



The Immune System and Schools Addressing Future Pandemics

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*Study your
enemy but first
know and honor
your allies.*

—Sun Tzu
The Art of War

School public health prevention efforts to protect students, employees and the community are designed to **reduce the burden of exposure to threatening viruses, allowing our immune systems to do their job.** We must understand something about those systems—our allies, if we want to protect school facility occupant.

Primary Protective Immune Systems

It's probable that a COVID-19-causing virus and many other viruses have touched you, and your primary immune system protected you.

The immune system is not an organ with a specific purpose like a brain that thinks or heart that pumps blood. It is a complex, multidimensional living process. If fluid containing a virus touches your eyes, tears typically wash out the invader with a blink; if it tries to enter through your ears, antiseptic earwax protects you; if it touches your skin, it is blocked by body heat, natural oils, and layers of tissue. If you inhaled a nearby person's bronchial fluid containing viruses through the nose, moist hairs filtered out many of them and mucous membranes kept others at bay. If fluid containing viruses entered your mouth, slightly acidic saliva attacked them and washed them out of your system. If you were exposed to heavy burdens of contaminated bronchial fluid and some penetrated and tried to blend with your lung fluids, the tiny, hyperactive cilia that coat your lungs escalated the foreign fluid up into your mouth and, with the help of salivary glands, flushed them out of your body.

The problem is, with heavy burdens of exposure, especially over time, some might still get through. That is why it's not the school's objective to eliminate all contact, that would be impossible, but to reduce the amount of exposure to the bronchial fluid of others. Even vaccines are not actually based on destroying the virus but empowering our precious immune system to control and overcome harm. The school's job is primarily to support the immune system by reducing the amount or burden of exposure to exhaled bronchial fluid possibly containing a virus. Calibrating and responding to the amount of shared breath exposures in an occupied school area is critical.



Our Proper Immune Systems

If there are heavy exposures and the virus penetrates your primary immune systems, it must then confront what is sometimes termed the “proper” immune cells and systems. Unlike many other viruses, the COVID-19-causing virus can also often evade our proper immune systems. This is where humanity has been put at risk. Our immune cells and systems are confounded by SARS-CoV-2, and without the aid of a vaccine to guide them, the virus sometimes multiplies into debilitating and potentially lethal disease. To those with immune systems unable to identify and eliminate the virus, serious disease and sometimes death may be the result.

Once an invader breaks through our primary protective systems, typically an interaction of chemicals and processes converts the human body into a biologic multi-phased battleground. As an example, a small, purplish organ between the lungs, the thalamus, sends out specialized cells to scout for the foreign invaders and then, once understanding the invader’s nature, instructs bone marrow in the production of an array of specialized white blood cells to eradicate the invader.

The immune system has many natural responses for all manner of invasive dangers. If the invader penetrates cut skin, the damaged area will swell and turn red with enriched blood and white blood cells. It will heat up to help kill the invaders, and produce what are termed lymphocyte cells. The lymphocytes will make you tired, which will help you sleep and heal. If the invader is a bacterium or virus, white blood cells will be configured in specialized forms designed to penetrate and destroy them before they multiply.

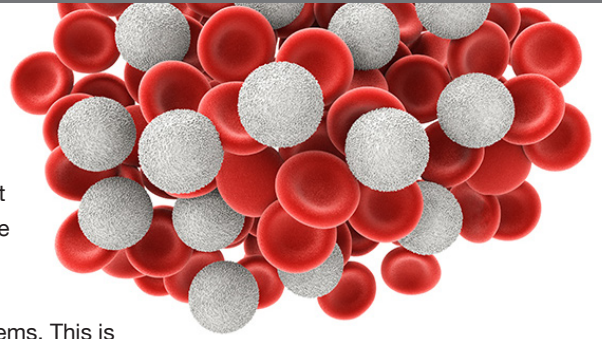
You may have a fever, with body heat causing discomfort and other problems, but through the heat and other actions your immune system will typically wipe out any penetrating enemy. In some cases, the conflict within the body can be excruciating and prolonged. Serious disease and sometimes even death can result.

Thankfully, once the body recognizes and expels a virus, the immune infrastructure often remembers the nature of the invader. For some period of time, sometimes a lifetime, if a similar invader appears, the proper immune system will almost instantly recall exactly how it can be destroyed.

Personally, I had mumps 70 years ago. If I’m ever again exposed I can be just about certain that my immune system accurately remembers its nature and mumps will never reestablish itself. I have immunity to mumps! How acquired immunity works with COVID-19 is not fully understood. There will almost certainly be some level of prolonged immunity from the virus that causes COVID-19 and periodic booster shots may be necessary. Every new virus will act and react differently.

Obviously, a valuable ally to our immune system, along with protective measures designed to prevent heavy exposures, is vaccination. The process of vaccination is like wearing face masks or selective isolation, a method to strengthen the odds for our immune system to better recognize and neutralize the invading virus.

Given our remarkable immune systems, why has COVID-19 caused debilitation and death to so many? As nearly as we can tell, three events caused us to face the historic COVID-19 crisis.



Bronchial fluid moisture bubbles are visible when exhaling in cooler temperatures.

- The SARS-CoV-2 virus, which causes COVID-19, transferred to humans from an animal. We think bats were part of the transfer process from another warm-blooded mammal. This uniqueness prevented rapid recognition by our immune system and allowed the virus time to thrive. Because SARS-CoV-2 was so completely foreign to the human immune system, once our primary protective systems were overwhelmed through heavy exposure, the internal or proper immune systems found it difficult to get a fix on how the virus can be attacked. As a result, the virus becomes so deeply established within the body that it often took a serious toll on human health.



Shortened duration of large assemblies and enhanced air exchange along with quality circulation will reduce risk.

- More and more humans live and congregate in unhealthy clusters, readily sharing heavy burdens of bronchial fluid and encased viruses through touch, and most especially breath. When a virus came along that couldn't be easily repressed, our crowded, often compact airborne bronchial fluid-sharing lifestyles created a perfect storm for spreading disease. This pandemic was exacerbated by extensive widespread local and global travel.
- Thirdly, unlike most viruses, including several other SARS viruses, there was an extended period of time following contracting COVID-19 where it was not symptomatic or perhaps only mildly symptomatic. Consequently, although not realizing it, a person may be infectious and unknowingly pass along the disease. This unusual characteristic rendered COVID-19 able to rapidly spread and become extraordinarily dangerous.

The School's Responsibility

- Develop protocols to identify and support treating those afflicted humanely and successfully. In the earlier stages of the disease individuals may be infectious and isolation necessary as well as outreach and safety procedures to those who may have been infected.
- Reduce the burden of infectious exposure through hygienic practices, possibly contained cohorts of students, and maintain a safer facility through personal protection, hygienic practices, and most importantly responsible air exchange and especially circulation within a room. This may involve testing and organized monitoring of CO₂ thresholds in individual school rooms. Understanding the nature of CO₂ burdens will help guide prevention responses.

We have been given a remarkable immune system that, through profound and beautiful interactions, protects us. The school's responsibility is to support those systems by reducing viral exposures to school building occupants.