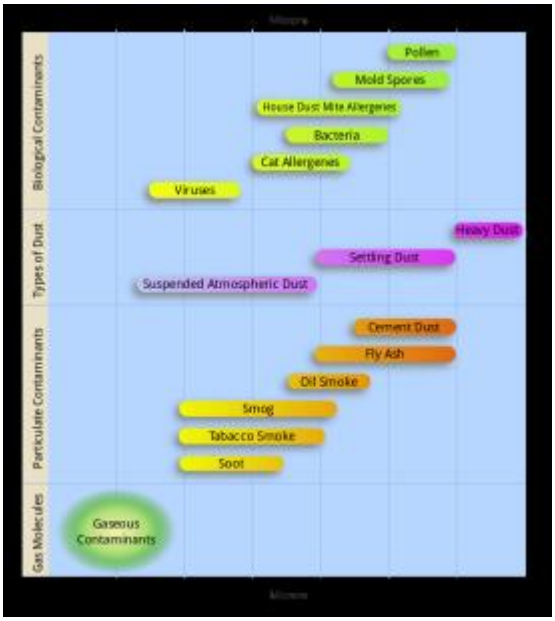
N95s - Sufficient Protection for Covid19?

There have been many questions regarding the effectiveness of masks, particularly N95 masks, for protection against COVID19. One recently published article, linked here, discusses the efficiency of cloth and surgical masks. The CDC, President Trump, and Governor Dunleavy have all advocated the use of cloth masks in social situations. The best data to date indicates that the use of surgical or simple face masks are sufficient in most healthcare situations. Only those within certain close contact scenarios need to use an N95 mask. South Peninsula Hospital's PPE guidelines reflect the best evidence recommendations at this time.

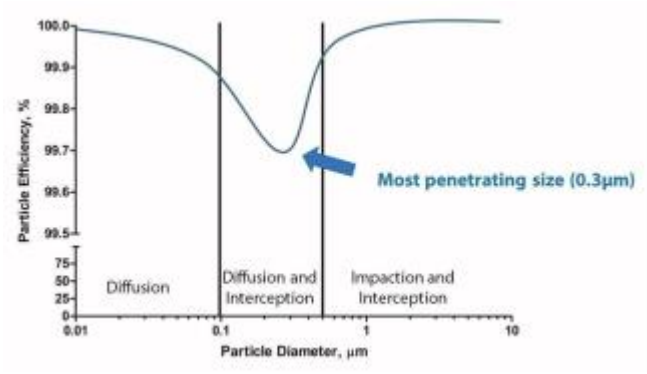
N95 mask packaging has a label or verbiage indicating protection down to 0.3 microns. Microns are small – 1 millionth of a meter. Pollen particles are often 10 microns or bigger. Bacteria are often about 1 micron. COVID19 has a diameter of approximately 60–140 nm or 0.06 to 1.4 microns.



While particulate matter or organisms of any size can cause adverse effects to our health, particles below 2.5 microns in size are especially dangerous. These are small enough to be absorbed directly into our bloodstream and enter our lungs, heart, and brains. Regular HEPA filters are fantastic at capturing particles under 0.3 microns.

In fact, smaller particles, like 0.01-micron particles are ***even easier*** to capture than 0.3 micron particles. It seems counterintuitive that 0.3 micron particles would be harder to capture than 0.01 microns (30 times smaller). That is because we think of filters like a net, thinking that if a particle is smaller than the holes in the net, it gets through. That is how HEPA filters or N95 masks work for particles >0.3 microns. These particles either cannot fit through, either because they are bigger than the filter hole size, or their inertia causes them to hit the filter fibers (impaction & interception).

Particles under 0.3 microns have so little mass the actually bounce around like pinballs when they hit gas molecules, so they move in random zigzag patterns. This is known as Brownian Motion.



Here's why that 0.3 micron number comes up all the time. The weirdness of Brownian motion happens under 0.3 microns. The more easily understandable filtering occurs above 0.3 microns. But where those two processes overlap is the weak spot. Particles at 0.3 microns lie in between the two, and that makes them the hardest particle size to capture. Researchers call this the most penetrating particle size (MPPS). The theory of 0.3 microns being hardest to capture works for fiber filters of all types, including N95 masks.

Scientists from NASA have tested the particle capturing efficiency of filters and found that 0.3 microns is the lowest point. Another piece of evidence comes from hospitals and airplanes, many of

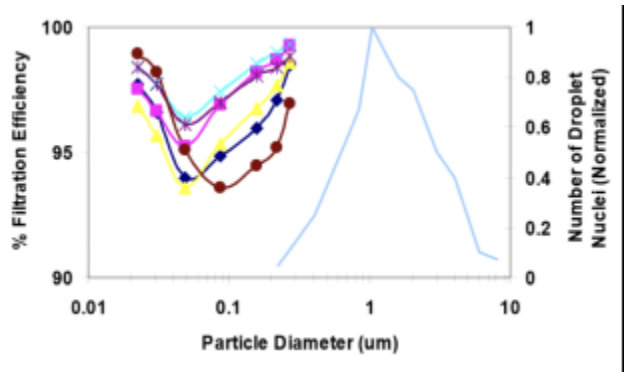
which use HEPAs to capture viruses as the "removal efficiency is generally greater for particles both larger and smaller" than 0.3 microns.

3M, one of the manufacturers or N95 masks, issued a Technical Data Bulletin in February 2020, addressing these same concerns. Key highlights include these statements: ". . . it is generally thought that airborne viruses are normally attached to other particles and rarely exist as naked organisms. Inhalation of these bioaerosols may be reduced by wearing respirators. The US Centers for Disease Control and Prevention (CDC), the World Health Organization (WHO), and many national health authorities have made numerous recommendations for respirator use where they believed the potential for the spread of disease through the airborne route exists. Considerations for selection and use of respirators to help reduce exposure to bioaerosols include:

- Filtration
- Microorganism survival on the filter
- Potential reaerosolization of the bioaerosol
- Reuse of the respirator
- Fit and the assigned protection factor of the respirator"

A number of questions have been raised regarding the use of respirators against biological agents. The primary question is whether or not particulate respirators can filter small particles such as fungal spores (2 to 5 µm), bacteria (0.3 to 10 µm), or viruses (0.02 to 0.3 µm). As noted previously, biological organisms may be carried on other particles including dust, blood, saliva, etc." The following graph illustrates this concept.

Figure 1. Averaged Filtration Efficiency for Six N95 Respirators* (on the left), and Size Distribution of Droplet Nuclei from a Sneeze (on the right).



"The MPPS included particles with a diameter between 0.04 and 0.1 µm. As seen in Figure 1 (left), particles that are smaller or larger than the MPPS are captured with higher filtration efficiency. Filtration via diffusion (most noticeable for particles smaller than 0.1 µm) actually increases as particle size decreases. Other research has confirmed that filter efficiency increases with decreasing particle size, even for particles as small as 0.003 µm (much smaller than that of virus)."

It is important to note that the only way to ensure 100% efficiency of blocking particle flow is to also block airflow. Without airflow, you will not receive oxygen, and you will suffocate and die. Scientific research and best practices are guiding the recommendations made regarding PPE use at South Peninsula Hospital.