HOW FACE MASKS WORK TO PROTECT FROM AIRBORNE VIRUS

Abstract

This article is focused on the mechanics of the face mask/respirator and how it prevents respiratory exhaled particles with a viral load (e.g. COVID-19) from spreading.

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How face masks work to protect from airborne viruses

Much of the confusion around wearing face masks and respirators is due to a lack of understanding of how they work to protect us and others from contagious airborne diseases such as viruses. This article is focused on the mechanics of the face mask/respirator and how it prevents respiratory exhaled particles with a viral load (e.g. COVID-19) from spreading.

Breathing results in aerosol and droplet particles as mist continuously leaving our nose and mouth. Respiratory particles exhaled can contain infectious viruses. Without a mask/respirator, potentially virus-laden particles are dispersed and can travel some distance (see blue particles in the illustration below) and remain suspended in air for prolonged periods because of their low settling velocity.

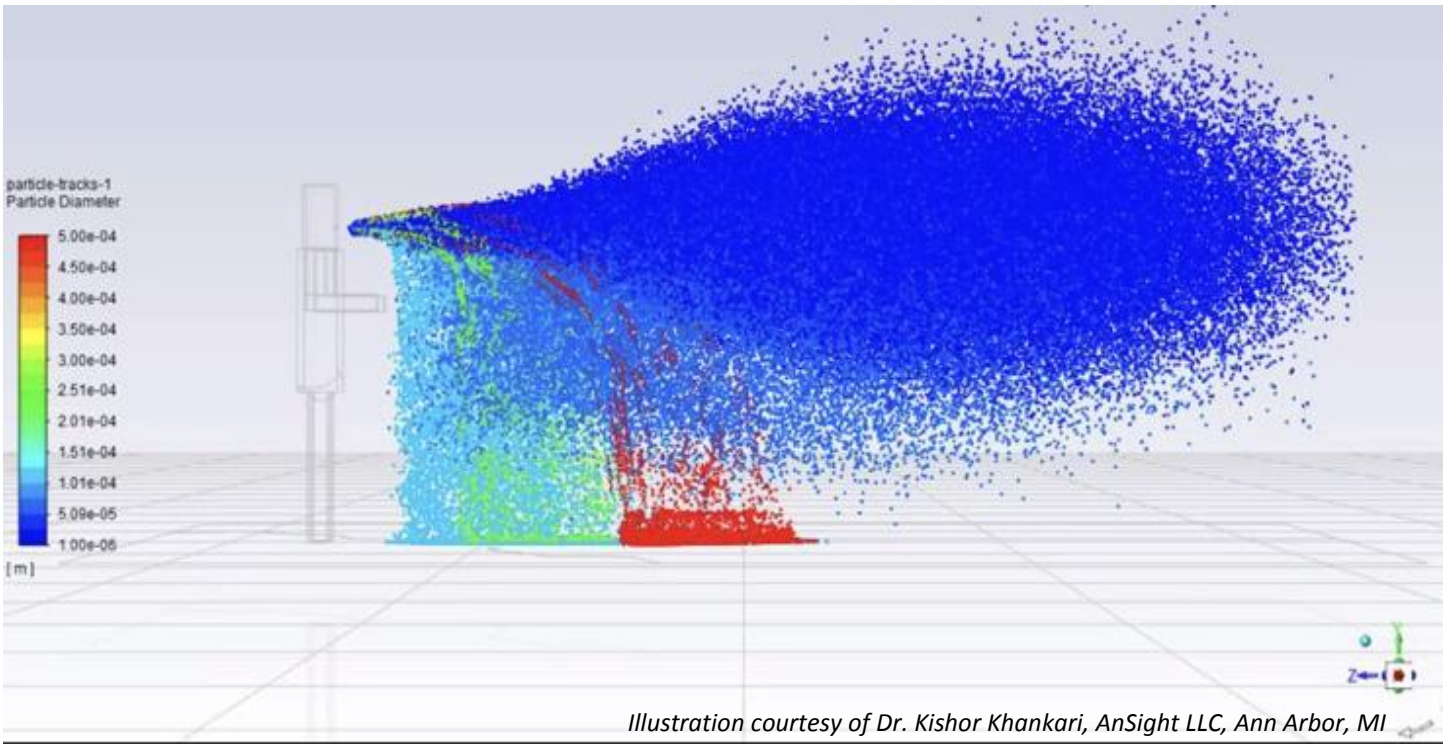

Illustration courtesy of Dr. Kishor Khankari, AnSight LLC, Ann Arbor, MI

What happens when you sneeze? The illustration above shows the various sizes of water droplets and how far they travel. The blue particles are ultra-fine particles.

When respiratory particles are exhaled into a mask, the particles are trapped by the mask, collide and form even larger particles. This process is known as agglomeration. Respirators trap and filter the respiratory particles. How do you know this is true? Simple, feel the inside of your mask/respirator. The interior of your mask/respirator becomes and remains moist when worn. If the mask/respirator is leaking (not sealed) and you wear glasses, the exhaled particles cause them to fog up. When wearing a mask/respirator, a barrier is formed and filtration occurs (respirator), preventing the spread of the exhaled particulate (see the light blue, green, and red particles in the above illustration).

The second important area to protect us and others is the seal of the mask/respirator. If the mask/respirator is not sealed the exhaled particulate can escape and spread (less spread than no mask). One qualitative way to check the seal is the glasses example above. Another is in front of a mirror, fit the mask then breath in and out and see if the mask/respirator retracts into the face when you breath in and expands when you breath out. There are quantitative ways to measure the seal of a mask/respirator, however these are usually limited to higher exposure risk workplace environments e.g. healthcare workers.

It is important to remember that correctly wearing any mask is better than no mask. Whatever mask/respirator you choose, it should provide a good fit and be comfortable enough to be worn correctly (covering nose and mouth) so it can be worn when required. Loosely woven cloth products provide the least protection, layered finely woven products offer more protection, well-fitting disposable surgical masks, N95 and KN95s offer even more protection Well-fitting respirators meeting Standards and Government approval e.g. N95s offer the highest level of protection.

The above illustration demonstrates the value of a mask. Without the mask, the blue ultra-fine and potentially virus-laden particles spread through the air around the person not wearing a mask. The more people present in the area, the greater the number and concentration of exhaled particles. It is easy to see that mask-wearing, which prevents the exhaled particles from filling the area, provides a significant level of protection.

Increased protection from exhaled particles comes from everyone in the space e.g. room wearing a mask. The mask significantly reduces the wearer's exhaled particles from being breathed by others in the space. We are all responsible for playing our part in reducing the risk by wearing a mask/respirator.