

Considerations for Making Facemasks as a Last Resort when there is no Availability of N95 Respirators or Facemasks

Purpose

Many people have contacted the Washington State Department of Labor & Industries (L&I) for information on making homemade masks. As the COVID-19 pandemic continues to expand, healthcare facilities face shortages of personal protective equipment (PPE). Because some people are making homemade masks, L&I's Safety and Health Assessment and Research for Prevention (SHARP) Program assembled information about materials and designs.

Homemade masks are a last resort when the only other choice is using nothing at all. Homemade masks likely offer minimal, if any, respiratory protection, could increase the risk of infection, and may provide a false sense of security. **Homemade masks are not PPE since their ability to protect healthcare workers is unknown.** Evidence-based information regarding protection provided by homemade masks is very sparse and of poor quality. Caution should be exercised when considering this option.

Every effort to obtain and extend the use of appropriate respiratory protection and comply with the Centers for Disease Control and Prevention's (CDC) **Strategies for Optimizing the Supply of N95 Respirators** and **Strategies for Optimizing the Supply of Facemasks**, should be undertaken before resorting to homemade masks. This includes using administrative and engineering controls, extending the use of known respiratory protection, using PPE only when required, and consulting with healthcare and public health officials. The strategies are also listed in order of priority and preference in the **Checklist for Healthcare Facilities: Strategies for Optimizing the Supply of N95 Respirators** during the COVID-19 Response.

This information does not substitute for an employer's responsibility to provide the appropriate level of respiratory protection to employees. Workers should be trained on the use and limitations of all PPE, and they should understand the limitations of homemade masks before wearing one. The training should include review of the CDC guidance on optimizing facemask use and considerations for using homemade masks. For example, in an exposure situation, homemade masks should be used in combination with a face shield that covers the entire front (that extends to the chin or below) and sides of the face. Homemade masks should be labelled as such especially if the mask is made of material that looks similar to certified masks.

This document may be superseded by additional state and federal guidance. This document is not an endorsement of the use of homemade masks of any particular design, nor are any representations being made that adequate protection will be provided to healthcare workers who use homemade masks, or that the use of homemade masks is compliant with any local, state, or federal regulation, including the L&I occupational safety and health regulations.

Homemade Mask Design Approaches

1. Build a mask that encloses the area around the nose and mouth, from the bridge of the nose down to the chin, and extending onto the cheek beyond the corners of the mouth so no gaps occur when talking or moving.
 - Consider different shapes and sizes of people's heads. The features of a good mask are a malleable metal piece, e.g. twist tie, that conforms to the bridge of the nose and mask sides that hug the face, such as sides that are pleated or stretchable.
 - Consider ties that pull the top of the mask over the crown of the head, and pull the lower section snugly behind the head. Elastic straps to secure the mask to the face may fit poorly but require less coordination.
2. Mask should be breathable but made from fabric or materials that are tightly woven, a blown non-woven material, or a combination that can be formed into a thick, dense bed. Consider multiple layers of fabric or a pocket design that allows for an insert.
 - There is significant variation in commercial fabrics. The goal is to create a physical barrier between the wearer and the immediate environment and where air travels through the mask instead of around it.
 - The materials tested in one study¹, where participants created their own facemasks from common materials, ranged from high to low 'filtration efficiency.' Ranked from better to worse, the tested materials included: vacuum cleaner bags, tea towels, cotton blends, antimicrobial pillowcase, linen, regular pillowcase, silk and cotton t-shirt. Despite high filtration efficiency, vacuum cleaner bags and tea towels were not recommended because they are hard to breathe through as evidenced by the documented high pressure drop. These materials will vary in quality and density and are not standardized, so the purchaser must make a best estimation. If double layering the material, beware of increased work of breathing. While not part of this study, non-woven fabric materials can have high filtration efficiency and may be suitable.
 - Materials that allow moisture and air out but limit droplets coming in are more likely to be protective. Pocket designs may allow insertion of a non-washable disposable layer, including non-woven materials such as tissues which may increase filtration efficiency.
3. The mask should be tolerant of expected amounts of moisture from breathing.
 - Exhaling into the mask will build up condensation. A moist facemask is uncomfortable to wear and may create a greater risk of viral penetration and greater risk of infection. While the mask needs to be able to withstand normal breathing, the mask will need to be changed

¹ Davies et al. Testing the Efficacy of Homemade Masks: Would they Protect in an Influenza Pandemic? DOI: 10.1017/dmp.2013.431

frequently. In a multilayered mask consider an outer material tolerant to moisture from the environment.

Design Assistance

Consider the design approaches above related to fit, filtration and prevention of moisture buildup for your facemask. For those innovating with their own designs, replicating the design of a surgical mask may be used as a starting point. Adapt designs to try to include fine gauge metal or twist-tie to conform to the nose. Elastic straps may be less adaptive to a tight and comfortable fit and therefore ties may be a design improvement.

Available links:

- <https://www.youtube.com/watch?v=tDt02kUpP9Q>
Surgical-style mask adopted by Seamstresses United, includes a pocket insert for non-woven fabric and metal contouring on the nose bridge for improved fit.
- <https://www.providence.org/lp/100m-masks>
Surgical-style mask used in Providence 100 Million Mask campaign includes a design tutorial using fabric ties. Includes resources for emerging manufacturers, hospitals, and community sewers as well as a face shield tutorial. Face shields provide splash protection for surgical masks.
- <https://www.deaconess.com/How-to-make-a-Face-Mask>
Surgical-style mask with elastic or ties, includes a video tutorial by Deaconess. Includes a directory for matching mask makers with organizations in need.
- <https://sweetredpoppy.com/how-to-sew-a-fitted-fabric-mask/>
This is a fitted-style mask pattern that is different from a surgical-style pattern. Pattern variations include elastic, fabric ties, and a metal insert over the nose bridge.

Manufacturing and packaging homemade masks

- **Your health**
Do not make masks if you are sick or think you might be getting sick. Wash your hands before handling mask making materials, and practice good hand hygiene throughout the making process. Do not eat or drink while making masks.
- **Your environment**
Keep all mask materials away from household members who may be sick, are not involved in mask making, and animals. Sanitize work surfaces and tools with a disinfectant before making masks.

- **Packaging**

Seek guidance from the institution where you will donate your masks regarding mask packaging. Consider these packaging practices:

- Wash material on a hot cycle before making masks.
- Wash finished masks in hot water and unscented detergent and dry with high temperature before packing.
- Pack in quantities of 10 or fewer to allow flexibility in distribution at the point of use. Label the outside of the packing bag with the mask style and quantity.
- Inform the institution where you will donate your masks that they must review the CDC Strategies for Optimizing the Supply of PPE and Equipment, specifically guidance on N95 Respirators, Facemasks, and Eye Protection before resorting to use of a homemade mask.

Using Homemade Masks

- **Donning and Doffing Reusable Masks**

- Masks must be made from washable material such as fabric. Choose a fabric that can handle high temperatures without shrinking or otherwise deforming.
- Each worker should have multiple masks that are able to fit their face (see sizing concerns/recommendations above). Masks should be changed ideally at the same frequency as disposable N95 respirators. At a minimum masks should be changed when condensation builds up from breathing, or after a gross contamination event. Use a face shield over the mask, if available.
- Dirty masks and clean masks must be clearly identified. Both should be in sealed containers to prevent contamination.
- Before donning a mask, wash hands and put on clean gloves. Take clean mask out of container. Don by placing the exterior of the mask into your gloved hand. Place inside of mask over your face covering your nose and mouth. Secure top strap over crown of head, secure bottom strap behind head. Adjust fabric to close any gaps – pay attention to cheeks and sides of nose. Pinch the adjustable clip by the bridge of the nose, if available.
- To doff the mask, first use hand hygiene to ensure you are not contaminating your hair/head and don new gloves. Do not touch the front of your mask as it may be contaminated. Tilt your head forward. Then, use two hands to grab the bottom strap, pull to the sides, then over your head. Or, if using ties, untie the lower strap first.
- Next, use both hands to grab the upper strap, pull to the sides, then over your head. Keep

tension on the upper strap as you remove it, which will let the mask fall forward. Or, if using ties, untie the upper strap last.

- While holding the mask by the top strap only, put dirty mask in the dirty container, seal shut to avoid contamination. Doff rest of PPE, do hand hygiene, don new PPE or stay in clean area.

- **Washing Masks**

Wash dirty masks between each use. Wash in hot water. Dry completely and at a high temperature. Cotton masks may need to be ironed after washing to ensure no rolls or gaps on sealing surface.

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