Pros and Cons of the Global Roll-Out of COVID-19 Vaccines

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Public Health Impact

- How do we measure the public health impact of vaccination campaigns?

Pros of Global Roll-Out

- Lives saved
- Infections and long-COVID prevention
- Relaxation of public health and safety measures

Cons of Global Roll-Out

- Missed vaccine targets
- Global vaccine inequity and hoarding
- Immune escape variants and reduced vaccine effectiveness

Far-reaching Pros and Cons of Global Roll-Out

- Increased investment in vaccine technology
- Increased attention towards measuring vaccine uptake/impacts
- Negative effects on vaccine confidence and polarisation of vaccine debates
- (Hopeful) beneficial impacts for new vaccine development timelines and investment

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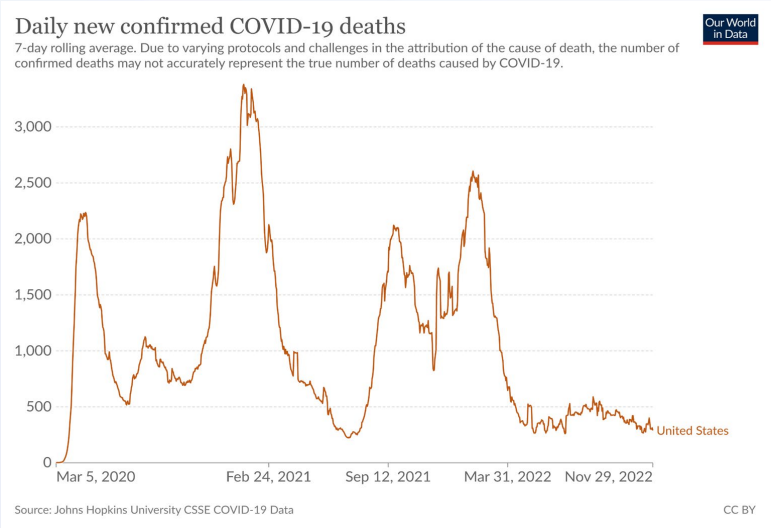
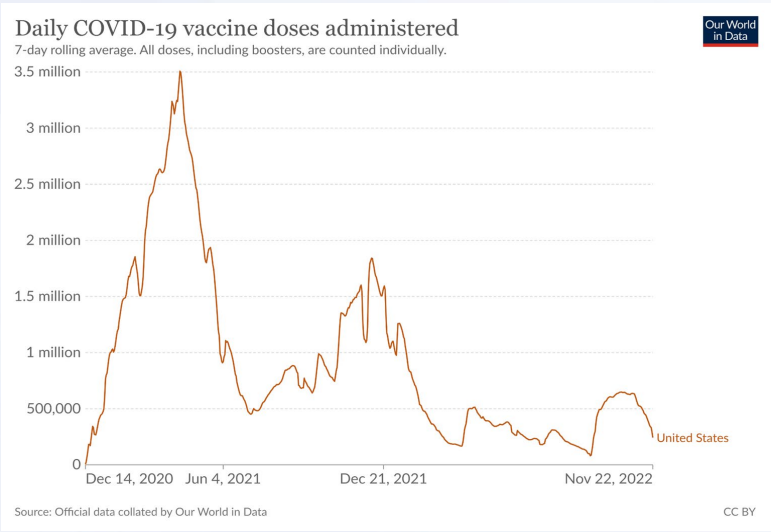
- Need a “counterfactual” scenario:
    - How would the pandemic have played out without vaccines?

- Infinite possible counterfactuals:
    - Would public health measures and lockdowns been permanently in place?
    - Would we have developed better antiviral treatments?
    - Would different variants of concern have arisen?

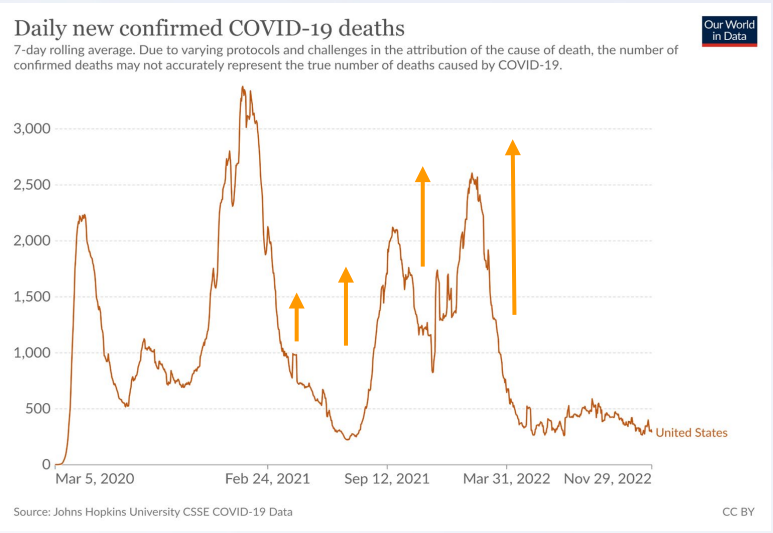
- In response, most approaches explore the “simplest” scenario:
    - Exactly the same pandemic… but without any vaccines used.

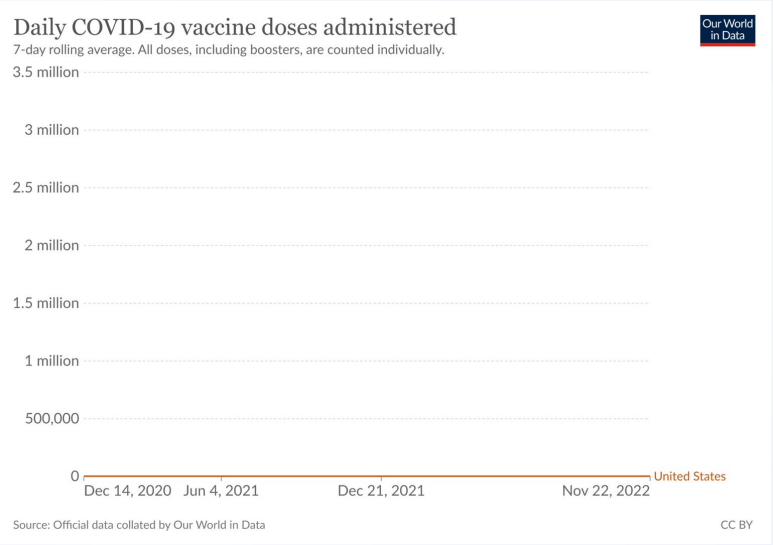
What does this counterfactual look like?





Remove vaccination





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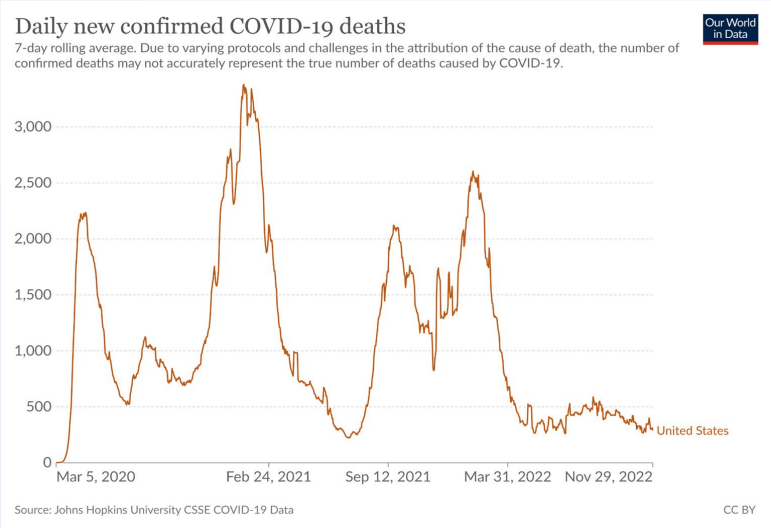

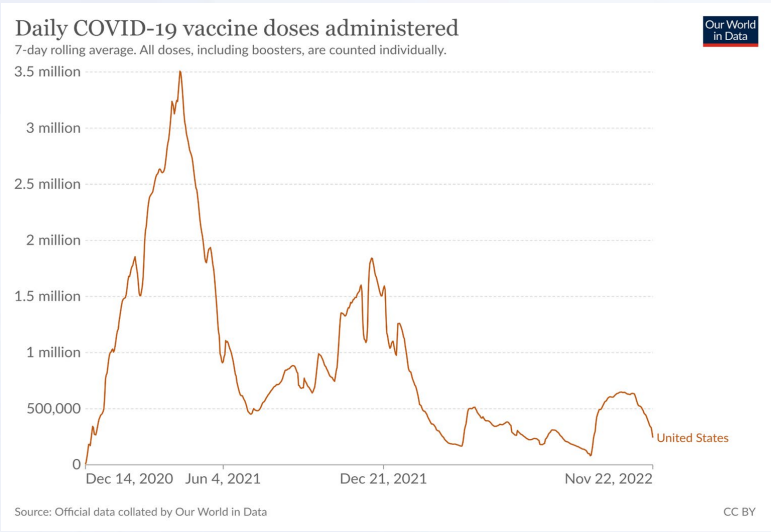

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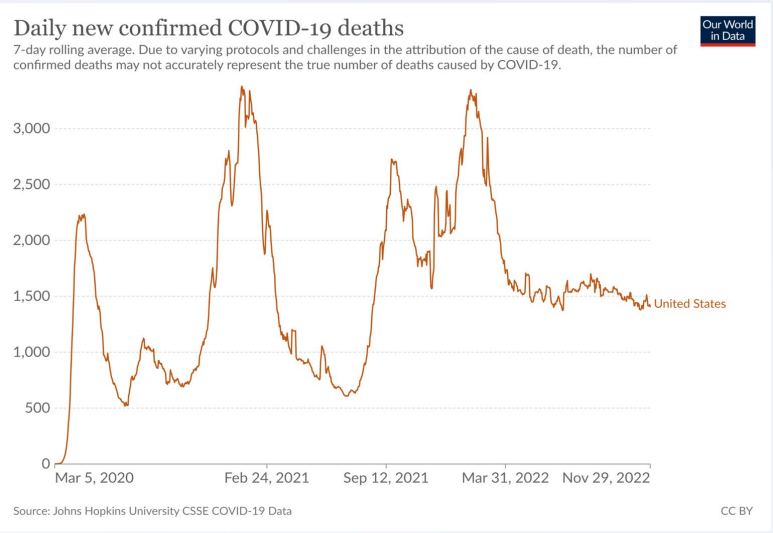

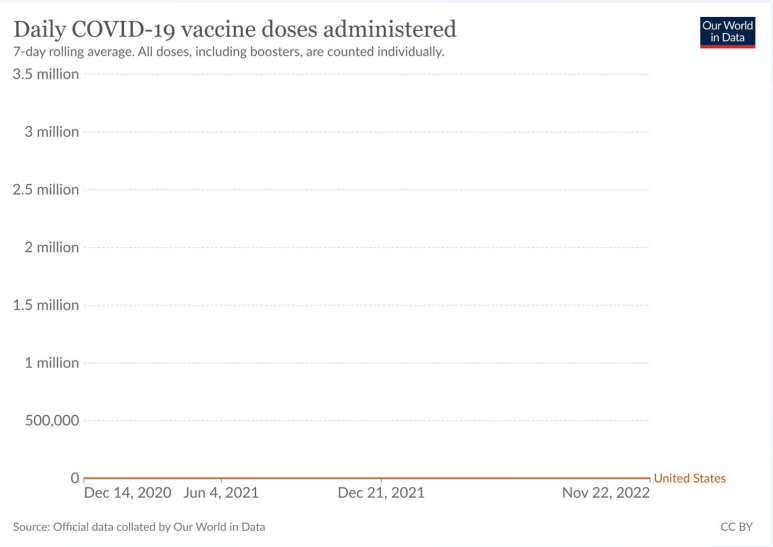

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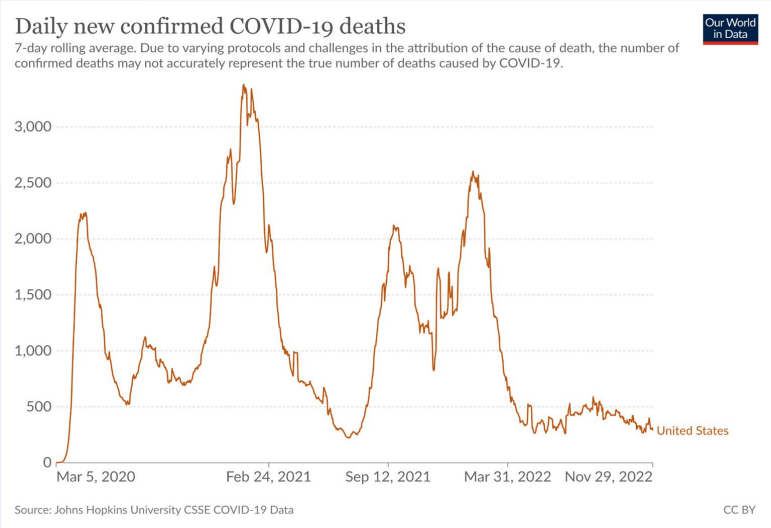

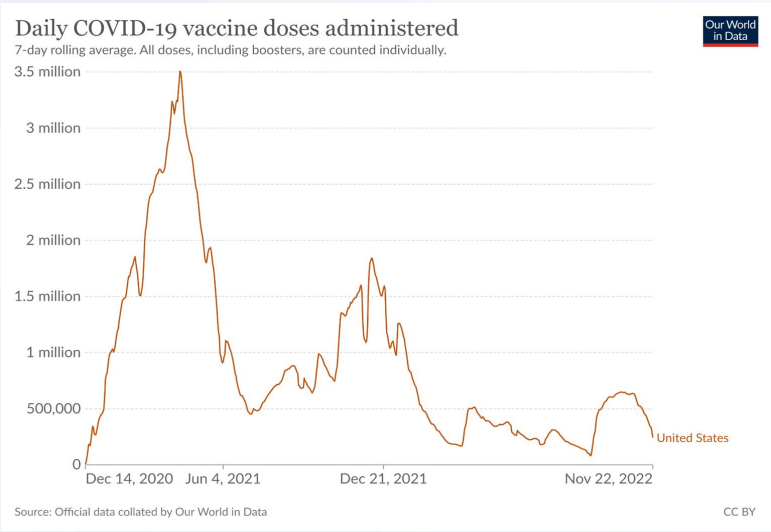

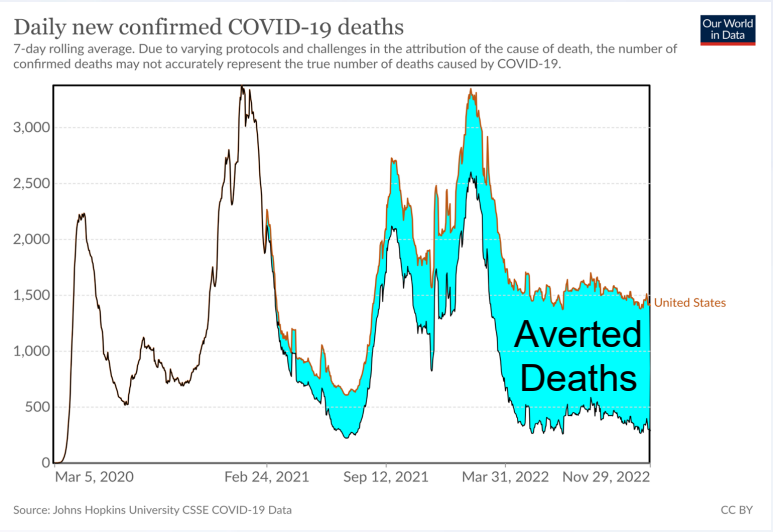

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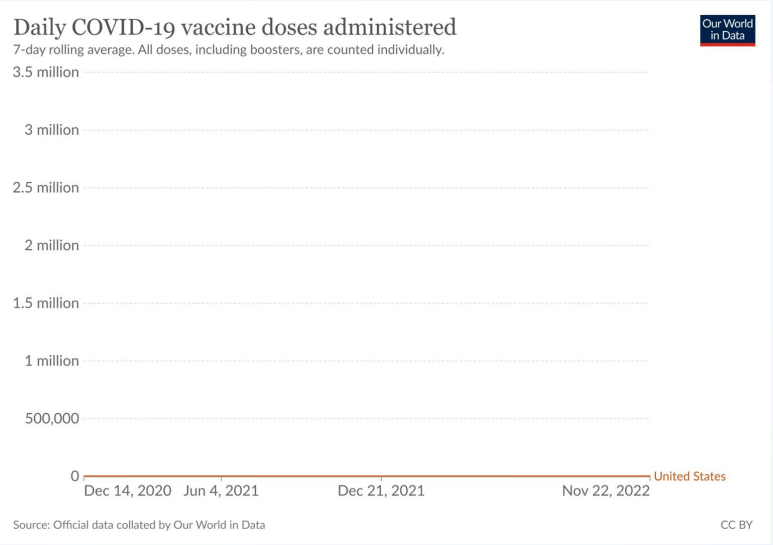
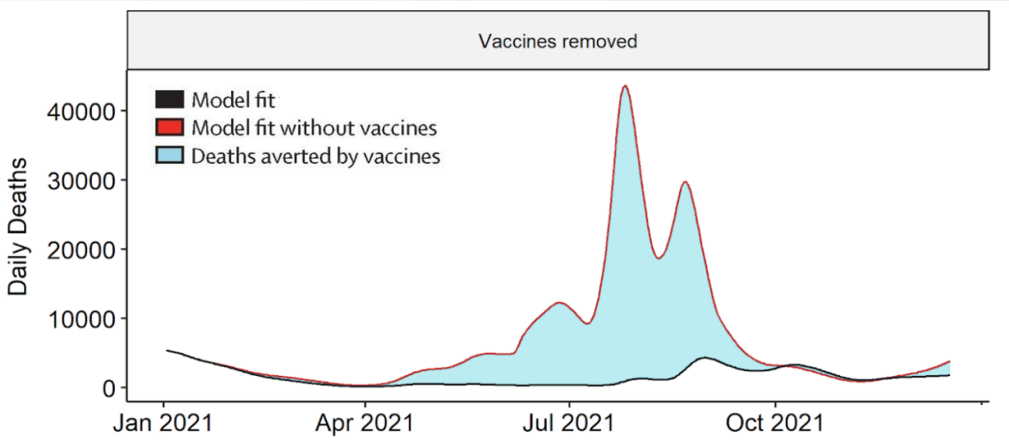


How do we estimate what this counterfactual look like?

- Use mathematical models of COVID-19 transmission:
  - Fit models to the epidemic that did happen in each country
  - Form these fits, estimate R_t - mean number of secondary infections in the absence of both infection-induced and vaccine-derived immunity
  - Simulate the epidemic using R_t but without vaccines.



Watson et al. Lancet Infectious Disease. 2022

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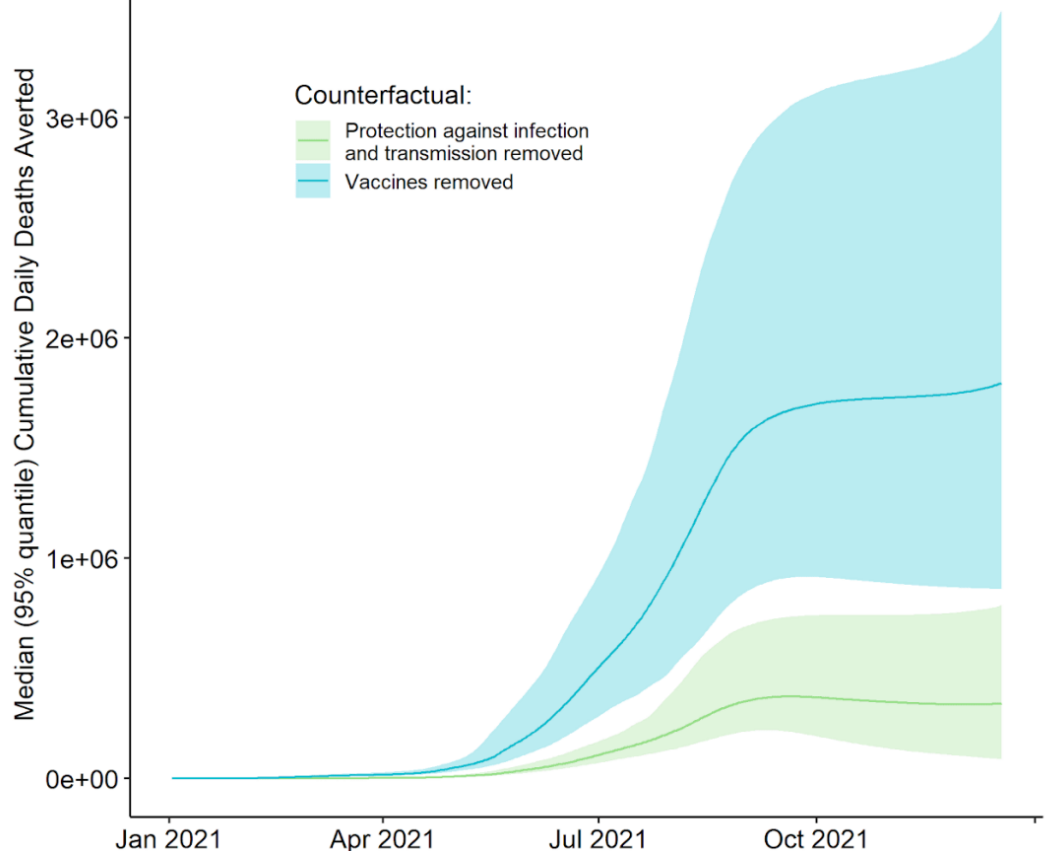
- Explore additional counterfactuals:
  - What if vaccines only provided direct protection, i.e. no reduction in risk of being infected but same reduction in risk of death?



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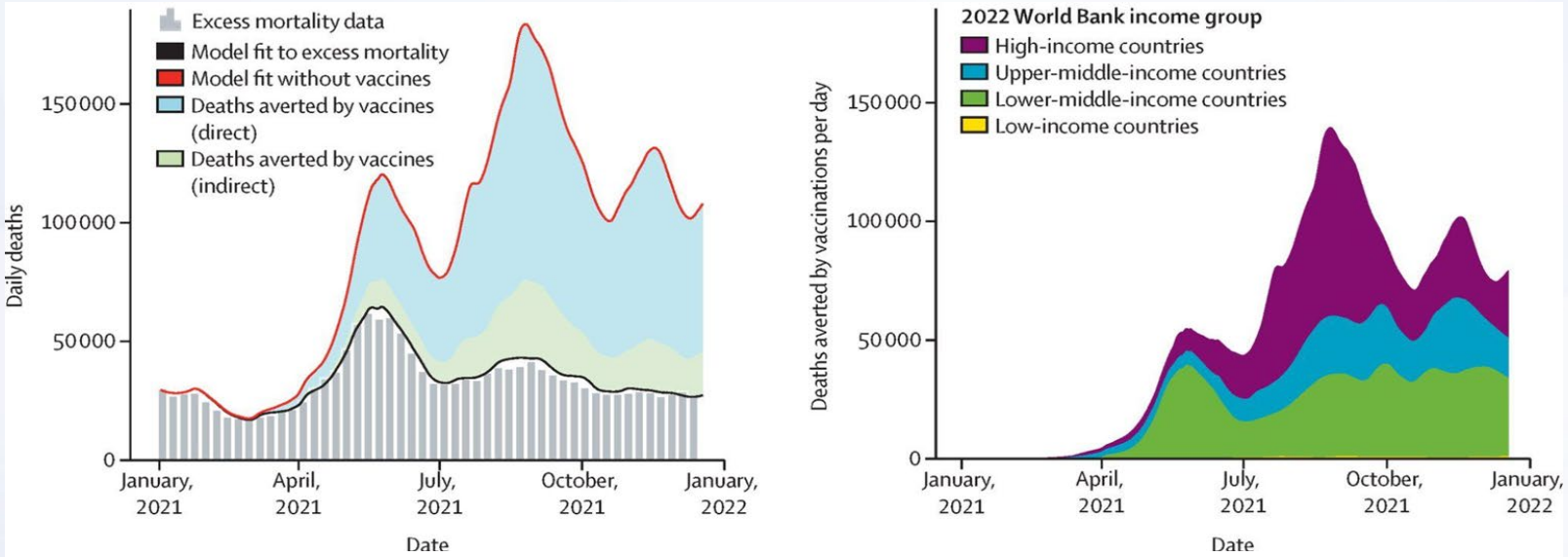
Pros of the Global Roll-Out of COVID-19 Vaccines?

Pros of the Global Roll-Out of COVID-19 Vaccines

Lives saved from vaccine prevented deaths

- 20 million deaths were prevented worldwide during the 1st year of COVID-19 vaccination
- Over 12 million deaths prevented in high and upper-middle income countries
- 7 and a half million deaths were prevented in countries covered by the COVID-19 Vaccine Access initiative (COVAX)



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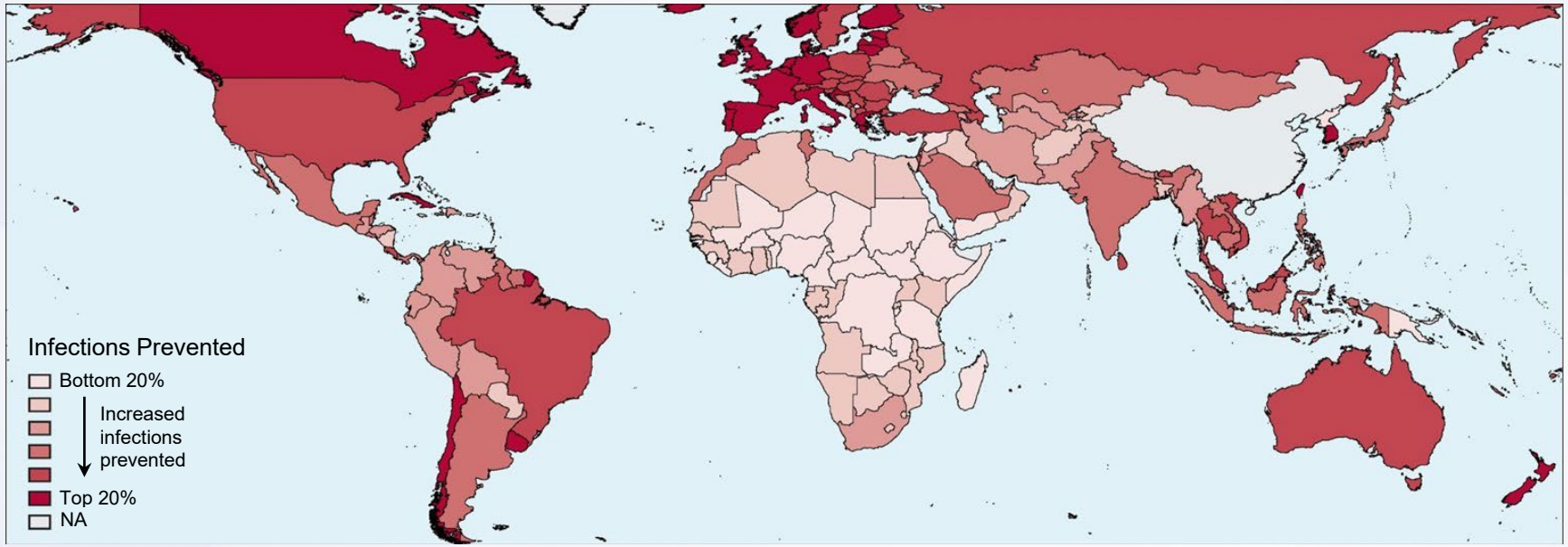
Pros of the Global Roll-Out of COVID-19 Vaccines

Prevented Infections and Long-COVID

- 1.5 billion infections averted during the first year of COVID-19 vaccinations
- Between 1% - 20% (depending on Long-COVID definitions and severity) of infections develop Long-COVID symptoms.
- Between 15 million - 300 million cases of Long-COVID likely prevented due to global vaccination campaign

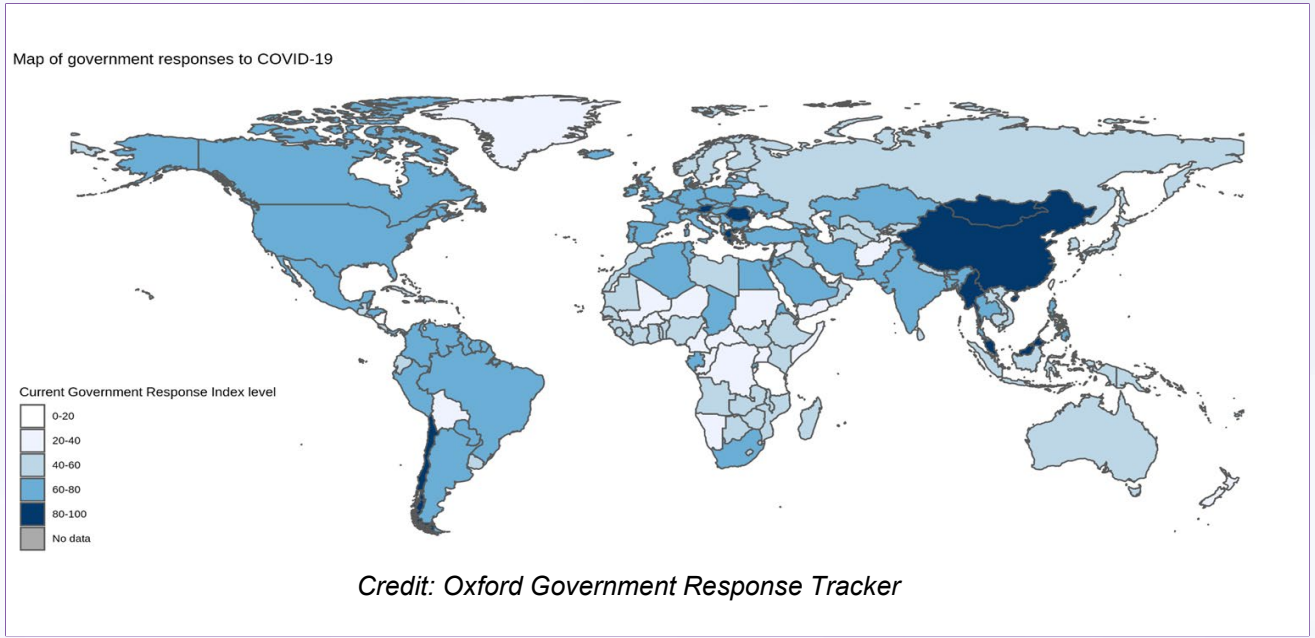


Pros of the Global Roll-Out of COVID-19 Vaccines

Relaxation of public health and safety measures

- Substantial restrictions of individual freedom to prevent spread of COVID-19 during 2020.

8th December 2020 - Day of 1st COVID-19 Vaccine



Credit: Oxford Government Response Tracker

Pros of the Global Roll-Out of COVID-19 Vaccines

Relaxation of public health and safety measures

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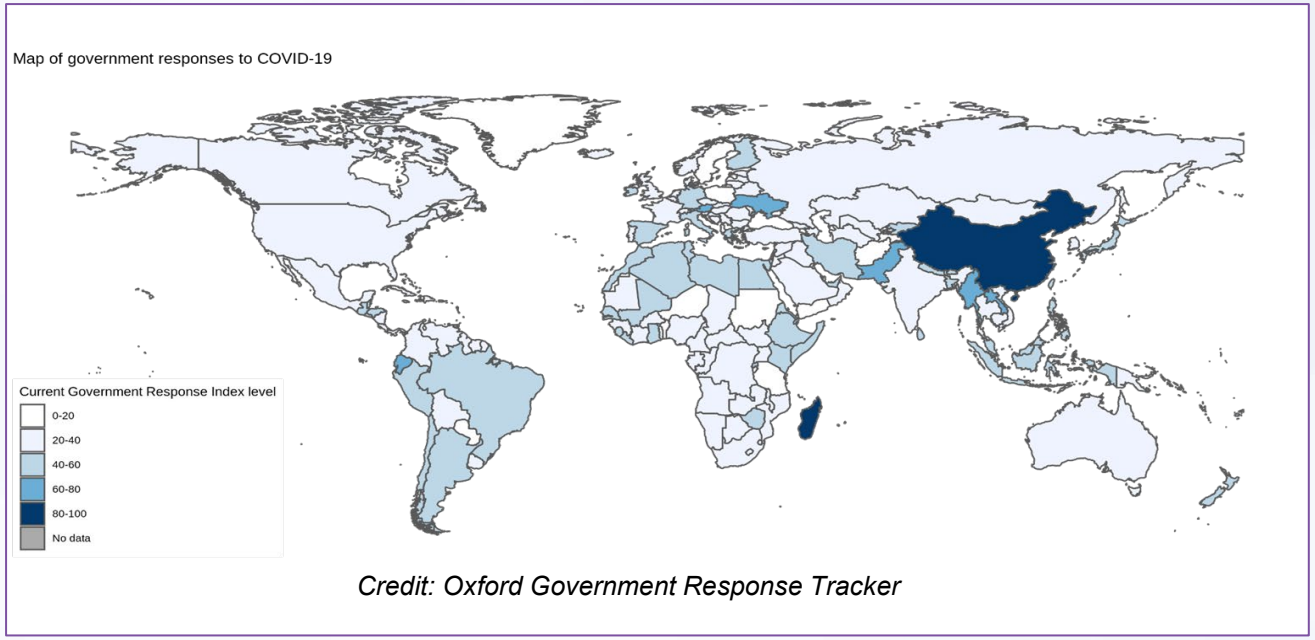
- Restrictions largely lifted worldwide due to vaccines.

20 July 2022 - Significant reductions in interventions



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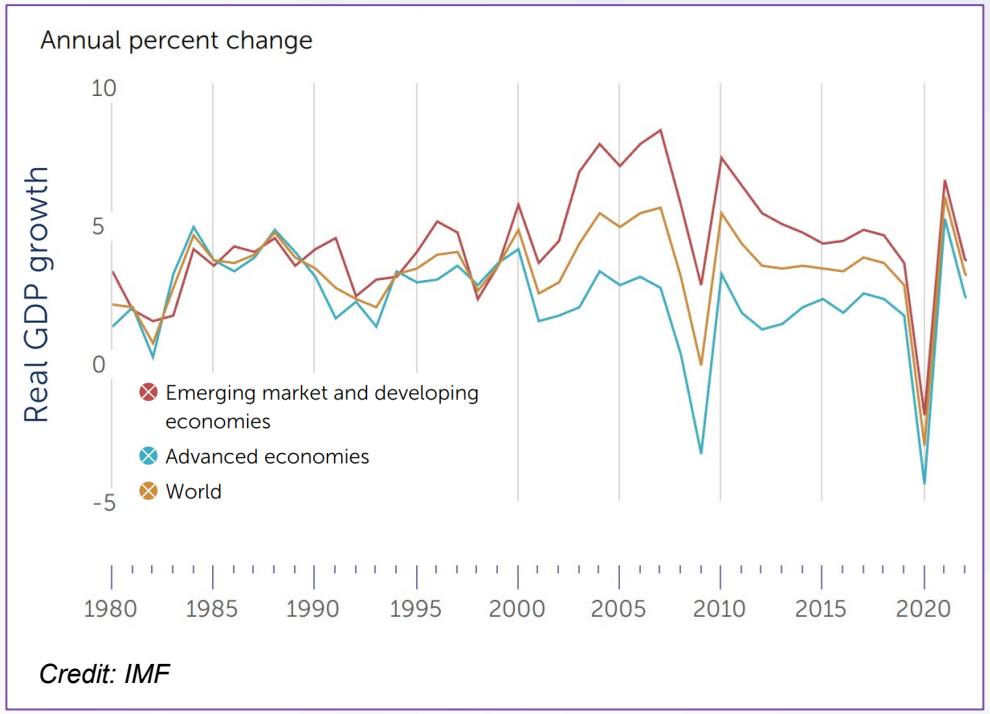
- Return to pre-pandemic economic growth observed in most parts of the world that have been able to relax public health interventions as a result of vaccination.



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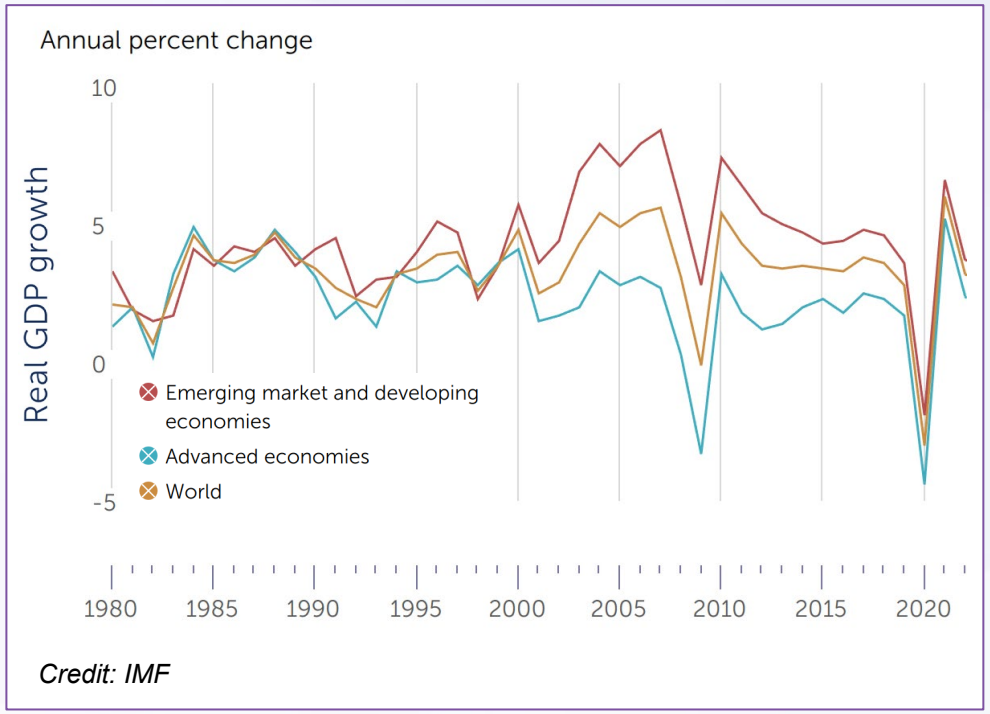
- Restrictions largely lifted worldwide due to vaccines.
- Return to pre-pandemic economic growth observed in most parts of the world that have been able to relax public health interventions as a result of vaccination.
- **Return attention to other areas of public health that have been overlooked during the pandemic.**



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Cons of the Global Roll-Out of COVID-19 Vaccines?

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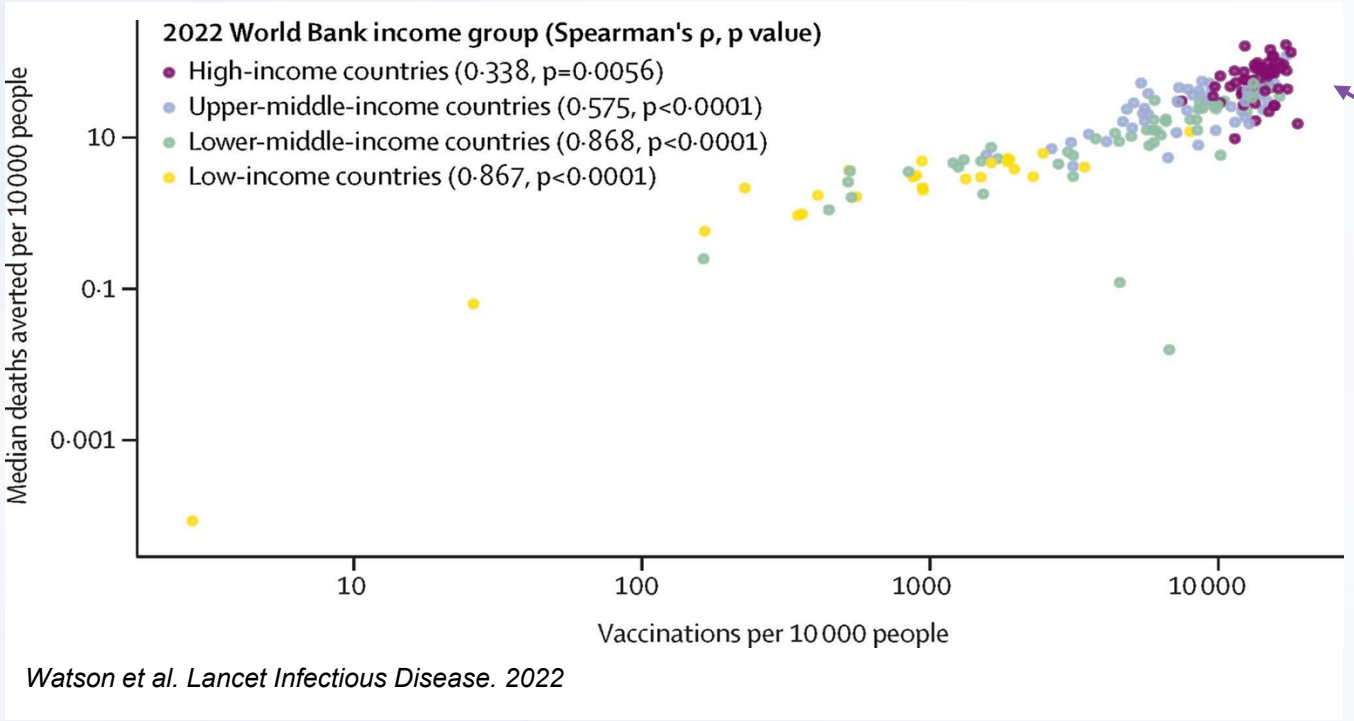
Missed vaccine targets

- COVAX (COVID-19 Vaccine Alliance) and the WHO set vaccination targets for the end of 2021.
- WHO set a target of ensuring that 40% of each country's population was fully vaccinated by the end of 2021
- If WHO targets had been achieved, 1 in 5 of the lives lost due to COVID-19 in low-income countries could have been prevented



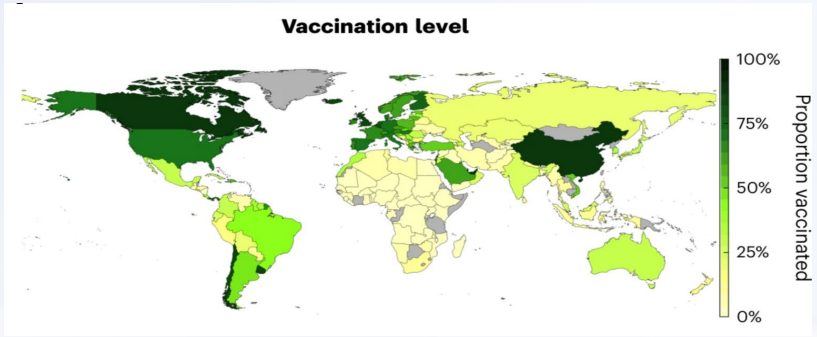
Watson et al. Lancet Infectious Disease. 2022

Countries that were able to quickly achieve high vaccine coverage with more effective mRNA vaccines saved the most amount of lives.

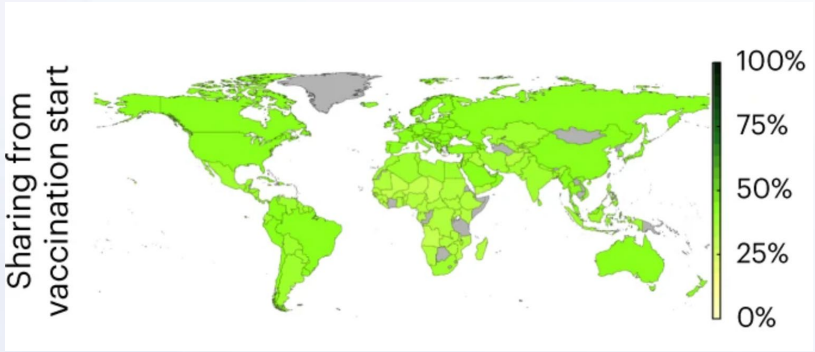
Cons of the Global Roll-Out of COVID-19 Vaccines

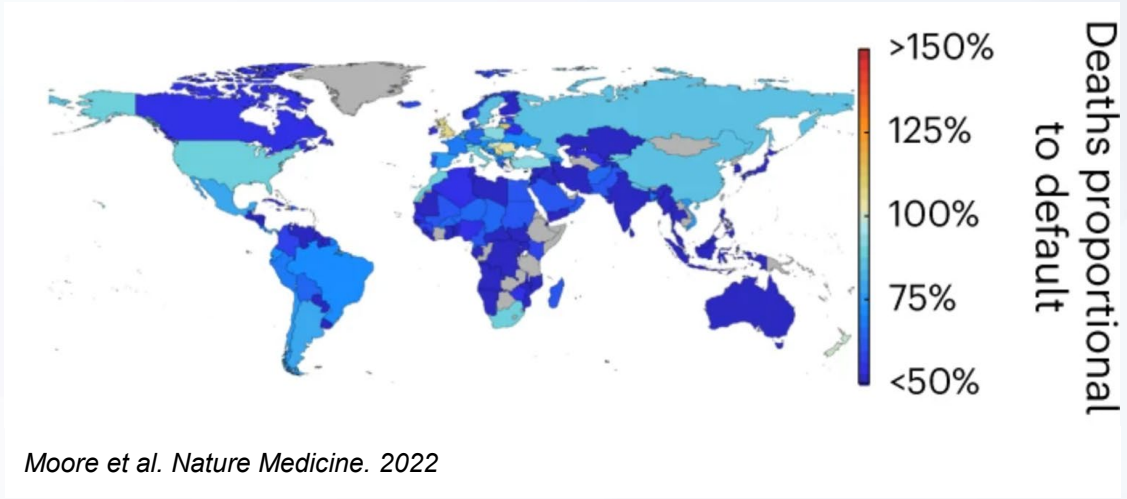
Global vaccine inequity and hoarding

- More than 1 million lives could have been saved if COVID-19 vaccines had been shared more equitably with lower-income countries in 2021.
- This could have occurred without significant increases in COVID-19 deaths in high-income countries reducing their vaccine coverage.



Vaccine sharing redistributing vaccines





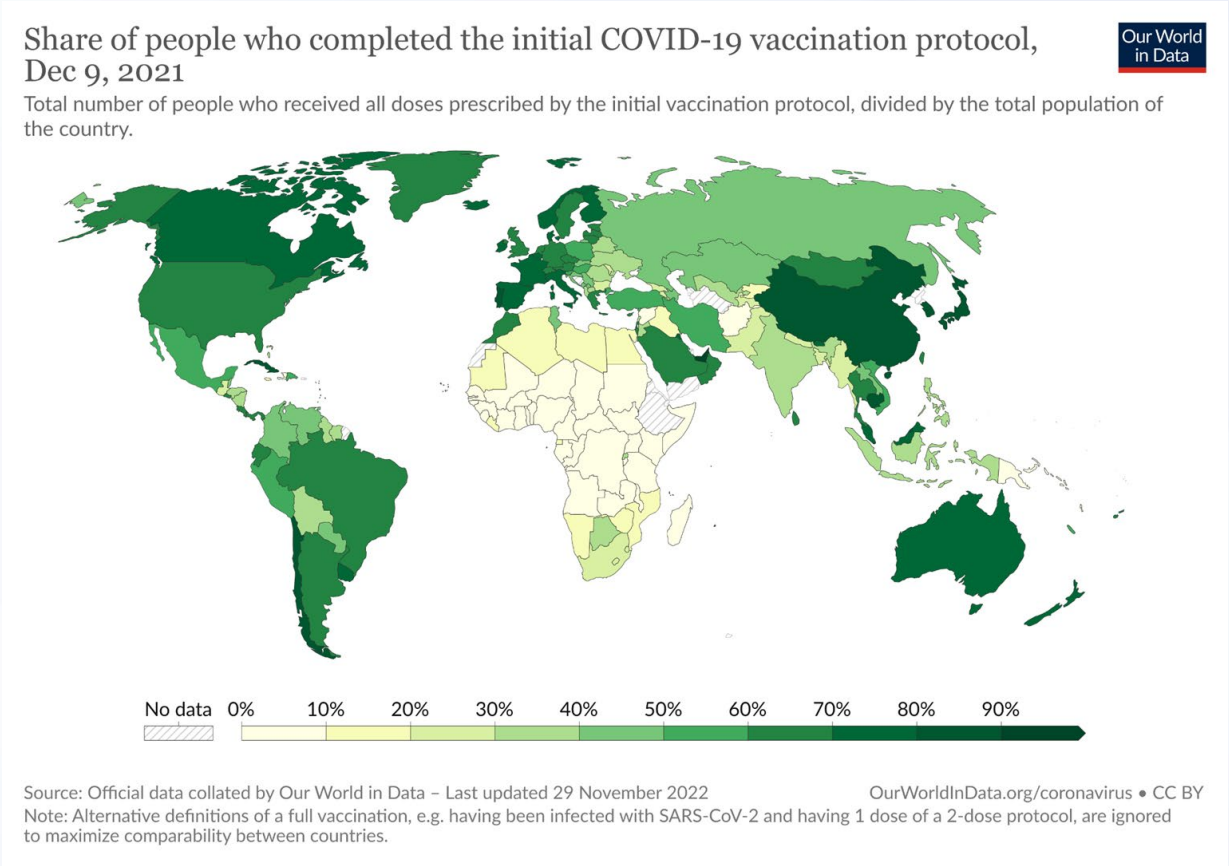
Moore et al. Nature Medicine. 2022

Reduction in deaths relative to actual vaccine roll out

Cons of the Global Roll-Out of COVID-19 Vaccines

Immune escape variants and reduced vaccine effectiveness

- Before the emergence of the Omicron variant, vaccine coverage in low-income countries was extremely low.
- If transmission is allowed to occur, there is always a risk of new variants emerging.
- New variants of concern exhibited immune evasive properties, reducing how effective vaccines were at preventing infection (protection against death still remained very high).
- **Impossible to know how the emergence of variants of concern would have been different… but global vaccine inequity undoubtedly increased the speed of new mutations arising.**



Far-reaching Pros and Cons of Global Roll-Out?

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Increased investment in vaccine technology

- Coalition for Epidemic Preparedness Innovations 100-day vaccine development target

Increased attention towards measuring vaccine uptake/impacts

- Ongoing research to continually track and improve vaccine hesitancy → key model parameters for policy makers
- Increased focus on monitoring vaccine side effects, how to report these and how this shapes public perceptions

Negative effects on vaccine confidence and polarisation of vaccine debates

- More research needed to understand the impacts of vaccine policies.
    - Do vaccine mandates increase vaccine uptake?
    - What impact have childhood vaccination campaigns had on transmission and vaccine hesitancy?

(Hopeful) beneficial impacts for new vaccine development timelines and investment

- First malaria vaccine was approved in 2021.
- In 2022, new malaria vaccines with up to 80% effectiveness in trials at preventing disease in young children (Datoo et al. Lancet ID. 2022)

Public Health Impact

Pros of Global Roll-Out

- Lives saved: **20 million lives saved by the end of 2021**
- Infections and long-COVID prevention: **1.5 billion infections prevented by the end of 2021**
- Relaxation of public health and safety measures: **Return to normal population activity → focus can return to other health needs.**

Cons of Global Roll-Out

- Missed vaccine targets: **600,000 deaths worldwide, 1 in 5 deaths in low-income countries could have been prevented**
- Global vaccine inequity and hoarding: **>1 million deaths could have been averted with vaccine sharing**
- Immune escape variants and reduced vaccine effectiveness: **Reduced transmission could have slowed variant evolution**

Far-reaching Pros and Cons of Global Roll-Out

- Increased investment in vaccine technology:
  - **Hopes for a vaccine within 100 days from sequence identification**
- Increased attention towards measuring vaccine uptake/impacts:
  - **Vaccine hesitancy tracking and new research on side-effect perceptions needed to improve uptake for future pandemics.**
- Negative effects on vaccine confidence and polarisation of vaccine debates
  - **More social research required to understand the impacts of vaccine mandates and role of childhood vaccination**
- (Hopeful) beneficial impacts for new vaccine development timelines and investment:
  - **First malaria vaccine now approved after 30 years of development**