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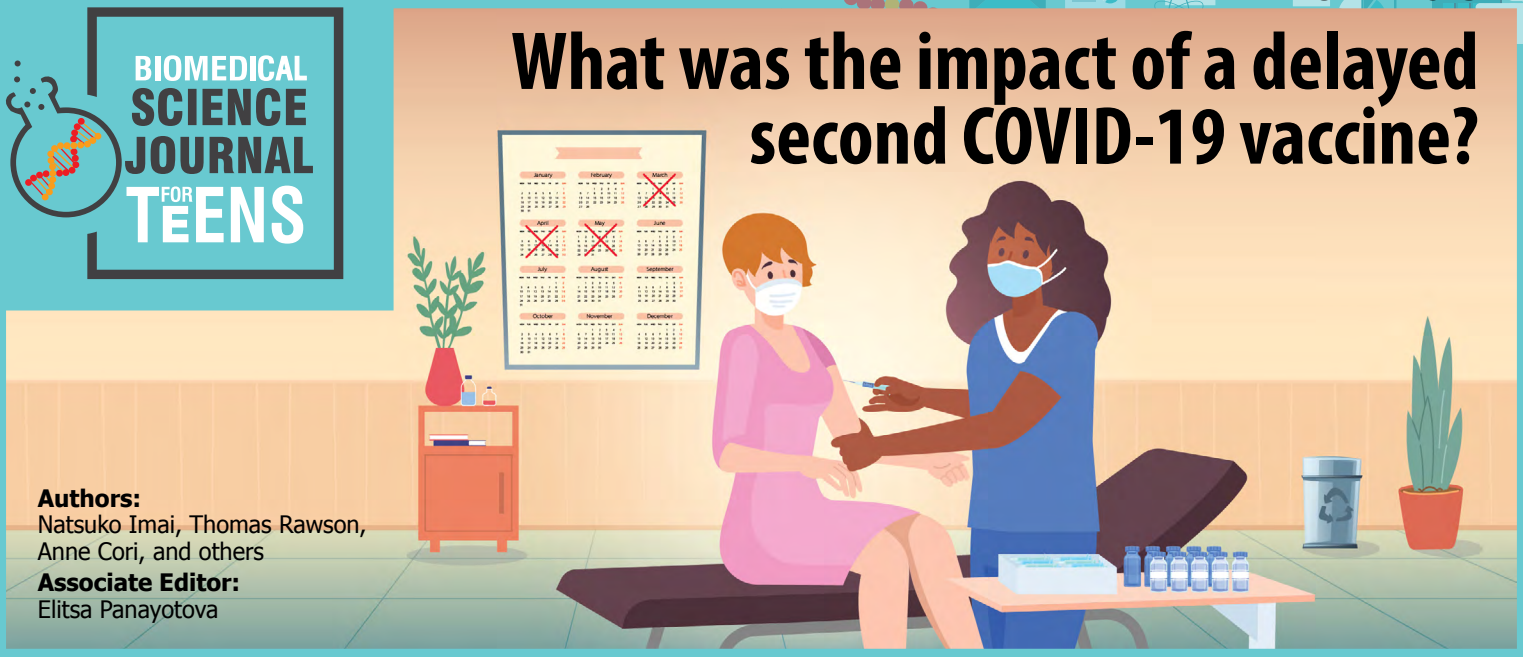
What was the impact of a delayed second COVID-19 vaccine?



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Abstract

Do you remember the first days of the COVID-19 pandemic? It got quite scary at times. There were many unknowns and governments had to make hard decisions. At first, there were lockdowns. Then, less than a year later, scientists developed vaccines.

The UK was the first country to start national vaccination. A full vaccination course required 2 doses for each person. But some evidence suggested that even one dose could provide decent protection for some time. So the UK government decided to delay the second dose and have more people receive the first dose as fast as possible.

What was the impact of this decision? We used a mathematical model to find out. It turned out that delaying the second dose prevented around 58,000 hospitalizations. It has saved more than 10,000 lives!

Introduction

COVID-19 is still around us. But in many countries, the situation is calmer than before. There are hardly any **restrictions**. Remember staying at home all the time? It wasn't fun, right? Do you know why it's different now? It's because of the many strategies that countries put into action. One of the most important strategies was mass **vaccination**. The more people are vaccinated, the fewer will get seriously ill.

In the UK at the beginning, medics gave the second dose of the vaccine 3 weeks after the first one. This was the recommendation from the experts based on the **clinical trials**. But there were not enough vaccines yet and new, more dangerous variants of the virus were emerging. This posed a new dilemma. Should more people get at least the first dose, or should fewer people get both doses? There was evidence that even just the first dose provided around 80% protection against getting really ill. Moreover, this protection lasted for about 3 months. So, some experts recommended delaying when people received their second dose of the vaccine – from 3 weeks to 12 weeks.

The UK government agreed. Everyone hoped that having more people with at least some **immunity** would save more lives. Many people criticized this decision. But what do the numbers say? What was the impact of this decision? This is what we wanted to find out now.

People wait in line to enter a vaccination center to receive the coronavirus vaccine, amid the outbreak of the coronavirus disease (COVID-19), in London, Britain, January 22, 2021. **Photo**: REUTERS/John Sibley

Methods

We assessed the impact of vaccination in England between December 2020 and September 2021. That is, from the beginning of national vaccination until there were enough first and second doses for everyone.

First, we collected some data (information):

- the number of hospitalizations and deaths from COVID-19 per day,
- the daily number of positive COVID-19 tests,
- the number of first and second vaccine doses given each day,
- the age of the vaccinated,
- which COVID-19 **variants** were present, and
- the **antibody** status of the population.

These data from real life were the result of a "delayed strategy". In reality, the second dose came 12 weeks (instead of 3 weeks) after the first.

We wanted to compare them to what could have happened if we had stuck to the shorter 3 weeks between doses. That would be the "non-delayed strategy".

We used a **mathematical model** to figure out what could have happened differently. The model took into account all of the measured data as well as:

- the vaccine's **effectiveness** against the different variants;
- the **waning** of the protection after each dose in the non-delayed strategy.

Results

During the analyzed period, there were 233,000 hospitalizations. Almost 55,000 people died of COVID-19. (These are the real-life numbers during the delayed strategy.)

Our model estimated outcomes for the non-delayed strategy. It showed that without the delay, there would have been 291,000 hospitalizations (Figure 1). And almost 65,000 people would have died.

With which strategy were there more hospitalizations? What could explain that?

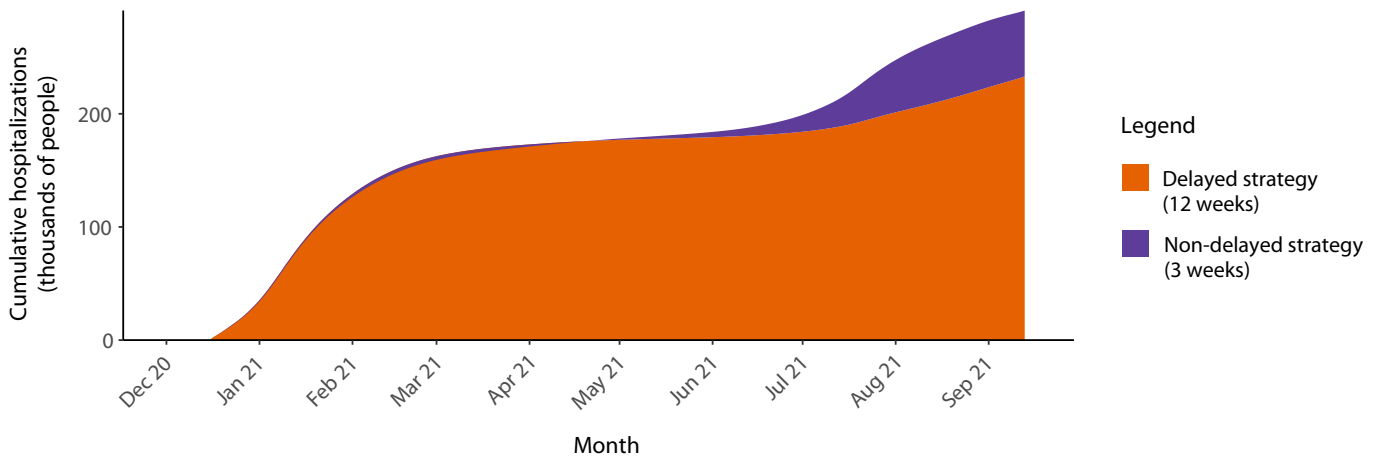

Figure 1: Cumulative daily hospitalizations in England. The orange shows the actual data with the delayed strategy. The purple shows the modeled data for the non-delayed strategy.

Discussion

It is hard to make decisions during an emergency. Especially when people's lives are at stake. So, it's important to consider every piece of evidence. Our results show that the decision to delay has likely saved more than 10,000 lives! It also prevented tens of thousands of people from being admitted to the hospital.

But why? One reason is that in the non-delayed strategy, there would have been fewer vaccinated people in the first months, so more people could have gotten seriously ill.

Another reason is that the earlier you receive the second dose, the earlier the protection starts to wane. So, delaying the second dose delayed the waning as well. This was very important. When the more severe **Delta variant** came along in the summer of 2021, more people were still immune. Thus, the delayed second dose saved more lives.

Conclusion

Mathematical models are a powerful tool! We used ours to see what could have happened and to assess the impact of delaying the second dose of the vaccine. But we could also use it to help with decisions in future situations. And we will have to because COVID-19 is still around us.

In the meantime, you can help by protecting yourself and others around you from COVID-19 and other diseases. How?

- Get all your routine vaccines.
- Avoid seeing people if you are feeling sick.
- Wear a facemask in crowded, stuffy areas.
- Wash your hands often.

Check your understanding

1. Why did the UK government decide to delay the second COVID-19 vaccine dose?
2. Why were there restrictions, such as lockdowns, at the beginning of the pandemic?
3. Fewer hospitalizations mean more people are healthy. But there is another reason why it is very important to have fewer hospitalizations. Can you guess what it is?
4. What strategies did your country take in the fight against COVID-19? Take a little time to review the statistics: how many people had COVID-19 in 2020, how many people were vaccinated later, and then how many people were infected in 2022. How well did the vaccination strategy in your country work?
5. Mathematical models help us every day. Can you think of any examples?

Glossary of Key Terms

Antibodies - proteins that can recognize a part of a virus or bacteria. Antibodies can kill them directly or they can tag them for further attack by other parts of the immune system.

COVID-19 - Coronavirus disease 2019, a disease caused by the SARS-CoV-2 coronavirus. Symptoms may include fever and dry cough in milder cases or difficulty breathing and death in more severe cases.

Clinical trial - a type of research that studies new medical treatments and evaluates their effects on human health outcomes.

Delta variant - a type of SARS-CoV-2 virus, which has small genetic differences from the initial virus that allow it to spread faster and cause more severe disease.

Effectiveness (of the vaccine) - a measure of how well the vaccine protects the person who gets it in real-world conditions.

Immunity - the ability of your body's defense system (immune system) to fight off disease. We gain immunity either by being exposed to the disease or by vaccination.

Mathematical model - a set of mathematical equations in a computer program that attempts to simulate a system (for example, human society) and to predict how the system would behave in the real world.

Restrictions - limits on what people are allowed to do. These can include closing down schools, shops, restaurants, and other public buildings; not allowing public gatherings, especially indoors; and restricting sporting and cultural events.

Vaccine - a medicine made from parts of a virus or bacterium, weakened versions of the pathogen, or information that tells our cells how to make a protein that triggers our immune system and develops antibodies against them without getting sick. After receiving the vaccine, the immune system knows how to fight this type of infection. For instance, children receive Measles, Mumps, and Rubella vaccine (MMR) to prevent them from getting these diseases in the future.

Variant - a subtype of a virus (or another microorganism) with somewhat different genes from the main type but not enough to be separated as a new virus. SARS-CoV-2 has several variants, most notably Alpha, Delta, and Omicron.

Waning (of protection) - the progressive loss of antibodies against a disease. This is why we need booster vaccine doses.

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