Molnupiravir: Fighting COVID-19 With An Antiviral Pill

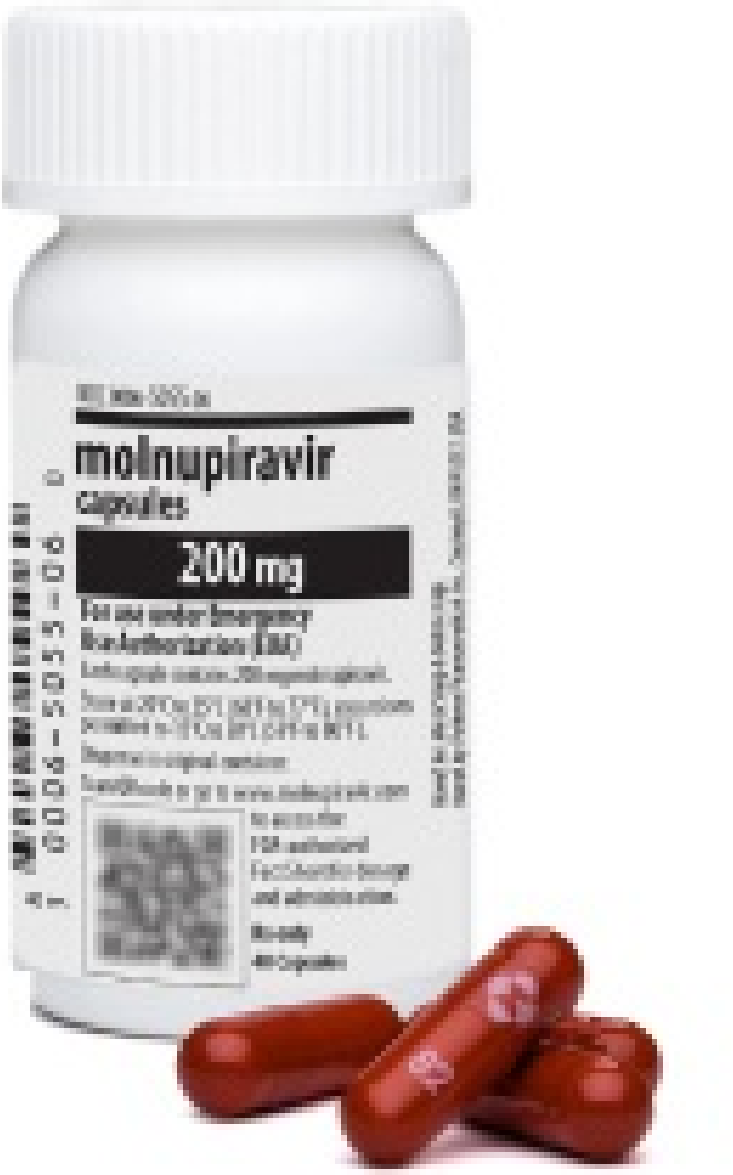
Emory University

Several years before COVID-19 emerged and started its fatal path across the globe, Emory scientists were already developing a potential groundbreaking treatment for the deadly virus. Molnupiravir was one of the world's first approved oral medications for the treatment of COVID-19, especially effective for patients with a high risk of the disease escalating in severity.

Since the early 2010s, scientists George Painter, PhD, Gregory Bluemling, PhD, Michael Natchus, PhD, David Guthrie, PhD, and David Perryman, JD, had been working on an antiviral drug known as EIDD-2801, which was being studied as a treatment for a number of highly infectious viral diseases. Back then, Painter and his team had been developing the drug as a treatment for soldiers for Venezuelan equine encephalitis, which had been used as a bioterrorism weapon in the Cold War. Later, they found that EIDD-2801 worked against other coronaviruses such as influenza and, eventually, a disease no one had heard of until 2019: COVID-19.

When EIDD-2801 was repurposed to focus on the COVID-19 pandemic, it was christened Molnupiravir – named after Thor's mythical hammer.

A Powerful Treatment for SARS-CoV-2



Those fevers, runny noses, coughs, and other symptoms associated with COVID-19? They don't just happen on their own. SARS-CoV-2, the virus that causes COVID-19, makes copies of itself – and with more copies of the virus, the sicker and more contagious we get. If taken early enough, Molnupiravir prevents the virus from replicating by introducing errors in the viral enzyme that copies SARS-CoV-2's genetic material.

Molnupiravir makes spelling errors on SARS-CoV-2's viral code, so when copies of the virus are made, they're incorrect, ineffective, and fail to infect you further.

This method is thought to be effective against multiple SARS-CoV-2 viral variants – not just COVID-19. More testing is happening now for treatment, preparing us for the next pandemic when it happens.

From Emory to the World

Since 1985, Emory's Office of Technology Transfer (OTT) has connected Emory innovations to industry partners who can further develop the innovations. Then, those companies bring the technologies to the marketplace in hopes of benefitting people who need them.

"The largest driver of U.S. innovation is federal funding for academic research. The government uses taxpayer dollars to fund our research, and the remarkable minds here at Emory use that funding to create new innovations that hopefully make their way to the market and benefit the taxpayers. Molnupiravir is an excellent example of this," said Todd Sherer, Associate Vice President for Research and OTT Executive Director.

But long before an Emory product reaches the market, OTT works to license it and protect the inventors' intellectual property. When the office licenses an invention to a company wanting to develop it as a new product or drug, Sherer rings a brass bell outside his office, and everyone within earshot applauds.

Which brings us to 2013: Sherer rang the Deal Bell for an obscure drug called EIDD-2801. It had been licensed to the Drug Innovation Ventures at Emory (DRIVE) LLC, of which Painter is the CEO. DRIVE is a wholly owned, nonprofit subsidiary with more than $20M in foundational funding from Emory.

Painter and his team continued to develop EIDD-2801 as a countermeasure against bioterrorism, and they soon found that it was effective against respiratory viruses. But when COVID-19 brought the world to its knees, the team pivoted quickly to develop the drug as a treatment. It was then that it took on the name "Molnupiravir."

"[Molnupiravir] was but a glimmer in the eyes of us all," Sherer said. "This is standard fare for universities, where discovery occurs years before success becomes obvious."

DRIVE, OTT, and Emory University's general counsel worked together to facilitate Molnupiravir's license from DRIVE to Ridgeback Biotherapeutics in 2020. The Deal Bell rang again – virtually, this time. Ridgeback conducted the first human clinical trials. With the trials showing promise for the treatment of COVID-19, it partnered with Merck, who continued the clinical trials.

"What happened with Molnupiravir shows the strength of our system. The federal government funded us initially. We worked hard for many years to discover and develop Molnupiravir to anticipate and address emerging infections. In the face of the pandemic, we moved the drug quickly into the hands of biotech, and it quickly got through phase 1," said Painter.

In November 2021, Molnupiravir was approved for use for at-risk patients in the United Kingdom, making it one of the world's first approved oral medications for treating COVID-19. Just over a month later, the U.S. Food & Drug Administration granted Emergency Use Authorization for Molnupiravir as a "treatment of mild-to-moderate coronavirus disease (COVID-19) in adults with positive results of direct SARS-CoV-2 viral testing." Molnupiravir was DRIVE's first drug to make it to market.

Molnupiravir wasn't a first line of defense: The drug was authorized for use in patients with a high risk of the disease escalating in severity, resulting in hospitalization or death. Additionally, the FDA's conditional authorization specified the drug should be used by patients for whom alternative approved treatments were not feasible.

And effective it was: In additional clinical trials, data indicated that Molnupiravir eliminated infectious coronavirus from nose swabs within five days.

When he spoke to Dean Li, MD, PhD, president of Merck Research Laboratories, and found that Molnupiravir could help treat COVID-19 patients at high risk for severe disease, Painter began to weep.

“It was a little overwhelming, to tell the truth,” said Painter.

In addition to its strength, Molnupiravir is also practical. It’s a small red pill you can swallow – not a shot you get intravenously – which means it’s a more attractive option for those averse to needles. It also can be distributed easily, as it has no specific transportation requirements and can be provided as a pill in an outpatient setting.
Painter, his team, and more Emory researchers aren’t done developing treatments that tackle the world’s health problems. Currently, these dedicated Emory scientists are preparing for the future by studying it as a treatment for other infectious diseases like encephalitis, influenza, and other RNA viruses.

While Molnupiravir – now called Lagevrio, the brand name from Merck – continues to help at-risk COVID-19 patients, revenue from the drug is being reinvested back into the Emory innovation ecosystem. The funds help DRIVE continue its mission of translating academic research into drugs that treat viral diseases, and it goes to various schools within Emory to train and educate the next generation of drug developers.

“Our continuing mission is to search for other antiviral agents that are usable by the general public to address other tough diseases,” said Painter. “So, we are on it. That’s our job.”

This story was originally published in 2026.