U.S. DEPARTMENT OF
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Lab Home Testing of Residential Isolation Space Control to Minimize Infectious Disease Transmission in Existing Single-Family Homes

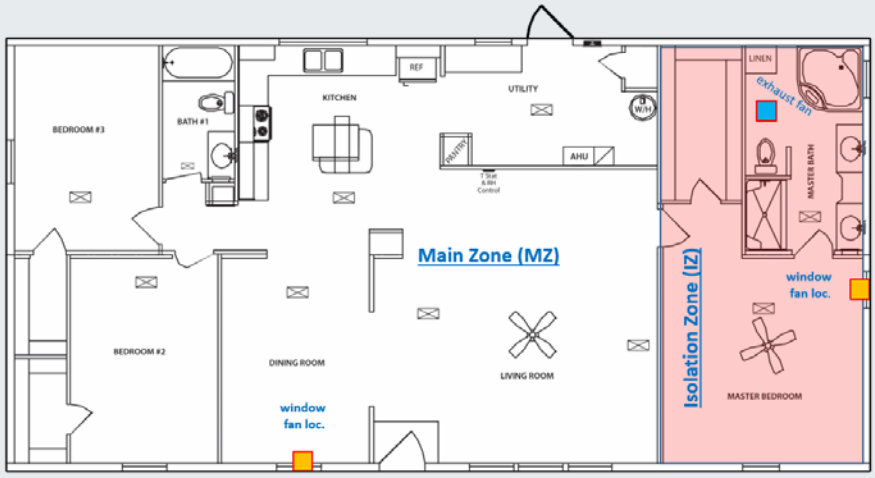

Figure 1. The FSEC Manufactured Housing Lab was used for experimentation with the master bedroom (pink) used for the isolation zone and the living room used as the safe zone, or main zone. *Image courtesy of FSEC*

Purpose

The FSEC Energy Research Center at the University of Central Florida performed research to test the effectiveness of interventions to isolate an ill person recovering from a contagious disease in a single-family home from the rest of the occupants in the home. Focus was placed on interventions requiring minor cost and effort on the part of the occupants.

Background

Existing evidence strongly suggests that viral infectious diseases can be transmitted via an airborne route across distances in indoor environments. Accordingly, sharing indoor space in the presence of infected individuals poses a major risk in the transmission of the disease. The public health emergency associated with SARS-CoV-2 makes controlling airborne transmission of respired viruses in indoor environments critical, especially in poorly ventilated indoor environments.

Common methods such as high MERV filtration, high ventilation rates, and related equipment can help mitigate the risk of airborne virus transmission and maximize health protection. However, most occupants are not likely to have the time or means for advanced measures found in hospitals such as creating a negative-pressure isolation zone (IZ) for a contagious person. However, in a single-family home, a basic IZ for the contagious person could be created with little cost and effort. The IZ could be in a bedroom with a door separating it from the rest of the house, such as a master bedroom. Ideally, a home would have at least two bathrooms, and the ill person's IZ would include the master bedroom plus a bathroom to limit exposure from sharing a bathroom. If the master bathroom has an exhaust fan, that would further improve containment of infection.

This research project, using the home layout in **Figure 1**, focused on testing relatively simple promising efforts that utilize existing or easy to acquire materials and simple processes that could create a negative-pressure IZ in single-family homes.

Methods

The primary metric used in this project to evaluate potential containment effectiveness is the pressure difference between the IZ and the main zone (MZ) (a minimum of -2.5 Pa, as per ASHRAE Standard 170). This means that containment is more likely to occur if the IZ is at least -2.5 Pa compared to the MZ. Because homeowners do not have manometers to measure pressure, they could test for depressurization by holding a piece of tissue paper at the bottom of the IZ's closed door undercut. This will not guarantee that at least -2.5 Pa is achieved, but will verify airflow control in the desired direction. If placed on the ground on the MZ side of the door, the tissue should get pulled into the IZ through the undercut. If it hangs limp, there is no significant pressure difference (meaning weak containment), and if it blows into the MZ, there is no containment.

Figure 2. An inexpensive window fan can aid with containment.
Photo courtesy of FSEC

Figure 3. A portable air conditioner can be used to aid with containment, and provide comfort to the isolation zone, because it is recommended that supply and return grilles in the isolation zone be closed off during containment. *Photo courtesy of FSEC*

Recommendations for Strong Isolation Zone Containment

- The infectious person should stay in a room with a closeable door. Placing them in a master bedroom with direct access to a bathroom will help limit exposure if there is a second bathroom available for healthy occupants in the home.
- Air pathways between the IZ and MZ should be sealed. The IZ door should remain closed at all times, except for occasional opening/closing as would be needed to tend to an ill person. All other doorways should remain open or at least cracked open.
- In the IZ only, the heating and cooling supply air grilles should be sealed off using duct tape or tape with paper or plastic over the grilles.
- The IZ should be kept at a lower air pressure than the MZ. This can be accomplished by placing a window fan in the IZ window arranged to blow air from the IZ to outdoors. A $32 window fan bought online for this project arrived within days and offered the most economical isolation control. This could also be done using a master bathroom exhaust fan with at least 100 CFM airflow. Many older existing exhausts are likely to produce inadequate containment, but would be better than using no other exhaust method.
  - Although it is expected that containment is only needed for a short-term period of less than a month, situations requiring longer-term containment should ensure that potential for moisture-related durability concerns is minimized. Such concerns arise when outdoor dew points are high (exceeding 72°F), and due to the long-term infiltration of the humid air that results from space depressurization. In such cases, space-cooling set points should not be set below the outdoor air dew point. This is especially important in homes with vapor-impermeable wall and/or floor coverings, such as vinyl wallpaper.
- If there is not an operable window in the IZ, a window fan capable of moving about 300 CFM airflow can be placed in a window anywhere in the MZ. The fan must be arranged to blow air from outdoors into the MZ for this method to work.
- Sealing off IZ supply grilles may result in uncomfortable conditions for the isolated person, so a room space heater or room air conditioner may be needed. An electric space heater and a room air conditioner could cost $75 and $300–$600, respectively.
- A portable room air conditioner with around 7,000 Btu/h output that exhausts air outdoors can provide cooling and help provide adequate negative IZ pressure with respect to MZ when it is operating, but containment ends whenever the unit cycles off unless another source of IZ exhaust is also used.
- Achieving adequate depressurization by opening windows is unpredictable because containment would be intermittent depending upon wind speed and direction. ■

Figure 4. Window fan installed in the main zone providing outdoor air into the home. This pressurizes the main zone, resulting in a lesser pressure in the closed-off isolation zone with reference to the main zone, which helps with containment. *Photo courtesy of FSEC*

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