# Why the coronavirus and most other viruses have no cure

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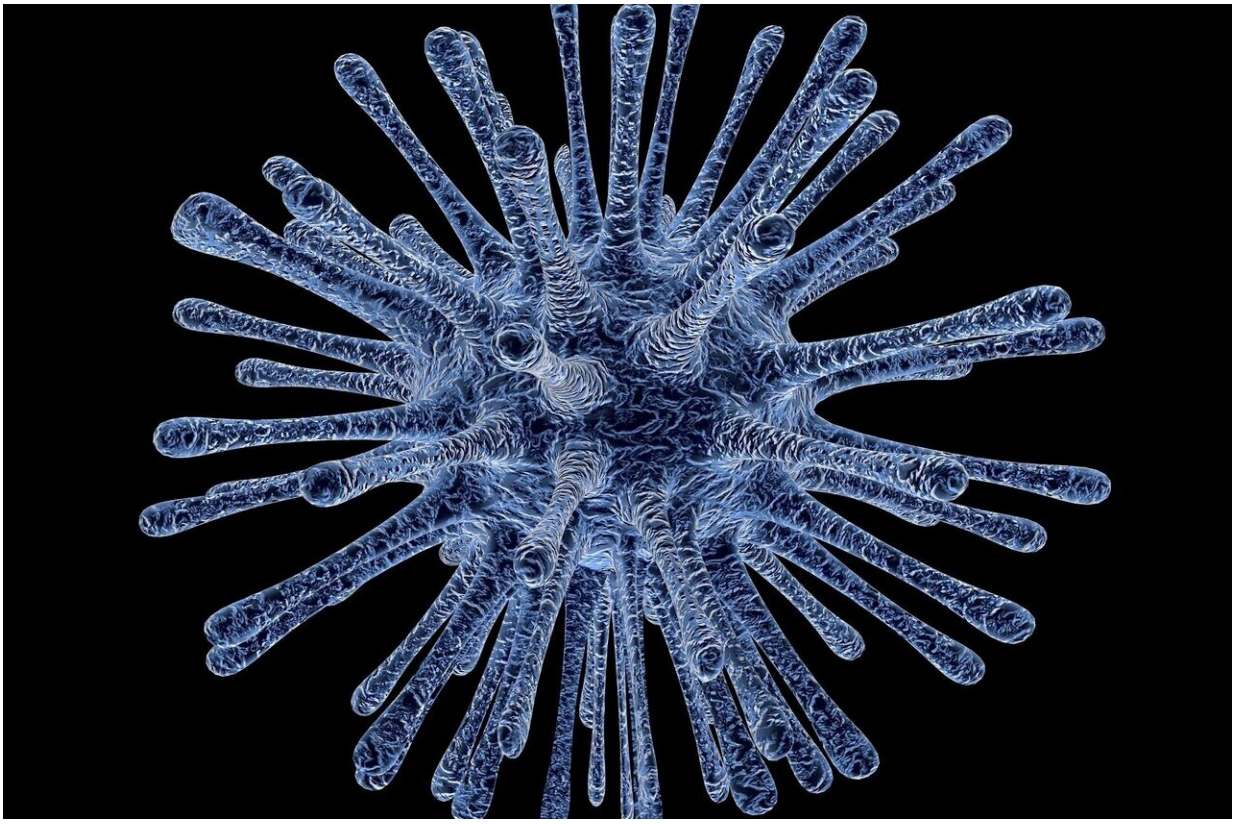

Credit: CC0 Public Domain

People hospitalized with severe symptoms from the coronavirus are given medicine to bring down the fever and fluids to keep them hydrated, generally by intravenous tube. Some patients are connected to

a ventilator: a mechanical device that helps them breathe.

This menu of treatments is called supportive care, and despite the lukewarm-sounding name, there is no question that it saves lives.

But as for waging a direct attack against this virus, and most other viruses, there are no drugs. The human immune system is on its own.

The reasons involve biology and, to a lesser extent, money. Drug companies have developed treatments for a handful of viruses in the last few decades, such as HIV and the flu, but the arsenal is minimal when compared with all the antibiotics we have for treating bacteria. Remember that viruses are not bacteria, so antibiotics are no help.

The main difficulty is that viruses are technically not alive, instead depending on the "machinery" inside human cells to reproduce, said Zachary A. Klase, associate professor of biology at the University of the Sciences. So a drug that targets any part of that parasitic cycle could harm the patient in the process.

"You want something that targets the sickness and not you," he said. "You need to look for the special things that only the virus is doing."

A few of the enzymes used by various viruses are distinct enough from their human counterparts that they can be targeted without harming the patient, said Megan Culler Freeman, a fellow in the pediatrics department at the University of Pittsburgh. That is how antiviral drugs work against HIV, for example. But even then, such drugs do not eliminate the virus, but instead keep it under control, she said.

Another reason viruses are so hard to treat with drugs is their wide variety, Klase said.

Bacteria all are related to each other, at least distantly, and share some common characteristics, such as having a cell wall. So a drug that works against one kind of bacteria, say, by disrupting that cell wall, often works against another. (That is what is meant by "broad-spectrum" antibiotics, though lately, those tried-and-true weapons have been overused, leading certain bacteria to develop resistance.)

Certain classes of viruses, on the other hand, are fundamentally different from each other. Some use RNA as their genetic code, for example, while others use DNA. Some are surrounded by an envelope, others not.

A good analogy is to imagine that bacteria are about as similar to each other as various kinds of cars, Klase said. Various classes of viruses, on the other hand, can be as distinct from each other as cars and boats.

That's where the money issue comes in. Developing a new drug for each unrelated virus requires a fresh commitment of time and resources.

"A drug company would rather have one drug that'll cure everything than to have to have 100 drugs that they're going to have to sell a bit of at a time for each different problem," Klase said.

That has not kept pharmaceutical companies from testing drugs for one virus to see whether they work against another. With the new coronavirus, for example, scientists have been testing a drug called remdesivir, which was originally developed to treat Ebola. But it did not work very well against Ebola, and results so far against the coronavirus are unclear.

The interest in a coronavirus treatment is so keen that misinformation has a way of spreading much like the microbe itself. Earlier this week, Johnson & Johnson issued a statement to dispel rumors that one of its antiviral drugs showed promise. The company said that it was screening

a variety of antiviral compounds against the coronavirus, but that so far there is "no evidence" that darunavir, the drug that sparked the rumors, has any effect.

In fairness to the scientists, they have not been at this problem for very long.

Bacteria were first observed under a microscope in 1683. The existence of viruses, which can be less than one-tenth the size of bacteria, was not verified until more than 200 years later.

And even then, scientists could not see them. In 1892, Russian scientist Dmitri Ivanovsky reported he had extracted fluid from a diseased tobacco plant and run it through a type of filter that was known to remove bacteria. He then demonstrated that the filtered fluid could be used to infect healthy plants. Some invisible agent—which would not be seen until the advent of electron microscopes a few decades later—was somehow transmitting disease.

Effective antibiotics have been around for close to a century. Antiviral drugs have come along only in the last few decades, and only for a handful of serious threats.

And they do not always help. Timing is important. Antiviral drugs can lessen the duration of the flu, for example, but only if given early in the course of the disease. By the time a person develops severe symptoms, antiviral drugs are of little use, said Freeman, the Pitt physician.

That might also hold true for the new coronavirus, but more research is sorely needed, said Freeman, who studied the biology of a different coronavirus, SARS, while a Ph.D. student at Vanderbilt.

"It's important to be able to learn these things ahead of a disaster so we'll

have tools in our toolbox," Freeman said.

Multiple teams of researchers also are at work on vaccines for the new coronavirus, teaching the human immune system to make its own medicine: antibodies. The first stages of safety testing already are underway, but it will be at least a year before such a vaccine is approved for widespread use, experts predict.

For now, that leaves supportive care. But as University of Pennsylvania medical historian David Barnes has found, nurses and doctors have been making that concept work for a long time.

At the Lazaretto Quarantine Station, a hospital on the Delaware River used to treat immigrants with yellow fever in the early 19th century, patients were more likely to survive the illness than were many in the general population, he said. The regimen was straightforward: clean bedding, rest, adequate food and drink, and palliative medicines to ease the worst symptoms, said Barnes, who is writing a book on the topic.

"There are actually plenty of cures for viral illnesses," he said. "We just don't think of them as cures. We're still kind of myopically fixated on finding a cure, when what we really should be doing is getting adequate basic nursing care for all patients."

That may yet prove to be a challenge in the coronavirus outbreak. The nation's hospitals have fewer than 70,000 adult intensive-care beds, while epidemiologists say the number of U.S. coronavirus patients with severe symptoms could reach the hundreds of thousands.

If they all get sick during a short period of time, then even what Barnes calls the "care cure" may be in short supply.