Study Objective
As a result of the Covid-19 pandemic, there is an increased awareness for the need of surge capacity temporary isolation spaces. Having an ample number of "on demand" isolation environments is crucial during a pandemic or event that greatly increases demand for hospital beds. Depending on the type of acausal patient, it is important to be able to quickly create a clean negative or positive pressure environment. The CDC guidelines for isolation spaces include a minimum of 12 air changes per hour, a minimum negative pressure of 0.01" W.G. with the surrounding space, and a significant reduction in particles (0.5 µm and larger) via use of HEPA filters. The objective of this study was to show how a portable isolation unit can dramatically reduce particle counts inside surge capacity hospital rooms and meet the CDC guidelines listed above.

Materials and Method:
IsolationAir® (Air Innovations, Syracuse, NY) system creates positive or negative pressure through air ducting mechanisms. The system also maintains room temperature and uses H2A and filtration and ultra-violet light to remove air contaminants within the patient room. Once familiar with the equipment and room installation of the unit takes approximately 30 minutes.

An isolation Air unit was installed and tested on June 5th, 2020, in a "temporary, on-demand" isolation space at the Berkshire Innovation Center in Pittsfield, Massachusetts. The room used for the testing was made from double-walled "5/8" thick corrugated cardboard. The room had an area of 70.86 square feet with a height of 10 feet, giving the room a total volume of 718.225 cubic feet. Alumina brackets along the outside edges secured the cardboard pieces together, and a plenum ceiling and window allowed for sufficient natural lighting. Full height double doors were located at the right front corner of the room with door sweeps to increase a tight seal. The bed, also constructed from corrugated cardboard was positioned in the left back corner of the room. Access from the left was provided via the isolationAir® unit. Two 10" ducts were built into the back corners of the room about 5" off the ground so that the isolationAir® unit had the necessary ducts to operate. The ducts were set up at 90 degree angles from each other to minimize interaction between the supply and exhaust airflow. A detailed layout of the room is shown in Figure 1, and the duct installation shown in Figures 3 and 4.

Figure 1: Diagram of Room
Figure 2: Room Before Installation
Figure 3: Particle Counter
Figure 4: Pressure Sensor Setup

A 65-minute test was performed for both negative and positive pressure conditions. During each test, 2417 µm particle count samples were taken with a hold of 5 seconds between each sample. Pressure was measured every 5 minutes into the test to make sure a sufficient difference between the sampling space was reached. At 15 minutes, the tester entered the room and checked the system, also providing a rough simulation of a person entering the patient room.

Negative Pressure Results and Analysis
In the negative pressure test, an equilibrium was reached at virtual zero percent of the initial particle count. The initial count for particles ≥ 0.3 µm and larger was 37,285, and this number dropped to virtually 0 at equilibrium. An equilibrium pressure of 0.25" W.G. was reached within minutes. There was a subtle spike in particle count when the tester entered the room at 15 minutes, but the count quickly dropped back off to just above zero percent of the initial count when the tester leaves the room and closes the door. Figure 5 shows the particle counts over the 65-minute positive pressure test as both a percentage of the initial particle count and the total number of particles over time.

Figure 5: Room After Installation for Negative Pressure

The following chart gives the key performance data collected for the positive test.

| Performance | Air Changes at Hour | 30 |
| Pressurization | 0.25" |
| Equilibrium Reached in 15 min. | 0.25" |
| Particles ≤ 0.3 µm | 0.25" |

Figure 6: Negative Pressure Chart

Conclusion:
IsolationAir® system creates positive and negative pressure isolation environments that meet or exceed the CDC Isolation space guidelines (1A-01) for pressure management, particle count reduction, and air changes per hour. This system can be very effective in both surge capacity temporary hospital rooms and permanent isolation spaces. The unit acts quickly in reducing particle counts, reaching an equilibrium in under 15 minutes in the test room for positive pressure and in under 5 minutes for negative pressure.