Evidence check

6 August 2020

Rapid evidence checks are based on a simplified review method and may not be entirely exhaustive, but aim to provide a balanced assessment of what is already known about a specific problem or issue. This brief has not been peer-reviewed and should not be a substitute for individual clinical judgement, nor is it an endorsed position of NSW Health.

Extended use or reuse of personal protective equipment

Rapid review question

What is the evidence for extended use or reuse of personal protective equipment (PPE) during COVID-19?

In brief

- Single-use personal protective equipment (PPE) is intended to be discarded after each encounter or procedure. During times of supply disruption or extraordinary demand, such as airborne disease outbreaks, extended use and reuse protocols have been implemented to conserve PPE.(1, 2)
- Extended use refers to the practice of wearing the same PPE for repeated close contact encounters with several patients, without removing it between those encounters. Extended use is suited to situations where multiple patients are infected with the same respiratory pathogen and patients are placed together in dedicated waiting rooms or hospital wards.(1)
- Reuse refers to the practice of using the same PPE for multiple patient encounters but removing it ('doffing') after each encounter.(1)
- The evidence on reuse is primarily focused on masks and respirators and there is limited information available on extended use or reuse of other types of PPE.
- The World Health Organisation (WHO) and US Centres for Disease Control and Prevention (CDC) suggest considering PPE decontamination methods, which not only demonstrate effective reductions in pathogen burden, but also preserve the structural and functional integrity of the mask without causing any residual chemical hazard to the wearer.(3-5)
- Occupational health and safety guidance for infection prevention and control recommends that PPE is considered in the context of broader, more effective hazard reduction approaches, such as elimination, engineering and administrative measures, including cohorting patients or bundling patient care activities in hot and cold zones.(2, 4, 6, 7)
- Reviews found evidence supporting extended use of respirator (N95 or equivalent) over intermittent reuse, as extended use involves less touching of the respirator and therefore, less risk of contact transmission.(2, 6, 8, 9)

- The NSW Clinical Excellence Commission (CEC) recommends that reprocessing of single-use PPE not be undertaken without prior written approval from the NSW Ministry of Health and local PPE Governance Committees (10)

Face respirators and masks

- The CEC advocates for extended use only up to four hours and advises against reuse of face mask (10).
- Methods to decontaminate masks fall into three broad categories: heat sterilisation, chemical cleaning and ultraviolet germicidal irradiation.(2) Three systematic reviews published in 2020 investigated interventions such as microwave irradiation, heat, chemical disinfectants and ultraviolet germicidal irradiation for decontamination of N95 filtering face piece respirators. Vaporised hydrogen peroxide and ultraviolet germicidal irradiation demonstrated effective sterilisation without compromising mask performance. Moist heat, ethylene oxide, disinfectants and dry oven heating have also shown promising outcomes. However, methods using microwave irradiation can compromise the physical integrity of respirator components.(11-14)
- A recent systematic review published on 8th July suggests ultraviolet germicidal irradiation (UVGI) and vaporized hydrogen peroxide (VHP) to be the most promising methods, based on their reduction of the microbial threat (including SARS-CoV-2) while maintaining the function of N95 filtering facemask respirators as well as the lack of residual toxicity.
- CDC advises that decontaminated respirators should not be worn by healthcare providers when performing aerosol generating procedures due to the uncertainties about the impact of the decontamination on respirator performance.(5, 8)
- Risks associated with extended N95 use and reuse include discomfort, loss of fit, loss of filtration effectiveness and risk of infection spread so the maximum hours of extended use or number of reuse needs to be defined by local protocol.(2, 6)
- A 2020 systematic review concluded that there is insufficient evidence about the safety or efficacy of any decontamination intervention for extended use or reuse of surgical masks in the clinical setting due to heterogeneity of the interventions, non-standardised test conditions, inconsistent assessment methods.(3)
- The Therapeutic Goods Administration (TGA) advises that all face masks currently included on the Australian Register of Therapeutic Goods are single use items that are not intended for reprocessing to make suitable for reuse.(15)

Other PPE

- The World Health Organisation (WHO) notes that extended use or reuse of PPE (masks, gowns, goggles, face shields) may pose risk of transmission and recommends that PPE should be discarded if wet, contaminated, soiled, damaged, difficult to use, upon leaving the care setting/exposure environment, or after a pre-defined number of reuses according to local guidance/policy.(4) CDC and ECRI recommend the maximum of five donnings.(1, 2)

- WHO guidance clearly states that gloves should be changed between dirty and clean tasks during care to a patient and when moving from one patient to another, accompanied by hand hygiene.

Limitations

Evidence on extended use and/or reuse of PPE is emerging. Local guidelines may vary according to specific context across jurisdictions. Available evidence on extended use, or reuse with or without decontamination is based on low quality studies. Recommendations in this review are copied from source material and no attempt has been made to integrate the different guidance.

Background

PPE, including masks, gowns and gloves are regulated by the TGA under the *Therapeutic Goods Act 1989*. Single-use PPE are intended to be discarded after each encounter or procedure warranting their use. During times of supply disruption or extraordinary demand, such as airborne disease outbreaks, extended use and reuse protocols have been implemented for conserving PPE.

Extended use refers to the practice of wearing the same PPE for repeated close contact encounters with several patients, without removing it between those encounters. Extended use is suited to situations where multiple patients are infected with the same respiratory pathogen and patients are placed together in dedicated waiting rooms or hospital wards.(1)

Reuse refers to the practice of using the same PPE for multiple patient encounters but removing it ('doffing') after each encounter.(1) However, frequent handling of PPE after use may lead to increased risk of self-contamination in high clinical demand environments.

Effective hazard reduction strategies such as elimination, engineering and administrative measures are recommended along with a risk based approach for extended use or reuse.(7)

PPE decontamination methods are required to reduce the pathogen burden but also preserve the structural and functional integrity of the mask without causing any residual chemical hazard to the wearer.(3-5)

Methods (Appendix 2)

PubMed and Google were searched for existing evidence reviews on 25 May 2020 and again on 28 July. Only systematic and evidence reviews are included for decontamination and reuse of face masks and respirators. Guidance from major national government bodies is included through grey literature. Additional studies were added that were screened for eligibility during daily evidence check searches.

Results

Table 1: Evidence from peer-review literature on extended use or reuse of PPE

Source	Summary
Peer reviewed sources	
Decontamination and reuse of N95 filtering facemask respirators: A systematic review of the literature Rodriguez-Martinez et al 2020 (16)	Systematic review of 15 studies reporting on the different decontamination methods that might allow disposable N95 filtering facemask respirators (FFRs) to be reused, including small-scale energetic methods and disinfecting solutions/spray/wipes. • It specifically focused on issues related to biocidal efficacy, filtration performance, fitting characteristics, and residual chemical toxicity, as well as other practical aspects such as the equipment required for their implementation and the maximum number of decontamination cycles. These issues largely depend not only on the decontamination method itself, but also on other factors, such as the N95 FFR model, the presence of soiling agents, the surface type, the directness of exposure to the target surface for decontamination, the type of nucleic acid of the virus, the water-vapor content on the surface, and specific characteristics of each decontamination method, such as dose, intensity, concentration, and time of exposure. • Among decontamination methods, ultraviolet germicidal irradiation and vaporized hydrogen peroxide seem to be the most promising decontamination methods for N95 FFRs, based on their biocidal efficacy, filtration performance, fitting characteristics, and residual chemical toxicity, as well as other practical aspects such as the equipment required for their implementation and the maximum number of decontamination cycles. • UVGI decontamination is the most frequently studied and reported decontamination method for N95 FFRs that has demonstrated significant reductions in influenza virus recovery and viability even with soiling conditions and it has shown substantial reductions in the recovery of pathogens after exposure to UVGI for as little as 5 minutes, inactivation of 99.9%-99.999% of respiratory viruses. All these biocidal effects have been demonstrated without known health risks to the users nor a meaningfully

Source	Summary
Peer reviewed sources	
	significant effect on filter aerosol penetration, filter airflow resistance, fit and seal, discomfort, difficulty in donning, or physical appearance after up to 20 of cycles of decontamination. Additionally, UVGI is the most viable treatment for large-scale applications, due to its simplicity of use and its ability to rapidly scale up the process by adding inexpensive FFR UVGI exposure units. • An additional factor to consider is that UVGI performance can vary among different models of N95 FFRs, different parts of the respirators, distinct types of UVGI, and number of cycles of decontamination. The UVGI dose required for decontamination, which is microbe specific. However, at the higher UVGI doses, there are greater reductions in the strength of the layers of FFR material. • All these biocidal effects of VHP have been demonstrated without meaningfully significant effects on filtration performance, filter aerosol penetration, fit, and filter airflow resistance after up to 50 cycles of decontamination. Additionally, there are no vapors potentially toxic to humans nor environmentally hazardous residues as a result of the VHP decontamination process.
Microwave- and Heat-Based Decontamination of N95 Filtering Facepiece Respirators (FFR): A Systematic Review Gertsman et al. 2020 (12)	Systematic review of 11 studies on N95 filtering facepiece respirator (FFR) decontamination using microwave irradiation and heat reported: • microwaves and heat may both be suitable options for decontamination of N95 FFRs during a PPE shortage, especially for institutions that do not have access to UVGI apparatus. • Microwave irradiation and moderate temperature heat (<90^{o}C), in both moist and dry conditions, demonstrate effective sterilisation without compromising mask performance or function. The most significant disadvantage of both methods was damage to certain mask models. • Autoclaving is an effective germicidal but caused significant degradation and reduction of filter efficiency in some mask types and so its use is not supported by the results of this review. • Overall, it is recommended that any mask decontaminated by microwave irradiation or heat is assessed for physical damage before reuse.

Source	Summary
Peer reviewed sources	
Efficacy and safety of disinfectants for decontamination of N95 and SN95 filtering facepiece respirators: a systematic review O'Hearn et al. 2020 (14)	Systematic review on 13 eligible studies concluded that: • A single cycle of vaporised H_2O_2 successfully removes infectious pathogens without affecting mask function or fit, and with little change in FFR physical appearance. • Residual hydrogen peroxide levels following decontamination were below the safety limit. • There is no available data on removal of infectious pathogens from FFRs using liquid H_2O_2 or multiple decontamination cycle of vaporised H_2O_2.
Decontaminating N95 and SN95 masks with Ultraviolet Germicidal Irradiation (UVGI) does not impair mask efficacy and safety: A Systematic Review O'Hearn et al. 2020 (13)	Systematic review of 13 studies , comprising 54 ultraviolet germicidal irradiation (UVGI) intervention arms and 58 N95 FFR models. • The function of N95 masks, based on aerosol penetration and airflow filtration, is maintained following a single cycle of UVGI. • Decontamination using UV light in the laboratory setting suggests that this can be a successful method of removing infectious pathogens from FFRs. • The study recommends a cumulative dose of no less than 20,000 and ideally 40,000J/m2 be used for clinical application of UVGI and further investigation. However, it is important to note that these evaluations were all performed in a laboratory setting and do not represent real world conditions.
Facial protection for healthcare workers during pandemics: a scoping review Garcia et al. 2020 (11)	The review included 67 peer-reviewed articles. • Overall, strategies involving the use of UVGI, ethylene oxide, dry oven heating and hydrogen peroxide vapour may be most promising for preservation of mask function and integrity. • Methods using microwave irradiation, microwave-generated steam and moist heat incubation can compromise the physical integrity of respirator components. • Decontamination with UVGI, moist heat incubation and microwave-generated steam does not appear to significantly affect N95 respirator fit or comfort.

Source	Summary
Peer reviewed sources	
	• Decontamination with hydrogen peroxide gas plasma, autoclave, 160°C dry heat, 70% isopropyl alcohol and soaking in soap and water may cause significant loss of filtration efficiency. • Application of above decontamination methods has not been adequately investigated in the hospital setting. Their safety and effectiveness in the context of the SARS-CoV-2 outbreak is unknown.
Decontamination interventions for the reuse of surgical mask personal protective equipment: a systematic review Zorko et al. 2020 (3)	• There is inadequate evidence on the safety or efficacy of any decontamination intervention for extended use or reuse of surgical masks in the clinical setting. Studies evaluated different interventions, using heterogenous and non-standardised test conditions and assessed a variety of outcomes using inconsistent methods. This limits comparisons between interventions and conclusions regarding their efficacy or safety. • Furthermore, no studies provided explicit information on the feasibility, resource requirements, or applicability of these decontamination methods in institutional or hospital settings, making it challenging to determine if any of the interventions evaluated could be easily implemented during situations of high PPE demand. • It is well established that viral load reductions can occur by virtue of time. Based on the limited evidence in this review, dry heat may alter surgical mask performance less than high-pressure moist heat or chemical interventions, however the germicidal effect of dry heat in surgical masks is unclear.
COVID-19-associated shortage of alcohol-based hand rubs, face masks, medical gloves and gowns – proposal for a risk-adapted approach to ensure patient and healthcare worker safety Kampf et al. 2020 (17)	**Face masks:** a. The mask should not be disinfected or sterilised. b. FFP2 mask: keep the same mask for up to 8 hours maximum. c. Surgical face mask: keep the same mask for up to 4 hours (French Society for Hospital Hygiene) or 6 hours (WHO) maximum. d. The masks should be worn as long as possible. **Gown:** In case of acute shortage of gowns, the following options can be considered:

Source	Summary
Peer reviewed sources	
	a. Extending the wear time of disposable gowns by the same caregiver for several COVID-19 patients in same room. b. The gown should be worn with an additional disposable plastic apron, which must be changed between patients. c. Tightness and integrity should be ensured. The gown should not be touched or worn outside treatment areas. d. Cotton gowns can be washed and disinfected, e.g. in a washing machine with warm water (60°C – 90°C) and laundry detergent. **Gloves:** a. Restrict glove use to the recommended indications only and control this restriction. b. If shortage continues, consider promoting the targeted disinfection of gloved hands according to the five moments for ongoing care on the same patient. **c.** If shortage still persists, consider promoting the targeted disinfection of gloved hands according to the five moments for ongoing care on all patients with same pathogen in the same room (e.g. COVID-19 patients).

Table 2: Grey literature on extended use or reuse of PPE

Source	Summary
Grey literature	

Infection prevention and control application of PPE during COVID-19 Version 2.1
CEC, 2020 (10)
	• CONSIDER EXTENDED USE, DO NOT REUSE MASK AT ANY STAGE: Once removed, a mask should not be reapplied
	• International guidance states that surgical masks can be worn for not more than 4 hours and a P2/N95 respirator for up to 8 hours continuously or uninterrupted for multiple patients without removing the mask unless damaged, soiled or contaminated. However, the use of one mask for longer than 4 hours is likely to be poorly tolerated (increasing risk of self-contamination) and is not recommended.
	• Any individual or entity reprocessing medical devices for reuse meets the legislative definition of a manufacturer under the therapeutic goods legislation and will need to meet all legislative obligations and responsibilities for manufacturers.
	• The reprocessing of single use PPE is not recommended and should only be considered as one of the temporary emergency strategies when the supply of new items is inadequate
	• Factors to consider when reprocessing single-use medical devices for reuse in order to meet the Essential Principles include the following:
	  ○ Reprocessing single-use PPE must not be undertaken without prior written approval from the NSW Ministry of Health.
	  ○ Requires approval by an LHD/SHN PPE Governance Committee
	  ○ Procedures and safeguards be implemented to prevent inadvertent environmental contamination with hazardous microorganisms (including from the point of collection environment through to the reprocessing environment)
	  ○ Procedures and safeguards be implemented to prevent inadvertent exposure of individuals in these environments to hazardous microorganisms
	  ○ Processes should be established for reprocessed items to enable traceability and tracking during reprocessing and reuse.

Source	Summary
Grey literature	
Extended use or re-use of single-use surgical masks and filtering facepiece respirators: A rapid evidence review Toomey et al 2020 (9)	• While extended use or reuse of single-use surgical masks or respirators (with or without reprocessing) is generally not recommended, guidance from various organisations supports such measures as a last-resort measure during critical shortage. Extended use is preferred over reuse. • Comparisons across guidance documents and systematic reviews highlight limited evidence, varying levels of detail and areas of inconsistency, especially in relation to reuse of respirators (with or without reprocessing) during and after aerosol generating procedures. • The reprocessing of surgical masks is not recommended. • Reprocessing of respirators under controlled and standardised conditions is recommended, but there is inconsistency regarding how or when this should take place and further research is needed in this area (Figure 1). • Where extended use or reuse is being practised, healthcare facilities and institutions should ensure that policies and systems are in place to enable these practices to be carried out in the safest way possible in line with available guidance.
Decontamination and Reuse of Filtering Facepiece Respirators CDC, 29 April 2020 (5)	• While disposable filtering facepiece respirators (FFRs), like N95s, are not approved for routine decontamination as conventional standards of care, FFR decontamination and reuse may be needed during times of shortage to ensure continued availability. • Based on the limited research available, as of April 2020, ultraviolet germicidal irradiation, vapourous hydrogen peroxide and moist heat have shown the most promise as potential methods to decontaminate FFRs. No current data exist to support the effectiveness of these decontamination methods, specifically against SARS-CoV-2 on an FFR. Given the uncertainties about the impact of decontamination on respirator performance, these FFRs should not be worn by healthcare providers when performing or present for an aerosol generating procedure. • Before using any decontamination method, it should be evaluated for its ability to retain: ○ filtration performance

Source	Summary
Grey literature	
	○ fit characteristics achieved prior to decontamination ○ 3) safety of the FFR for the wearer (e.g. by inactivating SARS-CoV2). • The document provides a summary of crisis standards of care, decontamination methods and the effect on FFR performance and relevant recommendations.
Strategies for Optimizing the Supply of N95 Respirators CDC, 2020 (18)	This guidance describes the following measures that may be considered in the setting of a potential impending shortage of N95 respirators: • Extended use of N95 respirators. • Use of respirators beyond the manufacturer designated shelf life for healthcare delivery for care of patients with COVID-19, tuberculosis, measles and varicella can be considered. • Use of respirators approved under standards used in other countries that are similar to Institution of Occupational Safety and Health (IOSH) approved N95 respirators. • Limited reuse of N95 respirators for COVID-19 patients. • Prioritise the use of N95 respirators and face masks by activity type. • In settings where N95 respirators are so limited that routinely practiced standards of care for wearing N95 respirators and equivalent or higher level of protection respirators are no longer possible and surgical masks are not available, as a last resort it may be necessary for healthcare personnel to use masks that have never been evaluated or approved by NIOSH or homemade masks. It may be considered to use these masks for care of patients with COVID19, tuberculosis, measles and varicella. However, caution should be exercised when considering this option.
Recommended Guidance for Extended Use and Limited Reuse of N95 Filtering Facepiece Respirators in Healthcare Settings	Strategies to extend use and limited reuse of N95 • Minimise the number of individuals who need to use respiratory protection through the preferential use of engineering and administrative controls.

Source	Summary
Grey literature	
CDC. 2020 (1)	• Use alternatives to N95 respirators (e.g., other classes of filtering facepiece respirators, elastomeric half-mask and full facepiece air purifying respirators, powered air purifying respirators), where feasible. • Implement practices allowing extended use and/or limited reuse of N95 respirators, when acceptable. • Prioritise the use of N95 respirators for those personnel at the highest risk of contracting or experiencing complications of infection. • Discard N95 respirators following: a. use during aerosol generating procedures. b. contamination with blood, respiratory or nasal secretions, or other bodily fluids from patients. c. close contact with or exit from the care area of any patient co-infected with an infectious disease requiring contact precautions. • Consider use of a cleanable face shield (preferred) over an N95 respirator and other steps (e.g., masking patients, use of engineering controls) to reduce surface contamination. • Hang/store each used respirator separately in a designated storage area. • Avoid touching the inside of the respirator. Perform hand hygiene after touching the inside. • Use a pair of clean (non-sterile) gloves when donning a used N95 respirator. • Follow the employer's maximum number of donnings (or up to five) and recommended inspection procedures.
Respiratory infection: reuse, or extended use, of disposable masks and respirators Marin, 2020 (8)	• Surgical/medical masks must be discarded after each use and disposed of immediately upon removal. • A surgical or medical mask may be worn for up to six hours of continuous wear and should be replaced when damp. • Respirator (N95 or equivalent) lifespan should be extended rather than intermittently reused because it involves less touching of the respirator and therefore less risk of contact transmission. • Extended use of a respirator may be implemented when multiple patients are infected with the same respiratory pathogen and patients are placed together in dedicated waiting rooms or hospital wards.

Source	Summary
Grey literature	
	• Respirators should not be reused after aerosol generating procedures or if it becomes contaminated or damaged or difficult to breathe through. (Grade B) • If a respirator is reused, it should be decontaminated with UVGI. However, ethylene oxide (EtO) or VHP may be considered in the absence of UVGI.

Safety of Extended Use and Reuse of N95 Respirators
 	
ECRI. 2020 (2)
	• Limited evidence from 21 laboratory studies supports prioritising extended use over reuse because N95s may readily spread infection by touch if donned and doffed and are prone to mechanical failure upon reuse.
	• Covering respirators with surgical masks had no clinically significant effect on breathing effort and gas exchange.
	• Decontamination of N95 respirators by steam, disinfectants (e.g., bleach, hydrogen peroxide vapour), or ultraviolet germicidal irradiation (UVGI) may be safe and effective in some settings but each method needs to be tested on each respirator model because model materials vary.
	• Risks associated with N95 extended use and reuse include:
	  ○ discomfort
	  ○ loss of fit
	  ○ loss of filtration effectiveness
	  ○ risk of infection spread.
	Measures to reduce the risk of mask-to-hand contamination include:
	• Patient cohorting (i.e., limiting encounters to only infected or non-infected patients).
	• Prioritising extended use over reuse.
	• Discarding respirators visibly contaminated with body fluids or other potential pathogen sources.
	• Covering N95s with surgical masks that are changed after each patient encounter.
	• Using proper hand hygiene and gloves when handling potentially contaminated N95s.
	• Storing used N95s in designated areas between reuses.
	• Decontaminating N95s between reuses.

Source	Summary
Grey literature	
Advice on surgical masks and gowns during COVID-19 TGA, 16 April 2020 (19)	• While standard conventional supply levels or contingency supply levels are available, all 'instructions for use' should be adhered to, such as single use and clinical guidelines and protocols. • All face masks that are currently included on the Australian Register of Therapeutic Goods are single use items that are not intended for reprocessing to make suitable for reuse. • While not recommended, where there is low supply or high demand, masks can be used past their shelf life if: a. the straps are intact b. there are no signs of visible damage c. they can be fit tested. • Where there is high demand and/or limited access to surgical masks and gowns, healthcare facilities could consider allowing healthcare professionals to continue wearing the same mask and gowns between treating patients with the same diagnosis or infectious disease.
Reuse of face masks and gowns during the COVID-19 pandemic TGA. 21 May 2020 (15)	• Reprocessing (cleaning and disinfection and/or sterilisation) may have a severe deleterious effect on the safety and performance of the masks and gowns that may not be obvious to the end user. • Face masks that have undergone reprocessing activities and are not supplied in a "sterile" state are regulated as Class I non-sterile, non-measuring medical devices. • Healthcare facilities that reprocess single-use medical devices to make them suitable for reuse during the COVID-19 pandemic are responsible for all risks and associated liabilities with 'off-label' use of medical devices. • The provisions in place to facilitate the planned decontamination of PPE is limited to N95/P2 respirators. It does not extend to other types of PPE such as gloves, gowns and medical or surgical face masks unless full comprehensive data supporting the safe and effective decontamination of that type of PPE is provided.

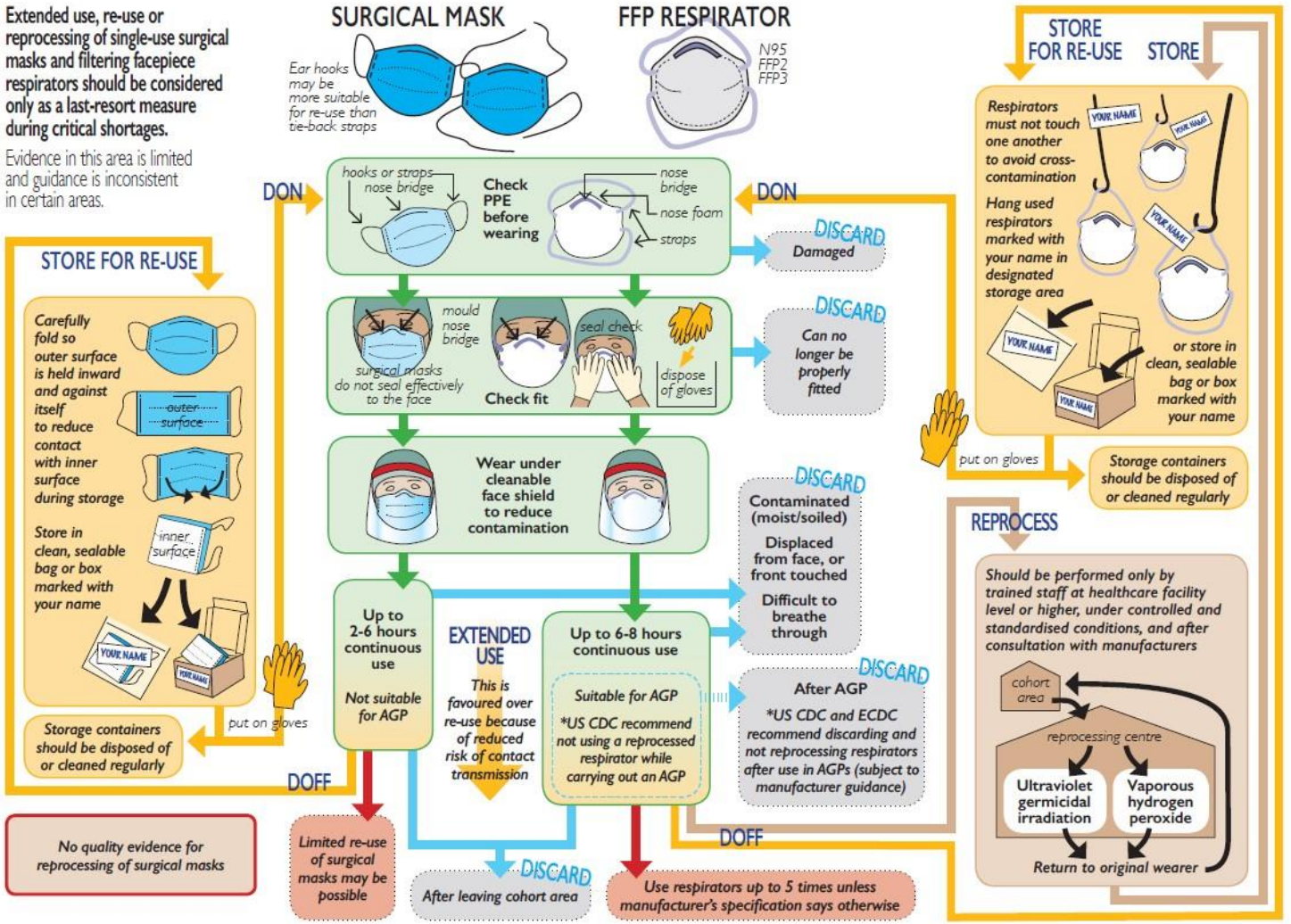
Source	Summary
Grey literature	
Rational use of personal protective equipment for coronavirus disease (COVID-19) and considerations during severe shortages Interim guidance, WHO. 2020 (4)	The WHO stresses that these temporary measures should be avoided as much as possible when caring for severe or critically ill COVID-19 patients and for patients with known co-infections of multi-drug resistant or other organisms transmitted by contact. Issues to consider when reprocessing: a. efficacy of the process to guarantee disinfection or sterilisation b. reprocessing method not resulting in residual toxicity for healthcare workers c. maintenance of functional integrity and shape of item for fit. Further, when considering reprocessing and reuse, manufacturers' instructions for reprocessing should be followed, if available. Extended use or reuse of PPE (masks, gowns, goggles, face shields) in acute shortage may pose risk of transmission and needs to be discarded when: a. PPE becomes wet, soiled, damaged, or difficult to use. b. PPE is exposed to splash of chemicals, infectious substances or body fluids. c. The PPE has been reused the maximum number of times according to local pre-defined guidance and policy. d. Providing care outside a designated cohort of COVID-19 patients. The respirator should be allocated to one caregiver and returned to original wearer after reprocessing cycle. Safe procedure for removal should be followed and avoid touching the front of the face shield. Gloves: • Using the same gloves for a cohort of COVID-19 cases (extended use) must not be done.

Source	Summary
Grey literature	
	• Changing gloves between dirty and clean tasks during patient care and when moving from one patient to another, accompanied by hand hygiene, is absolutely necessary.
Infection Prevention and Control Management of COVID-19 in Healthcare Settings CEC. 2020 (7)	• Extended use refers to the practice of wearing the same PPE (P2/N95, surgical mask, gown, apron or eye protection) for repeated close contact episodes with several patients without removing them between patient care. • Similarly, sessional use refers to a period of time where a healthcare worker is undertaking duties in a specific clinical care setting or exposure environment, such as several patients in a cohort bay or ward. A session ends when the healthcare worker leaves the clinical care setting or exposure environment. • Frequent handling of PPE after use to discard or replace may lead to increased face touching or self-contamination during PPE removal, which could theoretically increase the risk of exposure in high clinical demand environments. • PPE should be discarded if soiled, compromised or uncomfortable to the wearer, duration of use exceeds manufacturer instructions, once PPE is removed or when the healthcare worker leaves the care setting or exposure environment. • Sessional use should always be risk assessed and considered where there are high numbers of hospital cases. Extended use of aprons or gowns can be considered if there is minimal contact of the apron or gown with the patient or their surroundings, it is not used during an AGP and it is not visibly contaminated. • Operational strategies include limiting number of healthcare worker interactions by bundling the patient care activities or cohorting patients and healthcare workers for COVID-19 symptomatic cases where possible or practical.

Source	Summary
Grey literature	
Optimizing the Supply of Personal Protective Equipment During the COVID-19 Pandemic Recommendations from Ontario Health, Canada. 2020 (20)	Administrative measures for conserving PPE: • Cohort patients with suspected or confirmed COVID-19, assign designated teams of healthcare providers, and batch patient encounters to help conserve the use of PPE. Limited reuse of PPE (applicable to N95 respirators, surgical/procedure masks, cloth isolation, gowns, eye protection). • Once the PPE is wet, damaged or soiled, it should be placed in the appropriate waste receptacle. • The PPE is safely stored between patient encounters and put back on again ('donned') before the next encounter with a patient. Take great care when removing or redonning the PPE as this is when self-contamination may occur. • Reuse carries a higher risk of self-contamination than with extended use. • Restrictions are placed to limit the number of times the same item is reused. • Limited reuse of PPE, including N95 respirators, is not recommended for when performing an aerosol generating procedure. • Gloves should be changed between every patient encounter.
Operational Considerations for Personal Protective Equipment in the Context of Global Supply Shortages for Coronavirus Disease 2019 (COVID-19) Pandemic: non-US Healthcare Settings CDC. 2020 (6)	• Wherever possible, emergency PPE strategies should not be used in hospital wards housing severe or critically ill patients with COVID-19, as well as those with known co-infections of multi-drug resistant or other organisms transmitted by contact. • Extended use should be prioritised over reuse or any other approaches. • Manufacturers should be consulted for their guidance and experience in disinfecting their respective products. • The effectiveness of reprocessing methods to inactivate coronavirus (or other enveloped virus) on a medical mask and on preserving the integrity of the mask has not been established to date. Many of the most promising methods are resource-intensive and may not be feasible at a facility level.

Source	Summary
Grey literature	
	Engineering and administrative control measures for patients with COVID-19, including: a. Reducing or cancelling elective surgical procedures and non-critical and non-urgent outpatient visits b. Reducing face-to-face healthcare worker encounters with patients c. Limiting the number of visitors to healthcare facilities d. Cohorting patients and healthcare workers. • Extending use of PPE (medical masks, gowns, goggles or face shields) for one healthcare worker to use on multiple patients with COVID-19 (multiple single-rooms when seen in succession or cohort of patients) during a single shift. PPE should be discarded if it a. Becomes moist, damaged, visibly soiled or difficult to breathe through. b. If the mask is removed for any other reason. c. Reach maximum hours decided by local protocol (likely be a maximum of six hours). • Gowns: ○ Reusable gowns can be safely laundered and reused if they are in good condition. • Eye Protection: ○ Eye protection should be removed using appropriate technique and sent for reprocessing or disposal following local protocols, at least daily (after every shift). ○ A face shield should be dedicated to one healthcare worker. After reprocessing, a face shield should be stored in a transparent plastic container and labelled with the healthcare worker's name to prevent accidental sharing.

Figure 1: Schematic summary of current international guidelines on re-use, reprocessing and extended use of single-use masks and respirators (9)



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Appendix 1: Mask Utilisation Priority during Pandemic Planning – NSW Health

AIM: PROVIDE GUIDANCE ON RATIONAL, RISK-BASED USE OF MASKS TO ENSURE OPTIMAL USE

The level of demand should be calculated based on local risk assessment and made in conjunction with facility management, local infectious diseases, public health unit, infection prevention and control and advice from the CEC.

Mask type	Normal Demand	Increased Demand - CAUTION	High Demand - ALERT
Surgical Masks	**Health workers to use surgical mask:** • While performing any procedure where there is a likelihood of blood or body substances exposure (Standard Precautions) including terminal cleaning • When in contact within 1.5 metres of a suspected or confirmed COVID-19 case or any other communicable disease capable of transmitting by the droplet route i.e. influenza, acute respiratory illness (ARI), pertussis **Patients to use surgical mask:** • At the time of presentation to a healthcare facility with an ARI • If symptomatic confirmed and suspected cases of COVID-19 or ARI when out of their allocated zone and while in transit • When unwell with symptoms of ARI (coughing, runny nose, fever) while in the public area	**Health workers to use surgical mask:** Minimise the number of individuals who need to use respiratory protection through: • Preferential use of engineering and administrative controls (e.g. social distancing, room configuration, equipment that maintains closed circuits, cohorting of patients) • Implement and document practices allowing optimal **and extended/sessional use*** • Prioritise use for those personnel performing procedures that place them at the highest risk of contracting an infection • Wear face shield for risk of splash or spray • Reserve mask use to HWs inside patient zone only (e.g. surgery, patient room)	**Health workers to use surgical mask:** • For symptomatic patients confirmed as having a droplet spread infection including COVID-19 or influenza while providing care within 1.5 metres • Implement practices allowing optimal **and extended/ sessional use*** • Re-consider elective procedures that can be delayed or postponed **Patients to use surgical mask:** • Symptomatic confirmed influenza or COVID-19 when out of their allocated zone • Restrict visitors while patient is in infective stage • Patients with ARI to postpone their routine appointments/seek phone advice or phone ahead when safe to do so

Appendix 2

PubMed search terms

(((((2019-nCoV[title/abstract] or nCoV[title/abstract] or covid-19[title/abstract] or covid19[title/abstract] or "covid 19"[title/abstract] OR "coronavirus"[MeSH Terms] OR "coronavirus"[title/abstract]))) AND ((PPE OR personal protective equipment [title/abstract]))) OR (("face mask"[Title/Abstract]) AND (Mask[Title/Abstract]))) AND ((("Extended use") OR (reuse)) OR (conservation))

(((((2019-nCoV[title/abstract] or nCoV[title/abstract] or covid-19[title/abstract] or covid19[title/abstract] or "covid 19"[title/abstract] OR "coronavirus"[MeSH Terms] OR "coronavirus"[title/abstract]))) AND ((PPE OR personal protective equipment [title/abstract]))) OR (("face mask"[Title/Abstract]) OR (Mask[Title/Abstract]))) AND (("Extended use") OR (reuse)) OR (conservation) OR (decontamination)

Google and Twitter search terms

PPE, extended use/reuse, face mask, N95 respirators, conserving PPE, infection prevention measures in PPE shortage in COVID19.

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Original publication **22 May 2020**	**Updates**
19 June 2020	• Re ran search • Update in-brief and table to reflect new evidence