EVIDENCE SYNTHESIS BRIEFING NOTE

TOPIC: EFFECTIVENESS, USE AND RE-USE OF MASKS IN HOSPITALS DURING THE OMICRON WAVE

Information finalized as of Jan 10, 2022.[a] This Briefing Note was completed by the Research, Analysis, and Evaluation Branch (Ministry of Health) based on information provided by members of the COVID-19 Evidence Synthesis Network. Please refer to the Methods section for further information.

Purpose: This briefing note summarizes scientific evidence on the filtration performance of masks and their optimal use and re-use in hospital settings in the context of the Omicron variant during the COVID-19 pandemic. It also summarizes jurisdictional best practices for mask use/re-use by hospital staff.

Key Findings and Implications: It is important to note that most of the scientific evidence and jurisdictional practices identified in this note was published prior to the emergence of the Omicron variant.

- Mask Fit and Filtration Performance: In comparing four different types of masks (i.e., N95 respirators, surgical masks, medical masks, non-medical masks) as personal protective equipment (i.e., to protect the wearer, not as source control), a high-quality systematic review recommended N95 masks (or equivalent: FFP2 and KN95) as the primary choice whenever possible in health care or community settings. Given the high transmissibility of the Omicron variant and the potential increased contribution of aerosol transmission, it is important to select a mask that optimizes fit (e.g., length of facial hair can affect fit) and filtration.
  - In Australia, it is recommended that fit checks must be completed by a wearer every time they put on a respirator, and that respirators (i.e., P2, N95, KN95, and FFP2) need to be tested to ensure that they filter out a minimum of 94% or 95% solid and liquid aerosols that do not contain oil. The United Kingdom (UK) and the United States Food and Drug Administration recommend that if respirator masks (e.g., N95s) are not fluid repellent, additional protection, such as a visor, be used in situations where there is a splash risk. Both also recommend fit testing for all staff and prioritization of health care workers involved in performing aerosol-generating medical procedures.
- Mask Processing and Re-Use: Different sterilization processes result in different effects on filtration efficiencies of masks (including N95s, KN95s, and surgical masks). After decontamination, the filtration efficiency and fit factor of the N95 mask was found to be higher than the KN95 mask. Ultraviolet germicidal irradiation and vaporized hydrogen peroxide damaged respirators the least. However, more research is needed on decontamination effectiveness for SARS-CoV-2, particularly for the Omicron variant.
- Types of Masks and Their Use in Hospitals: In the context of Omicron, the UK and the World Health Organization recommended universal mask use for all health care staff including doctors, nurses, midwives, medical attendants, cleaners, community health workers. The Public Health Agency of Canada recommends masking in all health care settings for the full duration of shifts during the COVID-19 pandemic. Depending on community transmission rates, the mask chosen can be a well-fitting medical mask or a respirator.
- Mask Re-Use: The decision to implement policies that permit extended use of N95 respirators should be made by the professionals who manage the institution's respiratory protection program, in consultation with public health and occupational health and infection control departments. Health care organizations can prioritize the use of N95 respirators and well-fitting facemasks by activity type when the supply of N95 respirators is limited. N95 respirators beyond their manufacturer-designated shelf life, when available, are preferable to use of well-fitting facemasks.

Implications for Ontario: In the context of Omicron, the interim recommended personal protective equipment when providing direct care for patients with suspect or confirmed COVID-19 includes a fit-tested, seal-checked N95 respirator (or equivalent or greater protection), eye protection, gown, and gloves.

[a] This briefing note includes current available evidence as of the noted date. It is not intended to be an exhaustive analysis, and other relevant findings may have been reported since completion.

Supporting Evidence

Table 1 below summarizes scientific evidence on the filtration performance of masks and their optimal use and re-use in hospital settings in the context of the Omicron variant during the COVID-19 pandemic (i.e., from November/December 2021). It also includes information on jurisdictional best practices for use (e.g., by activity type), re-use, and reprocessing of N95 masks in hospital settings. See additional details in the Appendix, as follows: Table 2 (Systematic reviews on the effectiveness of reprocessing/reusing N95 masks); Table 3 (Experiences in other countries for uses of KN95 masks in hospitals compared to N95 masks, and approaches to improving fit and performance of KN95 masks); Table 4 (Grey literature and jurisdictional information on mask use and re-use during COVID-19); and Table 5 (Summary of reprocessing methods and recommendations for N95 respirators).

The following limitations should be noted:

- The scientific evidence searches were limited to systematic reviews, meta-analyses, and reviews. However, some individual studies were included if identified and relevant. Limited information was identified on the topics of interest.
- Most of the identified literature focused on COVID-19 variants prior to the emergence Omicron. This literature was included because there may be applicable lessons learned. It will be stated explicitly when Omicron-specific results are discussed.
- The methodological quality of some of the identified literature was rated using AMSTAR[b] by McMaster Health Forum. These ratings are available here. The methodological quality of all other sources identified is unclear as they have not been assessed as the Research, Analysis, and Evaluation Branch, which does not have the expertise to make such assessments.

Table 1: Summary of Evidence and Jurisdictional Practices on Masking in Hospitals during the Omicron Wave of the COVID-19 Pandemic

Scientific Evidence	• **Mask Filtration Performance**: One systematic review and two single studies found that N95 masks (or their equivalent) have the best filtration performance. A high-quality systematic review (February 2021, pre-print) compared the filtration performance of four different types of masks (i.e., N95 respirators, surgical masks, medical masks, and non-medical masks). The review indicated that N95 or equivalent (e.g., FFP2 and KN95) masks should be the primary choice whenever possible, whether in health care or community settings. However, the review did not analyze findings for N95 and KN95 masks separately.[1,c] ○ Two highly relevant single studies focused on filtration performance of KN95 masks compared to surgical masks or N95 masks and factors affecting the performance of KN95 masks such as decontamination: ▪ How different sterilization processes results in different effects on filtration efficiencies of masks (June 2020) (including N95s, KN95s, and surgical masks), with fewer negative effects associated with hydrogen peroxide sterilization than with chlorine dioxide solution; and ▪ The impact of multiple mild-steam decontaminations (June 2021) on the performance of disposable KN95 filtering facepiece respirators.[2]

[b] AMSTAR rates overall quality on a scale of 0 to 11, where 11/11 represents a review of the highest quality. It is important to note that the AMSTAR tool was developed to assess reviews focused on clinical interventions.

[c] This analysis mainly focused on using facemasks as personal protective equipment (i.e., to protect the wearer) rather than as source control or transmission prevention, and the interpretation of the results was confined to this regard (Kim et al., 2021).

	• **Mask Fit**: Based on the evidence, it is important to select a mask that optimizes fit (e.g., in relation to facial hair) and performance with the N95 mask providing the best filtration. ○ Three highly relevant rapid reviews of low- and medium-quality focused on filtration performance of KN95 masks compared to surgical masks or N95 masks, factors affecting the performance of KN95 masks, and/or approaches to improving the fit and performance of KN95 masks: ▪ A low-quality rapid review (December 2021) concluded that given the high transmissibility of the Omicron variant and the potential increased contribution of aerosol transmission, it is important for the public to select a mask that optimizes fit and filtration (e.g., non-fit tested N95, KN95, three-layer cloth mask); and ▪ A medium-quality review (February 2021) found a significant reduction of adequate fit of KN95 masks as the length of facial hair increased, and a low-quality review (June 2021) found the same and suggested adopting the use of simple resistance exercise bands as an approach to improve the fit of commonly used face masks (including N95, KF94, KN95, and procedure masks).[3] ○ Three single studies also focused on aspects of mask fit: • Evaluating aerosol particle penetration and total inward leakage (October 2021) through different types of masks (including reusable fabric two-layer masks, re-useable fabric multi-layer masks, disposable procedure/surgical masks, KN95 masks, and fit-tested and seal-checked N95 masks) revealed that N95 masks are the best option to protect individuals to aerosols in high-risk settings; • The level of proper fit for various types of masks (January 2021) (including N95s, KN95s, surgical masks, and fabric masks), emphasizing that fit checks may not be accurate, especially for those without prior mask fit education; and • The filtration efficiency, fiber integrity, and charge density of N95 and KN95 masks (July 2020) before and after various decontamination methods showed that the filtration efficiency and fit factor of the N95 mask is higher than the KN95 mask.[4] • **Reprocessing and/or Re-using N95 Masks via Decontamination Methods**: Three systematic reviews[5,6,7] (quality not assessed) focused on the effectiveness of different decontamination methods for mask re-use in the context of the COVID-19 pandemic, prior to Omicron. For example: ○ A systematic review (March 2021) found that ultraviolet germicidal irradiation (UVGI), hydrogen peroxide vapour (HPV), moist heat, and microwave-generated steam processing effectively sterilized N95 respirators and retained filtration performance. UVGI and HPV damaged respirators the least. However, more research is needed on decontamination effectiveness for SARS-CoV-2 because few studies specifically examined this pathogen.[8] ○ A systematic review (June 2021) found disinfectant/sterilizing agents most frequently tested at different concentrations and exposure periods were UVGI, HPV, and steam sterilization. The only disinfectants/sterilizers that did not caused degradation of the material-integrity were alcohol, electric cooker, ethylene oxide, and peracetic acid fogging. Exposure to UVGI or microwave-generated steam resulted in a non-significant reduction in filter performance.[9]
International Scan	• **Types of Masks, Use and Fit**: Information about jurisdictional practices related to types of mask used in hospital settings and conditions of use including fit was identified in Australia, the United Kingdom (UK), the United States (US), and the World Health Organization (WHO).

- Australia: The Australian Department of Health (December 9, 2021) recommended that fit checks must be completed by a wearer every time they put on a respirator, and that respirators, including the P2, N95, KN95, and FFP2, need to be tested for particulate filtration to ensure that they filter out a minimum of 94% or 95% solid and liquid aerosols that do not contain oil.[10]
- UK: The Health Protection Surveillance Centre in the UK recommends that if respirator masks (FFP2s or N95s) are not fluid repellent, additional protection, such as a visor, be used in situations where there is a splash risk. Fit testing is also recommended for all staff and prioritization of health care workers (HCWs) who are most likely to be involved in performing aerosol-generating medical procedures (AGMP). Moreover, based on the RAG (Red, Amber, Green) rating of wards, the Royal College of Physicians of Edinburgh recommends that in green zones (non-COVID-19 area), surgical masks must be worn when within two metres of a patient or in isolation rooms, surgical masks must be worn at all times in amber zones (COVID-19 cases without AGMP being performed), and FFP3 respirators must be worn at all times in red zones (COVID-19 cases with AGMP being performed).[11]
  - In the context of Omicron, UK guidance (December 2021) recommends universal use of face masks (Type II or IIR)[d] for staff and face masks/coverings for all patients/visitors within health and care settings over the winter period (i.e., until at least March/April 2022).[12]
- US: Similar to the UK, the US Food and Drug Administration (FDA) recommends that if respirator masks (FFP2s or N95s) are not fluid repellent, additional protection, such as a visor, be used in situations where there is a splash risk. Fit testing is also recommended for all staff and prioritization of HCWs who are most likely to be involved in performing AGMP. Other information from the US includes:
  - The US FDA's Emergency Use Authorization (EUA) authorizes the use of certain National Institute for Occupational Safety and Health (NIOSH)-approved respirator models in health care settings. The EUA is based on findings from NIOSH research suggesting that all approved filtering facepiece respirators with exhalation valves, even without covering the valve, performed the same or better than surgical masks, procedure masks, cloth masks, or fabric. The FDA also noted that some N95 respirators are intended for use in a health care setting, specifically single-use, disposable respiratory protective devices used and worn by HCWs during procedures to protect both the patient and health care personnel from the transfer of microorganisms, body fluids, and particulate material.
  - The NIOSH Certified Equipment List identifies that the elastomeric respirators (equipped with a replaceable particulate filter) without exhalation valves or with filtered exhalation valves may be used in surgical settings. Other powered air purifying respirators (PAPRs) approved by NIOSH should not be used in surgical settings due to concerns that the blower exhaust and exhaled air may contaminate the sterile field. Lastly, in an update to address NIOSH-Approved Air Purifying Respirators for Use in Health Care Settings During Response to the COVID-19 Public Health Emergency, the FDA indicated that facilities using elastomeric respirators and PAPRs should have up-to-date cleaning and disinfection procedures, which are an essential part of use for protection against infectious agents.[13]

[d] Whereas a type II medical face mask has no splash protection, a type IIR medical face mask has high splash protection (Ansell.com, 2022).

	▪ Pre-Omicron, the Centers for Disease Control and Prevention (CDC; September 2021) advised prioritizing the use of N95 respirators and well-fitting facemasks by activity type when N95 respirators are so limited that routinely practiced standards of care for all HCWs wearing N95 respirators when caring for a patient with SARS-CoV-2 infection are no longer possible. N95 respirators beyond their manufacturer-designated shelf life, when available, are preferable to use of well-fitting facemasks. The use of N95s or elastomeric respirators or PAPRs should be prioritized for HCWs with the highest potential exposures including being present in the room during AGMPs performed on persons with SARS-CoV-2 infection.[14] ○ WHO: According to the WHO (January 2022), in areas of community or cluster transmission, HCWs, caregivers, and visitors should always wear a respirator or mask when in the health facility, even if physical distancing can be maintained. Masks should be worn throughout their shifts, apart from when eating, drinking or needing to change the mask for specific reasons. Health workers and caregivers include doctors, nurses, midwives, medical attendants, cleaners, community health workers, and any others working in clinical areas.[15] ▪ In the context of Omicron, the WHO (December 2021) advised that a respirator (FFP2, FFP3, NIOSH-approved N95, or equivalent or higher-level certified respirator) or a medical mask should be worn by HCWs along with other personal protective equipment (PPE) (i.e., a gown, gloves and eye protection) before entering a room where there is a patient with suspected or confirmed COVID-19. Respirators should be worn in the following situations: in care settings where ventilation is known to be poor,[e] cannot be assessed, or the ventilation system is not properly maintained based on HCWs' values and preferences and on their perception of what offers the highest protection possible to prevent SARS-CoV-2 infection.[16] • **Mask Re-Use**: In September 2020, when P2 and N95 masks were the only particulate filter respirators (PFRs) in compliance with Australian standards, the Infection Control Expert Group in Australia recommended that single-use PFRs can be used for a single session of care lasting up to four hours and that they should be discarded as soon as they are removed, and not stored or decontaminated for re-use. They also recommended that users be instructed in the correct method of fitting, removing, and fit-checking PFRs, as training can improve facial seal achieved.[17] • **Conditions of Mask Re-Use**: Pre-Omicron, the CDC (September 2021) noted that the decision to implement policies that permit extended use of N95 respirators should be made by the professionals who manage the institution's respiratory protection program, in consultation with their occupational health and infection control departments with input from the state/local public health departments.[18] ○ Extended use[f] is well suited to situations wherein multiple patients with the same infectious disease diagnosis, whose care requires use of a respirator, are cohorted (e.g., housed on the same hospital unit such as a COVID-19 unit). ▪ HCWs can consider using a face shield or surgical facemask over the respirator to reduce contamination of the respirator, especially during AGMPs or procedures

[e] WHO guidance for adequate ventilation: "In health facilities where a mechanical ventilation system is available, the ventilation rate should be six-12 air changes per hour (e.g., equivalent to 40-80 L/s/patient for a 4x2x3 m^3 room), and ideally 12 air changes per hour for new constructions, with a recommended negative pressure differential of ≥2.5Pa (0.01-inch water gauge) to ensure that air flows from the corridor into patient rooms" (WHO, 2021).

[f] Extended use refers to the practice of wearing the same N95 respirator for repeated close contact encounters with several different patients, without removing the respirator between patient encounters (CDC, 2021).

	that might generate splashes and sprays. It is not known how facemasks placed over the respirator can affect the fit so caution should be used.[19] ○ Limited re-use of N95 respirators:[g] This might become necessary when caring for patients with SARS-CoV-2 infection. However, it is unknown what the potential of contact transmission is for SARS-CoV-2, and caution should be used.[20] ○ Mask Re-Use Storage and Care: One strategy to mitigate the contact transfer of pathogens from the respirator to the wearer could be to issue each HCW who may be exposed to patients with SARS-CoV-2 infection a minimum of five respirators. Each respirator will be used on a particular day and stored in a breathable paper bag until the next week. This will result in each worker requiring a minimum of five N95 respirators if they put on, take off, care for them, and store them properly each day. If this strategy is used, the total number of donnings should still not exceed five times before discarding the respirator, when no manufacturer instructions are provided to indicate otherwise.[21]
Canadian Scan	• **Mask Fit and Filtration**: Prior to the emergence of Omicron, the Public Health Agency of Canada (PHAC; last update on November 2021) offers advice for the use of COVID-19 medical masks and respirators, specifically that N95 respirators achieve a minimum particulate filtration efficiency of 95% and that when worn properly, the edges of the mask form a seal around the nose and mouth. Moreover, Health Canada accepts the US NIOSH certification as an appropriate quality standard for N95 respirators, and all certified N95 respirators must have an approval number stamped on the mask, represented as TC-84A-####n. An expired respirator can still be effective at protecting HCWs if it can be fit-tested, the straps are intact, and there are no visible signs of damage. In addition, Health Canada has asked manufacturers and importers to stop the sale of any products that do not meet the filtration criteria of 95% and re-label them as non-medical use face masks, as they could be used in settings where 95% filtration is not needed.[22] • **Hospital Staff Mask Use**: In the context of Omicron, PHAC guidance (December 23, 2021) recommends masking for the full duration of shifts in all health care settings during the COVID-19 pandemic. Depending on community transmission rates, the mask chosen can be a well-fitting medical mask or a respirator. HCWs can choose to wear a respirator at any time taking into account such factors as the community incidence of SARS-CoV-2, patient's ability to tolerate a mask, patient behaviours such as shouting or heavy breathing, requirement of extensive or prolonged close proximity, and other factors. Employers must ensure that every HCW has access to a respirator, so that they can put it on quickly if the need is identified during the point of care risk assessment.[h] No HCW should be denied a respirator at any time.[23] ○ In the context of Omicron, a technical brief (December 2021) from Public Health Ontario (PHO) noted that for standard care of patients with suspect or confirmed COVID-19, Alberta and BC recommend surgical/procedure (medical) masks, and an N95 respirator (or equivalent or greater protection) is recommended when AGMPs are being performed.[24]

[g] Re-use refers to the practice of using the same N95 respirator by one HCW for multiple encounters with different patients but removing it (i.e., doffing) after each encounter (CDC, 2021).

[h] Recommended PPE for all patient encounters should be based on a point of care risk assessment, which should consider: 1) community epidemiology of COVID-19 ventilation assessed by the organization as adequate; 2) crowding and occupancy of spaces; 3) patient not yet clinically evaluated (e.g., emergency areas); 4) likelihood of exposure to SARS-CoV-2 and other pathogens (i.e., based on specific interaction, specific task, specific patient, specific environment, and available conditions) (PHAC, 2021).

	▪ PHO also noted that given the undetermined impact of the Omicron variant, the interim recommended PPE when providing direct care for patients with suspect or confirmed COVID-19 includes a fit-tested, seal-checked N95 respirator (or equivalent or greater protection), eye protection, gown, and gloves. Other appropriate PPE includes a well-fitted surgical/procedure (medical) mask, or non-fit tested respirator, eye protection, gown, and gloves for direct care of patients with suspect or confirmed COVID-19. Fit-tested N95 respirators (or equivalent or greater protection) should be used when AGMPs are performed or anticipated to be performed on patients with suspect or confirmed COVID-19.[25]
Ontario Scan	• **Guidance for Mask Use**: In the context of Omicron, a PHO technical brief (December 2021) related to mask use for hospital staff advised: ○ There are early estimates of significant increased transmissibility and decreased vaccine effectiveness with the Omicron variant. It is unclear currently if there is a change in the infectiousness of aerosols as a possible explanation for this increase in transmissibility. Considering this, all layers of protection in health care settings should be optimized to prevent transmission until more information is available. ○ Given the undetermined impact of the Omicron variant, the interim recommended PPE when providing direct care for patients with suspect or confirmed COVID-19 includes a fit-tested, seal-checked N95 respirator (or equivalent or greater protection), eye protection, gown, and gloves. Other appropriate PPE includes a well-fitted surgical/procedure (medical) mask, or non-fit tested respirator, eye protection, gown, and gloves for direct care of patients with suspect or confirmed COVID-19. ○ Fit tested N95 respirators (or equivalent or greater protection) should be used when AGMPs are performed or anticipated to be performed on patients with suspect or confirmed COVID-19.[26] • **Guidance for Mask Decontamination**: Although prior to the emergence of Omicron, Ontario Health (April 2020) advised that UVGI and HPV are the most promising decontamination methods, based on available scientific evidence demonstrating their ability to inactivate infectious pathogens and maintain the integrity of the N95 respirator. However, the impact of each method on respirator performance (filtration and fit) is dependent on the respirator model. Those in charge of infection control practices in their jurisdictions should be aware of the N95 respirator models in their facilities and consider the pros and cons of each method when choosing a reprocessing method.[27]

Methods

The COVID-19 Evidence Synthesis Network is comprised of groups specializing in evidence synthesis and knowledge translation. The group has committed to provide their expertise to provide high-quality, relevant, and timely synthesized research evidence about COVID-19 to inform decision makers as the pandemic continues. The contents of this Evidence Synthesis Briefing Note are not intended to serve as guidance, but rather reflect the available evidence at the time of writing. The following members of the Network provided evidence synthesis products that were used to develop this Evidence Synthesis Briefing Note.

- Al-Khateeb S, Bain T, Bhuiya A, Mansilla C, Mehta V, Sood T, Wang Q, Soueidan S, Rintjema J, Wang A, Lavis JN, Wilson MG. COVID-19 rapid evidence profile #28: What is the filtration performance of KN95 masks compared to surgical and N95 masks, and how can their use be optimized in hospital settings? Hamilton: McMaster Health Forum, 10 January 2022.

- Evidence Synthesis Unit, Research Analysis and Evaluation Branch, Ministry of Health. January 10, 2022.
- Ontario Health. (April 20, 2020). Overview of Reprocessing Methods for N95 Respirators: Update and Information Summary.

For more information, please contact the Research, Analysis and Evaluation Branch (Ministry of Health).

Table 2: Systematic Reviews on Effectiveness of Reprocessing/Reusing N95 Respirators – Pre-Omicron[28]

Source	Reprocessing/Reusing N95 Respirators
Schumm, M.A. et al. (March 2021). Filtering Facepiece Respirator (N95 Respirator) Reprocessing: A Systematic Review. *Journal of the American Medical Association, 325 (13)*, 1296-1317.	• Purpose: To perform a systematic review to evaluate the evidence on effectiveness and feasibility of different processes used for decontaminating N95 respirators. • Evidence Review: A search of PubMed and EMBASE (through January 31, 2021) was completed for five types of respirator-decontaminating processes including UV irradiation, vaporized hydrogen peroxide, moist-heat incubation, microwave-generated steam, and ethylene oxide. Data were abstracted on process method, pathogen removal, mask filtration efficiency, facial fit, user safety, and processing capability. • Findings: Forty-two studies were included that examined 65 total types of masks. All were laboratory studies (no clinical trials), and 2 evaluated respirator performance and fit with actual clinical use of N95 respirators. Twenty-seven evaluated ultraviolet germicidal irradiation (UVGI), 19 vaporized hydrogen peroxide, nine moist-heat incubation, 10 microwave-generated steam, and seven ethylene oxide. • Conclusions and Relevance: UVGI, vaporized hydrogen peroxide, moist heat, and microwave-generated steam processing effectively sterilized N95 respirators and retained filtration performance. UVGI and vaporized hydrogen peroxide damaged respirators the least. More research is needed on decontamination effectiveness for SARS-CoV-2 because few studies specifically examined this pathogen.
Nicolau, T., et al. (March 2021). Ultraviolet-C as a Viable Reprocessing Method for Disposable Masks and Filtering Facepiece Respirators. *Polymers, 13 (5)*, 801.	• Purpose: This paper aims to describe the state-of-the-art for Ultraviolet-C (UV-C) sterilization in masks and FFR. To achieve this goal, the study adopted a systematic literature review in multiple databases added to a snowball method to make the sample as robust as possible and encompass a more significant number of studies. • Results: The study found that UV-C's germicidal capability is just as good as other sterilization methods. Combining this characteristic with other advantages (e.g., low-cost) makes UV-C sterilization desirable compared to other methods, despite its possible disadvantages (e.g., thermal deformation, reduction of mask filtration power, shadowing).[i] • Conclusion: More research is needed. A comprehensive study with multiple mask (and FFR) models would increase the likelihood of selecting the appropriate model(s) for UV-C sterilization, clearly explaining why the other models should not use it. Another potential avenue for future research is evaluating the physio–chemical changes masks and FFRs might pass when reprocessed by UV-C, such as the levels of chemical by-products. Finally, UV-LEDs might be useful because they are adjustable into different shapes than the longitudinal bulbs.
Gnatta, J. R., et al. (June 2021). Safety in the practice of decontaminating filtering facepiece respirators: A systematic review. *American Journal of Infection Control, 49* (6), 825-835.	• Background: Considering the new SARS-CoV-2 pandemic and the potential scarcity of material resources, the re-use of PPE such as FFRs for N95 filtering or higher is being discussed, mainly regarding the effectiveness and safety of cleaning, disinfection and sterilization processes. • Aim: To analyze the available evidence in the literature on the safety in processing FFRs. • Results: Forty studies were included in this review. The disinfectant/sterilizing agents most frequently tested at different concentrations and exposure periods were UVGI, vaporized hydrogen peroxide and steam sterilization. Microbial reduction was assessed in 21 (52.5%) studies. The only disinfectants/sterilizers that did not caused degradation of the material-integrity were

[i] Shadowing happens when parts of the masks or FFRs are poorly irradiated or not irradiated at all. Such a concern is a priority, especially when the object possesses inner-layers where microorganisms can remain (Nicolau, et al., 2021).

Source	Reprocessing/Reusing N95 Respirators
	alcohol, electric cooker, ethylene oxide, and peracetic acid fogging. Exposure to UVGI or microwave-generated steam resulted in a nonsignificant reduction in filter performance. • Conclusion: There is a complex relationship between the FFR raw materials and the cycle conditions of the decontamination methods, evidencing the need for validating FFRs by models and manufacturers, as well as the process. Some methods may require additional tests to demonstrate the safety of FFRs for use due to toxicity.

Table 3: Experiences in Other Countries for Uses of KN95 Masks in Hospitals Compared to N95 Masks, and Approaches to Improving Fit and Performance of KN95 Masks[29]

Country	Summary of experiences

Australia	• The Australian Department of Health recommended on 9 December 2021 that respirators including the P2, N95, KN95, and FFP2 need to be tested for particulate filtration to ensure that they filter out a minimum of 94% or 95% solid and liquid aerosols that do not contain oil
	  ○ They also need to be fit tested to ensure proper facial seal to the wearer
	  ○ Fit checks must be completed by a wearer every time they put on a respirator, ensuring that the respirator is sealed over the bridge of the nose and mouth and that there are no gaps between the respirator and face
	• The Infection Control Expert Group recommended in September 2020 that particulate filter respirators (PFRs) such as the P2 (most common in Australia), N95 or equivalent should be used when caring for patients with suspected, probable, or confirmed COVID-19
	  ○ Single-use PFRs should be discarded as soon as they are removed, and not stored or decontaminated for re-use
	  ○ PFRs can be used for a single session of care lasting up to four hours
	  ○ Users should be instructed in the correct method of fitting, removing, and fit-checking PFRs, as training can improve facial seal achieved
	• Queensland Health recommends that fit checking be done each time a PFR is put on as follows: perform hand hygiene, select correctly fitting PFR, slightly bend nosepiece to form gentle curve, separate headbands and position PFR under chin with nosepiece up, pull headbands over the head ensuring top strap is at back of head and bottom is below ears, use fingertips to mold nosepiece to ensure good facial fit, complete a positive seal check by exhaling sharply (positive pressure inside PFR = no leakage), and complete a negative seal check by inhaling deeply (negative pressure = no leakage, which will make the PFR cling to face)
	  ○ Additional instructions include: avoid touching the PFR while it is being worn, reapply the PFR after it is removed or leave the PFR dangling around the neck, change the PFR when it becomes moist, wash hands after touching the PFR, leave the patient room before removing the PFR, and dispose of the used PFR in a closed receptacle
	• In September 2020, Australia's Department of Health and Human Services (DHHS) withdrew KN95 masks from supply pending results of a review by the Therapeutic Goods Administration to ensure that they met standards for COVID-19 prevention
	  ○ Any service providers that used KN95 masks were advised to remove them from use and supply
	  ○ Only P2 or N95 masks comply with Australian standards
	  ○ P2/N95 masks were recommended for disability workers when providing direct contact care for a client with COVID-19 risk factors

South Africa	• The Department of Health of South Africa does not provide guidance or recommendations for KN95 masks • Although the South African Medical Association provides guidance on PPE for critical care providers during the COVID-19 pandemic that references the use of N95 respirators, there is no specific guidance on respirator usage and fit

United Kingdom	• The Health Protection Surveillance Centre recommends that FFP2 respirator masks and eye protection are worn by all health care workers when in contact with possible or confirmed COVID-19 cases and COVID-19 contacts
	  ○ FFP2 respirator masks are equivalent to N95 face masks
	  ○ If respirator masks are not fluid repellent, additional protection, such as a visor, is recommended in situations where there is a splash risk
	• The Health Protection Surveillance Centre recommends fit testing for all staff and prioritisation of health care workers who are most likely to be involved in performing aerosol generating procedures, and health care workers who are most likely to have the most prolonged exposure to COVID-19 in settings where aerosol generating procedures are performed when this is not possible
	• The Royal College of Physicians of Edinburg offers the following recommendations for PPE based on the RAG (Red, Amber, Green) rating of wards

	○ NHS hospitals are organized into green (non-COVID-19 area), amber (COVID-19 cases without aerosol generating procedures being performed) and red (COVID-19 cases with aerosol generating procedures being performed) wards, and PPE recommendations differ based on the rating of the wards ○ In green zones, surgical masks must be worn when within two metres of a patient or in isolation rooms, in amber zones, surgical masks must be worn at all times, and in red zones, FFP3 respirators must be worn at all times • In June 2020, the Health and Safety Executive (HSE) advised that KN95 masks should not be used unless assessments have been undertaken by HSE as the Market Surveillance Authority ○ It is unclear whether KN95 masks are being used in hospitals in the UK and which measures are being taken to improve their fit and performance
United States	• The CDC has authorized the use of KN95 masks as a suitable alternative to N95 masks for its response to COVID-19 and the new Omicron variant • According to the FDA, some N95 respirators are intended for use in a health care setting, specifically single-use, disposable respiratory protective devices used and worn by health care personnel during procedures to protect both the patient and health care personnel from the transfer of microorganisms, body fluids, and particulate material • On 2 March 2020, the FDA issued an Emergency Use Authorization (EUA) authorizing the use of certain NIOSH-approved respirator models in health care settings ○ NIOSH-approved alternatives to N95 respirators should be used where feasible, including other classes of filtering facepiece respirators, elastomeric half-mask and full facepiece air purifying respirators, and powered air purifying respirators (PAPRs) ○ Every other NIOSH-approved filtering facepiece respirator is at least as protective as the N95, including N99, N100, P95, P99, P100, R95, R99, and R100 (with or without an exhalation valve) ○ Findings from NIOSH research suggest that all NIOSH-approved filtering facepiece respirators with exhalation valves, even without covering the valve, perform the same or better than surgical masks, procedure masks, cloth masks, or fabric ○ The NIOSH Certified Equipment List identifies that the elastomeric respirators (equipped with a replaceable particulate filter) without exhalation valves or with filtered exhalation valves may be used in surgical settings ○ NIOSH maintains a searchable, online version of the certified equipment list identifying all NIOSH-approved respirators • The FDA recommends that if there is a risk that a worker may be exposed to splashes, sprays, or splatters of blood or body fluids, then a face shield or surgical facemask should be worn over the standard N95 respirator ○ Care should be taken not to compromise the fit of the respirator if a facemask is placed over the respirator • Other PAPRs approved by NIOSH should not be used in surgical settings due to concerns that the blower exhaust and exhaled air may contaminate the sterile field ○ PAPRs are reusable respirators that are battery-powered and when equipped with a high-efficiency (HE) filter, provide a higher level of protection than N95 respirators (they are 99.97% efficient against 0.3 micron particles) • On March 28, 2020, FDA issued an update to address NIOSH-Approved Air Purifying Respirators for Use in Health Care Settings During Response to the COVID-19 Public Health Emergency ○ The update indicated that facilities using elastomeric respirators and PAPRs should have up-to-date cleaning and disinfection procedures, which are an essential part of use for protection against infectious agents.

Table 4: Grey Literature and Jurisdictional Information on Mask Use and Re-Use During COVID-19

Jurisdiction / Source	Recommendations for Mask Use and Re-Use
Canada	
Public Health Agency of Canada (PHAC) Update with consideration of Omicron – Interim COVID-19 infection prevention and control in the health care setting when COVID-19 is suspected or confirmed (December 23, 2021)	• These PHAC recommendations apply to all health care settings (acute care, long term care, home care and ambulatory/outpatient care) including: ○ Full-shift Masking: Given ongoing community spread of COVID-19 within Canada and evidence that transmission occurs from those who have few or no symptoms, masking for the full duration of shifts or visits has become normal practice during the COVID-19 pandemic. The rationale for full-shift or visit masking of all staff and visitors is to reduce the risk of transmitting COVID-19 from staff or visitors to others, at a time when no symptoms of illness are recognized, but the virus can be transmitted. The mask also protects the wearer. ○ Medical Mask or Respirator: Depending on community transmission rates, the mask chosen can be a medical mask or a respirator. There is increasing evidence that the fit of the mask is the most important feature. Visitors should wear well-fitting medical masks or KN95 respirators (recognizing that there are many counterfeit KN95 respirators that may be difficult to verify at point of entry). ○ Respirator Use is Context-Specific: Health care workers (HCW) can choose to wear a respirator at any time taking into account such factors as the community incidence of SARS-CoV-2, patient's ability to tolerate a mask, patient behaviours such as shouting or heavy breathing, requirement of extensive or prolonged close proximity, and other factors. • **Employers Must Ensure that**: Every HCW has access to a respirator, so that they can put it on quickly if the need is identified during the point of care risk assessment (PCRA).[j] No HCW should be denied a respirator at any time.
Public Health Ontario (PHO) Interim IPAC Recommendations for the Use of Personal Protective Equipment for Care of Individuals with Suspect or Confirmed COVID-19 (December 15, 2021)	• Key findings from this PHO technical brief related to mask use for hospital staff include: ○ The selection and use of appropriate PPE in the health care setting is important given the risk associated with health care interactions. The body of existing evidence comparing N95 respirators (or equivalent) to surgical/procedural (medical) masks has substantial limitations related to high risk of bias and unmeasured confounding. This evidence does not currently support a significant protective effect of N95 respirator use over medical masks when caring for patients with suspect or confirmed COVID-19 based on studies conducted prior to the emergence of the Omicron (B.1.1.529) variant. ○ There are early estimates of significant increased transmissibility and decreased vaccine effectiveness with the Omicron (B.1.1.529) variant. It is unclear currently if there is a change in the infectiousness of aerosols as a possible explanation for this increase in transmissibility. Considering this, all layers of protection in health care settings should be optimized to prevent transmission until more information is available. ○ Given the undetermined impact of the Omicron) variant, the interim recommended PPE when providing direct care for patients with suspect or confirmed COVID-19 includes a fit-tested, seal-checked N95 respirator (or equivalent or greater protection), eye protection, gown, and gloves. Other appropriate PPE includes a well-fitted surgical/procedure (medical) mask, or non-fit tested respirator, eye protection, gown and gloves for direct care of patients with suspect or confirmed COVID-19. ○ Fit tested N95 respirators (or equivalent or greater protection) should be used when AGMPs are performed or anticipated to be

j Recommended PPE for all patient encounters should be based on a point of care risk assessment (PCRA), which should consider: 1) community epidemiology of COVID-19 ventilation assessed by the organization as adequate; 2) crowding and occupancy of spaces; 3) patient not yet clinically evaluated (e.g., emergency areas); 4) likelihood of exposure to SARS-CoV-2 and other pathogens (i.e., based on specific interaction, specific task, specific patient, specific environment, and available conditions) (PHAC, 2021).

Jurisdiction / Source	Recommendations for Mask Use and Re-Use
	performed on patients with suspect or confirmed COVID-19. ○ These recommendations are interim and will be re-evaluated as more information on the Omicron variant emerges. • Information identified about the approaches of other jurisdictions include: ○ For standard care of patients with suspect or confirmed COVID-19, WHO, Alberta, BC, PHAC and multiple UK jurisdictions recommend surgical/procedure (medical) masks. CDC preferentially recommends the use of N95 respirators, with medical masks as an alternative minimum standard. ○ In all jurisdictions (CDC, WHO, Alberta, BC, PHAC, UK), an N95 respirator (or equivalent or greater protection) is recommended when aerosol generating procedures are being performed.
United States	
Centers for Disease Control and Prevention (CDC) Strategies for Optimizing the Supply of N95 Respirators (September 16, 2021)	• **Purpose**: This document offers a series of strategies or options to optimize supplies of disposable N95 filtering facepiece respirators (commonly called "N95 respirators") in health care settings when there is limited supply. • **Hierarchy of Controls:** Controlling exposures to occupational hazards is a fundamental way to protect personnel. Conventionally, a hierarchy has been used to achieve feasible and effective controls. Multiple control strategies can be implemented concurrently or sequentially. This hierarchy in the order of most to least effective can be represented as follows: 1) Elimination; 2) Substitution; 3) Engineering controls; 4) Administrative controls; and 5) PPE. • **Surge capacity** refers to the ability to manage a sudden increase in patient volume that would severely challenge or exceed the present capacity of a facility. While there are no commonly accepted measurements or triggers to distinguish surge capacity from daily patient care capacity, surge capacity is a useful framework to approach a decreased supply of N95 respirators during the COVID-19 response. To help health care facilities plan and optimize the use of respiratory protection in response to COVID-19, CDC has developed a PPE Burn Rate Calculator. CDC's optimization strategies for N95 respirator supply offer a continuum of options for use when PPE supplies are stressed, running low, or exhausted. Contingency and then crisis capacity measures augment conventional capacity measures and are meant to be considered and **implemented sequentially**. Once N95 respirator availability returns to normal, health care facilities should promptly resume conventional practices. ○ Use of N95 respirators beyond the manufacturer-designated shelf life for training and fit testing: In times of anticipated shortage, consideration can be made to use N95 respirators beyond the manufacturer-designated shelf life. However, expired respirators might not perform to the requirements for which they were certified. Over time, components such as the strap and material may degrade, which can affect the quality of the fit and seal. Because of this, use of expired respirators could be prioritized for situations where HCW are not exposed to pathogens, such as training, fit testing, and source control. As expired respirators can still serve an important purpose, health care facilities should retain and reserve all N95 respirators during the pandemic. ○ Extended use of N95 respirators as respiratory protection: The decision to implement policies that permit extended use of N95 respirators should be made by the professionals who manage the institution's respiratory protection program, in consultation with their occupational health and infection control departments with input from the state/local public health departments. Beyond anticipated shortages, increased feasibility and practicality may also be considered in decisions to implement extended use for HCW who are sequentially caring for a large volume of patients with suspected or confirmed SARS-CoV-2, including those cohorted in a SARS-CoV-2 unit, those placed in quarantine, and residents on units impacted during a SARS-CoV-2 outbreak. ▪ Extended use refers to the practice of wearing the same N95 respirator for repeated close contact encounters with several different patients, without removing the respirator between patient encounters. Extended use is well suited to situations wherein multiple patients with the same infectious disease diagnosis, whose care requires use of a respirator, are cohorted (e.g., housed

Jurisdiction / Source	Recommendations for Mask Use and Re-Use
	on the same hospital unit such as a COVID-19 unit). It can also be considered for care of patients with tuberculosis, varicella, measles, and other infectious diseases where use of an N95 respirator or higher respirator is recommended. ▪ When practicing extended use of N95 respirators over the course of a shift, considerations should include: 1) the ability of the N95 respirator to retain its fit; 2) contamination concerns; 3) practical considerations (e.g., meal breaks); and 4) comfort of the user. N95 respirators should be discarded immediately after being removed. If removed for a meal break, the respirator should be discarded, and a new respirator put on after the break. N95 respirators should be discarded when contaminated with blood, respiratory or nasal secretions, or other bodily fluids from patients. HCW can consider using a face shield or surgical facemask over the respirator to reduce contamination of the respirator, especially during aerosol generating procedures or procedures that might generate splashes and sprays. It is not known how facemasks placed over the respirator can affect the fit so caution should be used. ○ Use of respirators beyond the manufacturer-designated shelf life for health care delivery: Consideration can be made to use N95 respirators beyond the manufacturer-designated shelf life for care of patients with diseases for which a respirator is recommended during their care (e.g., COVID-19, tuberculosis, measles, and varicella). Many models found in US stockpiles and stockpiles of health care facilities have been found to continue to perform in accordance with NIOSH performance standards. However, fluid resistance and flammability were not assessed. Use of the N95 respirators recommended in NIOSH's Beyond Shelf Life/Stockpiled Assessment Results can be considered. It is optimal to use these respirators in the context of a respiratory protection program that includes medical evaluation, training, and fit testing. If used in health care delivery, it is particularly important that HCW perform the expected seal check, prior to entering a patient care area. CDC does not recommend using N95s beyond the manufacturer-designated shelf life in surgical settings. On March 2, 2020, FDA issued an Emergency Use Authorization (EUA) authorizing the use of certain NIOSH-approved respirator models in health care settings. The EUA was reissued on July 12, 2021. Due to the increased availability of NIOSH-approved respirators, the FDA removed filtering facepiece respirators that were NIOSH-approved but have since passed the manufacturers' recommended shelf life. ○ Limited re-use of N95 respirators: Re-use refers to the practice of using the same N95 respirator by one HCW for multiple encounters with different patients but removing it (i.e., doffing) after each encounter. This practice is often referred to as "limited re-use" because restrictions are in place to limit the number of times the same respirator is re-used. Limited re-use of N95 respirators when caring for patients with SARS-CoV-2 infection might become necessary. However, it is unknown what the potential contribution of contact transmission is for SARS-CoV-2, and caution should be used. ▪ It is important to consult with the respirator manufacturer regarding the maximum number of donnings or uses they recommend for the N95 respirator model. If no manufacturer guidance is available, data suggest limiting the number of re-uses to no more than five total uses (five total donnings) per device by the same HCW to ensure an adequate respirator performance. • Example scenario: An HCW wears a respirator to care for a patient, removes it after exiting the room, and then later returns to care for the patient and puts the same respirator on again. This would count as two uses or donnings. HCW should always inspect the respirator and perform a seal check upon donning a re-used respirator. N95 and other disposable respirators should not be shared by multiple HCW. ▪ During times of crisis, practicing limited re-use while also implementing extended use can be considered. If limited re-use is practiced on top of extended use, caution should be used to minimize self-contamination and degradation of the respirator. If no manufacturer guidance is available, a reasonable limitation should continue to be five total donnings regardless of the number of hours the respirator is worn.

Jurisdiction / Source	Recommendations for Mask Use and Re-Use
	• Example scenario: An HCW wears a respirator during the first 3 hours of his or her shift, removes the respirator to eat lunch, and puts it back on after lunch. This would count as two uses or donnings. ▪ Respirators soiled or grossly contaminated with blood, respiratory or nasal secretions, or other bodily fluids from patients should be discarded. HCW can consider using a face shield over the respirator to reduce/prevent contamination of the N95 respirator, especially during aerosol generating procedures or procedures anticipated to generate splashes and sprays. It is important to perform hand hygiene before and after the previously worn N95 respirator is donned or adjusted. ▪ The surfaces of a properly donned and functioning NIOSH-approved N95 respirator will become contaminated with pathogens while filtering the inhalation air of the wearer during exposures to pathogen laden aerosols. The pathogens on the filter materials of the respirator may be transferred to the wearer upon contact with the respirator during activities such as adjusting the respirator, improper doffing of the respirator, or when performing a user-seal check when redonning a previously worn respirator. One potentially effective strategy to mitigate the contact transfer of pathogens from the respirator to the wearer could be to issue each HCW who may be exposed to patients with SARS-CoV-2 infection a minimum of five respirators. Each respirator will be used on a particular day and stored in a breathable paper bag until the next week. This will result in each worker requiring a minimum of five N95 respirators if they put on, take off, care for them, and store them properly each day. This amount of time in between uses should exceed the 72-hour expected survival time for SARS-CoV-2 (the virus that causes COVID-19). If this strategy is used, the total number of donnings should still not exceed five times before discarding the respirator, when no manufacturer instructions are provided to indicate otherwise. ▪ Decontamination or bioburden reduction of NIOSH-approved N95 respirators is no longer a strategy to conserve supplies as the availability to NIOSH-approved respirators has significantly increased. In July 2021, the FDA removed the EUA of decontaminated respirators from the scope of authorization. ○ Prioritize the use of N95 respirators and well-fitting facemasks by activity type: Source control (i.e., masking of patients) and maintaining physical distance from the patient are particularly important to reduce the risk of transmission. This prioritization approach to conservation is intended to be used when N95 respirators are so limited that routinely practiced standards of care for all HCW wearing N95 respirators when caring for a patient with SARS-CoV-2 infection are no longer possible. N95 respirators beyond their manufacturer-designated shelf life, when available, are preferable to use of well-fitting facemasks. The use of N95s or elastomeric respirators or powered air purifying respirators (PAPRs) should be prioritized for HCW with the highest potential exposures including being present in the room during aerosol generating procedures performed on persons with SARS-CoV-2 infection. ▪ When facemasks must be used by HCW entering a patient care area, improving the fit of a facemask can reduce exposure to infectious particles. Options to improve the fit of a facemask are discussed in Improve How Your Mask Protects You, and include, but are not limited to selection of a facemask with ties rather than ear loops, use of a mask fitter, tying the facemask's ear loops and tucking in the side pleats, fastening the facemask's ear loops behind the wearer's head, and using a cloth layer over the facemask to help it conform to the wearer's face. Use of facemasks to care for a patient with suspected or confirmed SARS-CoV-2 infection should only be used as a last resort if respirators are severely limited.

Jurisdiction / Source	Recommendations for Mask Use and Re-Use
International	
United Kingdom (UK) Department of Health and Social Care (DHSC) Guidance: Infection Prevention and Control for Seasonal Respiratory Infections in Health and Care Settings (including SARS-CoV-2) for Winter 2021 to 2022 (December 21, 2021)	• This updated guidance recommends universal use of face masks for staff and face masks/coverings for all patients/visitors to remain as an infection and prevention control (IPAC) measure within health and care settings over the winter period. This is likely to be until at least March/April 2022.[30] ○ Universal masking with face coverings or surgical masks (Type II or IIR)[k] to prevent the transmission of SARS-CoV-2 and other respiratory infectious agents in health and care settings, as a source control measure, should continue to be applied for all staff, patients and visitors. Surgical masks must: ▪ be well fitted covering both nose and mouth; ▪ not be allowed to dangle around the neck at any time; ▪ not be touched once put on; ▪ be changed when they become moist or damaged; and ▪ be worn once and then discarded in line with country-specific guidance or policy (hand hygiene must always be performed after disposal). ○ Respirator: A respirator with an assigned protection factor (APF) 20, that is, an FFP3 respirator (or equivalent), must be worn by staff when: ▪ caring for patients with a suspected or confirmed infection spread wholly by the airborne route, such as tuberculosis (TB) (during the infectious period) ▪ when performing AGPs on a patient with a suspected or confirmed infection spread wholly or partly by the droplet or airborne route ▪ Where an unacceptable risk of transmission remains following the hierarchy of controls risk assessment, it may be necessary to consider the use of respiratory protective equipment (RPE) for patient care in specific situations when managing respiratory infectious agents. The risk assessment should include evaluation of the ventilation in the area, operational capacity, and prevalence of infection/new SARS-CoV-2 variants of concern in the local area.[l] ▪ Respirators can be single use or sessional use (disposable or reusable). ▪ All tight fitting RPE, that is, FFP3 respirators must: • be fluid-resistant • be fit tested on all health and care staff who may be required to wear a respirator to ensure an adequate seal/fit according to the manufacturer's guidance[m] • be fit checked (according to the manufacturer's guidance) every time a respirator is donned to ensure an adequate seal has been achieved • be compatible with other facial protection used (protective eyewear) so that this does not interfere with the seal of the respiratory protection • be disposed of and replaced if breathing becomes difficult, the respirator is damaged or distorted, the respirator becomes obviously contaminated by respiratory secretions or other body fluids, or if a proper face fit cannot be maintained • not be touched once put on, if adjustments are needed ensure hand hygiene is undertaken • be removed outside the patient's room or cohort area • In the absence of an anteroom/lobby, remove RPE and eye protection in a safe area (e.g., outside the isolation/cohort room/area). All other PPE should be removed in the patient care area. Perform hand hygiene after removing and disposing of RPE.

Jurisdiction / Source	Recommendations for Mask Use and Re-Use
World Health Organization (WHO) WHO Recommendations on Mask Use by Health Workers, in Light of the Omicron Variant of Concern (December 22, 2021)	• A respirator (FFP2, FFP3, NIOSH-approved N95, or equivalent or higher-level certified respirator) or a medical mask should be worn by health workers along with other personal protective equipment (PPE) – a gown, gloves and eye protection – before entering a room where there is a patient with suspected or confirmed COVID-19. Respirators should be worn in the following situations: in care settings where ventilation is known to be poor[n] or cannot be assessed or the ventilation system is not properly maintained based on health workers' values and preferences and on their perception of what offers the highest protection possible to prevent SARS-CoV-2 infection.[31] • A respirator should always be worn along with other PPE (see above) by health workers performing aerosol-generating procedures (AGPs)(2) and by health workers on duty in settings where AGPs are regularly performed on patients with suspected or confirmed COVID-19, such as intensive care units, semi-intensive care units or emergency departments. • Appropriate mask fitting should always be ensured (for respirators through initial fit testing and seal check and for medical masks through methods to reduce air leakage around the mask) as should compliance with appropriate use of PPE and other precautions.
WHO Coronavirus Disease (COVID-19): Masks (Q&A) January 5, 2022	• Health workers are the most likely to be exposed to COVID-19 because they are in close contact with patients with suspected, probable, or confirmed COVID-19. In areas of community or cluster transmission, health workers, caregivers and visitors should always wear a mask when in the health facility, even if physical distancing can be maintained. Masks should be worn throughout their shifts, apart from when eating, drinking or needing to change the mask for specific reasons.[32] ○ Health workers and caregivers include doctors, nurses, midwives, medical attendants, cleaners, community health workers, and any others working in clinical areas. ▪ Health workers must remember to combine hand hygiene with any time they touch their mask or face, before and after putting on and removing their masks, as well as before they touch them to readjust them. ▪ In settings where there is community or cluster transmission of SARS-CoV-2, health workers in clinical areas should wear medical masks throughout their shift apart from when eating, drinking or needing to change the mask for specific reasons. • Health workers should continue to physically distance and avoid unnecessary close contact with colleagues and others in the facility when not providing patient care.

[k] Whereas a type II medical face mask has no splash protection, a type IIR medical face mask has high splash protection (Ansell.com, 2022).

[l] According to the DHSC, personal protective equipment (PPE) is the least effective measure of the hierarchy of controls. PPE should be considered in addition to all previous mitigation measures in the hierarchy of controls, however it is acknowledged that not all elements will be possible in some settings (e.g., a patient's home). PPE considerations include: 1) adequate supply and availability of PPE including RPE to protect staff, patients, and visitors; 2) all staff required to wear an FFP3 mask have been fit tested (this is a legal requirement); 3) face masks/coverings should be worn by staff and patients in all health and care facilities; 4) all staff (clinical and non-clinical) are trained in putting on removing and disposing of PPE; 5) visual reminders are displayed communicating the importance of wearing face masks, compliance with hand hygiene and maintaining physical distancing; and 6) PPE must be worn when exposure to blood and/or other body fluids, non-intact skin or mucous membranes is anticipated in line with standard IPAC and transmission-based precautions (DHSC, 2021).

[m] Where fit testing fails, suitable alternative equipment must be provided. Reusable respirators can be used by individuals if they comply with Health and Safety Executive (HSE) recommendations and should be decontaminated and maintained according to the manufacturer's instructions, this may be country specific (DHSC, 2021).

[n] WHO guidance for adequate ventilation: "In health facilities where a mechanical ventilation system is available, the ventilation rate should be 6-12 air changes per hour (e.g., equivalent to 40-80 L/s/patient for a 4x2x3 m3 room), and ideally 12 air changes per hour for new constructions, with a recommended negative pressure differential of ≥2.5Pa (0.01-inch water gauge) to ensure that air flows from the corridor into patient rooms" (WHO, 2021).

Table 5: Ontario Health: Summary of Reprocessing Methods for N95 Respirators (April 2020)[33]

Method	Recommendation	Main Reason for Recommendation
Ultraviolet germicidal radiation (UVGI)	Recommend	• Direct laboratory evidence of effect on COVID-19 virus • Favourable filter and fit performance
Hydrogen peroxide vapour (HPV)	Recommend	• Direct laboratory evidence of effect on COVID-19 virus • Favourable filter and fit performance for respirators that do not contain cellulose
Heat (dry or moist) Includes: • Steam • Microwave steam bags • Moist heat incubation • Dry heat	Alternative to consider	• Potential physical deformation (particularly for autoclave disinfection due to elevated pressure) • Any respirator decontaminated by heat (dry or moist) must be assessed for physical damage before re-use
Linear accelerator (gamma ray)	Recommend against	• Unfavourable filtration performance and odour residue
Microwave irradiation	Recommend against	• Physical deformation
Chemical submersion Includes: • Hydrogen peroxide • Bleach (sodium hypochlorite) • Mixed oxidants • Dimethyl dioxirane (DMDO) • Ionized hydrogen peroxide	Recommend against	• Leaves detectable chemical residue, information on disinfection effectiveness or physical degradation is unknown
Ethylene oxide gas	Recommend against	• Hazardous by-products left on respirators after reprocessing
Chemical wipes Includes: • Hypochlorite wipes (bleach) • Benzalkonium chloride • Inert wipes	Recommend against	• Very limited evidence shows varying degrees of disinfection on mask components (e.g., elastic straps) for the different options
Chlorine dioxide gas	Cannot make a recommendation	• Only unpublished evidence available (from manufacturer) claims effective disinfection and no degradation after 10–12 cycles
Ozone gas	Cannot make a recommendation	• No evidence available on effectiveness or safety
Hydrogen peroxide gas plasma (HPGP)	Cannot make a recommendation	• No evidence available on effectiveness

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