Ontario Health

Optimizing the Supply of Personal Protective Equipment During the COVID-19 Pandemic

Recommendations from Ontario Health

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Version History

Release Date	Source	Change(s)
April 11, 2020	COVID-19 Response: Personal Protective Equipment (PPE) Committee	• Initial release
May 10, 2020	COVID-19 Response: Personal Protective Equipment (PPE) Committee	• Additional information included about isolation gowns • Clarified the recommendation for extended use and limited reuse of PPE, including N95 respirators, after aerosol-generating medical procedures (AGMPs) • Clarified the need for individual tracking of N95 respirators and/or universal pooled supply when reprocessing • Removed the recommendation to collect and store surgical/procedural masks for future reprocessing • Updated guidance information for reprocessing N95 respirators from Health Canada and implementation considerations from the Toronto Region COVID-19 Hospital Operations Table • Updated glossary of terms, adding information to definitions for gowns and masks • Updated the summary table (in the appendices) to reflect changes from the body of the document • Updated reference list
August 11, 2020	COVID-19 Response: Personal Protective Equipment (PPE) Committee	• Added reference to Directive #5 • Added information about respirators with exhalation valves • Updated information on expired PPE • Added a link to Health Canada notice for KN95 respirators • Updated section on expired N95 respirators and limited reuse of N95 respirators • Updated section on decontaminating N95 respirators and linked to Health Canada • Additional information provided on reprocessing eye protection • Updated reference list
September 22, 2020	COVID-19 Response: Personal Protective Equipment (PPE) Committee	• Edited information on reusable PPE options (elastomeric respirators) and other sources of PPE with exhalation valves
December 21, 2020	COVID-19 Response: Personal Protective Equipment (PPE) Committee	• Added definition for “health care worker” • Created “Background” section. Added content on mode of virus transmission and universal masking for source control into background section

		• Removed the recommendation about the use of 3D printed face shields • Added detail to reusable PPE options section for elastomeric respirators and powered air purifying respirators • Added detail on extended use for gowns • Updated recommendations for N95 reprocessing to reflect current provincial approach • Updated the reference list and the links embedded in the document

Optimizing the Supply of Personal Protective Equipment (PPE) During the COVID-19 Pandemic

This document was developed by the *COVID-19 Response: Personal Protective Equipment Committee*, a committee convened to respond to urgent issues surrounding personal protective equipment during the novel coronavirus disease (COVID-19) pandemic. Chaired by Dr. Chris Simpson, the committee includes expertise from health system leaders in infection prevention and control (IPAC), infectious diseases, occupational health and safety, primary care, long-term care, home and community care, acute care, emergency medicine, and engineering. See Appendix A for the full list of committee members.

The recommendations provided in this document ensure the responsible stewardship of personal protective equipment (PPE) and contingency and crisis planning for any anticipated surge in COVID-19 cases when supplies may be running low or are depleted. The recommendations in this document will support health care organizations and health care workers to make evidence-based decisions for optimizing their supply of PPE and ensure the safety and protection of health care workers.

Included are recommendations for the following strategies to optimize the supply of PPE during the COVID-19 pandemic:

1. **Recommendations for procuring PPE**
    - Reusable PPE options
    - Other sources of certified PPE
2. **Recommendations for the extended use of PPE**
3. **Recommendations for the use of expired PPE**
4. **Recommendations for the limited reuse of PPE**
5. **Information for use of non-NIOSH certified PPE**
6. **Recommendations for decontamination of PPE using validated sterilization and disinfection methods**
7. **Recommendations for alternative innovation products**

The following definitions apply in this document:

- *Personal protective equipment (PPE)* refers to respirators, surgical/procedure masks, isolation gowns, gloves, and eye protection (goggles and face shields)
- *Health care worker* refers to both regulated and unregulated workers

See Appendix B[1,2] for a glossary of terms. See Appendix C for a summary table of ways to conserve existing supplies of PPE.

This document is a living document and includes recommendations supported by current available evidence. As this topic area and evidence evolves, the committee will continue to evaluate innovations in a timely way and update this document accordingly. For a supplemental information, see Appendices D to H.

Background

This document provides evidence-based recommendations for optimizing the supply of PPE to ensure that the health and safety of staff working in all health care settings is maintained—even during contingency and crisis situations. The Chief Medical Officer of Health issued Directive #5[3] for all public hospitals and long-term care homes, which outlines precautions and procedures for safe use, conservation, and stewardship of PPE when caring for patients with COVID-19 (suspected or confirmed). However, before we introduce our recommendations for optimizing PPE, it is important to consider a holistic approach to preventing transmission, including mode of transmission, administrative planning and decision-making, infection prevention and control, and best practices for PPE use in all health care settings (including hospitals, primary care, outpatient and ambulatory care, assessment centres, long-term care homes, retirement homes, home and community care).

COVID-19: Modes of Transmission

The committee has reviewed the evidence, the epidemiology of the disease, and their shared clinical experience, and agree with the prevailing guidance that the droplet and contact routes are the predominant modes of transmission, but that transmission via airborne aerosols is a possibility in certain circumstances.[4] The risk of significant airborne transmission increases in settings with small, enclosed spaces with inadequate ventilation.

Considerations for Organizational Planning

Personal protective equipment is the last line of defense.[3,5] Many administrative and engineering decisions must be made considered beforehand, including the appropriate use of telemedicine, the use of physical barriers, restricting visitors, and cohorting patients with COVID-19.[5-8] A hierarchy of controls needs to be incorporated into decision-making (see Directive #5). In addition, health care organizations must comply with the *Occupational Health and Safety Act, 1990*, and with the Health Care and Residential Facilities Regulation under the act. Their responsibilities include establishing policies, procedures, measures, and training for the protection of workers in consultation with their Joint Health and Safety Committee or Health and Safety representative. Health care workers must be instructed and trained in the care, use, and limitations of PPE before wearing or using it for the first time and at regular intervals thereafter. Public Health Ontario has provided further information on routine practices applicable to all health care settings.[2]

Personal Protective Equipment Use and Stewardship

When caring for all patients:

- Appropriate PPE selection is supported by a point of care risk assessment (PCRA), clinical and professional judgement, and evidence-based recommendations[2,3,9]
- Health care workers should follow hand hygiene best practices for every encounter with a patient, client, or resident[2]
- Universal masking (masks worn by everyone at all times) in health care settings is indicated as a means of source control (masks worn to protect others).[10] This applies to health care workers, patients/residents (if possible), caregivers, visitors, and other staff in any health care setting (e.g. inpatient facilities, home and community care settings).[11-14] This also applies to any individual accompanying patients/residents for their care (e.g., an inpatient walking down the hall for a test, family member assisting with care during a home and community care visit). Wearing a mask is not a substitute for physical distancing, hand washing, or other infection prevention and control measures[10]

When caring for patients/residents with suspected or confirmed COVID-19:

- Droplet/contact precautions (surgical/procedure mask, isolation gown, gloves, and eye protection) are used for all interactions[3,5,9]
- In addition to droplet/contact precautions, airborne precautions (N95 respirator, isolation gown, gloves, and eye protection) are used when aerosol-generating medical procedures (AGMPs) are planned or anticipated for patients with suspected or confirmed COVID-19[3,5,9]

Recommendations for Health Care Organizations

In conjunction with obligations outlined in Directive #5 and other requirements to ensure the health and safety of workers and patients, consider the following recommendations to ensure the responsible stewardship of personal protective equipment (PPE) and contingency and crisis planning for any anticipated surge in COVID-19 cases (during which supplies may run low or become depleted). A brief overview of the key recommendations is presented below. Please review the respective sections in this document for more information.

- **To help extend the supply of PPE, switch to reusable PPE options wherever they can be safely implemented:**
    - We support efforts to initiate acquisition of reusable PPE options (including reusable isolation gowns) as a sustainable contingency approach
    - When the supply of disposable N95 respirators is low, consider the use of elastomeric respirators or powered air purifying respirators (PAPRs). PAPRs are used in certain situations where staff will be wearing PPE for prolonged periods of time and where appropriate training can be provided and maintenance protocols can be put in place
    - Collaborate with your organization's occupational health and safety, IPAC, and infectious disease specialists to develop appropriate protocols for the use of reusable PPE options. Organizations without these key specialist groups should consider consulting with experts from their region
    - Establish procedures for fit-testing (where required) and cleaning/disinfecting, and provide education and training resources for health care workers on safe use of reusable PPE options

- **Consider using certified PPE from other medical and non-medical settings when regular supply is low or depleted:** Consider obtaining and using certified PPE products from other sources, including medical settings that no longer need them, and commercial, non-medical settings (e.g., industry-related settings). This includes disposable and reusable N95 respirators and other types of U.S. National Institute of Occupational Safety and Health (NIOSH) certifications that provide protection from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), including the following: N99, N100, R95, R99, R100, P95, P99, P100

- **Extend the use of existing PPE:** Ensure that health care workers caring for cohorted patients with suspected or confirmed COVID-19 are following extended-use recommendations as appropriate for their setting

- **Use of expired products:** Take stock of, and inspect, any expired N95 respirators (disposable)[15] and any other expired PPE
    - Expired N95 respirators (disposable) and other PPE items that have been stored in accordance with manufacturers' storage conditions require inspection and testing to ensure they are not damaged, and may be considered for use when regular supplies are low or depleted

- **Limited reuse:** Ensure that health care workers are following limited-reuse recommendations as appropriate for their setting

- **Take caution when using non-NIOSH certified PPE:** Verify the authenticity and fit test of any PPE products that may not meet NIOSH certification
- **The provincial planning for reprocessing N95 respirators is paused at this time.** Hospitals can now safely dispose of the used N95 respirators that they have collected and discontinue collecting used N95 respirators moving forward

- **If a validated process for reprocessing PPE is feasible at your health care organization**, move forward with developing an implementation plan following Health Canada and the reprocessing device manufacturer's requirements

- **3D-printed face masks/respirators and fabric/cloth masks**: 3D-printed face masks/respirators and fabric/cloth masks are NOT recommended as an alternate source of PPE for use by health care workers

1. Recommendations for Procuring Personal Protective Equipment (PPE)

In the context of low or depleted supplies of PPE during a pandemic, and in an effort to maintain the long-term sustainability of PPE, shifting from disposable PPE to reusable PPE should be considered in your contingency plans to ensure the health and safety of workers and patients.

Recommendations for health care organizations

- To help extend the supply of PPE, switch to reusable PPE options wherever they can be safely implemented:
    - We support efforts to initiate acquisition of reusable PPE options (including reusable isolation gowns) as a sustainable contingency approach
    - When the supply of disposable N95 respirators is low, consider the use of elastomeric respirators or powered air purifying respirators (PAPRs). PAPRs are used in certain situations where staff will be wearing PPE for prolonged periods of time and where appropriate training can be provided and maintenance protocols can be put in place
    - Collaborate with your organization's occupational health and safety, IPAC, and infectious disease specialists to develop appropriate protocols for the use of reusable PPE options. Organizations without these key specialist groups should consider consulting with experts from their region
    - Establish procedures for fit-testing (where required) and cleaning/disinfecting, and provide education and training resources for health care workers on safe use of reusable PPE options

- Consider the use of certified PPE from other medical and non-medical settings, when regular supply is low or depleted: Obtain and use certified PPE products from other medical settings that no longer need them and certified products from commercial, non-medical settings (e.g., industry-related settings). This includes disposable and reusable N95 respirators and other types of U.S. National Institute of Occupational Safety and Health (NIOSH) certifications that provide protection from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), including the following: N99, N100, R95, R99, R100, P95, P99, P100

1.1 Use Reusable PPE Options

As described in Table 1 (below), the following PPE are reusable: elastomeric respirators, reusable isolation gowns, reusable eye protection (goggles and face shields), and PAPRs.

Reusable refers to the ability for a product to be used repeatedly, with validated methods for cleaning and/or disinfection between uses.

Table 1. Types of PPE with reusable options

Type of PPE	Description
N95 respirator equivalent: **reusable elastomeric respirators (half-mask and full facepiece)**	• Consider using NIOSH-approved, reusable elastomeric respirators when the supply of disposable N95 respirators is low. If fit-tested and properly cleaned and disinfected between uses, reusable elastomeric respirators (half-mask or full facepiece) are as effective as disposable N95 respirators • If the elastomeric respirator has an exhalation valve, consider covering the respirator's exhalation valve for source control. To cover the exhalation valve, consider using a surgical/procedure mask or a cloth mask that does not interfere with the fit of the respirator.[16-19] Elastomeric respirators with exhalation valves should not be used when a sterile field is required • Reusable elastomeric respirators differ from disposable N95 respirators in that some users may experience issues with comfort/bulkiness, and interference with communication, and some people may feel claustrophobia or anxiety • Use of this type of reusable respirator needs the support from local administrative/occupational health and safety teams to ensure fit-testing and to support standardized cleaning protocols and a standardized filter changing schedule. If an employee presents with their own respirator, occupational health and safety units need to be engaged to support safe usage (e.g., declaration of its use, ensuring fit-testing, establishing a cleaning and disinfection protocol, training staff to inspect, don and doff the respirator and to perform a user seal check) • Refer to the manufacturer's instructions on cleaning and disinfection. Cleaning and disinfection are recommended after each use. The ideal way to disinfect these respirators (components include facepiece, valves and straps) is to submerge them in warm water and a compatible detergent (e.g., sodium hypochlorite solution, 70% isopropanol solution). However, the use of water and detergent may not be practical between patients. As an interim option, the exterior surface can be cleaned using organization-approved disinfectant wipes (alcohol, quaternary ammonia, hydrogen peroxide, or bleach).[20] Do not get the cartridges and filters wet

	• Pay special attention to the appropriate handling and reuse of potentially contaminated detachable filters. Some detachable filters have exposed fibres that present a self-contamination hazard; this type of filter is not recommended unless it can be safely discarded. Do not get the cartridges and filters wet. The attached filtering cartridges are replaceable and can be changed. Filters should be disposed of if they are damaged, soiled, or clogged *Sources of additional information: 3M Cleaning and Disinfecting Technical Bulletin,[21] 3M Replacement and Cleaning Training Video,[22] Standard Operating Procedure for Disinfection,[23] 3M Filtering Facepiece Respirators FAQ: Healthcare,[19] Health Canada List of Disinfectants for Use Against SARS-CoV-2,[24] CAN/CSA-Z94.4 Standards for Selection, Use, and Care of Respirators,[25] Lawrence et al, 2017.[26]*
Isolation gowns	• Switch to reusable isolation gown options, wherever possible: o Cloth isolation gowns o Reusable waterproof gowns • As a last resort, and if an organization's supply allows, reusable surgical gowns can be used
Eye protection	• Switch to reusable eye protection options, wherever possible: o Reusable goggles o Reusable face shields
N95 respirator equivalent: **powered air purifying respirators (PAPRs)**[27-30]	• Consider using PAPRs when the regular supply of disposable N95 respirators is low. NIOSH-approved powered air purifying respirators (PAPRs) provide equivalent protection to other established methods of protection for airborne hazards (note that PAPRs should not be considered a superior option to N95 respirators). PAPRs require careful doffing and complicated cleaning steps. Loose fitting hoods and helmets do not require fit-testing and can be worn with facial hair • PAPRs are a viable reusable option in specific circumstances, where: o They are used consistently by trained staff o They are used by staff who provide prolonged continuous care to patients, require airborne/droplet/contact isolation, and don and doff the PPE infrequently per shift (e.g., in the intensive care unit, paramedics during a lengthy transport, health care workers who cannot be successfully fitted for an N95 respirator) o Support from local administrative/occupational health and safety teams is needed to ensure: o A PAPR maintenance program is in place and includes staff trained in repairing or replacing components of the PAPR, cleaning and disinfection of the PAPR, and battery

	management procedures.[31,32] Refer to the manufacturer's instructions on cleaning and disinfection. Cleaning and disinfection of the PAPR includes the tubing and high-efficiency particulate air (HEPA) filters. Pay special attention to the appropriate handling of these parts. Contamination of the filtration unit worn with the PAPR hood is typically not a concern with airborne pathogens, but contamination can occur with droplet/contact transmitted pathogens. o Staff receive the appropriate training, including donning and doffing, charging and maintaining the batteries, and checking air flow rate[33] o There are strategies in place to mitigate the challenges associated with PAPR use. Challenges may include: o Risk of self-contamination. Using PAPRs primarily for droplet/contact precautions increases the possible risk of self-contamination upon removal (e.g., due to bulkiness of the hood, lack of validated procedures to attempt hood decontamination before removal, time-consuming manual decontamination), which is not a concern for the airborne pathogens for which the PAPR was created o Other considerations, such as restricted field of vision, interference with communication, or limited ability to use a stethoscope when wearing the PAPR • For these reasons, PAPRs are not generally recommended for the care of COVID-19 patients in settings where the above program requirements and challenges cannot be addressed *Sources of additional information: Appendix D, ANZICS COVID-19 Guidelines,[34] U.S. Food and Drug Administration,[35] Lawrence et al, 2017,[26] CAN/CSA-Z94.4 Standards for Selection, Use, and Care of Respirators.[25]*

1.2 Reclaim and Use Certified PPE from Other Sources

Health Canada, the regulator for medical devices in Canada, accepts the U.S. National Institute for Occupational Safety and Health (NIOSH) certification as an appropriate quality standard for N95 respirators used by health care workers. N95 respirators achieve a minimum filtration efficiency of 95% when worn properly. Health Canada states that equivalent alternate standards are also acceptable.[36] Here is the list of certified equipment according to the Centers for Disease Control and Prevention.

Table 2 describes the other sources for PPE items that meet NIOSH standards.

Table 2. Other sources for certified PPE

Recommendation	Description
Reclaim PPE from other medical settings	• Consider reclaiming medical-grade N95 respirators (disposable and reusable) and other PPE through solicited donations or buyback from other medical settings where they are not currently needed. For

	example, veterinarians, dentistry, universities, dermatology, ophthalmology, etc. *Source of additional information: Health Canada is calling for supplying goods and services in support of Canada's response to COVID-19.*
Use PPE from commercial, non-medical settings o This includes disposable and reusable N95 respirators, PAPRs, disposable surgical/procedure masks, eye protection, gowns, and gloves	• In circumstances where traditional N95 respirators and other medical PPE are not available, we recommend health care workers use commercial-grade non-medical N95 respirators and other PPE • These PPE items are marketed to the public for general, non-medical purposes, such as for use in construction and other industrial applications[37] • Consider the procurement of commercial-grade N95 respirators (disposable and reusable) and other PPE from non-medical settings where it is not currently needed (e.g., mining, construction, manufacturing, laboratories, farming, food safety, chemical, aircraft, and other industry-related settings where non-medical N95 or equivalent respirators are commonly used) • The nine types of certified particulate respirators that can be used by health care workers include the following: N95, N99, N100, R95, R99, R100, P95, P99, P100.[38] Respirators are rated "N" if they are not resistant to oil, "R" if they are somewhat resistant to oil, and "P" if they are oil-proof.[39,40] All of these NIOSH certifications[40] can protect health care workers. Consider covering the respirator's exhalation valve with a surgical/procedure mask when source control may be required (e.g., in a sterile field)[16,17] • Commercial-grade N95 respirators are not intended to provide liquid-barrier protection and are not tested for fluid resistance; however, fluid resistance is not needed for protection from respiratory droplets during the COVID-19 pandemic *Source of additional information: Health Canada.*[41] *Ontario Health's call for PPE: https://www.ontario.ca/page/how-your-organization-can-help-fight-coronavirus.*

2. Recommendations for the Extended Use of Personal Protective Equipment (PPE)

In the context of low or depleted supplies of PPE during a pandemic, the extended use of PPE should be considered in your contingency plans to ensure the health and safety of workers and patients.

Recommendations for health care organizations
• Extend the use of existing PPE: Ensure that health care workers caring for cohorted patients with suspected or confirmed COVID-19 are following extended-use recommendations as appropriate for their setting

Table 4 (below) describes the strategy for extended use of PPE.

Extended use is applicable to N95 respirators (disposable) or equivalent, surgical/procedure masks (disposable), isolation gowns (disposable and reusable), and eye protection (disposable and reusable goggles and face shields).

Table 4. PPE conservation strategy of extended use

Strategy	Description
Extended use Applicable to the following types of PPE: • N95 respirators (disposable) or equivalent • Surgical/procedure masks (disposable) • Isolation gowns (disposable and reusable) • Eye protection (disposable and reusable)	• We recommend that PPE is used over an extended period of time and over the course of many patients, in settings where it is feasible (e.g., while caring for a cohort of patients with suspected or confirmed COVID-19 in an inpatient setting) • Extended use of PPE, including N95 respirators, is **not** recommended after performing an AGMP o After performing an AGMP for a patient with suspected or confirmed COVID-19, PPE items should be safely removed ("doffed"). Disposable items that cannot be reprocessed should be discarded (e.g., gloves) and reusable items cleaned/disinfected (e.g., cloth gowns) • Consider the following key principles: o Cohort patients with suspected or confirmed COVID-19, assign designated teams of health care providers, and batch your patient encounters to help conserve the use of PPE o Extend the use of PPE for as long as possible, but once wet, damaged, soiled, removed, after making direct contact with a contaminated surface or with the patient, or after exiting the patient care area, PPE should be changed o Take extra care when removing the PPE, as this is when self-contamination may occur. Disposable items that cannot be

	reprocessed should be discarded (e.g., gloves) and reusable items cleaned/disinfected (e.g., cloth gowns) o Gloves should be changed between every patient encounter o Extended use of gowns is appropriate for a cohorted group of COVID-19 patients only if there are no additional co-infectious diagnoses transmitted by contact among these patients (e.g., *Clostridioides difficile*) o Adhere stringently to hand hygiene before and after handling PPE and between patient encounters. It is safe to wear your PPE for multiple patient encounters. In fact, you may reduce your risk of self-contamination by reducing the number of PPE changes o While wearing a mask, take extra care not to touch it. If you do, immediately perform hand hygiene *Sources of additional information: Centers for Disease Control and Prevention,[42] European Centre for Disease Prevention and Control,[43] Association for Professionals in Infection Control and Epidemiology position paper,[44] Infectious Diseases Society of America guidelines,[32] Appendix F.*
Layering PPE	• Layering involves wearing more than one piece of PPE at the same time, such as complementary items that provide protection to the same area (e.g., an N95 respirator with a face shield over top) or more than one of the same item (e.g., double gloves) • The evidence to support the practice of layering is inconclusive. However, some guidance suggests that face shields could protect a mask or respirator from surface contamination from larger splashes or sprays. Face shields are being used on top of masks to protect other parts of the face and extend the use of the mask worn underneath *Source of additional information: Infectious Diseases Society of America guidelines,[32] Appendix F.*

3. Recommendations for the Use of Expired Personal Protective Equipment (PPE)

In the context of low or depleted supplies of PPE during a pandemic, the use of PPE that is expired/beyond the manufacturer-designated shelf life should be considered in your **crisis plans** to ensure the health and safety of workers and patients.

Recommendations for health care organizations
• Take stock of, and inspect, any expired N95 respirators (disposable)[15] and any other expired PPE o Expired N95 respirators (disposable) and other PPE items that have been stored in accordance with manufacturers' storage conditions require inspection and testing to ensure they are not damaged, and may be considered for use when regular supplies are low or depleted

Table 5 describes the use of expired N95 respirators (disposable) and other types of expired PPE that may be used beyond the manufacturer-designated shelf life.

Table 5. Recommendations for expired PPE

Type of PPE	Description
N95 respirators[15,45-47]	• We recommend taking stock and inspecting any expired N95 respirators from existing stockpiles o Inspect the expired N95 respirators to ensure they are not damaged and have been stored in accordance with manufacturers' storage conditions. Inspection and testing should occur before distributing any expired stock. Seek assistance from the respirator manufacturer or an independent lab regarding testing of stored respirators • When supplies are low or depleted and demand is high, health care workers can consider using expired N95 respirators o N95 respirators that are past their designated shelf life are no longer NIOSH-certified. An expired respirator can still be effective if: it has been stored accordance to manufacturers' storage conditions, it can be fit-tested, the straps are intact, and there are no visible signs of damage • Upon distribution, clearly separate expired N95 respirators from the non-expired respirators. Disclose to health care worker(s) that the N95 respirator(s) are expired and have been inspected before distribution • Before wearing an expired N95 respirator, a health care worker should: o Inspect for visible damage or soiling o Check that the straps, nose bridge, and nose foam are intact, and that the straps remain elastic

	○ Perform a user-seal check each time they put on a respirator to check that it was donned correctly and that a tight seal is formed on their face • There is no specific timeframe for N95 respirators, beyond the expiry dates, at which they would no longer be considered suitable for use. However, the length of time past the respirator's shelf life or conditions of storage may affect its performance *Sources of additional information: Health Canada,[41] Centers for Disease Control and Prevention,[48] 3M Technical Bulletin: Respirators Beyond Their Shelf Life—Considerations,[15] ECRI Clinical Evidence Assessment,[49] Appendix F.*
Isolation gowns	• The majority of isolation gowns do not have a manufacturer-designated shelf life • In the situation where supplies are low or depleted, isolation gowns that do have a manufacturer-designated shelf life and are past their expiry date can be considered for use, as they should provide protection unless visibly degraded • Isolation gowns past their expiry dates should be inspected and tested for fluid resistance before use to ensure they are not soiled, contaminated, or discoloured with no visible damage like holes or tears. If the gown is damaged it should be discarded *Sources of additional information: Personal Protective Equipment Against COVID-19: Medical Gowns,[1] Centers for Disease Control and Prevention: Strategies for Optimizing the Supply of Isolation Gowns.[50]*
Surgical/procedure masks, gloves, eye protection	• PPE products that are expired/beyond the manufacturer-designated shelf life are typically discarded or used only for testing and training purposes. However, in situations where supplies are low or depleted, expired PPE can be considered for use, as they may still provide some protection • In all cases, PPE should be inspected before use to ensure the product is still intact, not soiled, contaminated, or discoloured, with no visible damage like holes, tears; otherwise, the product should be discarded *Source of additional information: Health Canada,[41] U.S. Food and Drug Administration: FAQs on Shortages of Surgical Masks and Gowns During the COVID-19 Pandemic,[51] U.S. Food and Drug Administration: Medical Gloves for COVID-19.[52]*

4. Recommendations for the Limited Reuse of Personal Protective Equipment (PPE)

In the context of low or depleted supplies of PPE during a pandemic, the limited reuse of PPE should be considered in your **crisis plans** to ensure the health and safety of workers and patients.

Recommendations for health care organizations
• Ensure that health care workers are following limited-reuse recommendations, as appropriate for their setting

Table 6 (below) describes the strategy of limited reuse.

Limited reuse is applicable to N95 respirators (disposable) or equivalent, surgical/procedure masks (disposable), reusable isolation gowns, and eye protection (disposable and reusable goggles and face shields).

Table 6. Conservation strategy for PPE

Strategy	Description

Limited reuse
 	
Applicable to the following types of PPE:
• N95 respirators (disposable) or equivalent
• Surgical/procedure masks (disposable)
• Reusable isolation gowns
• Eye protection (disposable and reusable)
	• *Limited reuse* refers to the practice of using the same PPE item for multiple encounters with patients, but carefully removing it ("doffing") after each encounter, storing it safely, then putting it back on ("donning") without disinfecting
	• Limited reuse of PPE carries a higher risk of self-contamination than with extended use.[49] The feasibility of limited reuse may depend on the health care setting. For example, it is not recommended in critical care settings or for aerosol generating medical procedures (AGMP). They are better used in settings like assessment centres, etc.
	• Limited reuse of PPE, including N95 respirators, is **not** recommended for when performing an AGMP
	  o After performing an AGMP for a patient with suspected or confirmed COVID-19, PPE items should be safely removed ("doffed"). Disposable items that cannot be reprocessed should be discarded (e.g., gloves) and reusable items cleaned/disinfected (e.g., cloth gowns)
	• Consider the following key principles:
	  o The PPE is safely stored between patient encounters and put back on again ("donned") before the next encounter with a patient
	  o Take great care when removing or redonning the PPE as this is when self-contamination may occur. Also take care to avoid contaminating the inside of the mask

	o Even when reuse is practiced or recommended, restrictions are in place that limit the number of times the same item is reused (therefore referred to as "limited reuse") o Once the PPE is wet, damaged, or soiled, it should be placed in the appropriate receptacle. Disposable items that cannot be reprocessed should be discarded (e.g., gloves) and reusable items cleaned/disinfected (e.g., cloth gowns) o Gloves should be changed between every patient encounter o Adhere stringently to hand hygiene before and after handling PPE and between patient encounters o While wearing a mask take extra care not to touch it, and if you do, immediately perform hand hygiene *Sources of additional information: Centers for Disease Control and Prevention,[42] European Centre for Disease Prevention and Control,[42] Association for Professional in Infection Control and Epidemiology position paper,[44] Infectious Disease Society of America guidelines,[32] Appendix F.*

5. Recommendations for Non-NIOSH Certified Personal Protective Equipment (PPE)

In the context of low or depleted supplies of PPE during a pandemic, the use of non-NIOSH certified PPE may be considered **with caution in your crisis plans.** This includes evaluation to ensure the PPE meets the same standards of traditional sources of commercial PPE for medical settings.

Health Canada, the regulator for medical devices in Canada, accepts the NIOSH certification as an appropriate quality standard for N95 respirators used by health care workers.[38] Health Canada lists N95 respirators as a Class I medical device and they are manufactured by companies that hold a Medical Device Establishment Licence (MDEL). They achieve a minimum filtration efficiency of 95% when worn properly. Health Canada states that equivalent alternate standards are also acceptable.[53] Here is the list of certified equipment, according to the CDC.

Information for health care organizations
• Take caution when using non-NIOSH certified PPE: Verify the authenticity and fit test of any PPE products that may not meet NIOSH certification

PPE with equivalent certification from other countries:

- Disposable respirators (also called filtering facepiece respirators) are subject to various regulatory standards around the world. These standards apply to certain required physical properties and performance characteristics (e.g., filter performance, flow rate, total inward leakage, inhalation resistance, exhalation valve leakage requirement)
- Products that are not NIOSH-certified need to be verified and validated for authenticity and fit-tested to ensure performance[37]
- Examples of respirators that are approved under standards used in other countries that are similar to NIOSH-approved respirators include: FFP2 from Europe, P2 from Australia/NZ, Special 1st from Korea, KN/KP95 from China, DS/DL2 from Japan, or PFF2 from Brazil. The CDC has compiled a list of respirators approved under standards used in other countries[54] that are similar to NIOSH-approved respirators. See Health Canada for important information about KN95 respirators, including ensuring they meet the filtration criteria of 95% in order to be authorized to be sold and used as respirators

Sources of additional information: Centers for Disease Control and Prevention List of Certifications,[55] 3M Technical Bulletin: Comparison of FFP2, KN95, and N95 and Other Filtering Facepiece Respirator Classes,[56] Appendix G.

PPE without NIOSH certification:

- In the context of the COVID-19 pandemic, domestic manufacturers may emerge with local capacity to manufacture PPE
- Ensure products used by health care workers meets Health Canada regulations and meets NIOSH standards, including fit-testing to ensure satisfactory performance
- Health Canada has outlined measures to facilitate and expedite access to licensing and registration requirements for PPE to help limit the spread of COVID-19

Sources of additional information: Health Canada,[36] National Institute for Occupational Safety and Health (Centers for Disease Control and Prevention).[40]

6. Recommendations for Decontamination of Personal Protective Equipment (PPE) using Validated Sterilization and Disinfection Methods

In the context of low or depleted supplies of PPE during a pandemic, using validated sterilization and disinfection methods to decontaminate PPE for future use should be considered in your crisis plans in settings where it can be safely done.

The notice from Health Canada, Important Regulatory Considerations for the Reprocessing of Single Use N95 Respirators during the COVID-19 Response,[57] describes the regulatory requirements for both "reprocessing devices that are manufactured and sold to decontaminate N95 respirators" and for "companies who reprocess and distribute N95 respirators to health care facilities." According to Health Canada, organizations that reprocess and distribute N95 respirators to health care facilities will follow the federal regulatory framework and meet the minimum requirements for the decontamination process. Health Canada authorization is not required if hospitals are decontaminating N95 respirators within their institutions for their own reuse, and if hospitals are decontaminating N95 respirators from an external institution and sending the respirators back to the same institution.

As stated by Health Canada,[58] the "reprocessing of devices intended for single use only is not a new concept. It has been done successfully with other devices used in Canada and similar technology can be applied to N95 respirators. To do this, Health Canada has invited applications from medical device companies with extensive experience manufacturing the equipment used in reprocessing in order to authorize these technologies to safely and effectively reprocess N95 respirators."

Recommendations for health care organizations
• The provincial planning for reprocessing N95 respirators is paused. Hospitals can now safely dispose of the used N95 respirators that they have collected and discontinue collecting used N95 respirators moving forward • If a validated process for reprocessing PPE is feasible at your health care organization, move forward with developing an implementation plan following Health Canada and the reprocessing device manufacturer's requirements

Table 7 describes the recommendations for evidence-based strategies for reprocessing PPE; namely N95 respirators (disposable) and eye protection (goggles and face shields).

Table 7. Recommendations for sterilization and disinfection methods to decontaminate PPE

Type of PPE	Description of the sterilization and disinfection method
N95 respirators (disposable)	• In settings where decontamination can be safely implemented, reprocess N95 respirators using validated sterilization and disinfection methods. Decontaminated N95 respirators would only be used in the context of depleted supplies during a pandemic and as part of crisis plans, as directed by the Ministry of Health and the applicable Directives from the Chief Medical Officer of Health on the use of PPE • If a validated process for decontamination/reprocessing is feasible at your health care organization, move forward with developing an implementation

	plan following Health Canada and the reprocessing device manufacturer's requirements, which should include the following: o Ensure that disinfection and sterilization modalities meet quality assurance processes as per Canadian Standards Association (CSA) and Provincial Infection Disease Committee on Infection Prevention and Control (PIDAC-IPC) requirements and Accreditation Canada/Health Standards Organization Standards o Incorporate expert opinion (e.g., medical device reprocessing department [MDRD], occupational health and safety, industrial and occupational hygiene, microbiologists, infection prevention and control [IPAC], human factors, medical engineering, legal affairs) and best published evidence for reprocessing of N95 respirators (e.g., CDC recommendations, ECRI Clinical Evidence Assessments, independent research studies with rigorous methodologies) *Sources of additional information: Health Canada,[57] Toronto Region COVID-19 Hospital Operations Table—Planning Guidance for Toronto Region Hospitals,[59] Provincial Infectious Diseases Advisory Committee on Infection Prevention and Control,[60] Infectious Disease Society of America guidelines,[32] CADTH Horizon Scan.[61]*
Eye protection (disposable and reusable)	• Reprocess goggles and face shields with appropriate cleaning and disinfection according to standard CSA Z314 from the Canadian Standards Association • Goggles and face shields can be disinfected using your health care organization's standard protocol for disinfecting any solid, plastic surface. Discard the item if the disinfectant causes clouding or damage. If any irritation is experienced, consider rinsing the surface with water and drying before use *Sources of additional information: Centers for Disease Control and Prevention,[62] Health Canada List of Disinfectants for use against COVID-19,[24] Public Health Ontario.[63]*
Isolation gowns	• Reprocess reusable gowns with appropriate laundering according to standard CSA Z314 from the Canadian Standards Association • We do not recommend reprocessing disposable isolation gowns. Currently, there is no clear evidence that disposable isolation gowns can be reprocessed *Sources of additional information: Public Health Ontario,[63] Robinson et al, 2019.[64]*
Surgical/procedure Masks	• We do not recommend reprocessing surgical/procedure masks (disposable) • Currently there is no clear evidence supporting a validated method for sterilizing and disinfecting surgical/procedure masks *Source of additional information: Public Health Ontario.[63]*

Gloves	• We do not recommend reprocessing gloves • Currently, there is no clear evidence that gloves can be reprocessed *Source of additional information: Robinson et al, 2019,[64] Kpadeh-Rogers et al, 2019.[65]*

7. Recommendations for Alternative Innovation Products

The use of new alternative innovation products by health care workers as PPE during the COVID-19 pandemic is unregulated and untested. Therefore, the committee cannot endorse the use of these products as a replacement for PPE that is intended to protect health care workers from exposure to SARS-CoV-2. The committee will continue to evaluate emerging ideas and innovations to address the need for PPE during the COVID-19 pandemic.

Recommendations for health care organizations
• 3D-printed face masks/respirators and fabric/cloth masks are NOT recommended for use by health care workers

Table 8 describes alternative innovation products that are not recommended for use by health care workers.

Table 8. Recommendations on alternative innovation products	
The committee does not endorse the use of alternative innovation products as a replacement for PPE where there is no evidence to demonstrate their effectiveness.	
Type of PPE	**Description**
3D-printed face masks/respirators	• **We do not currently recommend the use of 3D-printed face masks or 3D-printed respirators in place of a surgical/procedure mask or N95 respirator** o A 3D-printed face mask/respirator is unlikely to provide the same fluid barrier and air filtration protection as an N95 respirator *Source of additional information: Health Canada,[66] Appendix E.*
Fabric/cloth masks[67-71]	• **We do not recommend the use of commercial or homemade fabric/cloth masks by health care workers. These would only be considered as a last resort** o Fabric/cloth masks are not able to provide the same level of protection and air filtration as surgical/procedure masks or N95 respirators.[71] There is variability in their functionality and manufacturing (e.g., fabric type, filter insert) o There may be utility for use by the general public, but fabric/cloth masks are not a suitable alternate source of PPE for health care workers *Source of additional information: Appendix H.*

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Appendix A: COVID-19 Response: Personal Protective Equipment (PPE) Committee

Name	Title(s) and Institution(s)
Chris Simpson (Chair), BSc, MD, FRCPC, FACC, FHRS, FCCS, FCAHS	Vice Dean (Clinical), School of Medicine, Queen's University Medical Director, Southeastern Ontario Academic Medical Organization Professor, Division of Cardiology, Queen's University Affiliate Scientist, Institute for Clinical Evaluative Sciences
Zain Chagla, MSc, MD, FRCPC	Co-Medical Director of Infection Control, St. Joseph's Healthcare Hamilton and Niagara Health System Associate Professor, Department of Medicine, McMaster University
Connie Clerici, RN, BScN	Executive Chair, Closing the Gap Healthcare Adjunct Lecturer, Institute of Health Policy, Management and Evaluation, University of Toronto
Jennifer Everson, BScN, MD, CCFP, FCFP	Vice President, Clinical, Ontario Health (West) Associate Professor, Faculty of Medicine, Department of Family Medicine, McMaster University
Michael Gardam, MSc, MD, CM, MSc, FRCPC	Infectious Disease Specialist Women's College and University Health Network Associate Professor, Department of Medicine, University of Toronto
Frank Gu, PhD	NSERC Senior Industrial Research Chair and Professor, Department of Chemical Engineering and Applied Chemistry, University of Toronto
Derek McNally, RN, MM	Executive Vice President, Clinical Services and Chief Nursing Executive, Niagara Health Adjunct Professor, Department of Nursing, Brock University
Howard Ovens, MD, FCFP(EM)	Chief Medical Strategy Officer, Sinai Health System Professor, Department of Family and Community Medicine, University of Toronto and Sr. Fellow, Institute of Health Policy, Management and Evaluation Ontario Provincial Lead for Emergency Medicine
Paul Preston, MD, CCFP, CCPE, CHE	Vice President, Clinical, Ontario Health (North)
Amit Shah, MD, CCFP(EM), FCFP	Emergency Department Lead, South West Region Emergency Physician, London Health Sciences Centre/St. Thomas-Elgin General Hospital Associate Professor, Division of Emergency Medicine, Western University
Henrietta Van hulle, RN, BN, MHSM, COHN, CRSP, CDMP	Vice President, Client Outreach, Public Services, Health and Safety Association
Tamara Wallington, MD, FRCPC	Program Chief and Medical Director, Trillium Health Partners Academic Lead, Family Medicine Teaching Unit

Appendix B: Glossary of Terms

Term	Definition
Extended use	*Extended use* refers to the practice of keeping an item of personal protective equipment on for extended periods of time without removing ("doffing").
Eye protection (goggles/face shield)	There are many types of protective eyewear used by health care workers. Goggles and face shields provide a barrier to protect health care workers' eyes and face from expelled splashes, sprays, and bodily fluids by a contaminated person. A face shield is a device that has a transparent window or supported visor in front of the face to shield the eyes and face.
Disposable	*Disposable* refers to an item of personal protective equipment that is intended to be used only once then thrown away. Also referred to as "one-time use" or "single-use."
Gloves	Single-use, nonsterile medical gloves are used by all medical personnel and many auxiliary workers in health care settings as a universal contact and droplet precaution to minimize skin contamination and transmission of pathogens. Gloves can be made of different types of material (e.g., natural rubber latex, nitrile, polyvinyl chloride).
Isolation gown	*Isolation gown* refers to a type of long-sleeved medical cover that offers a barrier to protect health care workers against the transmission of micro-organisms contained in substances such as bodily fluids, secretions, and excretions, including respiratory droplets. Gowns distributed and sold in Canada are grouped by category and level of risk. There are two types of medical gowns: *isolation gowns* and *surgical gowns*.[1]
N95 respirators	An N95 respirator, also known as a filtering facepiece respirator, is a respiratory protective device designed to achieve a very close facial fit and very efficient filtration of airborne particles. The "N95" designation means that when subjected to careful testing the respirator blocks at least 95% of very small test particles. These respirators are medical devices authorized by Health Canada.
Personal protective equipment (PPE)	*Personal protective equipment* refers to specialized clothing and equipment worn by health care workers for protection against hazards and to prevent injury or infection. In this document, PPE refers to N95 respirators, surgical/procedure masks, isolation gowns, gloves, and eye protection (goggles and face shields).
Reprocessing	*Reprocessing* refers to the cleaning, sanitization, disinfection, decontamination, and/or sterilization of devices and equipment in health care settings.

Reuse/Limited reuse	*Reuse* refers to the practice of using an item of PPE for multiple patient encounters with but removing it ("doffing") between encounters without disinfecting.
Reusable	*Reusable* refers to the ability for a product to be used repeatedly with validated methods for cleaning and/or disinfection between uses.
Surgical/procedure mask	A *mask* is a device that covers the nose and mouth, is secured in the back and is used to protect the mucous membranes of the nose and mouth. *Procedure masks*, also known as a *standard face mask*, are not fluid or water resistant, and they are designed to protect for minimal exposure to infectious droplets and tasks that do not involve exposure to blood/body fluids. *Surgical masks* are fluid and water resistant, thus they protect from exposure to infection droplets or blood/body fluids and are suitable for long duration tasks.[2] *Surgical and procedure masks* do not fit tightly to the face.

Appendix C: Summary Table: Recommendations for PPE Conservation and Sterilization/Disinfection Methods for Reprocessing During the COVID-19 Pandemic

Type of Personal Protective Equipment (PPE)		Reusable Option	Extended Use*	Use of Expired Stock	Limited Reuse*	Validated Methods for Reprocessing
Respirators	Disposable N95 respirators	✗	✓	✓	✓	• There are different validated sterilization and disinfection methods for decontaminating N95 respirators (see Health Canada)
	Reusable elastomeric respirators	✓	✓	—	✓	• Follow the manufacturer's instructions of cleaning, disinfecting, and maintenance of filter cartridges • Disinfect by submerging in water and detergent; filter cartridges are removed and replaceable • For interim cleaning, use disinfectant wipes
	Powered-air purifying respirators	✓	✓	—	✓	• Follow the manufacturer's instructions of cleaning, disinfecting, and maintenance of PAPR components
Surgical/ procedure masks	Disposable surgical/ procedure masks	✗	✓	✓	✓	✗
Isolation gowns	Disposable isolation gowns	✗	✓	✓	✓	✗
	Reusable isolation gowns	✓	✓	✓	✓	• Disinfect by laundering
Gloves	Medical gloves	✗	✗	✓	✗	✗
Eye protection	Disposable goggles and face shields	✗	✓	✓	✓	• Disinfect using standard methods for hard plastic surfaces
	Reusable goggles and face shields	✓	✓	✓	✓	• Disinfect using standard methods for hard plastic surfaces

*Extended use and limited reuse of PPE, including N95 respirators, are not recommended after performing AGMPs. After performing an AGMP for a patient with suspected or confirmed COVID-19, PPE items should be safely removed ("doffed"). Disposable items that cannot be reprocessed should be discarded and reusable items cleaned/disinfected.

Appendix D: Supplemental Information: Powered Air Purifying Respirators (PAPRs)

This supplemental information was generated by Ontario Health–Quality to support decision-making and to provide information on powered air purifying respirators (PAPRs) during the novel coronavirus disease (COVID-19) pandemic. They examined the recommendations from national and international health authorities and organizations and completed a targeted search of published literature.

The supplemental information can be found here: https://hqontario.ca/Evidence-to-Improve-Care/Health-Technology-Assessment/Other-Publications/Special-Reports

Appendix E: Supplemental Information: 3D Printing of N95 Respirators and Face Shields

This supplemental information was generated by Ontario Health–Quality to support decision-making and provide information on 3D printing of N95 respirators and face shields during the novel coronavirus disease (COVID-19) pandemic. They examined the recommendations from national and international health authorities and organizations and completed a targeted search of published literature to determine what is known around 3D printing of N95 respirators and face shields.

The supplemental information can be found here: https://hqontario.ca/Evidence-to-Improve-Care/Health-Technology-Assessment/Other-Publications/Special-Reports

Appendix F: Supplemental Information: Extended Use and Layering of N95 Respirators and Use of Expired Personal Protective Equipment

This supplemental information was generated by Ontario Health–Quality to support decision-making around the extended use and layering of N95 respirators and use of expired personal protective equipment (PPE) during the novel coronavirus disease (COVID-19) pandemic. They examined the recommendations from national and international health authorities and organizations and completed a targeted search of published literature to determine what is known about extended use, layering, and use of expired PPE.

The supplemental information can be found here: https://hqontario.ca/Evidence-to-Improve-Care/Health-Technology-Assessment/Other-Publications/Special-Reports

Appendix G: Supplemental Information: N95 Equivalents as an Alternative to N95 Respirators in a Health Care Setting

This supplemental information was generated by Ontario Health–Quality to support decision-making and to provide information on N95 equivalents from other countries during the novel coronavirus disease (COVID-19) pandemic. They examined the recommendations from national and international health authorities and organizations and completed a targeted search of published literature.

The supplemental information can be found here: https://hqontario.ca/Evidence-to-Improve-Care/Health-Technology-Assessment/Other-Publications/Special-Reports

Appendix H: Supplemental Information: Fabric/Cloth Masks

This supplemental information was generated by Ontario Health–Quality to support decision-making and to provide information on cloth masks during the novel coronavirus disease (COVID-19) pandemic. They examined the recommendations from national and international health authorities and organizations and completed a targeted search of published literature.

The supplemental information can be found here: https://hqontario.ca/Evidence-to-Improve-Care/Health-Technology-Assessment/Other-Publications/Special-Reports