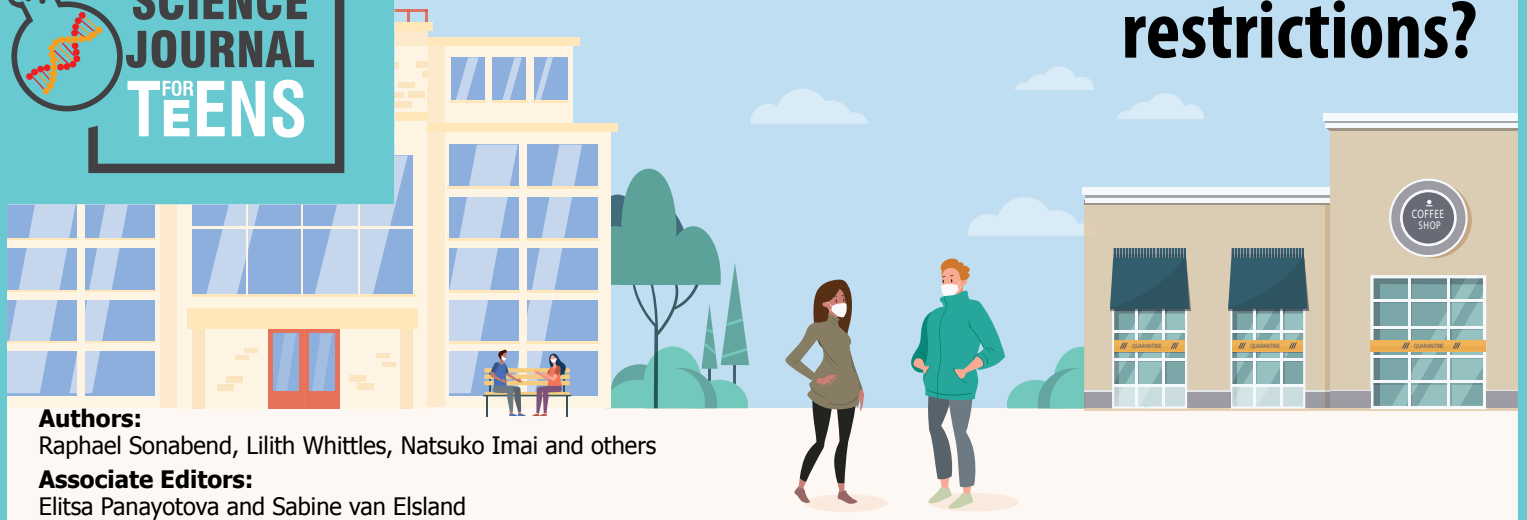
BIOMEDICAL SCIENCE JOURNAL FOR TEENS

OCTOBER 2021

How can we relax COVID-19 restrictions?



Authors:
Raphael Sonabend, Lilith Whittles, Natsuko Imai and others

Associate Editors:
Elitsa Panayotova and Sabine van Elsland

Abstract

COVID-19 has changed everyone's lives. At one time or another, most of us have had to stay at home and socially distance ourselves from others. But in some countries, people are starting to get out of lockdowns.

The last lockdown in England started in January 2021. Relaxing the restrictions afterwards happened gradually. It depended mainly on the number of immune people. Was this a good strategy? We created a mathematical model to see if lifting the restrictions was well timed. The strategy was successful at first. But the emergence of the Delta variant changed things. Our model shows that vaccination alone may not be enough to stop another peak of hospitalisations and deaths.

Introduction

COVID-19 has been all around us for almost two years now. Many of us had to stay at home during the **lockdowns**. As you probably remember, the **restrictions** were very strict at first. Then governments started lifting them step by step. What's the reason behind all this? **SARS-CoV-2**, the virus that causes COVID-19, spreads fast. If people interact with each other less often, it is more difficult for the virus to spread. This way, not only do we protect ourselves and our families, but we also make it easier for the healthcare system. If too many people get sick at the same time, the hospitals will be too full and many people won't receive adequate medical care. And not only for COVID-19, but for every other disease as well.

Vaccinating as many people as possible and lifting the restrictions step by step make sure this doesn't happen. Little by little, we return to our social lives, while hospitals don't get overwhelmed. But how do governments decide when it's time to loosen the restrictions?

Governments track how many people get infected and how many are in hospitals. Now that we have available **vaccines** against the virus, safely lifting the restrictions is also related to vaccine coverage. There are many people who have natural **immunity** as well – after recovering from COVID-19. Another thing governments need to consider is the appearance of new **variants**. Some spread faster, or vaccines don't work very well against them.

So, has England's strategy of lifting restrictions been successful so far?

COVID-19 vaccines can help prevent people from getting severely ill.
(**Photo credit:** Freepick)

Methods

We studied the situation in England. In January 2021, the government announced a full lockdown. Later, there were four steps of lifting restrictions:

1. Reopening schools in early March and allowing small groups to meet outdoors in late March;
2. Reopening hairdressers, museums, restaurants (outdoors), and other shops in April;
3. Allowing gatherings of small groups indoors and reopening outdoor venues for sports and large concerts in May;
4. Lifting all restrictions in late June. But the emergence of the Delta variant delayed this step until late July.

Was this timeline right? Was the delay in step four necessary? What will happen from now on? We created a **mathematical model** to assess the impact of each step and explore what the epidemic in England might look like in the future. The model took into account:

- the daily number of cases and hospitalisations;
- the vaccine coverage at each step;
- the number of people who are protected (with natural immunity) after recovering from COVID-19;
- how effective vaccines are;
- the emergence of the **Delta variant**, which spreads more easily;
- how much people socialised before restrictions were lifted and how they might socialise after.

The model tested many different **scenarios** because we cannot know for certain how people will mix in the future and there are a lot of unknowns about the new variant. First, natural immunity (from a previous infection with another variant) might not protect so well against Delta. Second, vaccines seem to be less effective against Delta.

Every virus, including the one that causes COVID-19, has an **R number** (reproduction number).

R shows (on average) how many **susceptible** people one infected person spreads the virus to. The R number needs to stay below 1 to lift restrictions. This means the epidemic is shrinking.

We used our mathematical model to calculate R over time in each scenario.

Results

Our results showed that the reopening of schools (step 1) didn't lead to an increase in cases. The reproduction number R remained below 1 even after step 2 in April (Fig. 1).

But this is when the Delta variant emerged. Soon, it became the most common variant and the R number increased above

Which events led to the greatest increase in R?

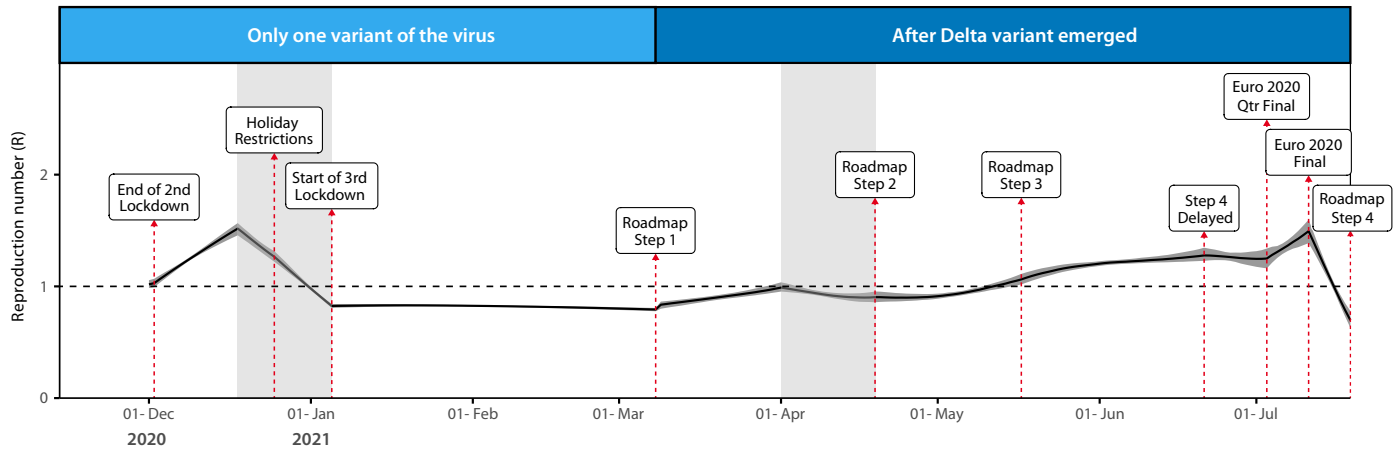


Figure 1: Graph showing how the virus' reproduction number (R) changed between December 2020 and July 2021. The shaded areas around the line show uncertainly. The grey areas on the graph show the winter and spring school holidays.

1 in May. Cases increased rapidly because Delta spreads more easily.

In step 3, the stadiums reopened. The European football championship in June also meant more people were socialising. Cases increased more.

As a result, the government decided to delay step 4 until late July. This delay gave millions more people in England the chance to get vaccinated. Our model shows that this vaccination prevented thousands of hospitalisations. It also reduced the predicted total deaths by 15%. If the Delta variant hadn't shown up, the R number would have remained below 1.

What about future projections? Uncertainty about vaccine efficacy and people's behaviour means that there are many different possible developments in the epidemic.

Discussion

Our study shows that lifting the restrictions step by step has been a successful strategy. Hospitalisations and deaths have been low throughout the spring and summer. Mass vaccination has been the main reason behind this. The time between each step allowed for the administration of millions of vaccines. And if more people are immune to the virus, it is more difficult for it to spread.

But the emergence of the Delta variant has made things difficult. It spreads better than the older variants. And vaccines and natural immunity are not so protective against it. But that doesn't mean they don't work at all! It means that vaccination alone may not be enough. There may still have to be some restrictions to avoid further healthcare system overload and to save many lives. The delay of step 4 and its benefits demonstrates that.

Conclusion

Lockdowns and restrictions are hard on everyone. But they are there to protect you and countless others. Moreover, COVID-19 has affected older people more until now, but the new variant is common among children and teenagers. To avoid getting infected (or infecting others):

- get vaccinated when/if you are offered a vaccine;
- wash your hands often with soap;
- wear a face mask in indoor public places.

If possible, keep a physical distance from your peers and avoid crowded places. Alternatively, get a free COVID-19 test before gathering with lots of people.

Check your understanding

1. What is the difference between COVID-19 and SARS-CoV-2?
2. Why did the UK government delay step 4 of relaxing restrictions by one month? What did this delay lead to?
3. If you know that the R number of a virus (e.g. the seasonal flu) is 3, what does that mean? How can we reduce it below 1?
4. If vaccines aren't that good against the Delta variant, why should we get vaccinated?
5. What is the situation in your country? What restrictions do you think are appropriate right now there, and why?

Glossary of Key Terms

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

Delta variant - a type of SARS-CoV-2 virus, which has small genetic differences from the initial virus, allowing it to spread faster.

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

Lockdown - because of the pandemic, many countries applied restrictions to limit the spread of the virus – people had to stay at home; if you had contact with infected people you had to quarantine, etc.

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

R number - reproduction number, the number of people an infected person spreads the virus to. It tells us how contagious a virus is. When R is above 1, it means the epidemic is growing. When R is below 1, the epidemic is shrinking – the actions we are taking against it have an effect.

Restrictions - these can include closing down schools, shops, restaurants, and other public buildings; not allowing public gatherings, especially indoors; and restricting sporting and cultural events.

SARS-CoV-2 - the virus that causes COVID-19 in humans.

Scenario - testing out the mathematical model's predictions under different conditions.

Susceptible - people that are more likely to get infected because they are not immune (they hadn't been infected before, and they are not protected by the vaccine).

Vaccine - a person receives 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: the immune system now knows how to fight this type of infection. For instance, most children receive Measles, Mumps and Rubella vaccine (MMR) to prevent getting these diseases in the future.

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

REFERENCES

Raphael Sonabend, Lilith K. Whittles, Natsuko Imai, Pablo N. Perez-Guzman, Edward S. Knock, Thomas Rawson, Katy A. M. Gaythorpe, Bimandra A. Djaafara, Wes Hinsley, Richard G. FitzJohn, John A. Lees, Divya Thekke Kanapram, Erik M. Volz, Azra C. Ghani, Neil M. Ferguson, Marc Baguelin, and Anne Cori (2021) *Non-pharmaceutical interventions, vaccination and the Delta variant: epidemiological insights from modelling England's COVID-19 roadmap out of lockdown – a mathematical modelling study.* The Lancet.
https://doi.org/10.1016/S0140-6736(21)02276-5

CDC: Delta Variant: What We Know About the Science
https://www.cdc.gov/coronavirus/2019-ncov/variants/delta-variant.html

National Geographic Kids: What is Coronavirus?
https://www.natgeokids.com/uk/discover/science/general-science/what-is-coronavirus/

Acknowledgement: This article's adaptation was supported by Imperial College London. Imperial College London