How to set up an emergency isolation room inside a home or apartment for a suspected infected occupant.

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See also: Simplified and Idealized Illustration of a Portable Fan/Filter (CR) Box in a Classroom

Revisions:
2022.01.24 added studio apartment example.

This is a triage approach and by no means implied to substitute the combined advice from a professional engineer and physician with experience in negative pressure rooms. There are many factors to consider in selecting the size of fans, filters and humidifiers. Consult a professional for advice.

When occupying a home with persons quarantined (healthy people living with suspected infected person(s)) wear proper personal protective equipment. I know that might be difficult for some, but it is only for the prescribed time and that is short relative to a death or a lifetime of challenges (see resources at bottom of this page).

Note: due to the urgency of this bulletin, there may be spelling and grammatical errors...if butchering the English language drives you crazy to the extent that you won't read the advice - all I can say is - good luck.
Figure 1. Home-based isolation bedroom with attached bathroom. The objective when a bathroom exhaust fan is available is to keep the bedroom under negative pressure relative to rest of the home. This is done by sealing up the bedroom from the rest of the home as noted, and keeping the bathroom exhaust fan on. Introduce outdoor air with an open window to maintain less than 800 parts per million (ppm) of carbon dioxide (CO2). Remove airborne particles with a minimum MERV 13 filter/fan assembly (see images below) and humidify room air with a portable unit fitted with ultraviolet light (UV-C disinfection). Use an electric space heater to maintain best acceptable thermal conditions during cold periods.
Figure 2. Home-based isolation bedroom with attached bathroom. The objective when a bathroom exhaust fan is NOT installed, and a window mounted fan is not possible; keep the bedroom under negative pressure relative to rest of the home. This is done by sealing up the bedroom from the rest of the home as noted, and installing a box fan between the bedroom and bathroom. Ideally the doorway opening should be creatively reduced to the size of the fan only but making it flexible (think curtain) for the quarantined person to use the washroom. This will aid in pressurizing the air in bathroom to force bedroom air out the bathroom window. Keep the box fan on. Introduce outdoor air with an open bedroom window to maintain less than 800 parts per million (ppm) of carbon dioxide (CO2). Remove airborne particles with a minimum MERV 13 filter/fan assembly (see images below) and humidify room air with a portable unit fitted with ultraviolet light (UV-C disinfection). Use an electric space heater to maintain best acceptable thermal conditions during cold periods.
Figure 3. Home-based isolation bedroom with attached bathroom. The objective when a bathroom exhaust fan is NOT installed, and a window mounted fan is not possible and fans are not readily available (this approach relies on the wind and is an emergency approach only until a fan can be installed); keep the bedroom under negative pressure relative to rest of the home. This is done by sealing up the bedroom from the rest of the home as noted, and opening up the bedroom and bathroom windows. Ideally the bedroom window should open into the wind (think sail) and bathroom window against the wind (think blowing across the top of an open bottle). When the wind is blowing it is possible (but not reliable) to use this set up to draw outdoor air into the bedroom and have it pulled out of the bathroom window (have your kids study Bernoulli). Adjust the bedroom window opening to maintain less than 800 parts per million (ppm) of carbon dioxide (CO2). Remove airborne particles with a minimum MERV 13 filter/fan assembly (see images below) and humidify room air with a portable unit fitted with ultraviolet light (UV-C disinfection). Use an electric space heater to maintain best acceptable thermal conditions during cold periods.
The objective when a bathroom exhaust fan is NOT installed but it is possible to install a window mounted exhaust fan; keep the bedroom under negative pressure relative to rest of the home. This is done by sealing up the bedroom from the rest of the home as noted, and installing a window mounted exhaust fan in the bathroom. Creatively reduce the window opening to just the size of the fan (think cardboard). Keep the exhaust fan on. Introduce outdoor air with an open window to maintain less than 800 parts per million (ppm) of carbon dioxide (CO2). Remove airborne particles with a minimum MERV 13 filter/fan assembly (see images below) and humidify room air with a portable unit fitted with ultraviolet light (UV-C disinfection). Use an electric space heater to maintain best acceptable thermal conditions during cold periods.
Figure 5. Home-based isolation bedroom WITHOUT attached bathroom. The objective when a bathroom with exhaust fan is NOT available is to keep the bedroom under negative pressure relative to rest of the home. This is done by installing a window mounted exhaust fan to pull air out of the bedroom and encouraging uncontaminated/treated air from the home to travel under the door into the bedroom. Creatively reduce the bedroom window opening to just the size of the fan (think cardboard). Keep the exhaust fan on. NOTE: this approach requires those home occupants not in quarantine - to be healthy verified by testing and executing low risks in day to day activities. The replacement air must be of good quality. Adjust windows in home to maintain less than 800 parts per million (ppm) of carbon dioxide (CO2) Remove airborne particles with a minimum MERV 13 filter/fan assembly (see images below) and humidify room air with a portable unit fitted with ultraviolet light (UV-C disinfection). Use an electric space heater to maintain best acceptable thermal conditions during cold periods.

**WARNING:** This approach (and others noted) carries a potentially high risk of introducing carbon monoxide (CO) into the home from natural draft (unsealed) appliances and fixtures such as furnaces, boilers, water heaters, stoves, fireplaces, and pollutants from attached garages etc. At no time should the exhaust fan operate unless the windows in the home are adjusted open to prevent back drafting. If this describes your home and you have no other alternative for an isolation room, then at the very least purchase an aviation-grade carbon monoxide sensor and alarm similar to those made by CO Experts. Install safety alarm in a common hallway serving the occupied spaces. These alert at lower and much safer values than UL/CSA products. Expect to pay a premium for this safety device. If you do not know if you have natural draft appliances and fixtures, consult a
mechanical contractor or engineer. Read our legal disclaimer noted at the bottom of the page. This is not child's play - carbon monoxide kills. If you are unclear what this means, you are better off battling COVID than dying unnecessarily of CO poisoning. This is a case where professional advice must be sought out...you have been warned.

Figure 6. Home-based isolation bedroom sharing a common bathroom with a non-isolated bedroom. The objective is to keep the bedroom under negative pressure (right side) relative to rest of the home; and be able to make the bathroom available to the non quarantined person (left side) (see Figure 7 below). This is done by sealing up the isolated bedroom from the rest of the home as noted, and exhausting with the ceiling or window mounted exhaust fan (as shown) in the bathroom. If necessary, creatively reduce the window opening to just the size of the fan (think cardboard). Keep the exhaust fan on. Introduce outdoor air into the isolated room with an open window to maintain less than 800 parts per million (ppm) of carbon dioxide (CO2). Remove airborne particles with a minimum MERV 13 filter/fan assembly (see images below) and humidify room air with a portable unit fitted with ultraviolet light (UV-C disinfection). Use an electric space heater to maintain best acceptable thermal conditions during cold periods.
Figure 7. As above in Figure 6 but shown set up for bathroom access to non quarantined person. The objective is to keep the air from the isolated bedroom from contaminating the rest of the home/apartment/condo. The non quarantined person should coordinate with the isolated person so that the bathroom is used for as short as period of time as possible. To change over, the quarantined person should vacate the bathroom, close the bathroom door and remain in bed with the bedroom portable filter on. The bathroom exhaust fan should be on all the time. After a few minutes of purging the bathroom air, the non-quarantined person should don personal protective equipment (PPE) and enter the bathroom to disinfect. Use N95 grade mask if available and face shield...search online for best practices) and seal the bottom of the isolated room door with a towel. If it is a pocket door tape the perimeter gaps with masking tape. Continue to let outdoor air flow into the bathroom from the open window to maintain less than 800 parts per million (ppm) of carbon dioxide (CO2). Remove airborne particles with a minimum MERV 13 filter/fan assembly (see images below) and humidify room air with a portable unit fitted with ultraviolet light (UV-C disinfection). Use an electric space heater to maintain best acceptable thermal conditions during cold periods.
Figure 7a. Studio apartment based isolation strategy for those on a tight budget. The objective is to maintain a steady supply of outdoor air mixed with filtered air flowing through the apartment into the bathroom and out the bathroom exhaust fan. If you can not afford a CO2 meter to regulate outdoor air flow, then control the window opening so that the baseboard heater doesn't freeze. For very cold climates you may have to cycle the opening times. If the stove and range are electric run the bathroom fan continuously. If you have a gas range increase the window opening during times of use.

Leave the bathroom door open except for times requiring privacy. Block the entry door threshold with a towel. A single MERV13/Filtrete 1900 strapped to the backside of a box fan is better than no filtration (see Fig 8, item 1) If you can afford it, build a four-panel filter/fan assembly known as #corsirosenthalbox (Fig. 8, item 5).

Occupants must be masked with ~N95's (see Fig. 11), work out schedules for masking breaks, allow 20 to 30 min between bathroom rotations to allow the exhaust fan to fully replace bathroom air with air from the living space.
Work out schedules for eating...uninfected and infected person should not be unmasked at the same time...the greater the time between eating rotations the better. Objective is for uninfected person to NOT breathe any residual contaminated air left behind by the infected person while unmasked.

Infected person should be positioned closest to the bathroom exhaust and the uninfected person closest to the open window.

Figure 8. Examples from the authors inventory of DIY filter/fan assemblies, instruments and humidifiers. All the components are available online.

1. Two stage filter/fan assembly (1” MERV 8 then a 1” MERV 13 then the fan). Strap filters to the inlet of the fan with zip ties. Air should enter the MERV 8 first then the MERV 13 then the fan. Manufacturers will mark the proper airflow direction on the filters...do not reverse. This set up will do most bedrooms with the lower cost MERV 8 pre-filter extending the life of the more expensive MERV 13 filter.

2. One stage filter/fan (4” MERV 13 then the fan). Strap filter to the inlet of the fan with zip ties. Air should first enter the MERV 13 then the fan. This set up will do most bedrooms. Without the MERV 8 pre-filter use a 2" or 4" MERV 13 filter.


4. ARANET4 CO2 sensor. Available through https://naltic.com/aranet4-co2.html
5. One stage - 4 sided filter/fan (MERV 13). Assemble the four filters in a box shape with construction tape using the shipping box from the fan on the bottom. Place the box fan on top of the filter assembly and seal to filters with construction tape. Airflow is through the filters then out the top.

6. Honeywell UV-C humidifier. Will do about 150 sf bedroom. This is an occupant controlled device...adjust fan flow so that the room moisture remains below condensation point on windows.

Last words: I spent nearly 40 years designing indoor climates...this is triage...are there better ways of doing this? Yes. There are more sophisticated devices and instruments and controls but for these consult a professional...what I have provided here will serve in a pinch if someone must be isolated.

Stay safe and please for the sake of our our already stressed out healthcare workers - do your part to keep others COVID free.

My three rules to stay safe:

1. There is no definitive safe social distance nor time- the virus and the particles it travels in/on does not have an onboard navigational system or a clock! The air is a conveyor belt...where it goes - so goes the virus. Physics wins every time. Just stay as far away from others as you can!

2. Wear proper masks properly in the presence of any unknown risks including friends and family. See your health authorities on masking protocols. Don't be delusional and think any fabric will do. Fabrics used for filters is a engineering science. Trust the science not the glossy sales brochure.

3. Personal and building hygiene is good but it is not a substitute for air hygiene which comes from ventilation and filtration. See your heath authorities for personal and building hygiene and ASHRAE for air quality strategies. See https://www.ashrae.org/technical-resources/residentialnew

Please sign the petition and encourage others to do so at https://www.covidisairborne.org/

Resources:
https://tinyurl.com/FAQ-aerosols
https://tinyurl.com/y36zolmz
https://tinyurl.com/y5zoannt

Additional Content: Treating the air in high use spaces such as home offices and bedrooms.
Figure 9. Authors home office...note the portable fan/filter on filing cabinet and humidifier on floor.
Figure 10. Authors 4 sided 1" MERV 13 filter/box fan assembly suitable for about a 200 sf room
Figure 10. Master bedroom...note the portable fan/filter on dresser. This is a HEPA/carbon filter. Not shown is the same portable UVC Humidifier as used above.
Figure 11. Authors sample of masks (elastomeric, N95 et al), rapid antigen test kits, environmental sensor (CO2, RH & Air Temperature), finger type: oxygen saturation and pulse meter

Figure 12. Personal story...I know from experience what it's like to almost die from respiratory failure. Short strokes - you and yours want to take every reasonable step to avoid becoming infected. Defend your personal air space, wear proper masks properly, get vaccinated with boosters, ventilate and filter the air in the spaces you occupy. If you or yours still become infected the resources you need at home are mostly affordable and its relatively easy to isolate those infected from those uninfected.
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