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

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 PPE and contingency 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 ensuring 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
   - 3D-printed face shields
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**

While this document addresses specific aspects of PPE reuse and reprocessing, appropriate stewardship of PPE remains very important. Health care workers should follow droplet/contact precautions (surgical/procedure mask, isolation gown, gloves, and eye protection) when caring for individuals with suspected or confirmed COVID-19. Health care workers should use an N95 respirator during aerosol-generating medical procedures (AGMP) performed on patients with suspected or confirmed COVID-19.

In this document, *personal protective equipment (PPE)* refers to respirators, surgical/procedure masks, isolation gowns, gloves, and eye protection (goggles and face shields). See Appendix B[1,2] for a glossary of terms. See Appendix C for a summary table of ways to conserve existing supply of PPE.

There are many factors that need to be considered before a health care worker uses PPE, such as administrative and engineering controls (e.g., the use of physical barriers, the use of telemedicine where appropriate, restricting visitors, cohorting patients with COVID-19).[3-6] Personal protective equipment is the last line of defense, and as such, to effectively reduce the risk of contracting infections in the workplace, a hierarchy of controls needs to be incorporated into decision-making. Health care organizations must always ensure compliance with the *Occupational Health and Safety Act* 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. In addition, 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 and the worker must participate in such instruction and training.

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.

Recommendations for Health Care Organizations

Please consider the following conservation strategies to extend the supply of PPE and to ensure the long-term sustainability of PPE during the COVID-19 pandemic. This page provides an overview of the key items—more information is provided in their respective sections.

- **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 cloth isolation gowns, as a sustainable contingency approach
    - Collaborate with your organization's occupational health and safety, IPAC, and infectious disease specialists to develop appropriate protocols for the use of reusable elastomeric respirators, which are a reusable equivalent to the more commonly known disposable N95 respirator. Organizations without these key specialist groups should consider consulting with experts from their region
    - Consider the use of powered air purifying respirators (PAPRs) in certain situations where health care workers will be wearing protective equipment for prolonged periods of time and where appropriate training can be provided (e.g., in the intensive care unit)
    - 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
    - If an employee presents with their own reusable respirator, occupational health and safety units need to be engaged in order to support safe usage

- **Use certified PPE from other medical settings and non-medical settings:** 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 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

- **Use 3D-printed face shields for eye protection, if needed:** 3D-printed face shields are an appropriate alternative to traditional face shields for eye protection. Ensure they meet the standards[7] set out by Health Canada

- **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)[8] 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 to ensure they are not damaged, and may be used when regular supplies are 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 of and fit test any PPE products that may not meet NIOSH certification

- **Collect and store used N95 respirators (disposable) for decontamination using validated sterilization and disinfection methods:**
    - Where feasible, all health care organizations should begin collecting used N95 respirators (disposable) that are not visibly soiled or damaged so that they may be reprocessed for future use using appropriate sterilization and decontamination methods
    - Used N95 respirators (disposable) that are unsoiled and undamaged should be collected and stored in disposal receptacles that are clearly labelled, dated, and separated from other types of PPE (e.g., in a biohazard bag, paper bag, or box)
    - Ensure inspection of respirators before reprocessing to confirm the condition of the N95 respirators are suitable for reprocessing if they have been stored for a length of time
    - Consider the feasibility of individual tracking versus universal pooled supply, as both are safe approaches. In either case, users will continue to wear the same type of N95 respirator that they are fit-tested for and appropriate fit is further confirmed through a careful user-seal check at the point of care
    - If a validated process for reprocessing is feasible at your health care organization, move forward with developing an implementation plan

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

1. Recommendations for Procuring Personal Protective Equipment (PPE)

In the context of 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.

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 cloth isolation gowns, as a sustainable contingency approach
    - Collaborate with your organization's occupational health and safety, IPAC, and infectious disease specialists to develop appropriate protocols for the use of reusable elastomeric respirators, which are a reusable equivalent to the more commonly known disposable N95 respirator. Organizations without these key specialist groups should consider consulting with experts from their region
    - Consider the use of powered air purifying respirators (PAPRs) in certain situations where health care workers will be wearing protective equipment for prolonged periods of time and where appropriate training can be provided (e.g., in the intensive care unit)
    - 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
    - If an employee presents with their own reusable respirator, occupational health and safety units need to be engaged in order to support safe usage

- Use certified PPE from other medical settings and non-medical settings: 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 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

- Use 3D-printed face shields for eye protection, if needed:
    - 3D-printed face shields are an appropriate alternative to traditional face shields for eye protection
    - Ensure they meet the standards[7] set out by Health Canada

1.1 Use Reusable PPE Options

As described in Table 1 (below), the following PPE are reusable: elastomeric respirators, cloth 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)**	• We recommend switching to reusable elastomeric respirators, wherever possible. 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 • 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/occupation health and safety teams to ensure fit-testing and to support standardized cleaning protocols. 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 protocol) • The ideal way to disinfect these respirators is to submerge them in water and bleach. However, the use of water and bleach is not 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).[9] Refer to the manufacturer's instructions on cleaning and disinfection • 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. Currently these filters cannot be reprocessed *Sources of additional information: 3M Cleaning and Disinfecting Technical Bulletin,[10] 3M Replacement and Cleaning Training Video,[11] Standard Operating Procedure for Disinfection,[12] Health Canada List of Disinfectants for Use Against SARS-CoV-2,[13] Lawrence et al., 2017.[14]*

Isolation gowns	• Switch to reusable isolation gown options, wherever possible:
	  ○ Cloth isolation gowns
	  ○ 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:
	  ○ Reusable goggles
	  ○ Reusable face shields

N95 respirator equivalent: **powered air purifying respirators (PAPRs)**[15-18]	• Powered air purifying respirators 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). Powered air purifying respirators require careful doffing and complicated cleaning steps; they do not require fit-testing and can be worn with facial hair
	• Powered air purifying respirators are a viable reusable option in specific circumstances, where:
	  ○ Appropriate training is provided
	  ○ They are used consistently by trained staff
	  ○ Staff 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)
	• Using PAPRs primarily for droplet/contact precautions can be challenging due to contamination of the PAPR hood and the possible risk of self-contamination upon removal. The use of PAPRs for droplet/contact transmission could increase the risk of health care worker transmission (which is not a concern for the airborne hazards for which the PAPR was created) if the above precautions are not followed
	• Similarly, while contamination of the tubing and high-efficiency particulate air (HEPA)–filtration unit worn with the PAPR hood is typically not a concern with airborne hazards, contamination can occur with droplet/contact transmitted pathogens. Refer to the manufacturer's instructions on cleaning and disinfection
	• Additional concerns related to possible user contamination upon removal relate to:
	  ○ Bulkiness of the hood
	  ○ Lack of formal training and practice in removing the hood
	  ○ Lack of validated procedures to attempt hood decontamination before removal

	○ Time-consuming manual decontamination and the requirement to handle and decontaminate the accompanying hood and HEPA filtration unit • For these reasons, PAPRs are not generally recommended for the care of COVID-19 patients in general unit settings where the above concerns cannot be addressed *Sources of additional information: Appendix D, ANZICS COIVD-19 Guidelines,[19] U.S. Food and Drug Administration,[20] Lawrence et al., 2017.*[14]

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 masks 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.[21] 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	• We recommend 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, and so on *Source of additional information: Health Canada is calling for all suppliers to help Canada combat COVID-19.*
Use PPE from commercial, non-medical settings ○ This includes disposable and reusable N95 respirators, PAPRs, disposable surgical/procedure masks, eye protection, gowns, and gloves.	• In circumstances in which traditional N95 respirators and other PPE made for health care settings 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[22] • We recommend the procurement of commercial-grade N95 masks (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. 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.[23,24] All of these NIOSH certifications[24] will protect health care workers • 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.*[21] *Ontario Health's call for PPE: https://www.ontario.ca/page/how-your-organization-can-help-fight-coronavirus.*

1.3 Use of 3D-Printed Face Shields for Eye Protection

Table 3 describes a recommendation on the use of 3D-printed face shields (eye protection).

Table 3. Recommendation for 3D-printed face shields (eye protection)

Type of PPE	Description
Eye protection: 3D-printed face shields	• 3D printed face shields for eye protection are recommended as an alternate source when traditional commercial face shields for eye protection are not available • There are several 3D printed face shield manufacturers. Ensure they meet the standards[7] set out by Health Canada. Health Canada provides guidance for 3D printing and other unconventional manufacturing of PPE in response to COVID-19 • Other considerations include the reusability and sustainability as some 3D printed face shields are disposable and others are reusable *Sources of additional information: Health Canada,*[7] *Appendix E.*

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

In the context of depleted supplies of PPE during a pandemic, the extended use of PPE should be considered in your contingency plans.

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), surgical/procedure masks (disposable), isolation gowns (disposable and cloth), 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)
• Surgical/procedure masks (disposable)
• Isolation gowns (disposable and cloth)
• 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
	  ○ 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), reusable items cleaned/disinfected (e.g., cloth gowns), and N95 respirators placed in the appropriate receptacles for reprocessing
	• Consider the following key principles:
	  ○ 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
	  ○ Extend the use of PPE for as long as possible, but once wet, damaged, soiled, or removed (e.g., to eat or drink), or after exiting the patient care area, PPE should be changed
	  ○ 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), reusable items

	cleaned/disinfected (e.g., cloth gowns), and N95 respirators placed in the appropriate receptacles for reprocessing ○ Gloves should be changed between every patient encounter ○ 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 ○ While wearing a mask take extra care not to touch it. If you do, immediately perform hand hygiene *Sources of additional information: CDC,[25] European Centre for Disease Prevention and Control,[26] Association for Professional in Infection Control and Epidemiology Position Paper,[27] Infectious Disease Society of America guidelines[28], 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 Disease Society of America guidelines[28], Appendix F.*

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

In the context of 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**.

Recommendations for health care organizations
• Take stock of and inspect any expired N95 respirators (disposable)[8] 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 to ensure they are not damaged, and may be used when regular supplies are 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[8,29-31]	• When supplies of N95 respirators are low or depleted, we recommend using expired N95 respirators from existing stockpiles
	• Inspect these N95 respirators to ensure they are not damaged and have been stored in accordance with manufacturers' storage conditions. Inspection should occur before distributing expired stock
	• 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:
	  ○ Inspect for visible damage or soiling
	  ○ 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
	Sources of additional information: 3M Technical Bulletin Respirators Beyond Their Shelf Life Considerations,[8] Health Canada,[32] Centers for Disease Control and Prevention,[33] ECRI Clinical Evidence Assessment,[34] Appendix F.

Isolation gowns	• The majority of isolation gowns do not have a manufacturer-designated shelf life • In the situation where supplies are 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 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.[35]*
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 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 not soiled, contaminated, or discoloured, with no visible damage like holes, tears; otherwise, the product should be discarded *Source of additional information: U.S. Food and Drug Administration.*[36]

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

In the context of depleted supplies of PPE during a pandemic, the limited reuse of PPE should be considered in your **crisis plans**.

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), surgical/procedure masks (disposable), cloth 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)
• Surgical/procedure masks (disposable)
• Cloth 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.[34] 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
	  ○ 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), reusable items cleaned/disinfected (e.g., cloth gowns), and N95 respirators placed in the appropriate receptacles for reprocessing
	• Consider the following key principles:
	  ○ The PPE is safely stored between patient encounters and put back on again ("donned") before the next encounter with a patient
	  ○ Take great care when removing or redonning the PPE as this is when self-contamination may occur. Also take care to avoid contaminating the inside of the mask

	○ 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") ○ 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), reusable items cleaned/disinfected (e.g., cloth gowns), and N95 respirators placed in the appropriate receptacles for reprocessing ○ Gloves should be changed between every patient encounter ○ Adhere stringently to hand hygiene before and after handling PPE and between patient encounters ○ While wearing a mask take extra care not to touch it, and if you do, immediately perform hand hygiene *Sources of additional information: CDC,[25] European Centre for Disease Prevention and Control,[25] Association for Professional in Infection Control and Epidemiology Position Paper,[27] Infectious Disease Society of America guidelines[28], Appendix F.*

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

In the context of 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 masks used by health care workers. 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.[21] Here is the list of certified equipment according to the CDC. Health Canada is fast-tracking the MDEL application process for companies that want to manufacture, import, or distribute Class I masks. Their goal is to complete the process within 24 hours from the time Health Canada receives a completed application.[21]

Information for health care organizations
• Take caution when using non–NIOSH certified PPE: Verify the authenticity of and fit test 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, etc.)
- 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[37] that are similar to NIOSH-approved respirators
- Products that are not NIOSH-certified need to be verified and validated for authenticity and fit tested to ensure performance[22]

Sources of additional information: CDC List of Certifications,[38] 3M Technical Bulletin: Comparison of FFP2, KN95, and N95 and Other Filtering Facepiece Respirator Classes,[39] 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 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[21], CDC-NIOSH[24]

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

In the context of 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.

A notice from Health Canada, Important Regulatory Considerations for the Reprocessing of Single Use N95 Respirators during the COVID-19 Response,[40] describes the regulatory requirements for reprocessing by a third-party organization. We have been advised by Health Canada that this notice does not apply to on-site reprocessing and decontamination by hospitals. Health care organizations who are considering on-site reprocessing should review the principles included to ensure the safety of their chosen sterilization and decontamination method:

- A validated process for disinfection/reprocessing
- Testing for the validation of bioburden reduction/disinfection
- Ensuring a chain of custody and safeguards to prevent inadvertent exposure
- Testing for performance characteristics and fit-testing

As stated by Health Canada,[41] 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

- Collect and store used N95 respirators (disposable) for decontamination using validated sterilization and disinfection methods:
  - Where feasible, all health care organizations should begin collecting used N95 respirators (disposable) that are not visibly soiled or damaged so that they may be reprocessed for future use using appropriate sterilization and decontamination methods
  - Used N95 respirators (disposable) that are unsoiled and undamaged should be collected and stored in disposal receptacles that are clearly labelled, dated, and separated from other types of PPE (e.g., in a biohazard bag, paper bag, or box)
  - Ensure inspection of respirators before reprocessing to confirm the condition of the N95 respirators are suitable for reprocessing if they have been stored for a length of time
  - Consider the feasibility of individual tracking versus universal pooled supply, as both are safe approaches. In either case, users will continue to wear the same type of N95 respirator that they are fit-tested for and appropriate fit is further confirmed through a careful user-seal check at the point of care
  - If a validated process for reprocessing is feasible at your health care organization, move forward with developing an implementation plan

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)	When reprocessing is required, the following should be considered: • A clearly outlined process for safely collecting and transporting used N95 respirators to prevent infections and cross contamination • A validated process for decontamination / reprocessing of N95 respirators • Ensuring technical expertise is available to support implementation • Testing for bioburden reduction and disinfection • Ensuring a chain of custody and safeguards are in place to prevent inadvertent exposure • Material compatibility • Testing for performance characteristics and fit • Testing for residual chemical hazard (off-gassing) • Tracking of sterilization cycles • Appropriate storage and environmental conditions for cleaned medical devices as per CSA standards If a validated process for decontamination/reprocessing is feasible at your health care organization, move forward with developing an implementation plan, which should include the following: • 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 Standards • 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,[40] Toronto Region COVID-19 Hospital Operations Table—Planning Guidance for Toronto Region Hospitals,[42] Provincial Infectious Diseases Advisory Committee on Infection Prevention and Control[43], Infectious Disease Society of America guidelines[28], CADTH Horizon Scan.[44]*
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

	Sources of additional information: Centers for Disease Control and Prevention[45], *Health Canada List of Disinfectants for use against SARS-CoV-2,*[13] *Public Health Ontario.*[46]
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,*[46] *Robinson et al., 2019.*[47]
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.*[46]
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*[47]*; Kpadeh-Rogers et al., 2019.*[48]

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,[7] Appendix E.*
Fabric/cloth masks[49-53]	• **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.[53] There is variability in their functionality and manufacturing (e.g., fabric type, filter insert) o There may be some 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.*

References

(1) Government of Canada. Important regulatory considerations for the supply of medical gowns: guidance to industry [Internet]. Ottawa canada.ca; c2020 [updated 2020 Apr 18; cited 2020 Apr 25]. Available from: https://www.canada.ca/en/health-canada/services/drugs-health-products/medical-devices/application-information/guidance-documents/covid19-medical-gowns.html

(2) Provincial Infectious Diseases Advisory Committee. Routine practices and additional precautions in all health care settings, 3rd edition [Internet]. Toronto, ON: Queen's Printer for Ontario; 2012 [cited 2020 Apr 25]. Available from: https://www.publichealthontario.ca/-/media/documents/B/2012/bp-rpap-healthcare-settings.pdf?la=en

(3) Centers for Disease Control and Prevention. Strategies for optimizing the supply of N95 respirators [Internet]. Atlanta (GA): cdc.gov; c2020 [updated 2020 Apr 2; cited 2020 April 10]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/respirators-strategy/index.html

(4) National Institute for Occupational Health and Safety and Health (NIOSH). Hierarchy of controls [Internet]. Cincinnati (OH): cdc.gov; c2020 [updated 2015 Jan 13; cited 2020 Apr 10]. Available from: https://www.cdc.gov/niosh/topics/hierarchy/default.html

(5) Public Health Ontario. Technical brief: updated IPAC recommendations for use of personal protective equipment for care of individuals with suspect or confirmed COVID-19 [Internet]. Toronto: Queen's Printer for Ontario; 2020 [cited 2020 May 5]. Available from: https://www.publichealthontario.ca/-/media/documents/ncov/updated-ipac-measures-covid-19.pdf?la=en

(6) World Health Organization. Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19) [Internet]. Geneva: The Organization; 2020 [cited 2020 Apr 10]. Available from: https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPPE_use-2020.1-eng.pdf

(7) Government of Canada. 3D printing and other manufacturing of personal protective equipment in response to COVID-19 [Internet]. Ottawa (ON): canada.ca; c2020 [updated 2020 Apr 3; cited 2020 Apr 10]. Available from: https://www.canada.ca/en/health-canada/services/drugs-health-products/medical-devices/covid-19-unconventional-manufacturing-personal-protective-equipment.html

(8) 3M. Technical bulletin: respirators beyond their shelf life—considerations [Internet]. Saint Paul (MN): 3M Company; 2020 [cited 2020 Apr 1]. Available from: https://multimedia.3m.com/mws/media/1807271O/respirators-beyond-their-shelf-life-considerations-technical-bulletin.pdf

(9) Subhash SS, Cavaiuolo M, Radonovich LJ, Jr., Eagan A, Lee ML, Campbell S, et al. Effectiveness of common healthcare disinfectants against H1N1 influenza virus on reusable elastomeric respirators. Infect Control Hosp Epidemiol. 2014;35(7):894-7.

(10) 3M. Technical bulletin: Cleaning and disinfecting 3M reusable elastomeric half and full facepiece respirators following potential exposure to coronaviruses [Internet]. Saint Paul (MN): 3M Company; 2020 [cited 2020 Apr 2]. Available from: https://multimedia.3m.com/mws/media/1793959O/cleaning-and-disinfecting-3m-reusable-respirators-following-potential-exposure-to-coronaviruses.pdf

(11) 3M Worker Health and Safety. 3M half facepiece respirator 7500 series training video. Chapter 10, replacement and cleaning [Internet]. Saint Paul (MN): 3M Company; 2013 [cited 2020 Apr 10]. Available from: https://youtu.be/KS7rKQ6uWuM

(12) Bessesen MT, Adams JC, Radonovich L, Anderson J. Disinfection of reusable elastomeric respirators by health care workers: a feasibility study and development of standard operating procedure. Am J Infect Control. 2015;43(12):1376.
(13) Government of Canada. List of hard-surface disinfectants for use against coronavirus (COVID-19) [Internet]. Ottawa (ON): canada.ca; c2020 [updated March 30, 2020; cited 2020 Apr 10]. Available from: https://www.canada.ca/en/health-canada/services/drugs-health-products/disinfectants/covid-19/list.html
(14) Lawrence C, Harnish DA, Sandoval-Powers M, Mills D, Bergman M, Heimbuch BK. Assessment of half-mask elastomeric respirator and powered air-purifying respirator reprocessing for an influenza pandemic. Am J Infect Control. 2017;45(12):1324-30.
(15) Heimbuch B, Harnish D. Research to mitigate a shortage of respiratory protection devices during public health emergencies: report for the period September 30, 2014-September 30, 2019 [Internet]. Albuquerque: Applied Research Associates, Inc.; 2019 [cited 2020 Apr 10]. Available from: https://www.ara.com/sites/default/files/MitigateShortageofRespiratoryProtectionDevices_2.pdf
(16) Nebraska Medicine. COVID-19 PPE guidance: extended use and limited reuse of disposable facemasks, respirators and protective eyewear [Internet]. Omaha: Nebraska Medicine; c2020 [updated 2020 Mar 19; cited 2020 Apr 7]. Available from: https://www.nebraskamed.com/sites/default/files/documents/covid-19/COVID-Extended-Use-Reuse-of-PPE-and-N95.pdf?date03212020
(17) Mumma JM, Durso FT, Casanova LM, Erukunuakpor K, Kraft CS, Ray SM, et al. Common behaviors and faults when doffing personal protective equipment for patients with serious communicable diseases. Clin Infect Dis. 2019;69(Suppl 3):S214-20.
(18) Zamora JE, Murdoch J, Simchison B, Day AG. Contamination: a comparison of 2 personal protective systems. CMAJ. 2006;175(3):249-54.
(19) Australian and New Zealand Intensive Care Society. ANZICS COVID-19 guidelines [Internet]. Melbourne: The Society; 2020 [cited 2020 Apr 10]. Available from: https://www.anzics.com.au/wp-content/uploads/2020/03/ANZICS-COVID-19-Guidelines-Version-1.pdf
(20) U.S. Food and Drug Administration [Internet]. Silver Spring (MD): The Administration; c2020. Press release, Letter to Dr. Robert Redfield, Director, Centers for Disease Control from Dr. Denise M. Hinton, Chief Scientist, Food and Drug Administration; 2020 Mar 28 [cited 2020 Apr 10]. Available from: https://www.fda.gov/media/135763/download
(21) Government of Canada. Optimizing the use of masks and respirators during the COVID-19 outbreak [Internet]. Ottawa (ON): canada.ca; c2020 [updated 2020 Apr 2; cited 2020 Apr 26]. Available from: https://www.canada.ca/en/health-canada/services/drugs-health-products/medical-devices/masks-respirators-covid19.html#a2
(22) U.S. Food and Drug Administration. Enforcement policy for face masks and respirators during the coronavirus disease (COVID-19) public health emergency (revised) [Internet]. Silver Springs (MD): The Administration; 2020 [cited 2020 Apr 10]. Available from: https://www.fda.gov/media/136449/download
(23) National Personal Protective Technology Laboratory. Respirator fact sheet [Internet]. Atlanta (GA): The Centers for Disease Control and Prevention; c2020 [updated 2020 Apr 9]; cited 2020 Apr 10. Available from: https://www.cdc.gov/niosh/npptl/topics/respirators/factsheets/respsars.html
(24) Centers for Disease Control and Prevention. NIOSH-approved particulate filtering facepiece respirators [Internet]. Atlanta (GA): cdc.gov; c2020 [updated 2020 Apr 9; cited 2020 Apr 26]. Available from: https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/default.html

(25) National Institute for Occupationals Safety and Health. Recommended guidance for extended use and limited reuse of N95 filtering facepiece respirators in healthcare settings [Internet]. Atlanta (GA): cdc.gov; c2020 [updated 2020 Mar 27; cited 2020 Apr 25]. Available from: https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html

(26) European Centre for Disease Prevention and Control. Infection prevention and control and preparedness for COVID-19 in healthcare settings. [Internet]. [updated March 31, 2020. Available from: https://www.ecdc.europa.eu/sites/default/files/documents/Infection-prevention-control-for-the-care-of-patients-with-2019-nCoV-healthcare-settings_update-31-March-2020.pdf

(27) Association for Professionals in Infection Control and Epidemiology. APIC position paper: extending the use and/or reusing respiratory protection in healthcare settings during disasters [Internet]. Washington (DC): The Association; 2009 [cited 2020 Apr 1]. Available from: http://www.apic.org/Resource_/TinyMceFileManager/Advocacy-PDFs/APIC_Position_Ext_the_Use_and_or_Reus_Resp_Prot_in_Hlthcare_Settings1209l.pdf

(28) Lynch JB, Davitkov P, Anderson DJ, Bhimraj A, Cheng VC-C, Guzman-Cottrill J, et al. Infectious diseases society of America guidelines on infection prevention in patients with suspected or known COVID-19 [Internet]: IDSA; 2020 April 28, 2020]. Available from: https://www.idsociety.org/practice-guideline/covid-19-guideline-infection-prevention/

(29) Viscusi DJ, Bergman M, Sinkule E, Shaffer RE. Evaluation of the filtration performance of 21 N95 filtering face piece respirators after prolonged storage. Am J Infect Control. 2009;37(5):381-6.

(30) Lin T-H, Tseng C-C, Huang Y-L, Lin H-C, Lai C-Y, Lee S-A. Effectiveness of N95 facepiece respirators in filtering aerosol following storage and sterilization. Aerosol Air Qual Res 2020;20:833-43.

(31) Rottach DR, Lei Z. Stockpiled N95 filtering facepiece respirator polyisoprene strap performance. J Int Soc Respir Prot. 2017;34(2):69-80.

(32) Health Canada. Optimizing the use of masks and respirators during the COVID-19 outbreak [Internet]. 2020 [updated March 28 2020. Available from: https://www.canada.ca/en/health-canada/services/drugs-health-products/medical-devices/masks-respirators-covid19.html

(33) Centers for Disease Control and Prevention. Release of stockpiled N95 filtering facepiece respirators beyond the manufacturer-designated shelf life: considerations for the COVID-19 response [Internet]. Atlanta (GA): cdc.gov; c2020 [updated 2020 Mar 6; cited 2020 Apr 10]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/release-stockpiled-N95.html

(34) ECRI. Clinical evidence assessment: safety of extended use and reuse of N95 respirators [Internet]. Plymouth Meeting (PA): ECRI; 2020 Apr 16 [cited 2020 May 01]. Available from: https://assets.ecri.org/PDF/COVID-19-Resource-Center/COVID-19-Clinical-Care/COVID-ECRI-N95-Respirators-updated-4.pdf

(35) Centers for Disease Control and Prevention. Strategies for optimizing the supply of isolation gowns [Internet]. Atlanta (GA): cdc.gov; c2020 [updated 2020 Mar 17; cited 2020 Apr 26]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/isolation-gowns.html

(36) U.S. Food and Drug Administration. FAQs on shortages of surgical masks and gloves [Internet]. Silver Springs (MD): The Administration; 2020 [cited 2020 Apr 10]. Available from: https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/faqs-shortages-surgical-masks-and-gowns

(37) Centers for Disease Control and Prevention. Strategies for optimizing the supply of N95 respirators: use of respirators approved under standards used in other countries that are similar to NIOSH-approved respirators [Internet]. Atlanta (GA): cdc.gov; c2020 [updated 2020 Apr 2; cited 2020 Apr 9]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/respirators-strategy/index.html#crisis

(38) National Personal Protective Technology Laboratory. Certified equipment list [Internet]. Atlanta (GA): Centers for Disease Control and Prevention 2020 [cited 2020 Apr 10]. Available from: https://www.cdc.gov/niosh/npptl/topics/respirators/cel/default.html
(39) 3M. Technical bulletin: comparison of FFP2, KN95, and N95 and other filtering facepiece respirator classes. Revision 2 [Internet]. Saint Paul (MN): 3M Company; [cited 2020 Apr 7]. Available from: https://multimedia.3m.com/mws/media/1791500O/comparison-ffp2-kn95-n95-filtering-facepiece-respirator-classes-tb.pdf
(40) Government of Canada. Important regulatory considerations for the reprocessing of single use N95 respirators during the COVID-19 response [Internet]. Ottawa (ON): canada.ca; c2020 [updated 2020 Apr 8]. Available from: https://www.canada.ca/en/health-canada/services/drugs-health-products/medical-devices/activities/announcements/covid19-notice-reprocessing-n95-respirators.html
(41) Health Canada. Reprocessing of N95 Respirators for Healthcare Professionals- Notice [Internet]. [updated April 17, 2020April 17, 2020]. Available from: https://www.canada.ca/en/health-canada/services/drugs-health-products/medical-devices/activities/announcements/covid19-notice-reprocessing-n95-respirators-health-professionals.html
(42) Toronto Region COVID-19 Hospital Operations Table. Sterilization and disinfection methods for reprocessing of N95 respirators during the COVID-19 pandemic: planning guidance for Toronto region hospitals Toronto: The Operations Table; 2020 Apr 19.
(43) Provincial Infectious Diseases Advisory Committee. Best practices for cleaning, disinfection and sterlization of medical equipment/devices in all health care settings, 3rd edition [Internet]. Toronto: Queen's Printer for Ontario; 2013 [cited 2020 Apr 26]. Available from: https://www.publichealthontario.ca/-/media/documents/bp-cleaning-disinfection-sterilization-hcs.pdf?la=en
(44) CADTH. Optimization of N95 Respirator Masks During Supply Shortages - Round Up (CADTH Horizon Scan) [Internet]. Ottawa, ON: CADTH; 2020 Apr [cited 2020 Apr 30]. Available from: https://cadth.ca/sites/default/files/covid-19/er0009-optimization-of-n95-respirator-masks-during-supply-shortages.pdf
(45) Centers for Disease Control and Prevention. Strategies for optimizing the supply of eye protection [Internet]. Atlanta (GA): cdc.gov; c2020 [updated 2020 Mar 17; cited 2020 Apr 10]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/eye-protection.html
(46) Public Health Ontario. Synopsis: COVID-19: what we know so far about...reuse of personal protective equipment [Internet]. Toronto: Queen's Printer for Ontario; 2020 [cited 2020 Apr 4]. Available from: https://www.publichealthontario.ca/-/media/documents/ncov/covid-wwksf/what-we-know-reuse-of-personal-protective-equipment.pdf?la=en
(47) Robinson GL, Hitchcock S, Kpadeh-Rogers Z, Karikari N, Johnson JK, Blanco N, et al. Preventing viral contamination: effects of wipe and spray-based decontamination of gloves and gowns Clin Infect Dis. 2019;69(Suppl 3):S228-S30.
(48) Kpadeh-Rogers Z, Robinson GL, Alserehi H, Morgan DJ, Harris AD, Herrera NB, et al. Effect of glove decontamination on bacterial contamination of healthcare personnel hands. Clin Infect Dis. 2019;69(Suppl 3):S224-S7.
(49) Davies A, Thompson KA, Giri K, Kafatos G, Walker J, Bennett A. Testing the efficacy of homemade masks: would they protect in an influenza pandemic? Disaster Med Public Health Prep. 2013;7(4):413-8.
(50) van der Sande M, Teunis P, Sabel R. Professional and home-made face masks reduce exposure to respiratory infections among the general population. PLoS One. 2008;3(7):e2618.
(51) Centers for Disease Control and Prevention. Use of cloth face coverings to help sow the spread of COVID-19 [Internet]. Atlanta (GA): The Centers; 2020 [cited 2020 Apr 10]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/diy-cloth-face-coverings.html

(52) Chughtai A, Seale H, Macintyre C. Use of cloth masks in the practice of infection control: evidence and policy gaps. Int J Infect Control [Internet]. 2013 Sept 09/06 [cited 2020 Apr 10]; 9(3):[about 12 p.]. Available from: https://www.semanticscholar.org/paper/Use-of-cloth-masks-in-the-practice-of-infection-and-Chughtai-Seale/f0b31640fd555dfc32d44af2009bacc416273ef9

(53) MacIntyre CR, Seale H, Dung TC, Hien NT, Nga PT, Chughtai AA, et al. A cluster randomised trial of cloth masks compared with medical masks in healthcare workers. BMJ Open. 2015;5(4):e006577.

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

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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 is wide variety of 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
N95 respirators	Disposable N95 respirators	×	✓	✓	✓	• There are a number of different validated sterilization and disinfection methods for decontaminating N95 respirators
	Reusable elastomeric respirators	✓	✓	✓	✓	• Disinfect by submerge in water and bleach; filter cartridges are removed and replaceable • Clean using disinfectant wipes
Surgical/ procedure masks	Disposable surgical/ procedure masks	×	✓	✓	✓	×
Isolation gowns	Disposable isolation gowns	×	✓	✓	✓	×
	Reusable cloth 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, reusable items cleaned/disinfected, and N95 respirators placed in the appropriate receptacles for reprocessing

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