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HUMAN HEALTH
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# TOWARD A HEALTHIER FUTURE: LESSONS FROM THE COVID-19 PANDEMIC

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AGE: 12

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The COVID-19 pandemic was a challenging time—many people got sick and even died, most people had to stay home from school and work, and fun things like going to the movies, traveling, and visiting friends and family were discouraged. However, the pandemic also taught us some key lessons. We learned that it is important for scientists and doctors to work together closely to understand health threats. Collaboration led to fast production of a safe, effective, COVID-19 vaccine. We learned that diseases can quickly spread all over the world, which taught us about the need for global cooperation and equal access to vaccination and other health services. The pandemic also showed us how critical it is to understand health information, so that we can tell accurate information apart from false claims. These lessons will shape our future, hopefully leading to even greater advances in science and healthcare that will create a healthier world.

## STORIES OF COVID-19

Do any of the adults in your life enjoy telling stories about their childhoods, describing the challenges they faced and the lessons they learned? Despite the common joke "When I was a kid, I had to walk to school uphill, both ways", the truth is that most everyone lives through tough experiences that make strong impressions on them, teach key lessons, and possibly even shape their futures. These events can range from personal challenges and difficulties like losing a job or having a big fight with a friend to society-wide events, like wars, natural disasters, or deadly terrorist incidents. You have already lived through at least one such experience! Someday, when you are older, you may be telling the young people in your life stories about how the COVID-19 pandemic affected you as a child—how, in early 2020, there were world-wide school and work closings, mask shortages, hospitals were overwhelmed, people avoided going out in public, and lots of people died.

Like all story-worthy life experiences, the COVID-19 pandemic taught us many things. Along with our memories of the time, these learnings will live on and influence our futures—both individually and as a society. Some of the valuable scientific and medical lessons we learned during the pandemic reach far beyond facts about COVID-19 itself. So, if you are looking for some exciting tidbits to include in the "when I was young" stories you might tell in the future, keep reading!

## THE COVID-19 PANDEMIC: CRISIS AND TEACHER

The COVID-19 pandemic caused several million deaths worldwide and cost the world's economy trillions of dollars. Despite the tragedy of the pandemic, at the same time we learned many things about COVID-19 and the virus that causes it, which is called SARS-CoV-2. As the pandemic progressed, doctors and scientists learned about how the disease affects the body, how to treat sick patients, and how to decrease the spread of the virus. Scientists went to work quickly to sequence the virus's genes and create a **vaccine**. This was a busy period for science. From 2020 to 2022, ~9% more medical and health science articles were published than predicted from previous years and, as you might expect, many of these were related to COVID-19 and/or SARS-CoV-2 (Figure 1).

**VACCINE**

A special medicine that helps our bodies fight off dangerous diseases by teaching the immune system how to protect us from dangerous viruses or bacteria.

The pandemic was also a time of great collaboration, and that is one of the major reasons our knowledge increased so quickly. In general, scientists tend to work quite independently and sometimes they even compete with each other. However, due to the urgency of the pandemic, scientists, doctors, and biotech companies all teamed up, sharing knowledge and data, to help each other understand the virus and to develop vaccines and treatments as quickly as possible. Much of the research and knowledge gained during this time advanced *other*

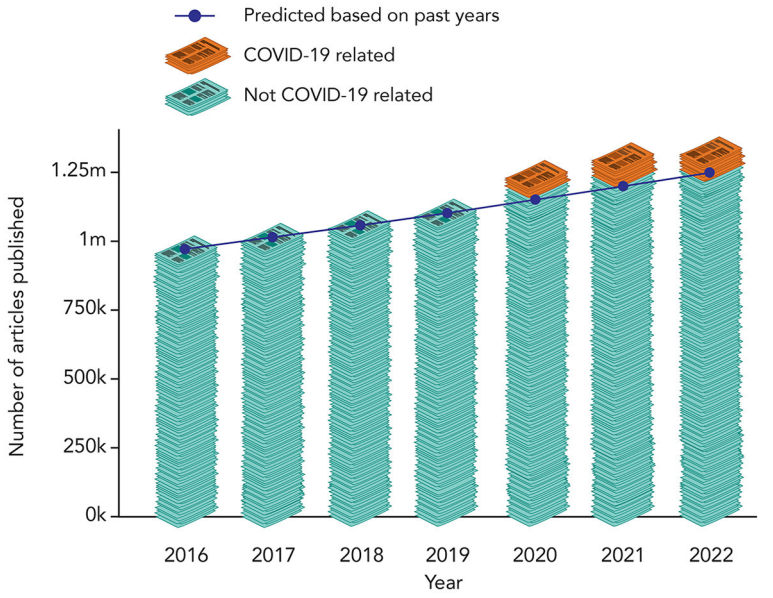


**Figure 1**

Compared to what was expected based on past years, the number of medical and health science articles was ~9% greater from 2020 to 2022, and many of these articles were related to COVID-19 or the SARS-CoV-2 virus. This shows that the COVID-19 pandemic fueled a busy period in science and medicine. All that hard work provided important knowledge that will benefit many fields beyond just COVID-19 research and will hopefully make the world a healthier place.

fields of science and medicine, too—some learnings may even change the way science is done! Next, we will describe just a few of the many lessons we learned from the COVID-19 pandemic and how these learnings could improve the science of the future (Figure 2).

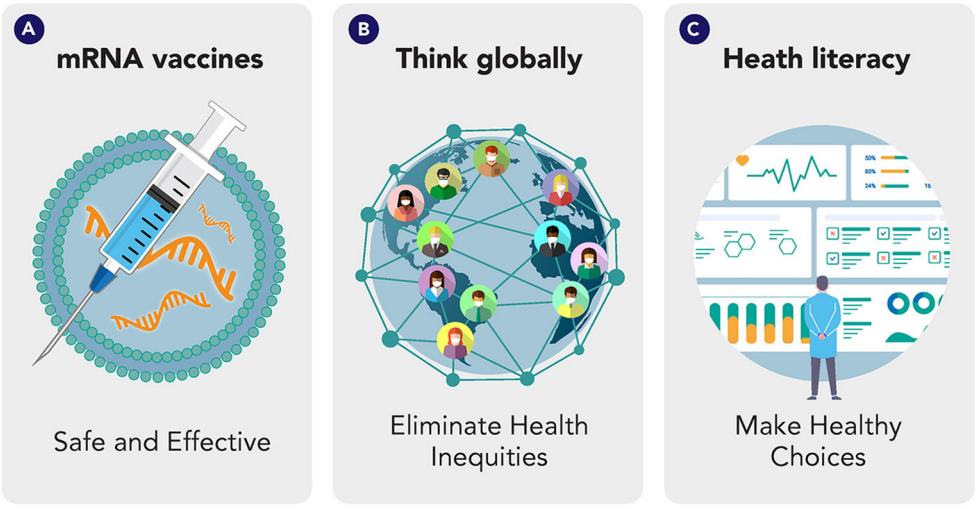


**Figure 2**

The COVID-19 pandemic taught us many important lessons that can help us to fight future pandemics or other health crises. Here are three of them. **(A)** mRNA vaccines are a powerful tool to fight infectious diseases and possibly for treating cancer. **(B)** We live in an extremely connected world, so our own health depends on the health of people everywhere and on how we treat the environment. **(C)** Understanding health information can help us identify false information and make choices that will protect our health and the health of others.

## LESSON 1: mRNA VACCINES HAVE MANY ADVANTAGES

Vaccines are one of the greatest medical achievements of modern civilization. More than 200 years after the first vaccines were developed, these "shots" are still the key to stopping the spread of dangerous diseases caused by viruses and bacteria. The vaccines most people get as kids are estimated to prevent at least 4 million

**IMMUNE SYSTEM**

The body system that protects us from germs and harmful things that can make us sick. It has special cells and defenses that work together to fight off diseases and keep us healthy.

**mRNA**

The genetic "instructions" that help cells make proteins. In COVID-19 vaccines, mRNA teaches our cells to make a harmless piece of the virus, which trains the immune system to fight it.

**Figure 3**

Some vaccines, like the flu vaccine, work by providing harmless ("dead") viruses (or pieces of them). These flu viruses are grown in the laboratory, often in eggs. Producing the flu vaccine can take half a year, and it is a lot of work. In contrast, mRNA vaccines like the COVID-19 vaccine provide the genetic instructions so that *our own cells* can make a harmless piece of the virus. In both cases, cells of the immune system recognize these harmless substances, which trains the cells to produce infection-fighting molecules that can inactivate the real viruses if they invade the body after vaccination.

deaths a year worldwide. Vaccines work by "training" the body's **immune system** to fight an infection, so that if we encounter that infection later on, we can kill or inactivate it before it makes us sick. Most vaccines contain either weakened or dead viruses or bacteria, or specific "chunks" of those organisms; but you may have heard that the vaccines developed against COVID-19 are unique. Instead of containing weakened or chopped-up SARS-CoV-2 viruses, they contain the **mRNA**, or genetic instructions, that allow *our own cells* to make a piece of the virus called the spike protein. The viral spike protein that our cells produce trains the immune system to recognize and attack SARS-CoV-2 (Figure 3). mRNA vaccines are not new—research on these vaccines has actually been going on since the 1990s, and the first mRNA vaccines were tested in humans almost 10 years ago [1, 2]. All that past research helped the COVID-19 vaccine to succeed (for more information about the COVID-19 mRNA vaccine, see this Frontiers for Young Minds article, or this one).

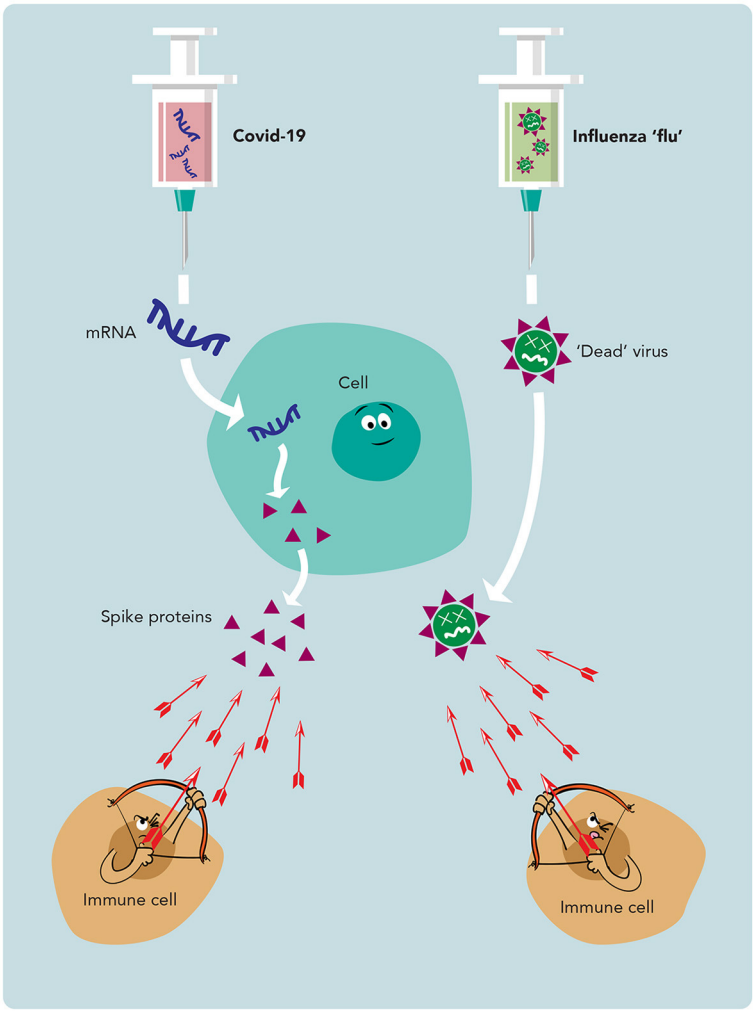


Figure 3

More than 13 billion doses of the COVID-19 vaccine have now been given all over the world, and we have learned several important

things from its wide use. First, we learned that mRNA vaccines are *effective*—this means they work! COVID-19 vaccines prevent severe disease, decrease the need for hospital stays, and reduce the number of people who die from the disease. COVID-19 vaccinations prevented several million deaths within the first year of their use [3], and they have saved the global economy many trillions of dollars.

We also learned that mRNA vaccines are *safe*. A safe vaccine is one that, except in very rare cases, does not cause serious side effects or dangerous reactions. COVID-19 vaccines were carefully tested before they were available to the public and, even after people started getting the vaccine, side effects have been closely monitored. All evidence shows that the risk of dangerous side effects is very small for most people and the benefits of vaccination are far greater than the risks.

Now that we know mRNA vaccines are effective and safe, scientists are testing them against other dangerous infectious diseases, including viruses like HIV, respiratory syncytial virus (RSV), and influenza; bacterial infections like tuberculosis, and even parasitic diseases like malaria. We may even be able to use them to treat cancer! This is a big advance in the field of vaccine development because mRNA vaccines are easier, faster, and cheaper to make than some of the older vaccines currently in use. They can even be created to include genetic instructions from multiple diseases. This could reduce the number of shots people have to get, which could make a lot of kids very happy!

## LESSON 2: WHEN FIGHTING DISEASES, WE MUST THINK GLOBALLY

The COVID-19 pandemic reminded us that microbes do not respect borders. We live in a time when even the most remote locations on Earth are only a plane ride away—and we carry our diseases with us when we travel. After COVID-19 was first identified in China, it spread across the globe in just a few months. Like many human diseases, COVID-19 started as a disease of animals that accidentally spread to humans. **Zoonotic diseases**, infections that can spread from animals to humans, are increasing due to human activity. As the human population grows, we are encountering wild animals more often as our communities expand into their habitats. Also, changes in the environment, like clearing of forests and climate change, can change where animals live and how they behave, bringing them closer to humans and making it easier for diseases to spread.

**ZOONOTIC DISEASE**

A type of illness that can spread from animals to humans.

**HEALTH INEQUITIES**

Unfair differences in health or access to healthcare that exist between groups of people, often because of factors like income, race, gender, or where they live.

COVID-19 also taught us that, to best protect people from future pandemics, we must try to decrease **health inequities**. Health inequities are unfair or avoidable differences in health or access to healthcare that exist between groups of people, often based on

income, race, gender, or where people live. During the COVID-19 pandemic, we saw that certain health inequities doubled, or even tripled, death rates [4, 5]. Some of these differences are due to discrimination and unequal availability of supplies and health facilities, for example.

Issues like increasing zoonotic diseases and health inequities are *huge* problems that require all countries of the world to work together. We must address the causes of these issues, including population growth, global warming, poverty, and unequal access to health care. While this might seem like an impossible task, the COVID-19 pandemic taught us that, in today's world, *we are all connected*—a health problem in one group of people can easily become a world-wide concern. So, to keep *ourselves* healthy, we must think globally and keep *all people* as healthy as possible.

## LESSON 3: WE MUST IMPROVE HEALTH LITERACY

**INFODEMIC**

When there is too much information, some false and some true, leading to confusion and often the spread of false or misleading information.

**VACCINE HESITANCY**

When some people are unsure or hesitant about getting vaccines. They may have concerns or doubts about a vaccine's safety or effectiveness.

**HEALTH LITERACY**

The ability to find, understand, and use health information to make good decisions about our health, to keep ourselves and others healthy.

Early in the COVID-19 pandemic, there was a huge amount of information coming out about the virus. Some of the information was true and some of it was not. Such a big "storm" of information is called an **infodemic** [6], and it can overwhelm people and cause a lot of confusion. Some people believed the false things they heard, like weird cures or scary stories that were not true, and other people did not know *what* to believe. Due to the spread of false information, some people were unsure about getting vaccinated. This is called **vaccine hesitancy**. Often, people who chose not to get vaccinated did not understand how the virus spreads or how vaccines work to protect us, and some were scared because they thought the vaccines might make them sick.

Because of these information-based challenges, not everyone took the right safety measures to protect themselves, and this slowed down the response to the pandemic, leading to infections and even deaths that could have been prevented [7]. It took time to communicate the right information and address people's concerns, and these delays ended up making it harder to control the spread of the virus and protect the public. In short, the COVID-19 pandemic taught us the importance of **health literacy**. This means making sure that everyone can understand health information, tell true information apart from false, and feel confident in making healthy choices. Health literacy is the key to keeping *everyone* healthy and safe in the face of future pandemics or other major health crises.

## STORIES FOR THE FUTURE...

COVID-19 was both a terrible health crisis and an excellent teacher. Heeding the lessons that the pandemic taught us will give us the best

chance of eventually living in a world where vaccinations prevent most diseases; people everywhere enjoy good health regardless of race, income, or location; and everyone understands health information and can make informed decisions to keep themselves healthy. If scientists continue to collaborate and share their knowledge and data openly, the speedy pace of research seen early in the pandemic will continue for years to come. And who knows what kinds of amazing scientific and medical advances will come from all that work! Maybe someday, when you are older and telling young people tales of your childhood, you will be able to tell them of a dark time before mRNA vaccines could cure cancer—and how you lived through the pandemic that contributed to that life-saving discovery!

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**AYIXIA, AGE: 12**
Ayixia is a very highly creative individual with an inquisitive mind. She loves dancing, reading, and swimming. She is also a good cook for different foods. During her free time she enjoys playing with her friends. She loves to take a travel around. She currently lives with her parents and little brother in northwest China.

**SILJANNA, AGE: 9**
I am curious and like getting to know new aspects of life.

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