Self-Organization of Personal Protection and that of the Population: DIY Masks

Vall de Sant Daniel
25th of March 2020
Contact: people_vs_pandemics@riseup.net

Disclaimer:
*Of course there is no guarantee that the use of DIY-equipment will protect anyone from being infected with coronavirus!*
*People with cardiovascular diseases should not use homemade masks (because of the increased effort of breathing)!*

Resume
- Homemade facemasks are useful to slow the spread of the infection
- Any cloth is better than nothing, but non-woven textiles filter better
- You need to find the middle way between filtering and breathability
- A good fit of the mask is important
- Make proper use of the mask
- **Wash your hands & practice social distancing**
- We can do this together!

Why masks?
First, we would like to clarify a couple of things we keep hearing: Hopefully, at this point we don’t have to convince anybody that covid-19 is not “just like a flu”. SARS-CoV-2 is not a foreign virus or a product of biological warfare (Andersen et al. 2020) and there seems to be no evidence of mother-to-child transmission (Stower 2020). Luckily, as difficult as the situation is, both for the public health crisis as well as for the **social inequalities that become even more visible**, there are a number of effective measures that can help us to protect ourselves and others. So stay at home and if you can, wear a mask in case you have to go out for something (and of course, wash your hands!). In this document, we resumed information about the production of DIY facemasks.
With the general shortage of masks, even for professional use, making masks at home has become a "trending topic" in recent days (e.g. #millionmaskchallenge).
But let’s have a look, should we wear masks or not? Many people are confused by the somewhat ambiguous declarations of health institutions.
in the past weeks. The authorities had spread the idea that the masks were rather useless for the general public. It is true that a badly worn mask can be counterproductive, but we assume that the intention was partly a tactic to prevent the hoarding of masks by a panicked population and to retain more material for the health sector (makes sense!).

However, we suggest that the responsible use of face masks should be encouraged, because masks protect a little bit the wearer and to a greater degree the surrounding people, if the wearer is potentially infected (and, as the proportion of infected people in the population is rising, odds are that you pertain to this group). Therefore, it would be best, if EVERYONE would be wearing a mask (Bin-Reza et al. 2012, Davies et al. 2013, MacIntyre et al. 2009, van der Sande 2008). So if you are one of the “lucky” hoarders who have professional masks, wear them. Even better, donate them to a hospital, health center, nursing home or similar, as they are much needed. If you don’t know how to sew, collaborate with someone who knows how to sew yours and theirs.

Remember: the most important thing is still correct hand hygiene and not touching your eyes, mouth or nose! But masks are also good for this, because if you have them on, you don’t touch your face as much.

- DIY-masks are very useful because the production of masks cannot meet the current global demand.
- You don't have to buy professional masks for private use! They have to be reserved for professionals and risk groups.
- It would be good if all people that work with risk groups (e.g. in nursing homes) or who have a lot of contact (e.g. in supermarkets, bus drivers) could always wear a mask.
- As there is already a brutal shortage in hospitals in badly affected regions, it also makes sense to produce them at home for health personnel (and for all people who also work in the hospital, but because they are not on the front line, upon shortage, they do not receive protective material), although there may be concerns about quality and issues with bureaucracy.

How does a mask reduce the infection with airborne diseases?
- It filters the air you breathe;
- it prevents your particles from getting out if you sneeze or cough;
- it discourages you from touching your mouth and nose.

The mask as a filter
Viruses are VERY small (0.1 μm, that is 1000 times smaller than a human hair). Therefore, intuitively we assume that DIY-masks won’t help. But
filters, even if they have much bigger holes than a virus, do work. And that’s for two reasons: Firstly, viruses don’t fly around alone. They usually travel with the droplets produced by sneezing, coughing or talking (droplets between 1 and 1000 µm diameter) (Han et al. 2013). If they are large, these droplets can contain many viruses, but are quite effectively filtered out by masks (Rengasamy et al. 2010). On the other hand, very small particles (<0.3 µm) also filter surprisingly well. This does not seem logical, but by laws of physics (for nerds: Brownian motion), microscopic particles move in a zig-zag because they collide all the time with the molecules in the air. Therefore, the fibers of the filter material quite easily trap very small particles. However, particles with a size closest to 0.3 µm are quite hard to catch for filter, professional filters receive an electrostatic charge for these (but at least we trap the other particles, thereby reducing the overall virus load). More useful info about filtering and DIY-masks: https://smartairfilters.com/en/blog/category/coronavirus/

There are infinite possible materials and without proper equipment it is impossible to determine the real filtering effectiveness of household-material. When choosing the material, be careful, woven textiles, whose structure consists of a regular network of fibers, have very large holes that are like portals for viruses (Fig. 1).

![Figure 1. Photo of cotton fabric at 40x magnification.](image)

Much better filters are non-woven (meltblown) textiles, where the fibers are randomly aligned (Figs. 2, 3 and 4). Professional filters are made of these materials. To increase the effectiveness of the mask, it seems that another possibility would be to bathe the filter material or the mask in a
saline solution (30 g/l). When drying, microcrystals of salt remain on the tissue, destroying the viruses by osmotic pressure (Quan et al. 2017). When producing masks at home, one must always find the middle ground between permeability and filtering ability. If you cannot breathe through the material (e.g. baking paper, proposed in some videos), the air will enter from the sides and your mask will not protect you!

Figure 2. Disposable cleaning cloth #1 at 40x magnification.

Figure 3. Disposable cleaning cloth #2 at 40x magnification.
Small particles don't travel that far, but remain suspended in the air for quite a time. For these particles, it is important to respect the safety distance (min. 1-2 m) and to aerate the closed spaces where people gather.

With the information we have gathered and thinking about the materials available right now (in Spain and other countries it is not possible to leave your house and most shops, except for food and pharmacy, are closed) we recommend making masks that cover nose and mouth in the most efficient way (see links to patterns) with the following materials:

1. Exterior: Non-elastic cotton (cloths, sheets, shopping bags are fine, but it is better not to use T-shirt fabric or similar).

2. Interior: A. Reusable filters that can be washed and sewn (thick wadding if available, yellow "Vileda" type cloth or similar microfiber).
   B. Disposable filters that can be thrown away safely (disposable cleaning cloth, kitchen paper or tissue, dry baby wipes, do not buy those with more chemicals, the perfume can also overwhelm some people). Try to breathe through the material. Vacuum cleaner bags or filter material for furnaces or air conditioners (HEPA, MERV 13+) can be used, but we didn’t test it.

Additional information on filters:

Very good video (except when he comes to the survival time of virus in fabrics, which is unproven):
Comfort and manipulation

Before choosing a filter and sewing it up or going out, check that you can breathe through it. Fundamental to comfort is the ease or difficulty of breathing through the mask. It’s normal that you notice a slightly increased effort breathing (otherwise the mask will filter little), but not so much that you have difficulties wearing the mask for a prolonged time. This can be regulated very well with the filtering material (type of material and number of layers) and is very important in children, where a balance must be found between filtering and comfort, so that the mask is not removed.

The fit of facemasks is key for their effectiveness. Try to make the edges of the mask closing as tight as possible without letting air pass through the top and sides (Guha 2017). A wire can be inserted over the nose to improve fit. At the same time, you have to be comfortable wearing the mask. This is an essential, so that people do not take the mask off during use. DIY-masks can be more comfortable than commercial ones, especially for children and non-standard (i.e. adult male) head shapes. It’s time to shave beards, as they decrease the fit of facemasks!

People wearing glasses can take advantage and put them on top of the mask increasing the fit with the contour of the face (the greatest gaps are usually between cheeks and nose). To reduce fogging, you can apply shaving cream or solid soap on the lenses and wipe it off with a soft cloth when dry.

Once "exposed", the mask should not be touched from the outside until you take it off. Always wash your hands before and after. We recommend washing the masks with soap to remove potentially attached virus. Another possibility would be to let the masks airing for 48-72 h. Although currently there is little confirmed information on how long the virus survives on textiles, probably not as long as on other materials such as steel or plastic (where it can remain active for up to 9 days! See Fig. 4).
Figure 4. Survival time of different coronaviruses outside the body, for different surfaces (Kampf, 2020)

The mask should not be removed or lowered during use. Be careful when removing the mask, those that fit behind the head should be removed from the bottom strip. Do not touch your face with dirty hands. Wash your hands before removing the mask (https://www.youtube.com/watch?v=6H_nHEZtjuM9), as well as your hands and face immediately after removing the mask. Here is a video showing you wearing a professional mask: https://www.youtube.com/watch?v=zoxpvDVo_NI

Masks should be changed after several hours of use to be effective. At least after a day’s work, they should be washed and used cleanly the next day, which is why it is advisable to have at least two masks per person. At home, it seems that the best thing is to wash the mask in the washing machine with soap.

Concluding, we would like to say that that we would like ALL to go out to enjoy, to live, but also to demand a change in the current socio-political system that, virus aside, is responsible for the drama that many people are experiencing right now at the level of health, but also in other aspects of quality of life. Maybe this crisis will help us to rethink society and to value the important stuff. However: when this is over, the other problems of the world won’t disappear magically, so we need to organize!
**Links with patterns**
(there are many!!)

Our favorite: Pattern in different sizes with or without pocket (we recommend the pocket) and that explains two ways of holding them. It is very comfortable and covers very well. If you add the wire in the nose area before putting it on, the fit is very good:

https://www.craftpassion.com/face-mask-sewing-pattern/

We’ve made them like this:

Other models:
https://www.youtube.com/watch?v=eLOh8AoXvcl
https://www.instructables.com/id/DIY-Cloth-Face-Mask/

Surgical masks:
https://mustsharenews.com/cloth-face-mask/
https://www.youtube.com/watch?v=S9RWII2-5_4
Bibliography


