How we know that masks, even the cloth ones, reduce the spread of COVID-19

April 22 2022, by Tom Avril

Credit: Pixabay/CC0 Public Domain

Two years into the COVID-19 pandemic, the public debate on masks is as heated as ever—especially in Philadelphia, which earned national attention for once again requiring masks in indoor public spaces.

Yet in the realm of science, there is plenty of evidence to support using the face coverings. Researchers who study airborne transmission of viruses say there is no question that masks—even the cloth variety—reduce the spread of the coronavirus.

Exactly how much depends on the type of material, how well the mask fits, and how many virus particles an infected person is shedding, among other factors. No mask is bulletproof, but that's not a reason to reject them entirely. No infection-control measure is absolute, short of complete isolation.

That's why public health officials have stressed multiple layers of protection: masks, social distancing, and, above all, vaccines. If one layer fails, another may do the trick.

Some physicians have questioned whether a universal mask requirement is appropriate at this stage of the pandemic, for reasons we'll get to below. But that question might be harder to answer, at least by science alone.

How scientists study masks

The evidence for wearing masks comes from three types of studies, says Seema Lakdawala, a scientist at the University of Pittsburgh School of Medicine who studies the airborne transmission of viruses.

Some researchers have placed infected and uninfected animals in cages, separating them with various materials to determine how well each blocks the spread of disease.

Others have opted for mannequins—masked models of human heads. In one such study, breathing was simulated by connecting the heads to nebulizers and ventilators.

As for studies in live humans, researchers generally do not expose people to the coronavirus on purpose, as it can have severe consequences. Instead, the human evidence for masks comes mostly from the real world, by comparing rates of disease in masked and unmasked populations.

What the evidence shows

Collectively, these studies leave little room for doubt, says Lakdawala, who coauthored a Science magazine review of airborne virus transmission.

Masks reduce the flow of virus particles in both directions, when exhaled and inhaled.

Medical-grade N95 masks, so named because they filter at least 95% of particles, are the most effective. KN95 face coverings are in the same league, though be sure to check the rating label to avoid counterfeits.

Surgical masks don't work quite as well, and cloth masks are the least effective. One study suggests that fabric masks block about half of virus-laden "aerosols," though the rate varies with the size of these particles. Two layers are better than one.

Even blocking half of particles is a lot better than nothing, said Lakdawala, an associate professor in Pitt's department of microbiology and molecular genetics. That's because the immune system's response to viruses is a numbers game.

Reducing the amount of virus exposure gives the immune system time to marshal its various defenses before the virus makes enough copies of itself to cause severe illness. Even if a masked person becomes infected, the disease is more likely to be mild, she said.

That's especially true when the mask is coupled with other layers of protection, such as a vaccine.

"Anything you can do to diminish the amount of virus you're breathing in is going to be helpful to reduce the risk," she said.

How do masks work, given that viruses are smaller than the holes in the fabric?

A common misconception about masks is that they can't block viruses because the infectious particles are smaller than the "pores" in woven fabric. Wrong, says Lakdawala.

First off, viruses are carried inside larger particles of mucus or saliva. Some are large enough to be visible, and are easily intercepted by the fibers in a mask. Most are too small to see, yet even those can be blocked if they run straight into the fibers.

But masks block viruses in other ways besides direct interception, and it doesn't matter that the particles are smaller than the pores in masks.

"They're not like a colander," she said.

Other molecular processes enable masks to trap even the smallest virus-laden particles, such as electrostatic charges in the mask material and the fabric's ability to disrupt airflow.

Masks in the real world

These microscopic phenomena can be studied in a laboratory, where researchers can control factors such as airflow and the amount of virus. But what about studying masks amid the chaos of the real world?

Time to call the epidemiologist.

In one of the most recent such studies, researchers enlisted more than 1,800 California residents who were tested for COVID at some point between mid-February 2021 and the end of that year. All were asked how often they'd worn masks during the two weeks prior to testing.

Those who said they always wore a mask in indoor public places were 56% less likely to test positive than those who said they never wore one, the authors reported in *Morbidity and Mortality Weekly Report*, a CDC journal.

Among those who specified wearing an N95 or a KN95 variety of mask, the odds of testing positive were 83% lower than for non-wearers. For those wearing surgical masks, the odds of infection were 66% lower than for non-wearers.

The impact of cloth masks, on the other hand, was not statistically significant. But just 200 of the participants reported using cloth masks; a larger study might have enabled a firmer statistical conclusion.

In another recent real-world study, Duke University researchers found evidence supporting mask mandates in schools, where cloth masks are the norm.

In school districts where masks were required, cases of in-school transmission were 72% lower during the late summer and fall of 2021, compared with those where masks were optional, the authors reported in *Pediatrics*. But the authors said they could not rule out if other precautions or demographic factors may have played a role.

Science and the public message

Then there's the issue of messaging. The science is all about relative risk, but public health officials ultimately have to translate that nuance into a yes-or-no policy—keeping guidance as simple and straightforward as possible, to improve understanding. If they started specifying which kinds of masks were OK for various situations and people, adherence might suffer.

Julia Raifman, an assistant professor of health law, policy, and management at Boston University, called Philadelphia's mask mandate a sound approach.

"It's an ideal policy to let people keep going to work and school, and keep engaging with each other and the economy, with less of a chance of exposure to the virus," she said.

Yet others caution that at this stage of the pandemic, when risk is fairly low, a blanket mask mandate may backfire.

Requiring everyone to wear masks may seem like "crying wolf," leading some people to tune out when risk is higher, said Leana Wen, a former Baltimore health commissioner and professor of health policy and management at George Washington University. A more effective approach, she said, might be to give free N95 masks to all who want them.

Is there a downside to masks?

Masks are not without consequences. They prevent the hearing-impaired from being able to read others' lips. And if a mask does not fit properly, it may contribute to eye problems, such as dryness and the reddish bumps called styes.

Detractors also have raised the possibility that masks could interfere

with speech development in young children, though researchers have generally not found that to be an issue.

None of these concerns outweighs the potential consequences of COVID. But now that most people have been vaccinated, the risk of severe disease is greatly reduced.

Should masks remain as a vital layer of protection? A real-world study of that very question is underway right now—in Philadelphia.