figures highlighted the following daily consumption of facemasks within these healthcare systems in the year to date:

Healthcare organisation	Daily consumption	Monthly consumption
National*	3,822,596	114,677,880
Acute Hospitals	50,000-100,000	
Community Hospitals	15,000-50,000	
Ambulance Services	10,000-15,000	
GP	100-250	2,000-5,000

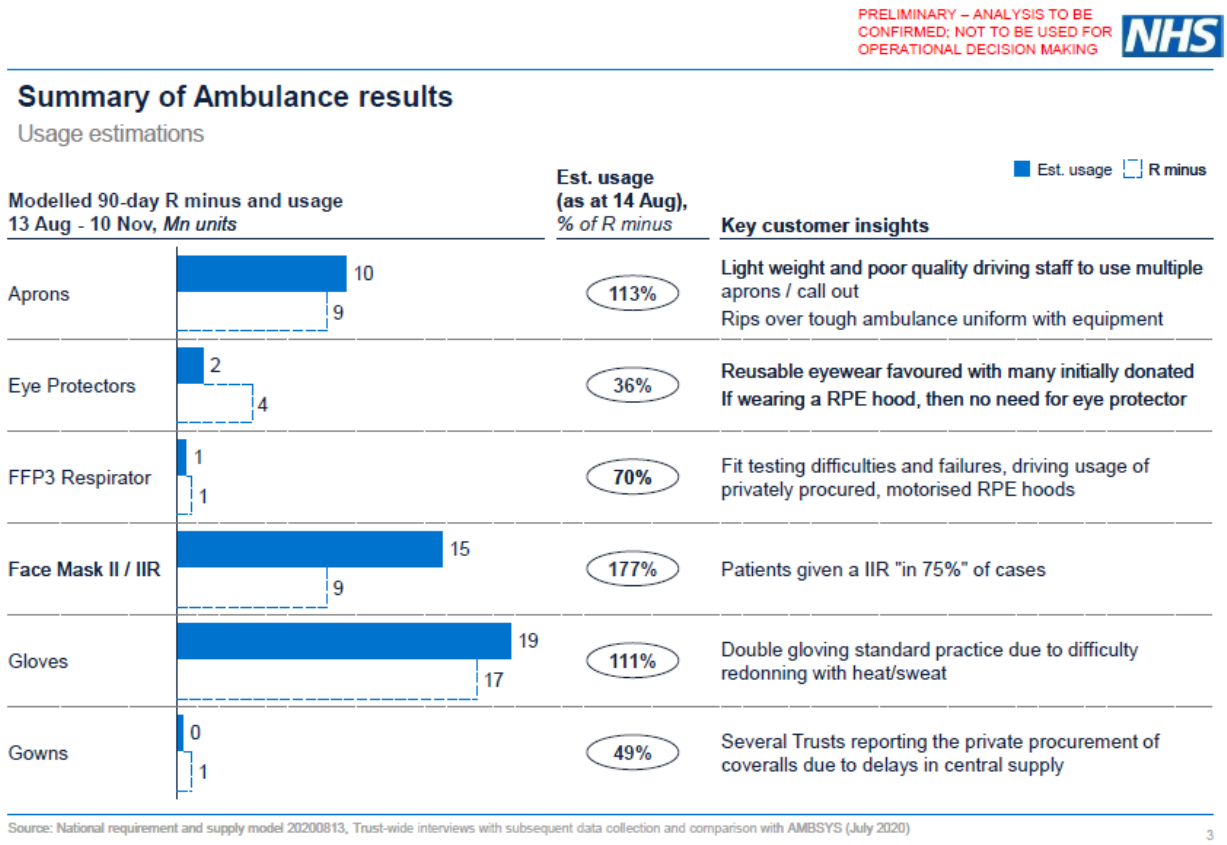
*average

Anecdotal information was provided by some of the Trusts and GPs involved in this trial as to how many facemasks they were consuming with their previous years consumption:

- YAS – 15,000 masks per day; 10,000 per year before
- Northampton – 13,000 masks per day; 100,000 per year before
- Sussex – 554,000 masks in 4 months
- GP surgery – 1,400 – 1,800 masks in 7 months; 0 - 30 per year before

2.5.4 Facemask use by the Ambulance Service

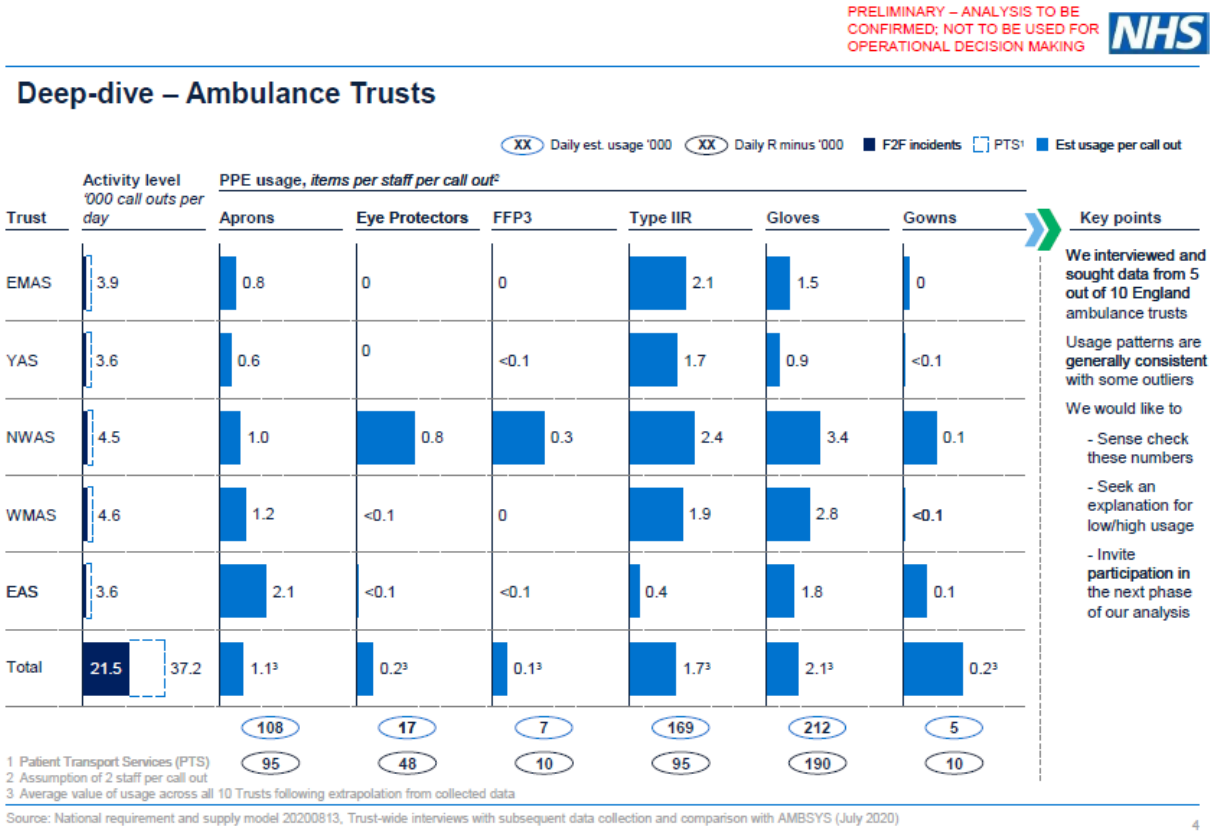
McKinsey has been working with the Department of Health and Social Care on the PPE Demand Planning workstream since March 24th 2020 to look at the consumption of PPE across the NHS. Initial PPE demand planning was based on modelled estimates and conservative assumptions to generate a 'requirement' for key PPE items, across all healthcare sectors. Analysis carried out by McKinsey and provided to the ambulance service in September 2021 is presented below:



The data shows that patients were given Type IIR facemasks in 75% of cases leading to a 177% increase in the amount of facemasks consumed in a three month period.
The data below shows the number of items associated with each ambulance service call out per ambulance service. The number of overall call outs per day with 21,500 call outs for A&E and a further 16,000 call outs for PTS (patient transport).

Assumptions were made that there were two staff per call out. The figures shown on this assessment show that there was on average a use of between 0.4 and 2.4 single use facemasks per call out. The estimates for single use facemasks was 169,000 facemasks per day.

These figures are estimates and not really representative of the data collated on the road, as assessments on staff consumption of facemasks show.



2.5.5 Face mask consumption by YAS trial participants

Yorkshire Ambulance Service (YAS) daily consumption is around 13,000 facemasks. The facemask consumption is broken down into two areas – front line staff and back office staff.

Frontline staff

Front line staff includes paramedics and patient transport staff. Front line staff were interviewed as to how many single use facemasks they are consuming on a daily basis. IPC within YAS have stipulated that a single use facemask is used per patient contact. The number of facemasks that front line staff use per shift is based in the area in which they operate.

- Rural staff use between 6 and 10 per shift
- Urban staff use between 10 and 15 per shift

Staff reported they require around 25 facemasks due to waste and facemasks breaking as well as presenting facemasks to patients and families.

Back office staff

Back office staff are located on stations and not interacting with patients are required to use facemasks in a sessional use i.e. used for up to a 4 hour period. This group therefore would require two to three facemasks per shift/working day.

2.6 Single use facemasks complaints

Due to the volume of facemasks used during this pandemic and due to the length of time that staff are using them, there has obviously been an increase in the number of complaints associated with the facemasks.

2.6.1 Reported Single use facemasks complaints

Through the official reporting route at Yorkshire Ambulance Service, the number of complaints relating to single use facemasks had increased from the previous year from zero complaints to over 30. Many more have not been reported through this route but to managers so unfortunately have not been captured.

The complaints related to facemasks are detailed below:

- No bendable nose strip
- Metal nose strip in flexible upper nose constraint band sticking through the fibres and causing pinprick sensation to nose
- The ear straps are not adjustable, the mask has ear loops so they do not sit at the crown or behind the neck
- There is significant gaping of the mask and it doesn't stay in place when moving the head side to side, or up and down.
- Ear straps snapped or broke when putting on
- No ear loops on any of the masks
- Fibres are coming loose and getting in eyes, nose and throat
- Staff member reported sore eyes after using Type IIR facemasks
- Staff member experienced a metallic taste in their mouth after wearing a face mask for a long time
- Staff member reported exacerbation of asthma with use of facemasks leading to being unable to breathe, having to take inhalers and having anxiety in using them
- Staff member reported a sore throat with prolonged periods of use of facemasks
- Staff member reported a rash/ erythema (superficial reddening of the skin, usually in patches, as a result of injury or irritation causing dilatation of the blood capillaries) line under their nose and to their ear. The rash had subsided by the following day but left with numerous cold sores along this line
- Staff reporting they are breathing in fibres - causing coughing whilst others feel as though they covered in hairs causing them to scratch their faces and noses
- Upper respiratory tract irritation due to facemasks. Symptoms are runny nose, cough, sneezing as well as some staff being unable to breathe correctly for several days after their shift
- Allergic reactions to the masks resulting in the face swelling and having a rash. Some staff report swelling to the face under the mask and a burning sensation after prolonged use
- The mask felt too small around the face and not fit for purpose.
- Feeling that the PPE (facemasks) are not fit for purpose

2.6.2 Anecdotal single use facemasks complaints

Anecdotal complaints from staff in relation to facemask complaints include:

- Not suitable for those with beards
- Steaming up of glasses/goggles as they don't create a seal at the nose
- Gaping holes at the side
- Don't fit the face
- Straps don't allow a close fit and are too loose on the face
- Rubbing behind the ears from prolonged use
- Uncomfortable to wear
- Facemask acne
- Breathing problems

3.0 Facemasks requirements

3.1 Challenges

At the start of the project several challenges were identified that need to be overcome in order to get the reusable facemasks into use within the NHS.

These challenges are detailed below:

- CE marking - CE marking wasn't at applicable to multiple use PPE products and facemasks cannot get CE marking
- Accreditation - The MHRA, HSE and OPSS have different responsibilities for PPE and the accreditation of reusables with appropriate certification for the facemasks
- Traceability – It was highlighted that there is a need to work through the requirements to trace the number of times that the facemasks have been washed. Technologies like RFID, QR codes, bar codes, apps, manual marked grids, colours per month and date stamps are under consideration for tracing the use of these products
- Certification – the masks needed to have Type IIR accreditation and be certified accordingly
- Protection – are there assurances on the impact that the masks would have to protect the users and the patients.
- Efficacy – the masks need to protect the users/patients from bacteria and viruses
- Washing – identifying the temperatures required to disinfect the facemasks as well as processes for washing masks internally and externally with other organisations
- Washing instructions required in the facemasks – i.e. details of temperature, number of washes, ironing etc
- Washing – establish the laundry procedures for staff to utilise in their working environments or for staff to use in the home washing
- How should the masks be issued – for personal issue vs multiple users i.e. washed and put back into a multi use space
- Per patient use vs sessional use
- Lack of Standard Operating Procedures for reusable facemask
- Viral coating - the IPC requirement is for products to be washed at a minimum of 60 degrees within health settings. Viral coating on the facemasks in general have a lower temperature and aid prolonged protection
- National IPC guidance on reusable products needs to change – at present it is stipulated that single use facemasks are required.
- PPE provided for free at present to NHS organisations through NHS push stock and the PPE cell

- Supply chain carbon footprint assessment
- UK manufacture of the facemasks
- Waste reduction benefits need to be understood
- Product recycling at the end of life – can we establish a circular economy?

4.0 Trial Remit

4.1 The facemasks

In this trial, reusable facemasks were supplied by accredited and certified British manufacturers and suppliers. Some of the facemasks supplied at the beginning of the trial were face coverings working towards becoming Type IIR accreditation, others already had Type IIR accreditation. Some of the facemasks had viral coating as well.

In total, 14 masks were trialled. These were identified as M1 – M14 for ease of responses. Details as to the masks are provided in the photographs below.

4.2 Mask certification

Many of these masks started as face coverings at the beginning of the trial and through this pilot project and working with the manufacturers, they developed their products to comply with the needs of the NHS as well as achieve necessary certification in order to be used alongside of or to replace single use facemasks.

The standards required under the legislation detailed in section 2.1 was complied with and the facemasks were tested to the Type IIR standards. Working with NHS Supply Chain, we requested details as to what they require in order to supply products on their procurement platform. They informed the pilot team that CE marking and compliance with the required legislation was required. Details as to the test result summaries and the mask certification is provided below:

Reusable Facemask Pilot Trial

Mask ID	Company Name	Type Mask	Washing Instructions	Washing Temp	Max. washing times	Bacterial Efficiency/ Viral Protection	Fluid repellency (EN standard)	Filtration	Breathability
M1	Revolution Zero/ Petratex	Type IIR equivalent	Tested to 130C (autoclave conditions) and tumble drying at 120C (40 x cycles)	60°C	40	Bioburden: <30 CFU/g production control (0-3) BFE: 99.8% initially, 99% after 40 washes	Yes: Splash resistance after 40 washes Splash Resistance: 32 Tests, 0 fails	3 micron 100% filtration after 40 wash/dry cycles	553 L.m-2.S-1
M2	Revolution Zero/ Petratex	Type IIR equivalent	Tested to 130C (autoclave conditions) and tumble drying at 120C (40 x cycles)	60°C	40	Bioburden: <30 CFU/g production control (0-3) BFE: 99.8% initially, 99% after 40 washes	Yes: Splash resistance after 40 washes Splash Resistance: 32 Tests, 0 fails	3 micron 100% filtration after 40 wash/dry cycles	553 L.m-2.S-1
M3	Revolution Zero/ Petratex	Type IIR equivalent	Tested to 130C (autoclave conditions) and tumble drying at 120C (40 x cycles)	60°C	40	Bioburden: <30 CFU/g production control (0-3) BFE: 99.8% initially, 99% after 40 washes	Yes: Splash resistance after 40 washes Splash Resistance: 32 Tests, 0 fails	3 micron 100% filtration after 40 wash/dry cycles	491 L.m-2.S-1
M4	PDS Tailors/ Wise Protec	Face Covering	Recommended 40°C but can be washed at 60°C	60°C	50	Antiviral coating on inner and outer layers tested against the SARS-CoV-2. Coating remains intact for at least 50 washes (fully tested). Shown to reduce virus activity by more than 99,7% after 1h; according to ISO 18184:2019 Bacterial reduction of more than 99,9% tested as ASTM E2149-13	Water repellence used is good enough for at least 10 washes.	94.2% filtration before washing and 95.7% after 50 washes as EN 14683:2019> 94% filtration so FFP2 equivalent	24,7 Pa/cm2 accordingly to EN14683:2019
M5	OmniProtect	Type II	Wash weekly. Run under cold water for two	Cold water	30	Sars-CoV-2, University of Berlin: 90% at 30 mins (1 log10), >99% at six hours (>3.375 log10)	Tested and passed to a 160mmHg at 30 washes	100% polypropylene filter with BFE	39.8 Pa/cm2

Mask ID	Company Name	Type Mask	Washing Instructions	Washing Temp	Max. washing times	Bacterial Efficiency/ Viral Protection	Fluid repellency (EN standard)	Filtration	Breathability
			minutes. Mild soap can be used to remove any stains.			Human Coronavirus 229E, University of Arizona: 99.5% reduction Escherichia coli, GMicro: >99.9% outer layer; 98.95% inner layer Staphylococcus aureus, GMicro: >99.9% outer layer; 99.10% inner layer Klebsiella pneumoniae, GMicro: >99.9% outer layer; 99.90% inner layer Pseudomonas aeruginosa, GMicro: >99.9% outer layer; 99.45% inner layer Salmonella Enteretis, GMicro: >99.9% outer layer; 98.05 inner layer H1N1, GMicro: 99.7% inner and outer layer		>98%	
M6	OmniProtect	Type II	Wash weekly. Run under cold water for two minutes. Mild soap can be used to remove any stains.	Cold water	30	Sars-CoV-2, University of Berlin: 90% at 30 mins (1 log10), >99% at six hours (>3.375 log10) Human Coronavirus 229E, University of Arizona: 99.5% reduction Escherichia coli, GMicro: >99.9% outer layer; 98.95% inner layer Staphylococcus aureus, GMicro: >99.9% outer layer; 99.10% inner layer Klebsiella pneumoniae, GMicro:	Tested and passed to a 160mmHg at 30 washes	100% polypropylene filter with BFE >98%	39.8 Pa/cm2

Mask ID	Company Name	Type Mask	Washing Instructions	Washing Temp	Max. washing times	Bacterial Efficiency/ Viral Protection	Fluid repellency (EN standard)	Filtration	Breathability
						>99.9% outer layer; 99.90% inner layer Pseudomonas aeruginosa, GMicro: >99.9% outer layer; 99.45% inner layer Salmonella Enteretis, GMicro: >99.9% outer layer; 98.05 inner layer H1N1, GMicro: 99.7% inner and outer layer			
M7	Virustatic	Face Covering	Washable up to 40 degrees without detergent	Hand washed below 40 degrees	Maximum of 10 The product is guaranteed for 3 washes. The Virustatic Shield can be worn for up to 50 hours in between washes, giving the Shield a lifespan of up to 200 hours of wear time.	ISO 18184:2019: Determination of antiviral activity of textile products. This was tested at Microbiological Solutions Limited (MSL). Influenza H1N1 with a 2 hour contact time: Virustatic Shield - 1.83 log (98.53%) Virustatic Shield after washing at 30 degrees – 1.75 log (98.22%) Influenza (H1N1) at Imperial College London – 98% effective at blocking/capturing the virus in airflow. Influenza: Tested at Manchester Institute of Biotechnology at The University of Manchester against influenza viruses to prove binding of up to 99%. SARS-CoV-2: 99% from an infected surface and then redeposited <1% of virus on a clean surface, Laboratory, Siena	N/A as hydrophilic	N/A	BS EN ISO 9237:1995 which requires a minimum air permeability of 5 mm/sec

Mask ID	Company Name	Type Mask	Washing Instructions	Washing Temp	Max. washing times	Bacterial Efficiency/ Viral Protection	Fluid repellency (EN standard)	Filtration	Breathability
M8	PDS Tailors/Wise Protec	Type IIR	Wash at 60 °C	60°C	50	It meets EN 14683 standards for Type IIR masks: Microbial cleanliness (EN ISO 11737-1:2018): 21 UFC/g Elastic Resistance (MI 177): Passed Visual inspection (MI 176): Passed	Water repellence tested according ISO 4920 Splash resistance pressure (ISO 22609:2004): 16.0 kPa	BFE (EN14683:2019+AC:2019) > 98.6%	Breathability (EN14683:2019+AC:2019): <20 Pa/cm2
M9	ViroBlock/ Omni Protect	Type IIR	Wash at 40 °C	40°C	30	Staphylococcus Aureus, Situ Biosciences: 99.9% Candida albicans, Situ Biosciences: >99.5% H3N2 (Human Influenza A), GMicro: >99.9% SARS-CoV-2, Doherty Institute: >99.9% Human Coronavirus 229E, University of Arizona: 99.5% reduction	Splash resistance to a pressure of >16kPa	Two layers of filtration with BFE 98.99% Filter 1: 44.5% wood pulp, 55.5% PET Filter 2: 100% polyester	23 Pa/cm2
M10	ANJ Trading Ltd	Type IIR	Wash at 60 °C	60°C	30	After 30 washes it is shown to be 99% effective against the following bacteria: Staphylococcus Aureus = 99% reduction of activity &organism Klebsiella Phneumoniae = 99% reduction of activity & organism We have also conducted Antimicrobial Tests according to standard AATCC 100 at the Vietnam Textile Research Institute. (certificate provided) for the following bacteria:	Splash resistance to a pressure of >16kPa	Bacterial filtration efficiency above 98%	The respiratory resistance (DP) is not greater than 9 mmH20, average of 40 Pa/cm2

Mask ID	Company Name	Type Mask	Washing Instructions	Washing Temp	Max. washing times	Bacterial Efficiency/ Viral Protection	Fluid repellency (EN standard)	Filtration	Breathability
						Escherichia coli - ATCC25922 = 99% reduction of Activity & organism Staphylococcus aureus - ATCC6538 = 99% reduction of activity & organism More info on Dupont's pages EN14683 and US equivalent ASTM F2100 pre and post wash certified.			
M11	ANJ Trading Ltd	Face covering	Wash at 40 °C	60°C	30	After 30 washes it is shown to be 99% effective against the following bacteria: Staphyloccocus Aureus = 99% reduction of activity &organism Klebsiella Phneumoniae = 99% reduction of activity & organism We have also conducted Antimicrobial Tests according to standard AATCC 100 at the Vietnam Textile Research Institute. (certificate provided) for the following bacteria: Escherichia coli - ATCC25922 = 99% reduction of Activity & organism Staphylococcus aureus - ATCC6538 = 99% reduction of activity & organism More info on Dupont's pages EN14683 and US equivalent ASTM F2100 pre and post wash certified.	Splash resistance to a pressure of >16kPa	Bacterial filtration efficiency above 98%	The respiratory resistance (DP) is not greater than 9 mmH20, average of 40 Pa/cm2

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Mask ID	Company Name	Type Mask	Washing Instructions	Washing Temp	Max. washing times	Bacterial Efficiency/ Viral Protection	Fluid repellency (EN standard)	Filtration	Breathability
M12	Revolution Zero/ Petratex	Type IIR	60 °C in industrial washing machine (40 x cycles)	60°C	40	99.8% BFE AITEX (Spain) Bioburden typical <3CFU/g No viral protection BFE: 99.8% initially, 99% after 40 washes	Splash Resistance: 32 Tests, 0 fails	99% filtration after 40 wash/dry cycles	491 l / m2 sec 15.9 Pa/cm2 553 after 40 washes
M13	Revolution Zero/ Petratex	Type IIR	60 °C in industrial washing machine (40 x cycles)	60°C	40	99.8% BFE AITEX (Spain) Bioburden typical <3CFU/g No viral protection BFE: 99.8% initially, 99% after 40 washes	Splash Resistance: 32 Tests, 0 fails	99% filtration after 40 wash/dry cycles	491 l / m2 sec 15.9 Pa/cm2 553 after 40 washes
M14	PDS Tailors/Wise Protec	Type IIR	Wash at 60 °C	60°C	50	Antibacterial tested according to ASTM E2149-13 Antiviral tested according to ISO 18184. 99.5% reduction of viral activity of SARS-CoV-2. It meets EN 14683 standards for Type IIR masks: Microbial cleanliness (EN ISO 11737-1:2018): 21 UFC/g Elastic Resistance (MI 177): Passed Visual inspection (MI 176): Passed Splash resistance pressure (ISO 22609:2004): 16.0 kPa	Water repellence tested according ISO 4920 Splash resistance pressure (ISO 22609:2004): 16.0 kPa	BFE (EN14683:2019+AC:2019) > 98.6%	Breathability (EN14683:2019+AC:2019): <20 Pa/cm2

4.3 The Pilot

4.3.1 Pilot trial participants

In total there were 64 organisations involved in the project with many more participating and being involved in assessments. NHS England/NHS Improvement have also been involved in this project to aid the process with regulatory organisations.

Due to the number of organisations that wanted to be involved in this project an initial pilot trial was run and then a second trial was run with different masks and manufacturers. Pilot 1 was run from September 2020 to December 2020. Pilot 2 was run from November 2020 to April 2021.

Details as to the participants involved in this trial are presented below:

Pilot 1	Pilot 2
Ambulance Service • Yorkshire Ambulance Service **Hospitals** • Leeds Teaching Hospitals • Nottingham Hospital • Royal Cornwall Hospital • Northampton General Hospital • Bradford Royal Infirmary • Queen Elizabeth Hospital Kings Lynn • Leeds University Medical department • Wolverhampton Hospital **GP surgeries** • Greener Practise • Witney Practice • The Medical Group - Durham • Herstmonceux Integrative Health Centre • Nightingale Valley Practice • Cam and Uley Family Practice • Somerset Gardens Family Health Centre • Sleights and Sandsend Medical Practice **Medical School** • Leeds University Medical School	**Ambulance Service** • North East Ambulance Service **Hospitals** • Edinburgh Hospital • Sheffield Children's NHS Foundation Trust • Stockport Hospital • Manchester Royal Infirmary • Newcastle Upon Tyne Hospital • Chelsea and Westminster Hospital • Oxford University Hospital • University College London Hospitals NHS Foundation Trust • Royal Free London NHS Foundation Trust • Sussex Community NHS Foundation trust • North Middlesex Hospital • Ysbyty gwynedd • Royal United Bath Hospitals • Salford Royal Foundation Trust • Kings College • Leicester Children's Hospital **GP surgeries** • East Trees Health Centre • The Old School Medical Practice • Modality Practice • Hollies Medical Practice • Mile Oak Medical Centre • Aberfeldy Practice • Weavervale Surgery • Chapeltown Practice • Manor House Surgery • Brohn UK • The Kirkbymoorside Surgery

Pilot 1	Pilot 2
	• Durham • Crondall New Surgery • St Johns Medical Centre • St Andrews Health Centre • Charlotte Keel Health Centre • Mill Road Surgery • Clifton Court Surgery • Westongrove Partnership • Jubilee Street Practice • Torbay Hospital • Abbey Grange Practise • Horton Park Medical Practice **Dental School** • Barts Health NHS Trust **Veterinary Practice** • Davies Veterinary Specialists

In total there were 26 Hospitals, 2 Ambulance services, 33 GP surgeries, 1 medical school and 1 Dental School that were involved in this pilot. There were also some medical and dental schools who participated.

Some participants wanted to be involved in the trial but had to overcome a lot of internal resistance in order to trial them in their healthcare environments including back office locations, therefore were not able to fully participate.

Additional assessments

Due to interest in this trial, we were contacted by a large veterinary practice who wished to participate in this trial in order to reduce their waste footprint. There was also a very positive response from the Vet trials although there was concern as to who should wash them and the quality control attached to this process. Due to the requirement for vets to comply with Track and Trace requirements and to wear Type IIR, they are reliant on the PHE guidance. They need guidance from the centre as to how they can take up these reusable facemasks.

4.3.2 Pilot trial assessments

The pilot trial required participants to:

- Use the masks
- Complete an assessment as to the facemasks and their use

All participants were requested to assess the facemasks that they were supplied with. The assessment took into account breathability, wearability, comfort, traceability and washing.

They were also asked to assess the circumstances that they wore the masks, how safe they felt in them and their useability. The different Trusts from hospitals to ambulance services, community hospitals to GPs were asked to map where they can use the masks and how

they can be used in those healthcare settings. They were also asked to assess how the masks could be washed within and external to their Trust (i.e. home washing).

4.3.4 Facemasks used in the pilot trial assessments

Two trials were run as part of this trial. Due to the overwhelming interest and demand to be involved in the pilot from healthcare professionals from the first trial, a second trial was run.

The masks that were supplied were different in the two trials due to the facemask manufacturers supplying the facemasks for free. Some of the facemask manufacturers did not wish to participate in the second trial. These are the masks that were trialled in the two pilots.

Pilot 1	Pilot 2
M1	M3
M2	M8
M3	M10
M4	M11
M5	M12
M6	M13
M7	M14
M9	

In total 1250 facemasks were dispatched to staff across the NHS in the two pilot trials.

A further pilot trial was carried out at Yorkshire Ambulance Service with 100 x M3, 50 x M12, 50 x M13 and 50 x M14 with the participation of front line paramedics.

5.0 Trial results

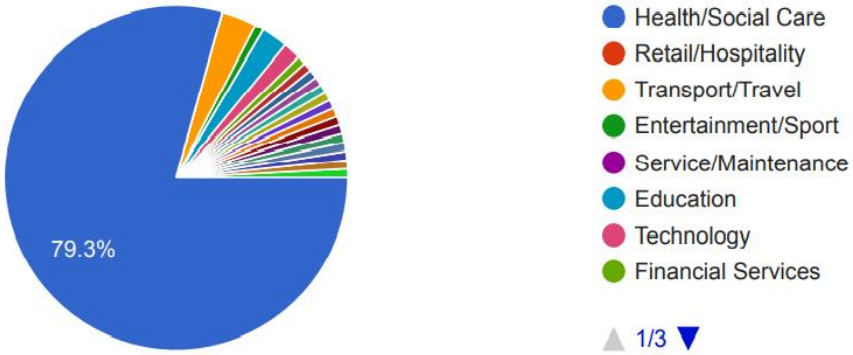
5.1 Pre assessment survey

A pre-assessment survey was sent out to participants in order to assess their use of facemasks and to gauge their reasons for participating in the trial.

The results can be reviewed on the Revolution Zero pages. Most of the respondents were from the health and social care sector. A summary of some of the key point is identified below:

The industry I work in is

121 responses

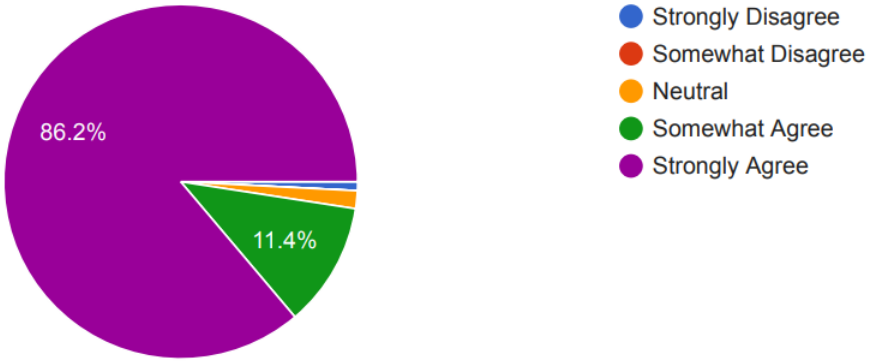


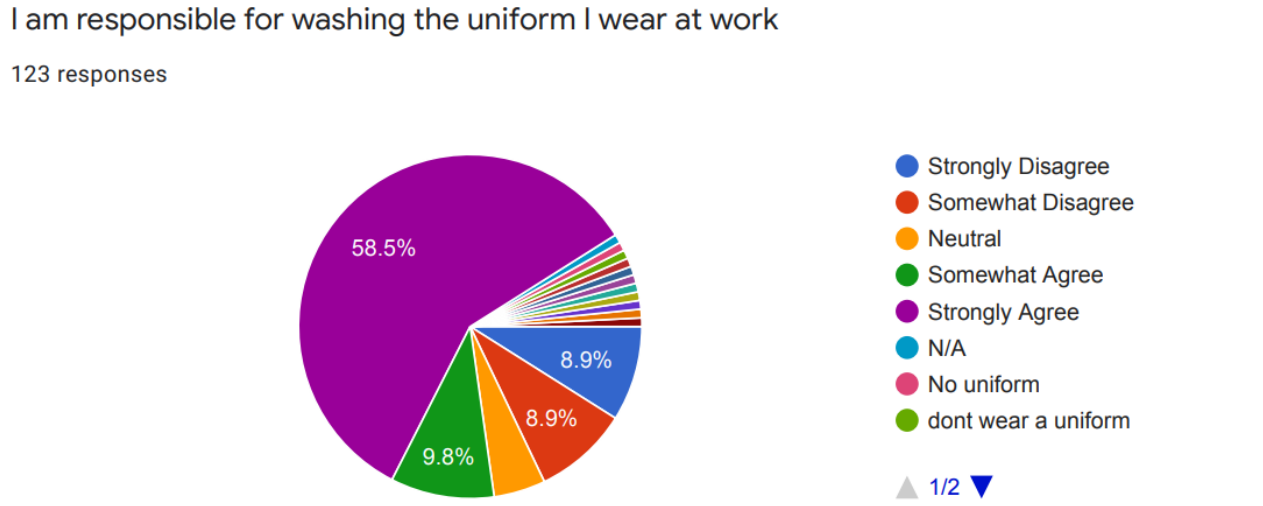
How many times a day do you wear/change a mask

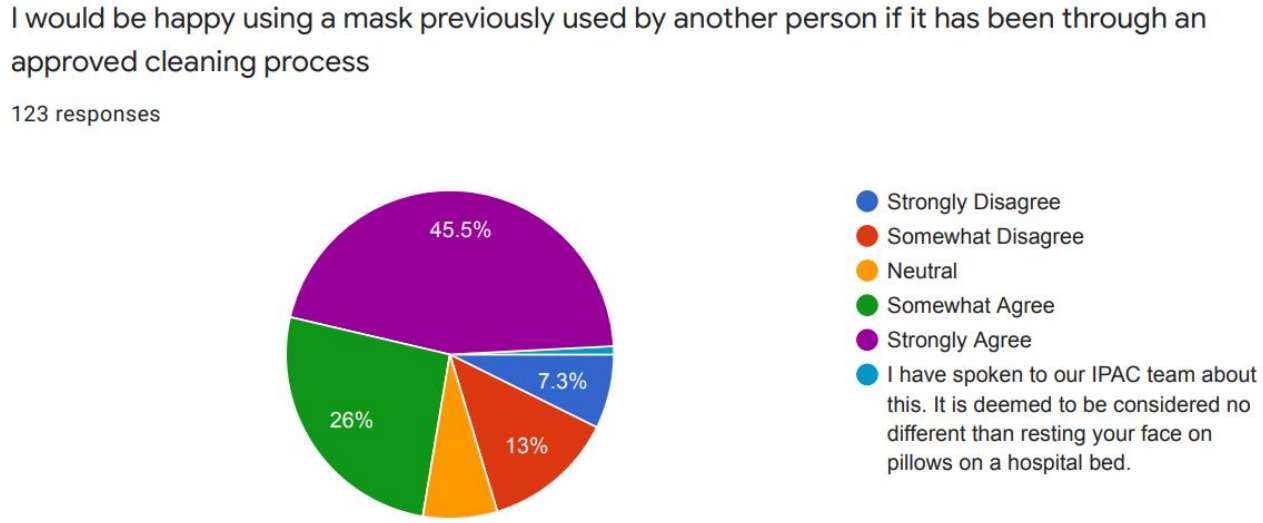
122 responses

It is critical that masks used at work have been accredited as being effective

123 responses







5.2 Staff feedback

As part of this trial, staff were requested to assess the facemasks that they trialled and provide their opinions on the facemasks.

5.2.1 Colour

The colours that were trialled as part of this pilot were:

- White
- Black
- Blue
- White and blue stripes

It was found that the white discolours after a few washes. Darker colours were found to be intimidating for older patients, especially ones that suffer with dementia.

Suggestions were made that the colours should be lighter (blues/greens), patterns were also suggested and emblems would be professional looking (but may increase cost).

5.2.2 Shape

Several shapes were trialled as part of this pilot. Each had different benefits to different members of staff. There were four basic shapes that were used – classic, duck billed, snood and face mask with straps around the back of the head.


Classic, Ear loops

Duck billed, ear loops


Snood

Round neck facemask

The shapes that were liked the most by the pilot triallers were the classic and duckbilled as they fitted the same Type IIR single use shape – over ear and would follow the classic donning and doffing procedures.

Different applications were applied to the different types of shapes. Many IPC leads were not happy with the overhead facemasks due to the requirement to take it back off over the head. However many of the users liked the capacity to have facemasks available throughout the day and for them to be located around their neck providing easy access. The round neck ones also took the pressure off ears for prolonged usage.

5.2.3 Texture

Staff feedback that they preferred the texture of the reusable masks to the single use facemasks. Some of the facemasks were easier to breathe through than others due to heavier lining or material type. Staff had fewer skin issues or abrasions with material masks over the single use masks.

5.2.4 Wearability

Clinical settings

Larger pilots have been undertaken as part of this trial, trialling them with front line members of staff. They were trialled as a 'per patient use' (a few minutes to half an hour) and as a sessional use (4-6 hour use).

Length of time worn

Pilot Group	Time worn	Appropriate
Back office staff	Up to 4 hours	Sessional use
GPs	10 minutes to 4 hours	Per patient or sessional
Patient transport	2-4 hours	Sessional
Paramedics	½ hour to 3 hours	Per patient
Hospital staff	Up to 4 hours	Sessional use

Comfort

In the majority of responses, pilot trailers stated that they found the face masks more comfortable to wear, provided a good seal as well as being breathable, the fabric was perceived to be softer and less abrasive than disposable masks.

Some stated that they may be less comfortable to wear in summer than in winter as they became warm and sometimes moist after a prolonged period of use. Some had issues with the ear toggles rubbing if worn for prolonged periods.

5.2.5 Metal nose strap

Some of the facemasks used in the first trial were problematic for those who wore glasses or goggles. Air from the facemasks was breathed out and exited the facemask upwards. These issues were fed back to the manufacturers who put a metal wire into the nose ridge of the mask. This resolved the problem.

During the trial some of the metal strips disconnected. The manufacturers were made aware and adapted their facemasks accordingly.

5.2.6 Glasses/Goggle wearers

There are a lot of complaints from glasses and goggle wearers about single use facemasks and how they do not prevent their glasses or goggles from steaming up. As per this trial, the reusable facemasks were assessed

Those who wore glasses or goggles on this trial were requested to give feedback as to how these performed in comparison to single use masks. A few stated that due to the thickness of some of the ear loops there was less room for your glasses. The ear toggles were also challenging if you wear glasses causing rubbing.

5.2.7 Breathability

Many staff who have been wearing single use facemasks continuously have complained of fibres coming loose and inhaling them. Some have also complained of continued asthma type symptoms and breathing problems that affect them for several days after wearing the single use facemasks.
No complaints have been made from any of the pilot trial participants as to any particles being inhaled, shedding or breathing issues associated with these reusable masks.

5.2.8 Facial hair

Staff members with facial hair struggled with the snood getting stuck in their hair. The other masks presented no issues.

5.2.9 Facial size

Facial size was an issue that was identified at the beginning of the pilot. Some staff members have a bigger distance from their nose to their ears or nose to chin than others. Some of the masks that were more restricted shape like the duck billed shape were trialled with small, medium and large. The toggles also gave some adjustability. The classic shape with the ear loops provided some challenges for staff with small faces due to some gaping

issues at the sides. These were redesigned to offer smaller versions for smaller faced wearers.

As part of this pilot, feedback was provided to the manufacturers throughout the trial period. They have taken on board the feedback and amended their designs and created alternatives for wearers to try.

5.2.10 Washing

Washing was an important part of this pilot trial. As part of the assessment, we invited IPC and the laundry managers to participate who raised this issue.

The temperature at which the facemasks could and should be washed became part of the assessment. Several of the facemasks in the trial were required to be washed at low temperatures or hand washed. This was due to the viral coating on the surface of the facemask. Others had been tested to 40 degrees as well as others that had been tested to 120 degrees.

IPC and laundry teams were uncomfortable with home washing as there is no standard and assurance that staff would comply with that required decontamination process.

Laundry Washing

Laundry standards within hospital settings are required to comply with the Health Technical memorandum - Decontamination of linen for health and social care (HTM 01-04).

Section 5.50 of the HTM code, Disinfection by heat states '*The washing process should have a disinfection cycle in which the temperature of the load is either maintained at 65ºC for not less than ten minutes or 71ºC for not less than three minutes when thermal disinfection is used. Alternative time– temperature relationships may be used as long as the efficacy of the process chosen is equal to or exceeds that of the 65º or 71ºC processes. With all these options, mixing time should be added to ensure heat penetration and assure disinfection. For conventionally-designed machines and those with a low degree of loading (less than 0.056 kg/L), four minutes should be added to these times to allow for adequate mixing time. For a heavy degree of loading (that is, above 0.056 kg/L), it is necessary to add eight minutes*.'

Home washing

There was some consideration made as to whether the reusable facemasks could be classified as uniform or workwear in order to be washed at home in domestic washing machines. The Department of Health's 'Uniforms and workwear: guidance on uniform and workwear policies for NHS employers' offers advice on home-laundering of uniforms in domestic facilities, but states "*wash uniforms … at the hottest temperature suitable for the fabric".* It then recommends a ten-minute wash at 60ºC. The time–temperature relationship discussed in this section is not applied to the domestic laundering setting. The level of soiling (due to the use of PPE), direct contact time with the service-user and therefore overall risk is less for uniforms and workwear than it is for other types of linen such as sheets and drapes.

Challenges were presented from IPC leads as to the regime in which home washing is carried out:

- Do staff wash their uniform at 60 degrees?

- These facemasks are classified as PPE/Medical device therefore should be treated in a unified manner for washing

IPC recommendations

The recommendations from IPC leads were:

- Laundering procedures for the masks should have assurance that it has been done to a particular standard
- Staff and patients should be protected through the cleaning procedures
- There should be traceability on the number of washes carried out

Clear guidance is required with additional work to be carried out to specify the manufacturers recommendations to users on washing standards and washing requirements.

5.2.11 Straps and Toggles

Single use facemasks only have one size strap and no toggles, so they are not adjustable. Many facemask wearers need to wear ear protectors in order to stop rubbing behind their ears for prolonged period of wear.

All of the reusable facemasks had elastic or fabric with adjustable toggles to allow the facemasks to fit the user.

Photograph to show the different types of straps and toggles presented on facemasks used on the trial

The straps of the facemasks were questioned as transmission points. All of the facemasks had viral coating and it was questioned if the facemask straps also had the same coating. The reason for this was if staff were to don and doff their facemasks through the day and reuse them, would the touchpoints be subject to viral coating as well or would they become a transmission area. IPC requested that any staff donning and doffing ensured that they cleaned their hands before and after they removed their masks.

There were four types of toggles used by manufacturers. Some of these provided different levels of comfort to the users. The adjustability enabled more accessibility to people with different face sizes and ensured a better fit to ensure proximity to the skin. Some of the toggles were less robust than others and snapped under pressure.

5.2.12 Viral Coating

Viral coating has been applied to all of these facemasks used in the trial. It is not an obligatory requirement of the Type IIR standard. Virucidal coating requires testing as it will classify it as a Cat 3 Medical Device. Any biocides (including virucides) need to approved for that use under the Biocidal Products Regulations. The regulations are enforced by HSE and there is existing guidance on the HSE website about how to apply for approval under BPR if the virucide is not currently approved. There are a number of different British Standards on how disinfectants can be validated.

The viral coating gave assurance to those wearing the facemasks that using the facemask would provide them with additional protection. It also gave them some assurance if they accidentally touched the mask that any coronavirus or other harmful bacteria would not be transferred through the mask.

Single use Type IIR facemasks are not viral coated.

5.2.13 Storage

The storage of the facemasks presented a challenge to users. Due to the number required for a ‘per patient use’ or a ‘sessional use’, they needed to be stored prior to use and after use. Many staff were trialling the masks with a sealable plastic bag to be used after they had used the mask in order to contain the used mask.

The storage bag used for staff on the road or operating on the front line that change their masks during the day will be essential to contain any contamination, reduce transmission rates and ensure the safe carrying of used masks. Equally staff will require a bag for clean masks to contain clean masks prior to use.

Two types of bags were tested as part of this trial – a plastic pocket ‘bag’ with popper button and a draw string net bag. Alternative bags were available to be manufactured including ones made from the same viral coated materials as the masks. Ideally any used reusable masks should have minimal contact post use and should be put straight into a washing facility.

There are opportunities to use used mask storage bags to be personally identifiable to enable the return of masks to the user if put into a central washing facility.

5.2.14 Labels

Labelling was identified as being key to the correct washing and use of the masks. Many pilot trailers were unsure of the temperature required to wash the masks, even though all the details were provided on paperwork and packaging supplied with the mask.

Most of the identifying information for the facemask use was included in the packaging and not on the mask. One mask manufacturer had the washing details printed on the fabric on inside of the mask (M4, M8, M14).

Type IIR was printed on the outside of the mask and this provided assurance to the wearers. Many NHS staff liked having NHS printed on their masks as well as they stated it looked professional and smart.

For tracking purposes, it would be useful for a simple grid is printed on the inside of the mask to ensure that the mask is not used more than the allotted washes and to guarantee that the mask is taken out of circulation when the allotted uses is completed.

IPC requested that the facemasks were labelled as being reusable.

It is deemed essential that the washing temperature, a basic grid (for washing tracking – see section 6.2 on tracking) and the number of washes that they mask can be washed for is provided on the mask. It would also be useful to provide a space for name labelling (written), especially for using in communal areas.

5.2.15 Facemask applicability

Different types of facemasks were assessed to be used in different circumstances.

Royal Cornwall Hospitals and Yorkshire Ambulance Service undertook a mapping assessment to look at the ways in which the different facemasks could be used in different settings. Each scenario had a different level of risk associated with it as perceived by each organisation.

The mapping assessments are provided below:

Ward & Diagnostics

Offices and public areas

(6000 M4 out and about round the Trust!)

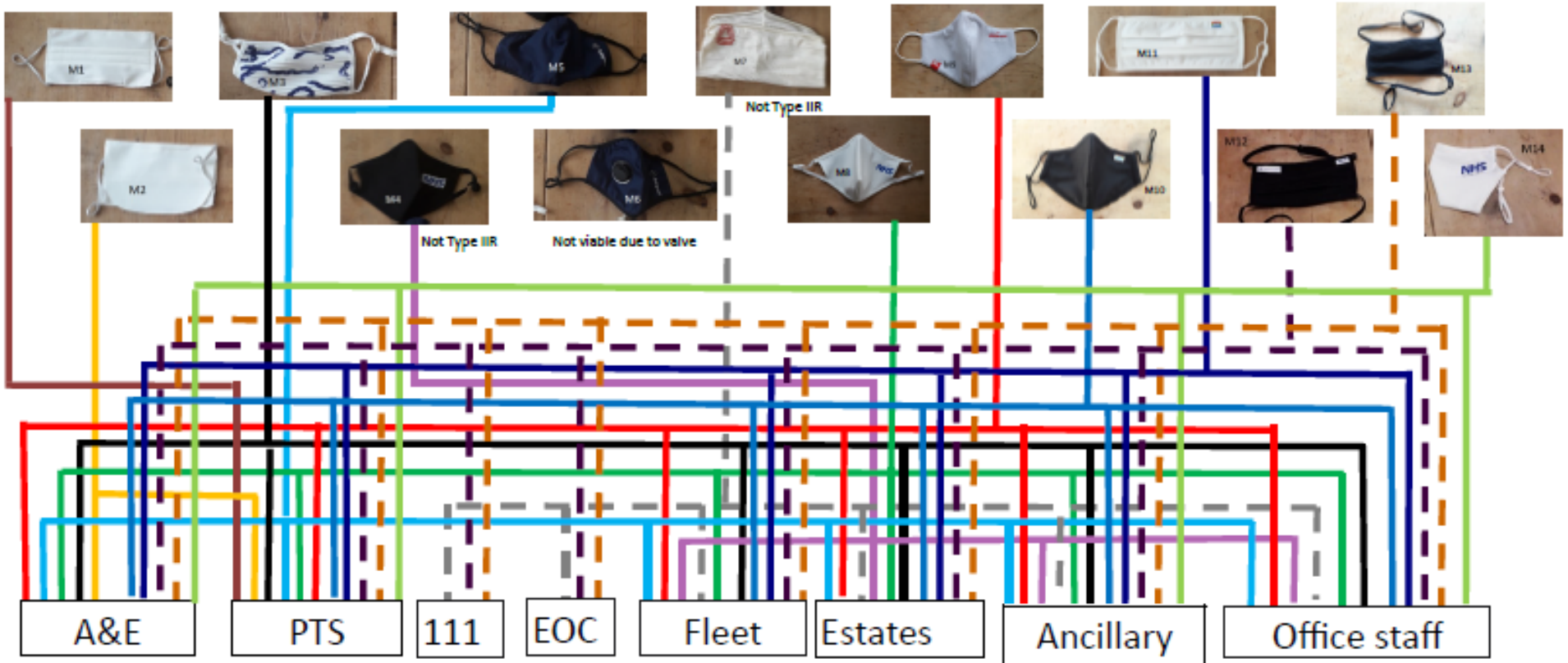
Type 2	Ref	Theatres	Ward	Outpatient	Diagnostics (endoscopy/ cath lab)	Offices & public areas
✔	M1		6		6	
✔	M2	1				
✔	M3	2				
	M4					7
✔	M5					3
✔	M6					3
✔	M7					4
	M8	Not received				
✔	M9					3

1. No team interested in wearing this style
2. Tested but no feedback from wearers
3. Not passed for fire in clinical areas
4. Not approved by IPAC
5. Not received
6. Tested, Type 2
7. Face covering

Royal Cornwall Hospitals Trust's assessment of reusable facemasks across the Trust

NB. Wise Protec Type II white and Why Labs revamped M1 currently on trial in endoscopy and OPD ophthalmology.

Reusable Facemask Trial



Mask ID	A&E	PTS	111	EOC	Fleet	Estates	Ancillary/AVP	Office	General use
M1	Y	Y							
M2	Y	Y							
M3	Y	Y			Y	Y	Y	Y	Y
M4					Y	Y	Y	Y	Y
M5	Y	Y			Y	Y	Y	Y	Y
M6	Not viable due to valve								
M7			Y	Y	Y	Y	Y	Y	Y
M8	Y	Y			Y	Y	Y	Y	Y
M9	Y	Y			Y	Y	Y	Y	Y
M10	Y	Y			Y	Y	Y	Y	Y
M11	Y	Y			Y	Y	Y	Y	Y
M12	Y	Y	Y	Y	Y	Y	Y	Y	Y
M13	Y	Y	Y	Y	Y	Y	Y	Y	Y
M14	Y	Y	Y	Y	Y	Y	Y	Y	Y

Viable in area identified

Can be used with correct donning/ doffing procedures

Yorkshire Ambulance Service's assessment of reusable facemasks across the Trust

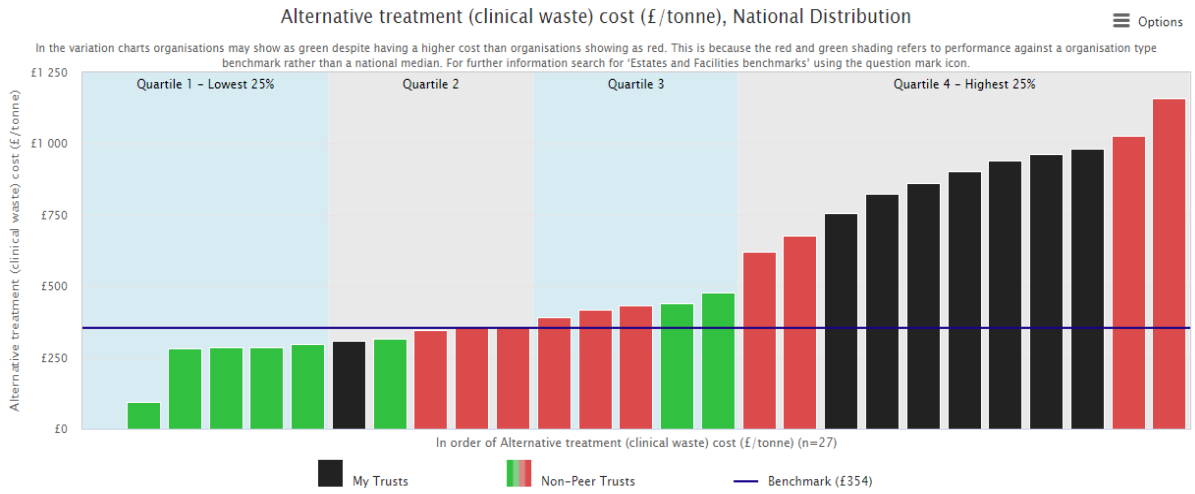
Reusable Facemask Trial

6. Additional Work

6.1 Waste Cost Assessment

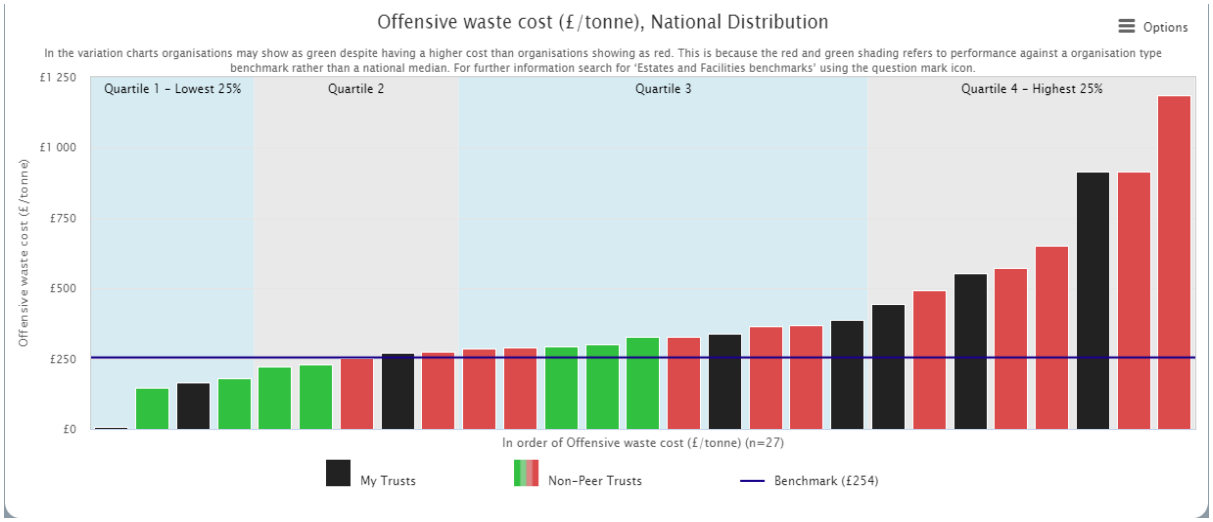
The cost of waste disposal per tonne ranges from £270 to over £1100 across the UK. The price is dependant on location and contract rates. What has been clearly understood through this pandemic is that there is very little capacity to accommodate the clinical (alternative or offensive) waste.

Alternative Treatment waste in the Trusts ranges from £309 - £962 and a national benchmark of £354



Source: [Model Hospital]

Offensive waste in the Trusts ranges from £271 - £913 and a national benchmark of £254



Source: [Model Hospital]

6.1.1 Waste Crisis

Due to the quantity of waste that has been generated by through the use of single use items throughout the COVID 19 pandemic, a waste crisis has been created. As previously identified, the total number of single use facemasks consumed by the NHS in England in 2019/2020 was 21,864,235. Over a one year period during the pandemic, NHS England used 1,377,853,516 single use facemasks. Of these, 1,267,146,614 were single use Type IIR facemasks.

The weight of waste generated from the 3.5g single use facemasks has totalled in excess of 4,435 tonnes for the year of 2020/21 in comparison to 76 tonnes in the previous year. Due to this waste being generated, in conjunction with the other single use waste from gowns, aprons, gloves etc there has been an increase in the waste created and increased pressures on the waste contractors.

6.1.2 Waste reduction

The waste generated by PPE has increased dramatically. There are national issues at present due to the disposal of this waste mountain that has been generated by the huge consumption of facemasks. Reusable facemasks with a circular economy associated with the end of life of the products will ensure that there is an elimination of waste completely. The replacement of a single use facemask product with a reusable facemask could take between 30 and 50 single use products out of the system. Multiply this by the nearly billion facemasks that we have consumed we can have a quick reduction in waste generated, reducing waste by between 100 and 175g per reusable facemask replacement.

The 1,250 facemasks used in this pilot trial replaced 41,920 single use facemasks or the equivalent of 1.467 tonnes of single use facemasks.

6.2 Tracking

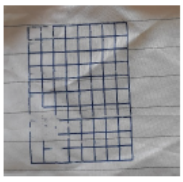
During this project, we contacted Reath.id who have been looking at tracking and reusability of products as part of an Innovate UK project. Reath.id designed a system for tracking reusable PPE (reusable FFP3 facemasks) in a closed loop, medical environment for an NHS Trust in Scotland. They received sign-off from their board to test how this works on a trial basis, as tracking removes a lot of the compliance, safety fears or even logistical barriers that reuse presents. They shared their initial Open Data Standard for reusable PPE that they built at the beginning of COVID-19, ahead of applying for the Innovate UK funding to trial this system.

Due to these facemasks being used more than once, investigations have been looked at the options available in order to track the number of times that a facemasks has been washed. Several options are available to track the facemasks. At least one of these should be considered necessary in order to protect the wearer as well as the organisation providing them. There are some options that would not be applicable to all organisations as some organisations would be able to manually check uses whereas larger organisations would probably benefit from an electronic version to trace the use.

The types of system that could be used to trace the PPE are: RFID (radio frequency identification - a method for tracking goods by means of tags which transmit a radio signal), manual marked grid, an app, QR codes, bar codes, expiry date, colours.

These technologies are listed below:

Tracking and Traceability of PPE

	Advantages	Disadvantages
No Tracking		No traceability of product No tracking of washing Unsure when out of date/use
RFID 	Traceability Removes requirement for staff to monitor	Not easy to recycle at end of use
Grid 	Provides manual monitoring Can be manually checked Useful for personal issue	May miss washes Reliant on manual monitoring
App	Use for personal use items Set up alert for replacement of product Can scan per use	Reliant on registration Reliant on staff scanning/ registering each use Reliant on alert being opened to get product out of service
QR code	Can be scanned per use Identifiable for each product	Reliant on scanning at the beginning and end of use
Bar code 	Can be scanned per use Identifiable for each product	Requires scanning for each use
Expiry date 	Gives a date to stop using Ensures they aren't overused	May create underuse of product Assumes use in that time period No tracking of actual use
Colour 	Can changed monthly/ number of washes Ensures they aren't overused	May create underuse of product Assumes use in that time period No tracking of actual use

6.3 Flammability and Fire risk assessment

Under the EN 14683:2019 standards for Type IIR facemasks, flammability tests covered under 16CFR part 1610 are not required to be conducted as part of the testing for a Type IIR facemask.

The US market has stringent flammability requirements for general wearing apparel, while there are no EU regulations for wearing apparel flammability. However, children's sleepwear is a high risk category which has more stringent flammability regulatory requirements in several countries including the US, Canada, Australia and the UK. General wearing apparel needs to be tested for flammability using 16 CFR 1610 (Code of Federal Regulations).
The ISO standard for flammability is laid out in ISO 14116:2015. The standard is laid out in the standard and the "*ISO 14116:2015 specifies the performance requirements for the limited flame spread properties of all materials, all material assemblies, and protective clothing in order to reduce the possibility of the clothing burning when in occasional and brief contact with small flames and thereby constituting a hazard. Additional requirements for clothing are also specified, including design requirements, mechanical requirements, marking, and information supplied by the manufacturer*."

In the US flammability test, a standard flame 5/8 of an inch long is lowered onto the fabric specimen, which is from a garment or production fabric, at a 45 angle for one second. This configuration is used to approximate the position of fabric during wearing. The flammability of the sample is evaluated using the time it takes the flame to travel along the five inch test specimen. Basically, the faster the time, the more likely a fabric will burn rapidly, before the garment could be removed or the fire extinguished. Testing is performed at two stages: the original fabric and the fabric after dry-cleaning and washing. The final classification is the lowest time of the two stages of testing.

The requirements are different for plain surface and raised surface fabrics. Fabrics are classified into Class 1 Normal Flammability, Class 2 Intermediate Flammability and Class 3 Rapid and Intense Burning, according to the time of the burn and the characteristics of the burn. Class 1 is the best class and Class 3 the worst. Fabrics or garments made from fabrics with a Class 3 testing result are not allowed to be sold on the US market.

Plain surface fabrics with a burn time of 3.5 seconds or more are classified as Class 1. Fabrics with burn time less than 3.5 seconds are classified as Class 3 and fail the flammability test. Class 2 Intermediate Flammability does not apply to plain surface fabrics. (quoted information data source: SGS webpage).
As part of this trial, Royal Cornwall NHS Trust carried out a fire assessment to look at the potential risks associated with the facemasks. They use facemask in AGP (aerosol generated procedures) in which there may be very high oxygen content in the air as well as other potential spark sources.

All the facemasks were set on fire and subjected to same process to see if they ignited.

They were filmed in order to show the process. They were also compared to a single use facemask.

The results showed that those that were made from polyester and covered in viral coating had a tendency to smoulder and potentially ignite if an ignition source was left on the mask for longer than 4 seconds. The other ones not coated in viral coating did not ignite. The single use facemask did not ignite.

Many of the masks have been assessed and are classified as Class 1 in these tests.

6.4 Circular Economy

In order to ensure that the transition to reusables does not result in a new pile of single use or multiple used facemasks destined for landfill, all of the manufacturers were put in contact with a circular economist. This enabled them to assess their end of life trajectory for their products.

The life cycle analysis identified in section 6.7 shows that all the facemasks if collected and returned to a central point/manufacturer can be recycled back into facemasks or other products. As long as this is enacted there is a reduction in the carbon footprint and an end of life for this product.

This should be embedded as a requirement for all products including single use products going forwards.

6.5 SOPs

We worked with Alder Hey's communication team to develop a national SOP (Standard Operating Procedure) for donning and doffing a reusable facemask.

6.6 Life cycle analysis

YAS created a life cycle analysis of the process for a single use and reusable facemask with the variable products and washing procedures. The circular economy element of the life cycle analysis was incorporated into the reusable mask

Oil

Plastic beads

Manufacture of facemasks

Medicines & Healthcare products Regulatory Agency

Regulatory approval

Single use facemask

Shipped to destination

Procurement and storage

Distribution

Facemask used once

Waste

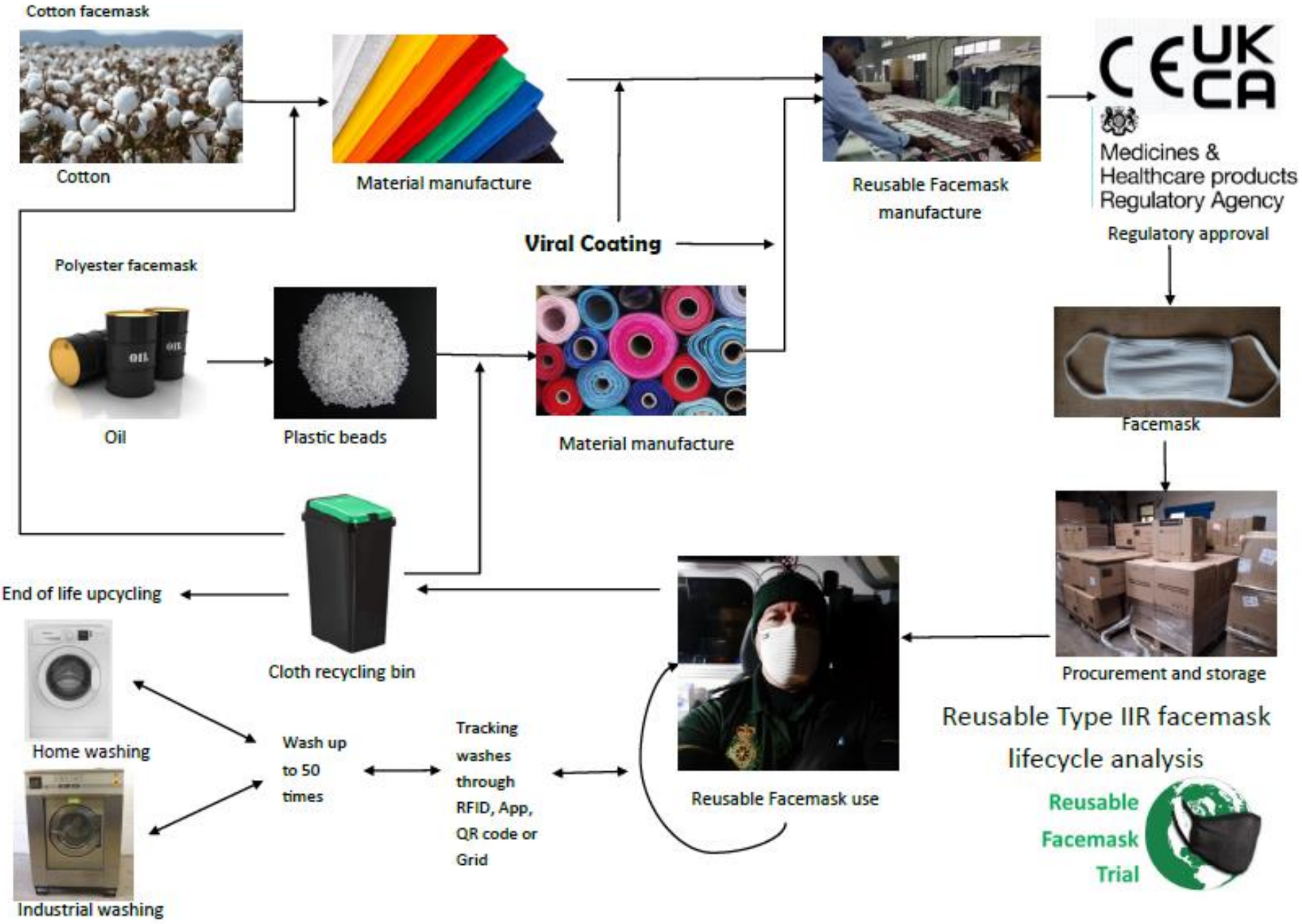
Landfill

Incineration

Refuse derived fuel

Single use facemask lifecycle analysis

Reusable Facemask Trial


Cotton facemask
Cotton
Material manufacture
Reusable Facemask manufacture
Medicines & Healthcare products Regulatory Agency
Regulatory approval
Viral Coating
Polyester facemask
Oil
Plastic beads
Material manufacture
Facemask
End of life upcycling
Cloth recycling bin
Procurement and storage
Home washing
Wash up to 50 times
Tracking washes through RFID, App, QR code or Grid
Reusable Facemask use
Industrial washing
Reusable Type IIR facemask lifecycle analysis
Reusable Facemask Trial

6.7 Carbon Footprint

Working with University College London with the Plastic Waste Hub, an assessment was carried out to look at the associated carbon footprint for single use and reusable facemasks. The highlights of this report have identified that a single use facemask will contribute around 1.19kg CO2e in comparison to a reusable facemask (Revolution Zero) which will contribute 0.19kg CO2e in carbon emissions. Details as to the report and the findings are presented in section 6.2.3 as part of a research assessment of the facemasks.

Translating these figures, based on the Revolution Zero mask lifecycle assessment presents details as to how many reusable facemasks as required to replace the same use of facemasks and the

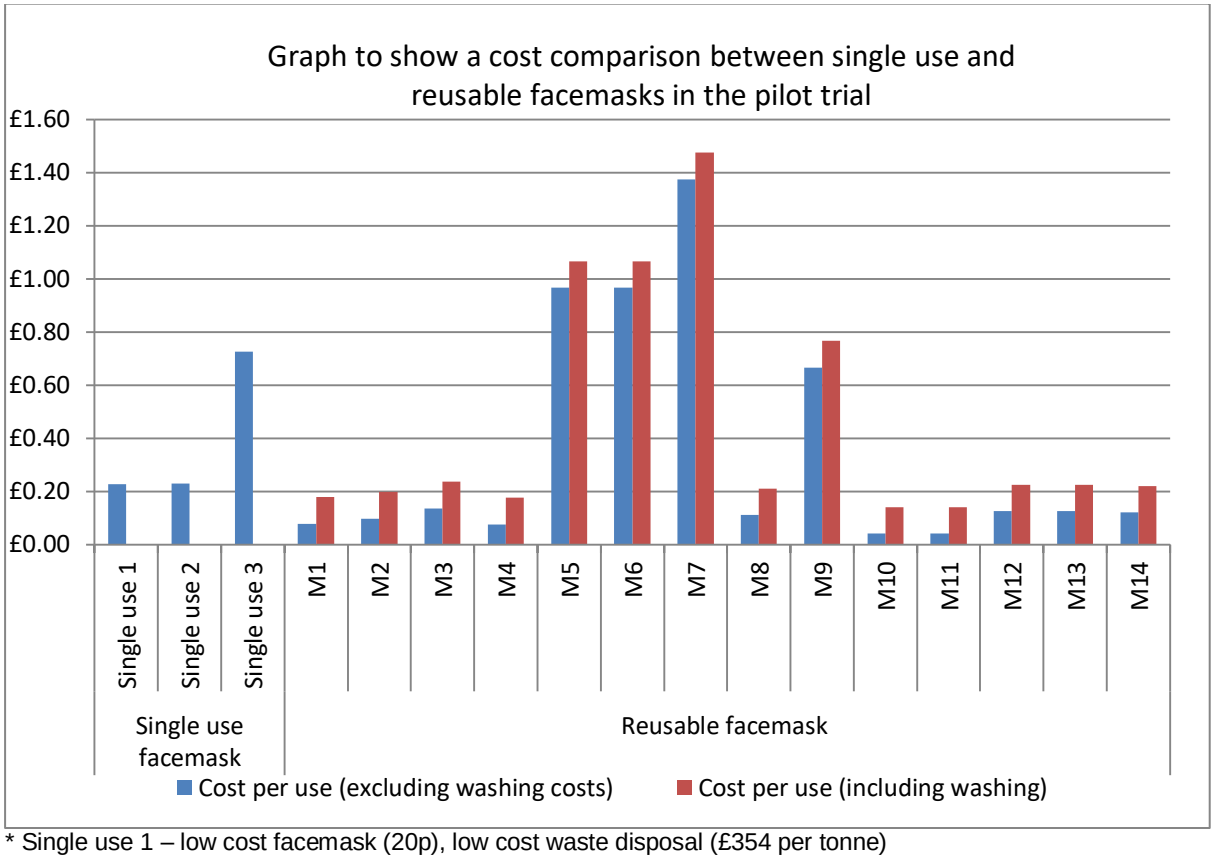
Single use masks

	Single Use Facemasks	**Reusable replacements**
National Consumption	1,900,000,000 single use masks	52,777,777 reusable masks
Worst CO2e	Based on 1.19kg/CO2e per single use mask	
Best CO2e	Based on 0.57kg/CO2e per single use mask	Based on 0.19kg/CO2e used 36 times
Carbon footprint	**2,261,000 t/CO2e** (worse case) **1,083,000 t/CO2e** (best case)	**361,000 t/CO2e**
This pilot	41,950 single use masks	1,250 reusable masks
Worst CO2e	Based on 1.19kg/CO2e per single use mask	
Best CO2e	Based on 0.57kg/CO2e per single use mask	Based on 0.19kg/CO2e used 36 times
Carbon Footprint	**49.950 t/CO2e** from the project (worse case scenario) **23.894 t/CO2e** from the project (best case)	**8.532 t/CO2e**

6.8 Cost Benefit

A cost benefit analysis was carried out to compare the whole life cost of a single use face mask versus a reusable facemask used between 30 and 50 times before being recycle
The cost benefit is not as pronounced at present due to PPE being provided for free during the pandemic. If facemasks were being paid for by Trusts there would be the opportunity for savings to be made in not procuring the single use facemasks, the cost of the waste disposal (between £400 and £1000 per tonne), bin bag consumption and ancillary staff time for bag removal as well as the unseen shipping and carbon costs.

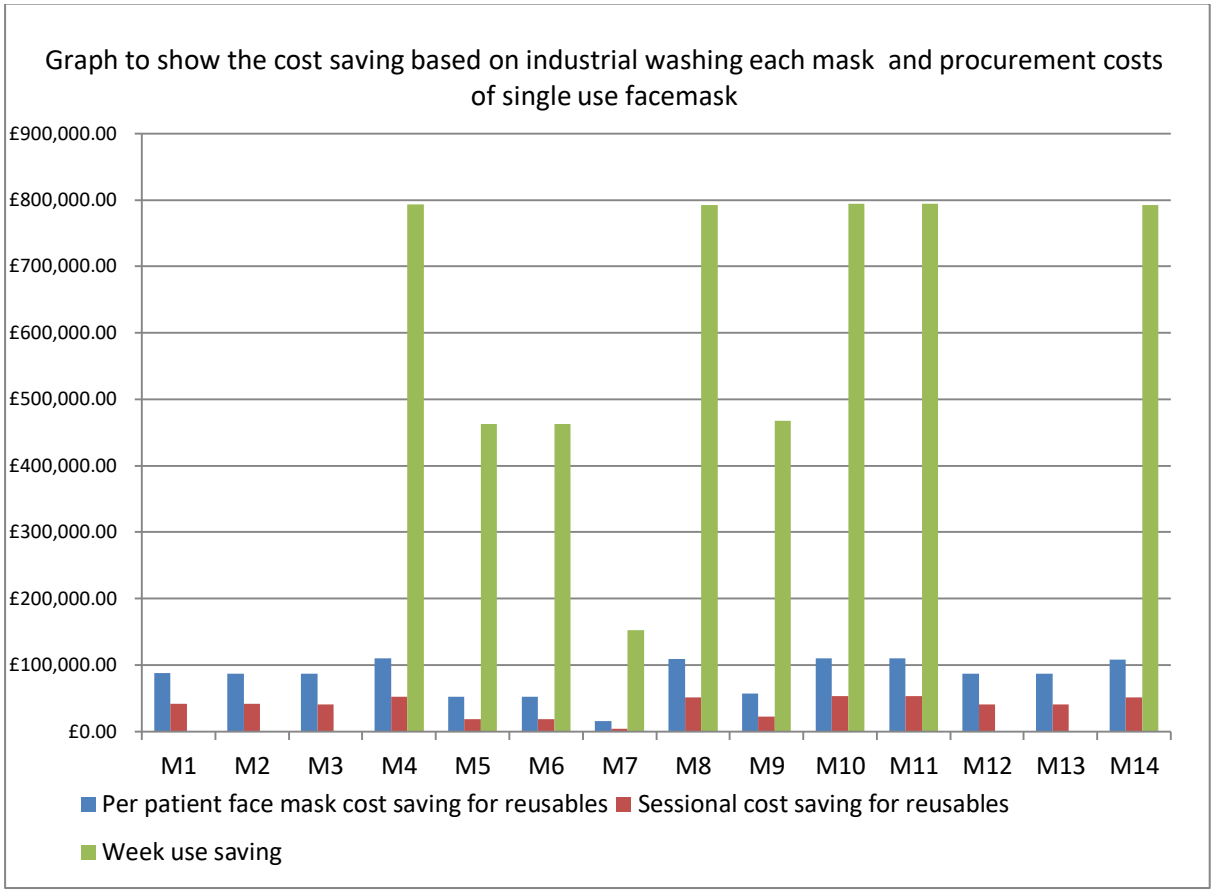
The cost comparison between the single use and the reusable products was conducted and as a simple per use comparison, the graph below shows that there is a financial benefit for most of the masks. The viral coated masks provide more options for the facemasks to be utilised over longer periods as well.



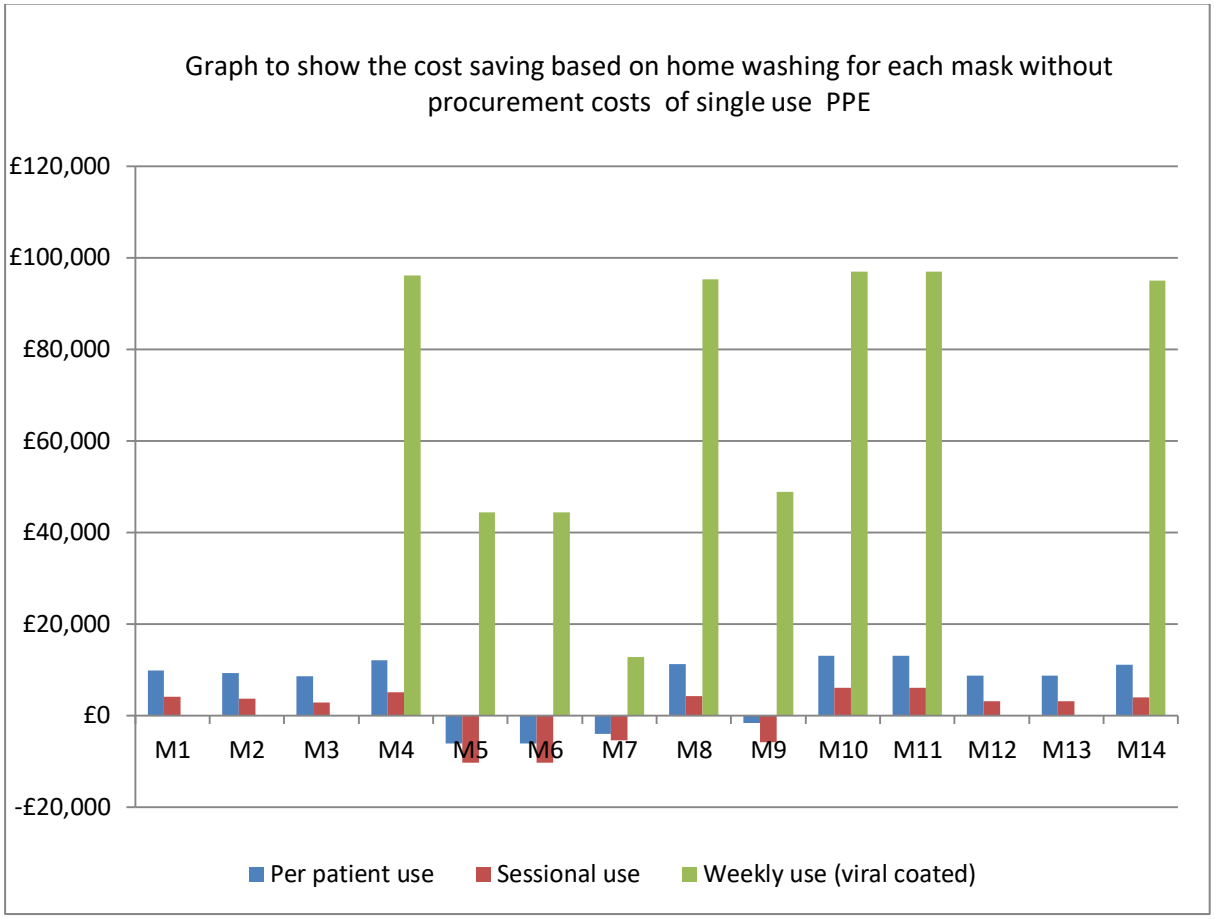
* Single use 1 – low cost facemask (20p), low cost waste disposal (£354 per tonne)
* Single use 2 – low cost facemask (20p), average waste (£500 per tonne)
* Single use 3 – High cost facemasks (70p at peak of pandemic), high cost waste disposal (£962 per tonne)

Comparisons were also made to assess the cost of using a reusable based on procurement of the masks and washing to assess the cost savings that can be made. Comparisons were made between washing after each patient, sessional use and washing each week with the benefit of viral coating.

The graph below shows the cost savings based on using an industrial laundry based on the cost being £0.10 per wash and purchasing the facemasks. The cost savings identified include savings from the procurement of single use facemasks, distribution costs, bin bag use, ancillary staff time for emptying the bins, shipping and waste disposal.



The graph below shows an ambulance service or GP scenario where they receive free facemasks and wash their facemasks in a home washing scenario.



6.9 Safe System of work

In order to ensure a safe system of work associated with the use of facemasks, healthcare systems need to ensure that they have the following in place:

- Specification of facemask assessment
- Donning and Doffing
- Standard Operative Procedure for using the mask
- Process of receiving the facemask
- Process for washing the facemask
- Storage procedures for clean and dirty masks prior to washing
- Process for recording the number of cycles of use
- Appropriate laundry and washing processes
- Identify appropriate occasions for use i.e. which clinical settings, office staff, patients
- Requirements for use i.e. per patient or sessional

This list is not exhaustive and there will other areas that need to be considered. In all incidences the reusable products should be compared to single use and the ways in which these are used.

6.10 IPC assessments

Through this project the Infection Prevention Control (IPC) teams from hospitals, community trusts and ambulance services were involved in assessing the facemasks as part of the trial

The pilot project held two sessions to allow the IPC leads to question the manufacturers and to ask questions related to the project. This also allowed the IPC leads to provide information to the manufacturers as to their own internal processes for laundering, washing procedures as well as initial feedback on the facemasks as to the applicability within their healthcare system.

Many of the same questions arose as part of this project. These are detailed below:

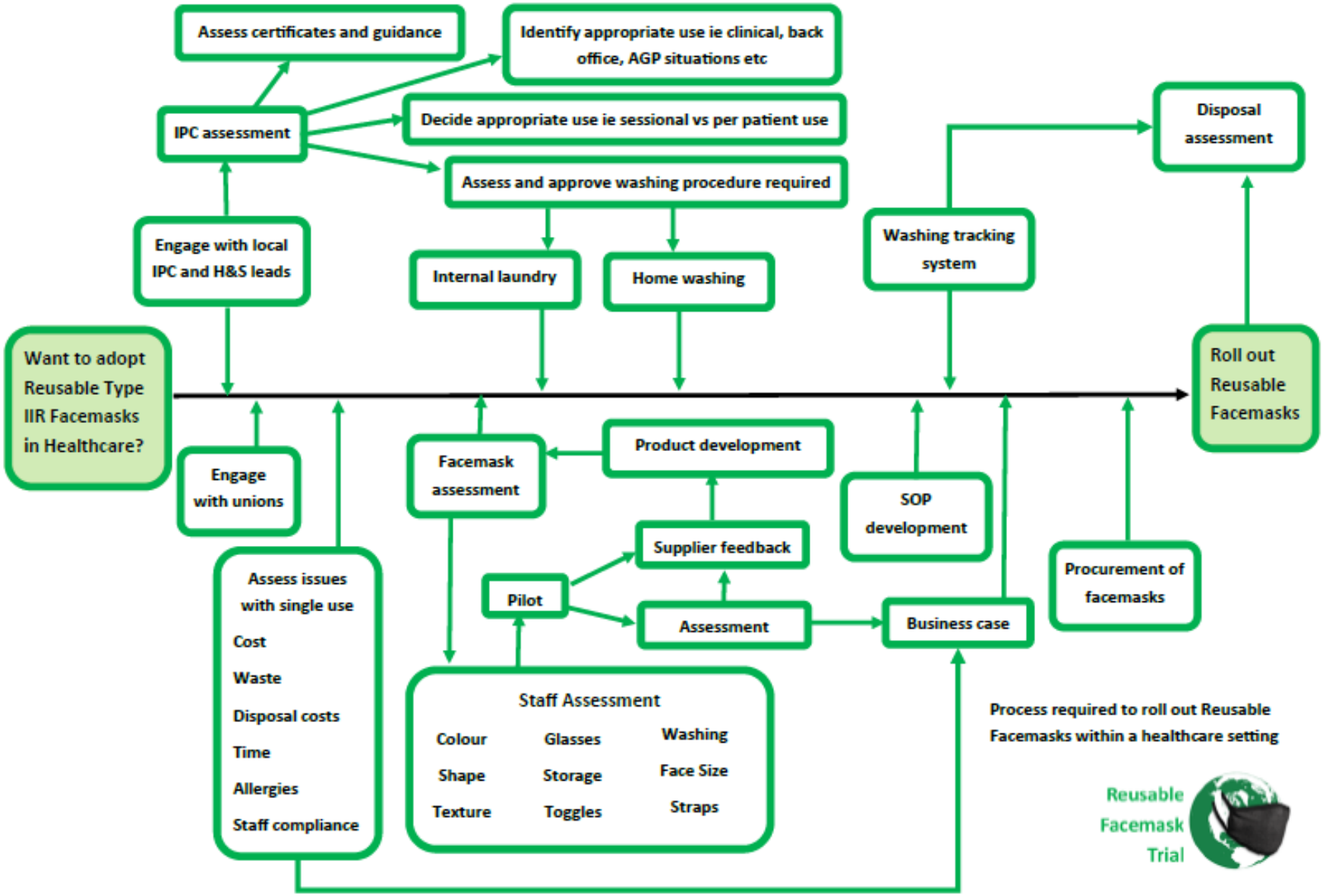
- Have HSE/MHRA been involved with your team?
- What standard do they comply with?
- Do these masks pass the regulations for filter and splash as for Type IIR?
- Are they PPE or medical device?
- How have you tested the efficacy of the viral coating i.e. are they tested against biocidal regulations?
- What is RFID technology?
- What is the washing temperature for these facemasks?
- How do you monitor quality of home laundering to ensure masks are safe?
- What happens if staff member gets infection and they have home laundered a mask?
- How does it fit within the health and safety at work act and the responsibility of the employer to provide adequate protection for its employees?
- Is this reliant on their washing machines washing at the correct temperature for the correct duration of time?
- Have you assessed the donning and doffing procedures for the facemasks?
- How do they manage the doffed masks per shift?
- How many do they need to take on shift?
- What are risks of picking up each other's masks?
- Do you use these facemasks per patient or sessionally?
- Where do staff store facemasks during a shift?
- Do you have the data sheet to prove their compliance against the pressure tests?
- Do they come in sizes as face mask fit has been problem?
- How would this be applied in primary care, community care and dentistry?
- Washing uniforms is different to washing facemasks as these are a critical element of preventing infection

6.11 UK Make

It is essential that we look at a UK make production. This would ensure that we have a short supply chain, a security of supply and the capacity for a circular economy to eliminate waste. Critical path supply chain analysis is also essential as well.

7.0 Process of Implementation

The process for implementing facemasks within a healthcare system is identified below:


Assess certificates and guidance
Identify appropriate use ie clinical, back office, AGP situations etc
IPC assessment
Decide appropriate use ie sessional vs per patient use
Assess and approve washing procedure required
Engage with local IPC and H&S leads
Internal laundry
Home washing
Washing tracking system
Disposal assessment
Want to adopt Reusable Type IIR Facemasks in Healthcare?
Roll out Reusable Facemasks
Engage with unions
Facemask assessment
Product development
SOP development
Supplier feedback
Assess issues with single use
Cost
Waste
Disposal costs
Time
Allergies
Staff compliance
Pilot
Assessment
Business case
Procurement of facemasks
Staff Assessment
Colour
Shape
Texture
Glasses
Storage
Toggles
Washing
Face Size
Straps
Process required to roll out Reusable Facemasks within a healthcare setting
Reusable Facemask Trial

8.0 Media

The use of media has been critical in gaining support and buy in across the NHS to transition to reusable facemasks. At the beginning of the pilot many contacted us via twitter and Facebook to find out more information on the pilot and to ask to get involved. Other forms of social media were used to promote the trial with many using Instagram, WhatsApp and their own internal newsletters and webpages to publicise their participation in this trial.

8.1 Hospital coverage

The Royal Cornwall Hospital has received a lot of coverage through this project for their adoption of reusable facemasks - A tonne of PPE is being recycled at Cornwall's main hospital every month | News - Pirate FM (planetradio.co.uk).

8.2 Ambulance Service coverage

The Ambulance service was covered in the Yorkshire and Humber Climate Commission's case study - Reusable facemask trial | Yorkshire & Humberside Climate Commission.

8.3 GP coverage

The GPs have been very active a part of this pilot to promote their participation and have supported other parts of the system in their use of reusables.

Tower Hamlets were covered by BBC news, wearing their facemasks - Tower Hamlets: How do you vaccinate a London borough? - BBC News

9.4 University Medical department

University of Leeds wrote a blog in relation to the project - University supports reusable mask trial for NHS – Sustainability.

9.5 Twitter

As an active form of assessment process as well as social acceptance, the social media platform, twitter, formed a part of the media to promote the use and trial of reusable facemasks. All of these tweets can be found in the public domain and permission was sought from the authors to include in this report.


Clare Nash RN @ClareNash20 · Oct 15, 2020
Today's #PPE evaluation is a reusable washable Type IIR - this one is a children's size but fits me well.
6
34
Rumina Önaç
@OSMPdoc
Beyond excited that our masks for #reusablePPE trial have arrived
plans quiet evening studying washing instructions with a glass of sherry
Thank you @alexiskeech!
3:40 PM · Nov 9, 2020 · Twitter for iPhone
Rumina Önaç
@OSMPdoc
Excited to start our #reusablePPE trial today!! @ValeofYorkCCG @alexiskeech @GreenerPractice @RevolutionZERO1
So far i can report superior performance re fogging
which is great for us optically challenged folk

You Retweeted

Thom Cooper
@thomc82

Delighted to be part of important progress in developing #reusablefacemasks for use in healthcare across the #NHS. Inspiring work by @alexiskeech in driving this forwards. Globally important and also supporting @UniversityLeeds #2023PlasticFree pledge!

University supports reusable mask trial for NHS - Sustainability
The University of Leeds is a proud participant in an on-going project to find a suitable reusable mask replacement to disposable face masks in the NHS.
sustainability.leeds.ac.uk

Sustainable RCHT
@SustainableRCHT

s what reusable PPE looks like! Royal Cornwall Hospitals Trust leading the way. PPE for non clinical areas. #GreenerNHS #ClimateAction
@RCHTWeCare @RCHTCharity @wiseprotec @SusHealthcare @NhsClimate @IBDdoc @bmj_latest @Thomlafferty @alexiskeech @NHSImprovement

Emma Radcliffe
@emmrad

Finally a mask I don't have to throw in the bin! Thank you @alexiskeech for running this trial #resuablePPE #ClimateEmergency #ReducePlasticWaste @GreenerPractice @sduhealth

Dr James Chan
@jameschanuk

Loving the prototype #NHS reusable type IIRB mask that @alexiskeech provided for a trial! Survived the first night shift with it. Now how do we roll this out to realise our NHS more eco-friendly? @GreenED_uk @RCollEM @BTHFT @MyiED

7:56 AM · Oct 11, 2020 · Twitter for Android

91 Retweets **33** Quote Tweets **396** Likes


Alexis Percival
@alexiskeech
All #climatechange health conferences should have a socially distanced touchy feely painting session to explain the impact that climate change does and will happen to the human body. Great way of explaining the impact
@SustainableRCHT #skillslab #climateart #shavedchest
11:44 PM · Oct 8, 2020 · Twitter Web App
william stableforth
@williamstablef1
#skillslab getting ready to talk climate and health.... Using art. Avoiding PowerPoint once more. What could possibly go wrong? @RCHTWeCare @MandaBrookman @SustainableRCHT @RCHTInnovation @DoctorsXr @MandaBrookman @healthdeclares @SusHealthcare @alexiskeech
William Baggott
@Jananthas
@alexiskeech
NHS
9:02 AM · Sep 8, 2020 · Twitter for Android
1 Quote Tweet 1 Like
Sherry @Sherry29538904 · 6m
Love my new climate stripes face mask. Great for the school and nursery run...but would be even better if this was adopted more widely across the NHS @RevolutionZERO1
NHS

9.7 Other media coverage

There has been some media coverage based around facemask use and the waste generated.

Guardian have run an article entitled - PPE use in England generated 'colossal' amount of carbon | Environment | The Guardian. The Mirror also covered some articles on facemasks - How face masks work and who they actually protect - and vital thing you must do - Mirror Online.

Through the assessment of the single use facemasks, Royal Cornwall Hospitals have installed a sterimelt system to Recycling unit answers the covid mask mountain problem.

They are also assessing the circular economy of their waste at the end of the melting process and are working with a kick start company to create a litter picker made from single use facemasks working with Retask the Mask: Recycling Covid's Plastic Pandemic by Waterhaul.

9.7.1 Manufacturers media coverage

The reusable facemasks featured on Sky News Revolution ZERO Sky News March 2021 - YouTube as part of the awareness campaign

The reusable facemasks featured on Sky News at vaccination centre based in York - COVID-19 PPE dilemma: 'Saving lives is having a harmful impact on the planet' | UK News | Sky News

The reusable facemasks also featured in the University of Exeter's newsletter - Sustainable PPE for health workers championed by Exeter professor - University of Exeter

9.7.2 Case Studies

The Yorkshire and Number Climate Commission has showcased an example of the good practise that can be shown to reduce the carbon emissions through this facemask trial - https://yorksandhumberclimate.org.uk/reusable-facemask-trial. Case studies have also been developed by the trail participants in order to identify their challenges, their benefits and the outcomes of the trials. These are available on request.

10.0 Research

10.1 Environmental impact of PPE

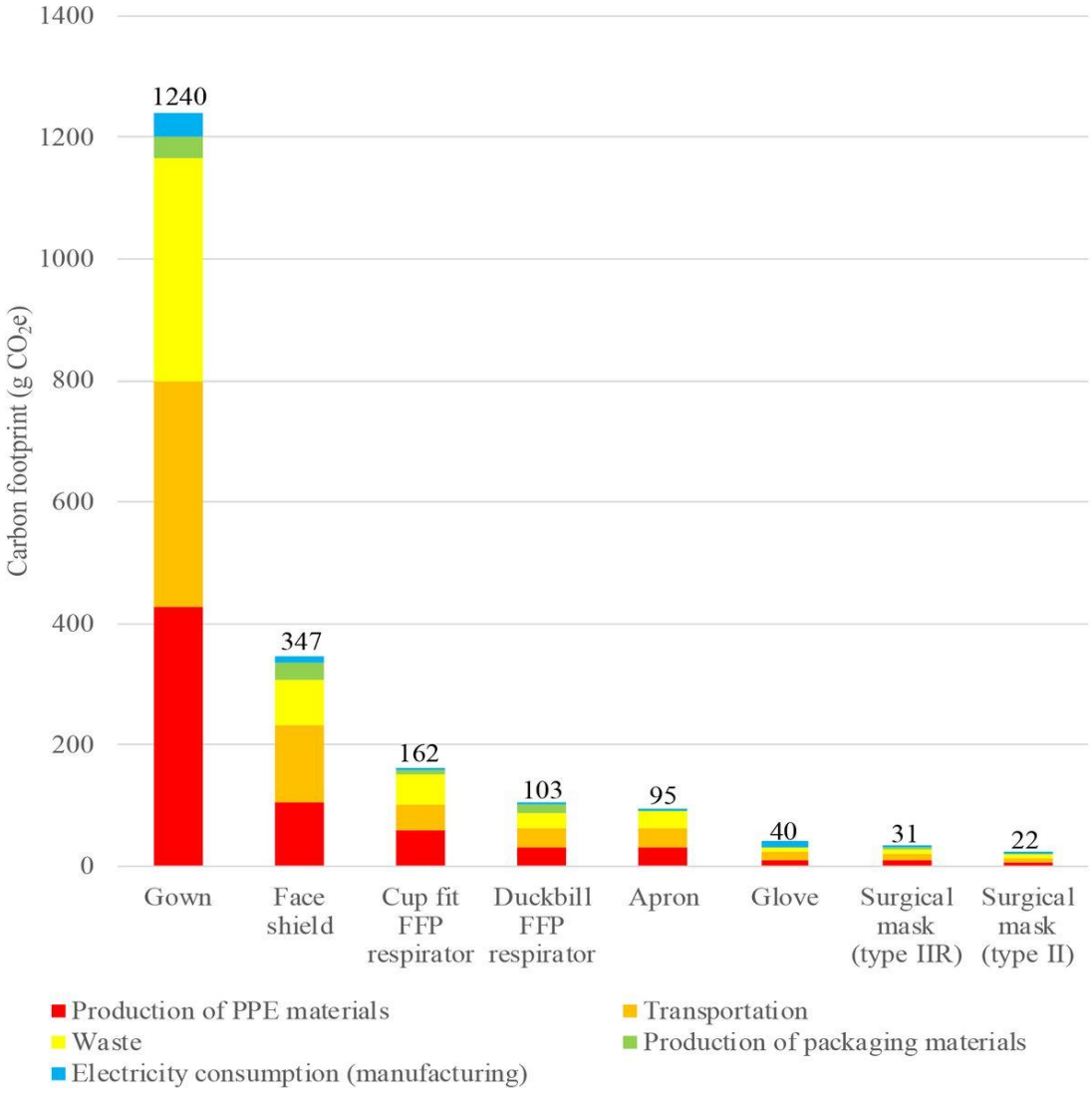
The report titled Environmental impact of Personal Protective Equipment supplied to health and social care services in England in the first six months of authored by Chantelle Rizan, Malcolm Reed and Mahmood F Bhutta, September 2020 looks at the use of Personal Protective Equipment (PPE) central to controlling spread of SARS-CoV2. This study aims to quantify the environmental impact of this, and to model strategies for its reduction.

The carbon footprint of PPE supplied during the study period totalled 158,838 tonnes CO_2e, with greatest contributions from gloves, aprons, face shields and Type IIR surgical masks. The estimated damage to human health was 314 DALYs (disability adjusted life years), impact on ecosystems was 0.67 species/year (loss of local species per year), and impact on resource depletion costing US $ 20.4 million.

The carbon footprint of individual items were estimated as follows:

Item	**Carbon Footprint per item**
Single-use gowns	1,240 g CO_2e
face shield	347 g CO_2e
cup fit FFP respirator	162 g CO_2e
duckbill FFP respirator	103 g CO_2e
apron	95 g CO_2e
single glove	40 g CO_2e
Type IIR surgical mask	31 g CO_2e
Type II surgical mask	22 g CO_2e

The full report can be read at
https://www.medrxiv.org/content/10.1101/2020.09.21.20198911v1.full-text or
https://journals.sagepub.com/doi/10.1177/01410768211001583.



10.2 The University College of London

The University College of London (UCL) Plastic Waste Hub have written several papers on facemasks and the impact of PPE during the Covid 19 pandemic. These are details below

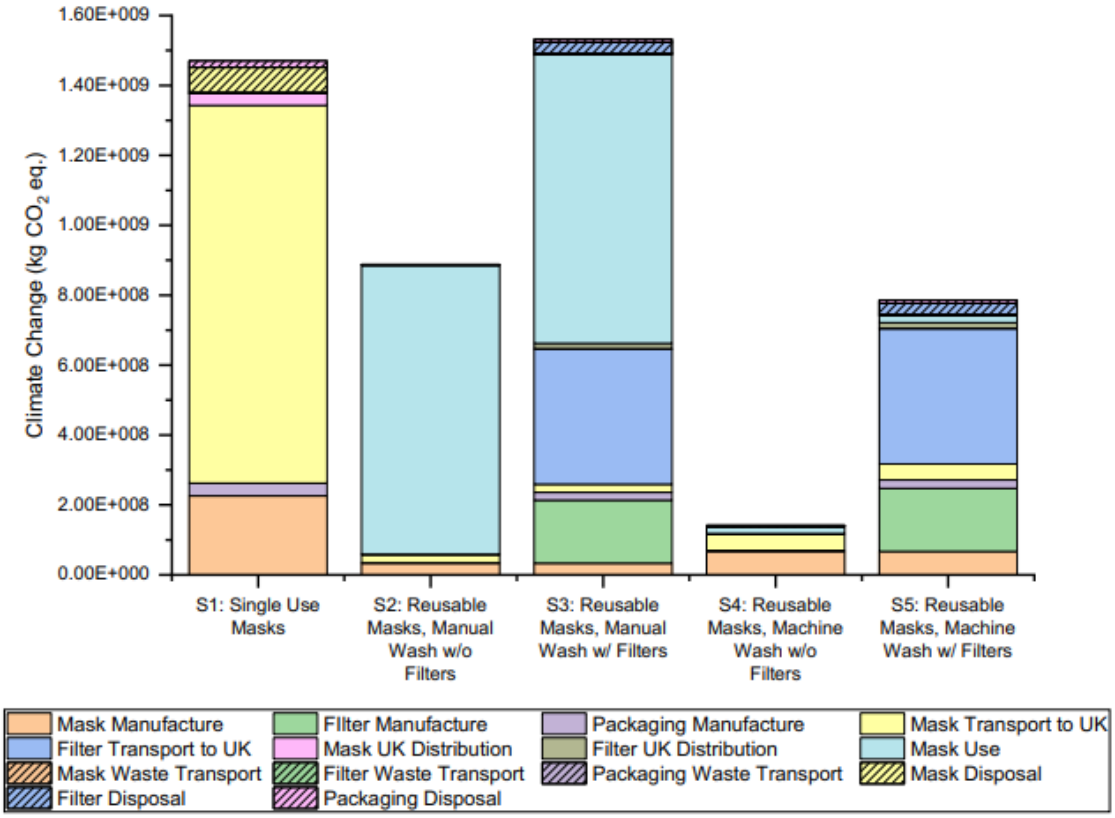
10.2.1 Environmental dangers of employing single use face masks as part of the COVID 19 exit strategy

The report entitled '[The environmental dangers of employing single-use face masks as part of a COVID-19 exit strategy' - Plastic Waste Hub] looked at the impact of face mask consumption in context to the environmental impact.

The comparative study result shows that using a higher number of reusable facemasks, in rotation to allow machine-washing, to be the most favourable method to use facemasks from an environmental perspective. The use of filters with reusable facemasks is discouraged but can generate a lower environmental impact compared to single-use facemasks use if facemasks are machine-washed.

The graph below shows the impact of the face mask in different scenarios.

Fig. 1: Climate change results generated for each scenario of face mask use.



Aside from whether reusable masks provide the same level of protection as single-use, the procedure for donning PPE and the methods for decontaminating them is essential, as it is for single-use masks. The International Scientific Forum on Home Hygiene has published a report on the infection risks associated with clothing (Bloomfield et al., 2011), which states that laundering processes eliminate contamination from fabric and linen materials. Hence, as long as reusable masks are machine washable, then they should be safe to reuse. This is if hygiene protocols such as hand washing after doffing PPE are adequately followed.

In terms of the public's engagement with reusable PPE, guidelines for correct donning and doffing of reusable PPE masks would be similar to that of single-use masks. Reusable PPE masks would, however, require a different method of 'disposal'. Instead of discarding PPE after single use, reusable masks would need to be safely stored in a separate container/laundry bag until it is put in the washing machine for laundering. These items can be safely laundered, in accordance with the manufacturer's instruction, after use. If washing items that are likely to cause illness (high-risk), the NHS recommends that they should be washed at 60°C with a bleach-based product (NHS, 2020).

Water scarcity was also assessed as part of this assessment. For Scenarios 2 to 5, each facemasks requires over 120 washes during the year of use.

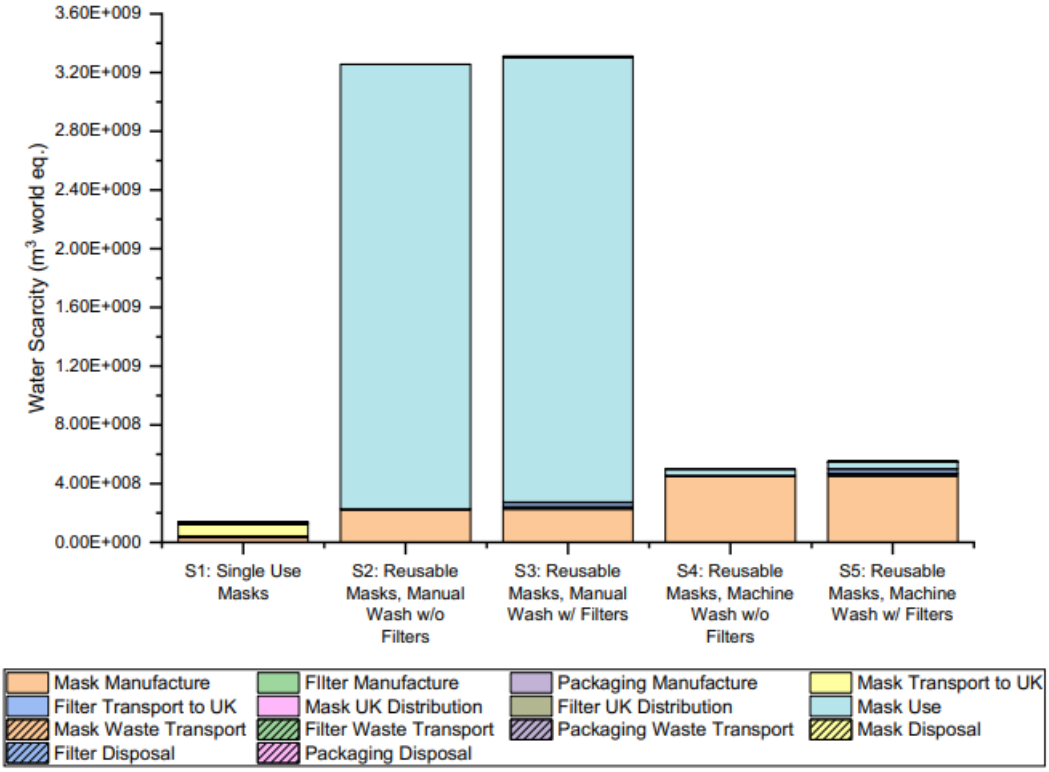


Figure A3: Water Scarcity results generated by each facemask scenario.

10.2.2 The impact and effectiveness of the general public wearing masks to reduce the spread of pandemics in the UK

The UCL Plastic Waste Hub issued a follow up assessment in October 2020, entitled 'The impact and effectiveness of the general public wearing masks to reduce the spread of pandemics in the UK: a multidisciplinary comparison of single-use masks versus reusable face masks.'

Their assessment concluded that most masks available for sale are made from layers of plastics and are designed to be single- use. Although current single-use masks have a higher standalone effectiveness against bacteria and viruses, studies show that reusable masks have adequate performance in slowing infection rates of respiratory viruses. Material Flow Analysis, Life Cycle Assessment and cost comparison show that reusable masks have a lower environmental and economic impact than single-use masks. If every person in the UK uses one single-use mask each day for a year, it will create a total waste of 124,000 tonnes, 66,000 tonnes of which would be unrecyclable contaminated plastic waste. Using reusable masks creates >85% less waste, generates 3.5 times lower impact on climate change and incurs 3.7 times lower costs.

Evidence suggests that reusable masks perform most of the tasks of single-use masks without the associated waste stream. The report stated that if the government decided to require the wearing of face masks in public, it should mandate reusable masks and not single-use masks. This will preserve single-use mask supplies for front-line healthcare workers, and reduce the risks associated with the disposal of thousands of tonnes of contaminated plastic mask waste in the household waste stream. Additionally, the use of

reusable masks by the general population would significantly reduce plastic waste and the climate change impact of this policy measure

The report can be read at publication on single-use masks - Plastic Waste Hub.

10.2.3 Revolution Zero Facemask Lifecycle Assessment

UCL Plastic Waste Hub carried out an assessment on the Revolution Zero Facemask.

The comparative study results show that using reusable face masks is the most favourable method of using face masks from an environmental perspective.

The highlights of this report have identified that a single use facemask will contribute around 1.15kg CO2e in comparison to a reusable facemask (Revolution Zero) which will contribute 0.2kg CO2e in carbon emissions.

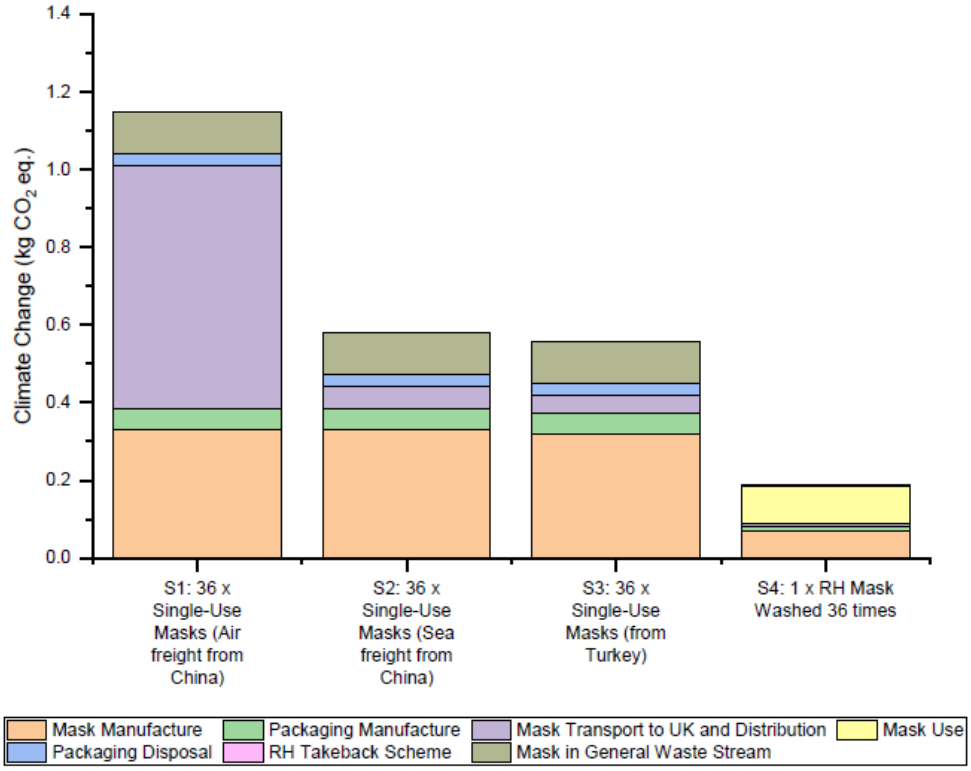


***Figure 2**: Climate change results generated for each scenario of facemask use.*

The impact of water use was also assessed as part of this assessment in comparison for single use products. Due to the requirement to wash the product in order to disinfect it, there is obviously a higher requirement for water use. There is an obvious requirement to look at this area in the future as well.

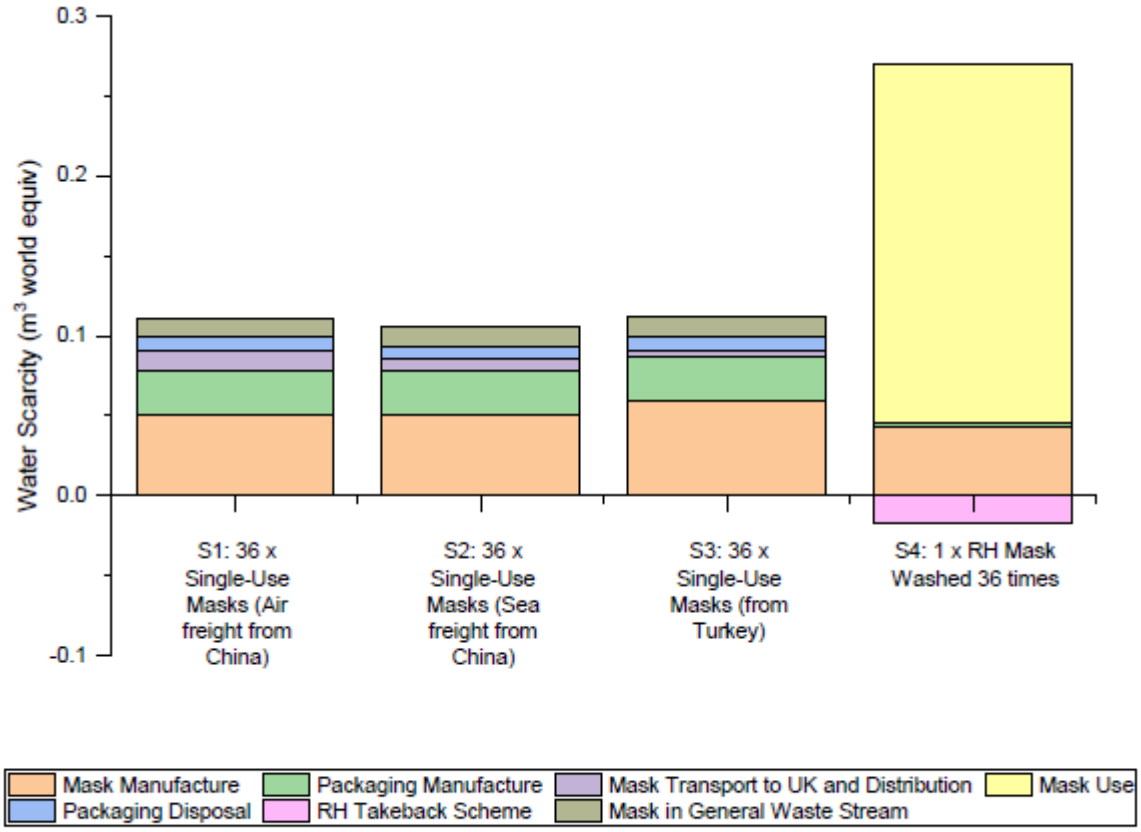


Figure 3: Water Scarcity results generated by each face mask scenario.

The report can be read in full on the Revolution Zero pages.

10.3 Medical mask versus cotton mask for preventing respiratory droplet transmission in micro environments

The report was written by Kin-FaiHo, Lian-YuLin, Shao-PingWeng, Kai-JenChuang. The objective of this study was to investigate whether cotton mask worn by respiratory infection person could suppress respiratory droplet levels compared to medical mask. They recruited adult volunteers with confirmed influenza and suspected cases of coronavirus disease 2019 (COVID-19) to wear medical masks and self-designed triple-layer cotton masks in a regular bedroom and a car with air conditioning.

Four 1-hour repeated measurements (two measurements for bedroom, the others for car) of particles with a size range of 20–1000 nm measured by number concentrations ($NC_{0.02–1}$), temperature and relatively humidity, and cough/sneeze counts per hour were conducted for each volunteer. The paired *t*-tests were used for within-group comparisons in a bedroom and in a car. The results showed that there was no significant difference in $NC_{0.02–1}$ or cough/sneeze counts between volunteers with medical masks and cotton masks in a bedroom or a car. They concluded that the cotton mask could be a potential substitute for medical mask for respiratory infection person in microenvironment with air conditioning. Healthy people may daily use cotton mask in the community since cotton mask is washable and reusable.

The report can be read at
https://www.sciencedirect.com/science/article/pii/S0048969720330278.

10.4 Time to act: what nurses can do to reduce the environmental burden of PPE

The paper entitled: Time to act: what nurses can do to reduce the environmental burden of PPE in the Nursing Times, authored by Clare Nash, lays out the importance of decarbonising the supply chain is critical to achieving carbon reduction and sustainable healthcare, and reusing personal protective equipment is crucial to this. This article considers the impact of Covid-19 on the climate emergency in terms of increased employment of single-use personal protective equipment and what nurses are doing to shift to greener alternatives.

This pilot project was highlighted to have an impact on PPE reduction with the infection prevention and control challenges being presented and ensuring that European Standards and certification meets requirements for reuse.

10.5 Standard Infection Control Precautions (SICPs) and Transmission Based Precautions (TBPs) Literature Review: surgical face masks

The ARHAI Scotland Surgical Masks for SICPs and TBPs literature review report makes the following recommendations:

What type of surgical mask is recommended for use for SICPs in health and care settings?

- Surgical masks should be well fitting and fit for purpose (Mandatory)
- Surgical masks should cover the mouth and nose in order to prevent venting (exhaled air 'escaping' at the sides of the mask) (Category B recommendation)
- Surgical masks must be 'CE' marked and compliant with Medical Device Directive (MDD/93/42/EEC) and the Personal Protective Equipment Regulations 2002. (Mandatory)
- Fluid resistant surgical face masks (Type IIR) (with eye protection) should be used when splashing or spraying of blood and/or body fluids is anticipated
- Surgical masks worn by healthcare workers for procedures where blood and/or body fluid splash and spray is not anticipated e.g. aseptic procedures, should meet type II or type IIR standards. (Category C recommendation)

10.6 SAGE report on facemasks

The SAGE report prepared by members of the Hospital Onset COVID-19 Working Group (HOCI) and Environmental Modelling Group (EMG) and entitled ' Masks for healthcare workers to mitigate transmission of SARS-CoV-2', 25th March 2021 (finalised 9 April 2021).

10.7 WHO guidance on use of masks

This document from the World Health Organisation provides updated guidance on mask use in health care and community settings, and during home care for COVID-19 cases. It is intended for policy makers, public health and infection prevention and control professionals, health care managers and health workers. It provides advice on the use of masks in the community, during home care and in healthcare settings in the context of the novel coronavirus (COVID-19) outbreak (who.int). The World Health Organization (WHO) advises the use of masks as part of a comprehensive package of prevention and control measures to limit the spread of SARS-CoV-2, the virus that causes COVID-19. A mask alone, even when it is used correctly, is insufficient to provide adequate protection or source control. Other

infection prevention and control (IPC) measures include hand hygiene, physical distancing of at least 1 metre, avoidance of touching one's face, respiratory etiquette, adequate ventilation in indoor settings, testing, contact tracing, quarantine and isolation. Together these measures are critical to prevent human-to-human transmission of SARS-CoV-2.

11.0 Conclusion

The reusable facemasks were trialled by 63 organisations, trialling 1250 facemasks, all responded with an overwhelmingly positive response. There is a need and a desire to adopt these reusable facemasks widely across the NHS and staff feel passionate that this should be done as fast as possible. The facemasks used in this pilot trial replaced 41,920 single use facemasks or the equivalent of 1.467 tonnes of single use facemasks, replacing them with 1,250 multiple use facemasks would save 41 tonnes/CO2e if compared to single use facemasks shipped from the Far East or 15 tonnes/CO2e if shipped from Turkey. Reusable facemasks can be recycled as facemasks or as other products so the waste generated is negligible.

For reusable facemask to be adopted across the health care system there needs to be national IPC and PHE guidance as well as buy in. Procurement systems also need to participate in this process as well.

In order for Trusts to implement reusable facemasks, they need to assess their appropriate use, washing procedures, staff assessment and the Trusts need to assess a variety of options, review and update their policies. Measures need to be in place to track the use of the facemasks and ensure that they are taken out of circulation at the end of their tested lifespan.

There are cost savings to be made to Trusts across the UK and healthcare systems across the world by implementing reusable facemasks. The implementation of a reusable Type IIR facemask within the healthcare systems across the world can help to increase reusability, local circular economies, reduction and elimination in healthcare waste and reduce littering. It can also start the process of investigating other reusable products.

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