



Covid-19: Preparing for the next pandemic wave

*WHO - WIPO - WTO Joint Technical Symposium on
The COVID-19 Pandemic: Response, preparedness, resilience - 16 December 2022*

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science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

CAPRISA hosts a
DSI-NRF Centre of
Excellence in
HIV Prevention



National
Research
Foundation



UNAIDS
CAPRISA is the UNAIDS Collaborating
Centre for HIV Research and Policy



CAPRISA hosts a MRC HIV-TB
Pathogenesis and Treatment Research Unit
CAPRISA hosts a DoH-MRC Special
Initiative for HIV Prevention Technology



MAILMAN SCHOOL
of PUBLIC HEALTH

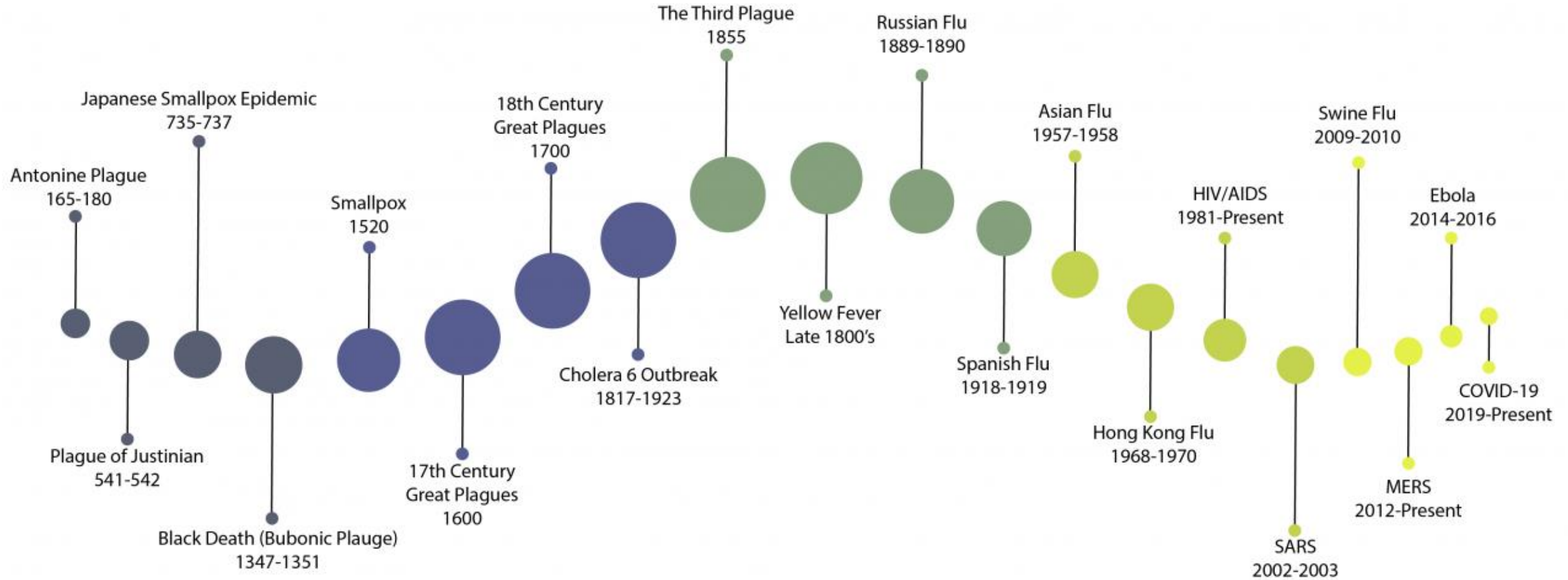


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YAKWAZULU-NATALI

Outline

- **The virus, the disease and the pandemic**
- **Covid-19:**
 - ...more than an acute respiratory infection
- **5 benefits of vaccines**
- **Beyond the Covid-19 pandemic emergency:**
 - ...living smartly with the virus
- **A key Covid-19 lesson**

History of deadly plagues, epidemics and global pandemics



Source: Trinitonian.com

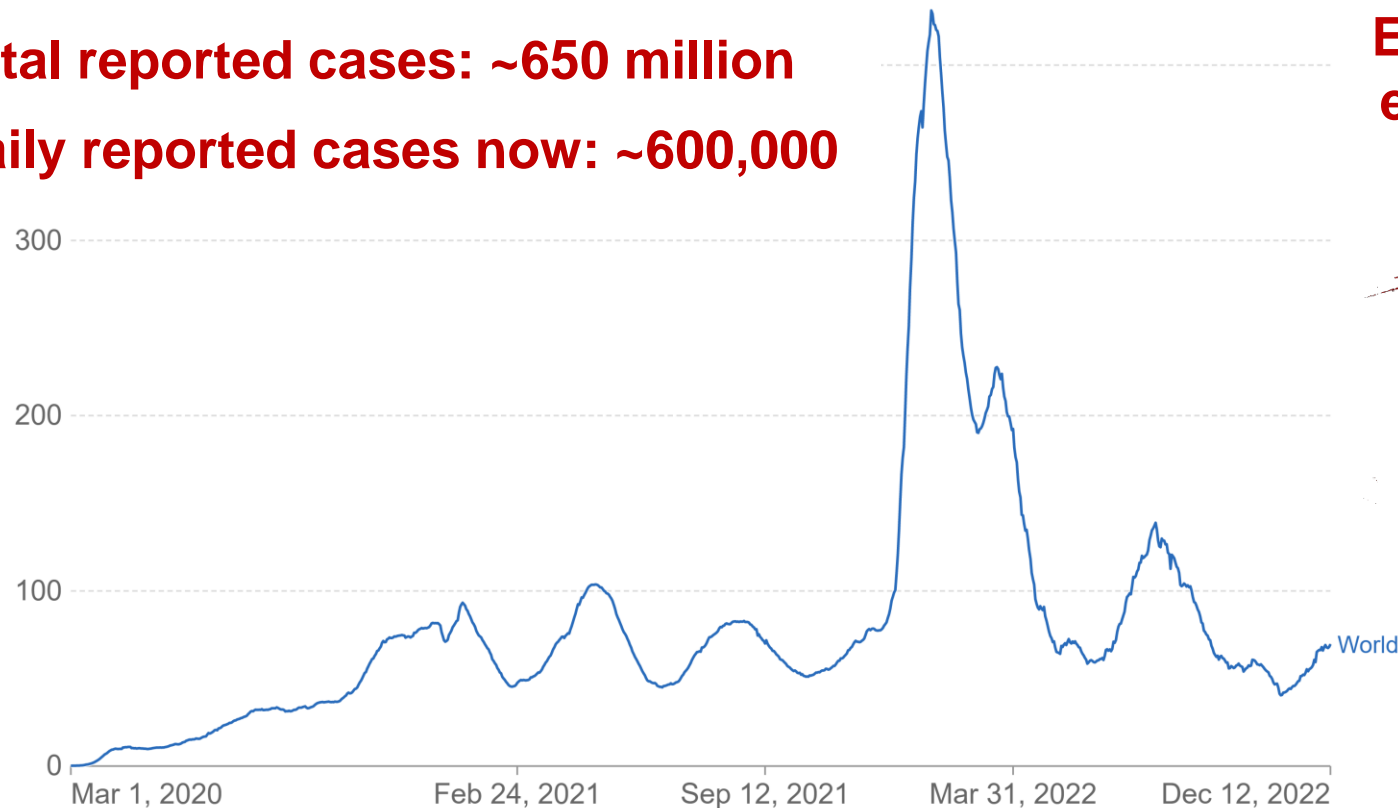
The global COVID-19 pandemic at a glance

Daily new confirmed COVID-19 cases per million people

7-day rolling average. Due to limited testing, the number of confirmed cases is lower than the true number of infections.

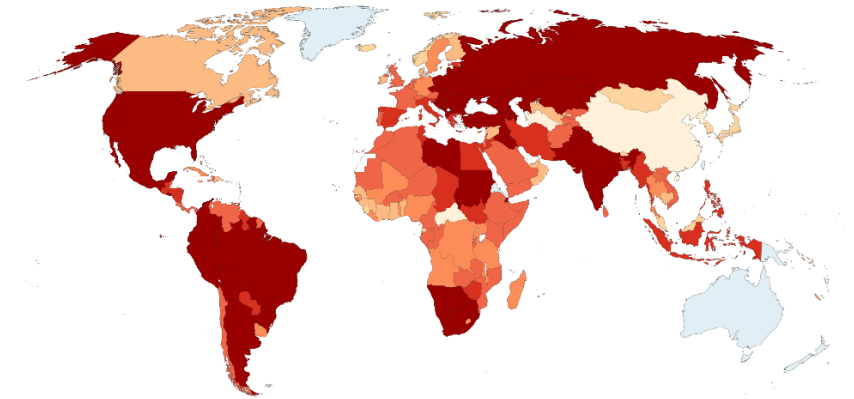
Total reported cases: ~650 million

Daily reported cases now: ~600,000



Source: Johns Hopkins University CSSE COVID-19 Data

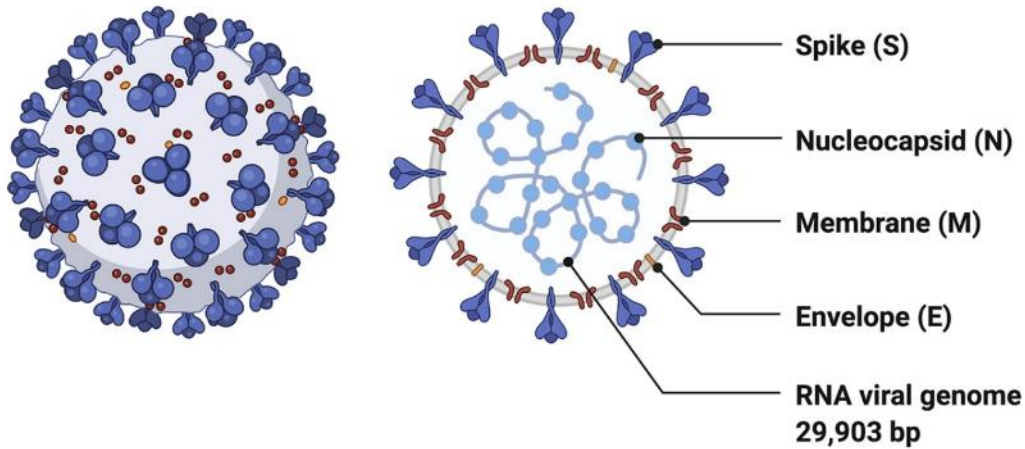
Reported deaths: 6.6m
Estimated 20 million (14m – 24m)
excess deaths worldwide during
the pandemic



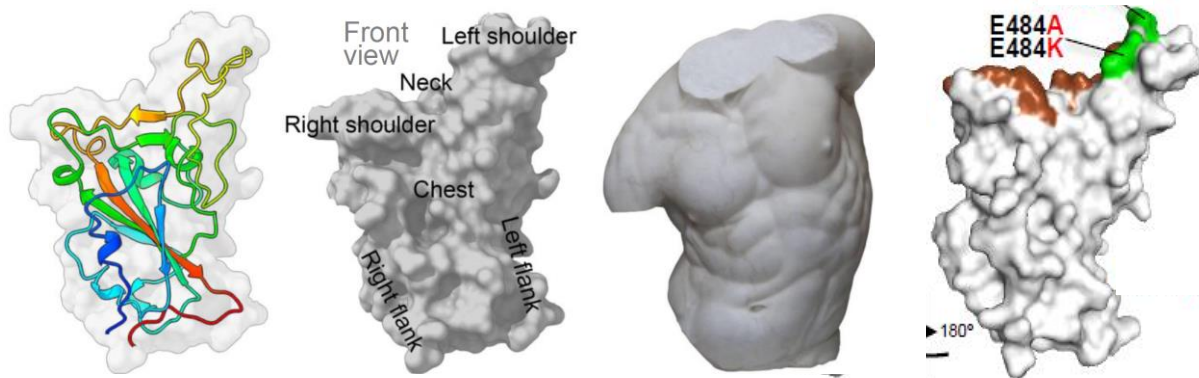
Still high in some countries
eg. USA Covid-19 deaths:
~ 400 per day

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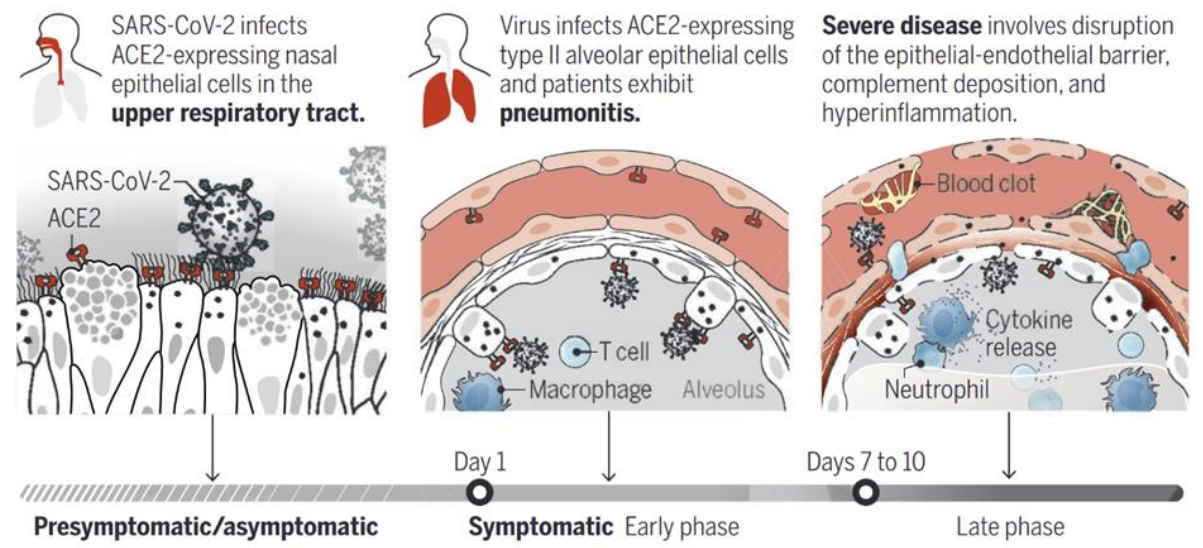
The virus & the disease: SARS-CoV-2 & Covid-19



Spike protein



Science **How does SARS-CoV-2 cause COVID-19?**
 Nicholas J. Matheson^{1,2} and Paul J. Lehner¹

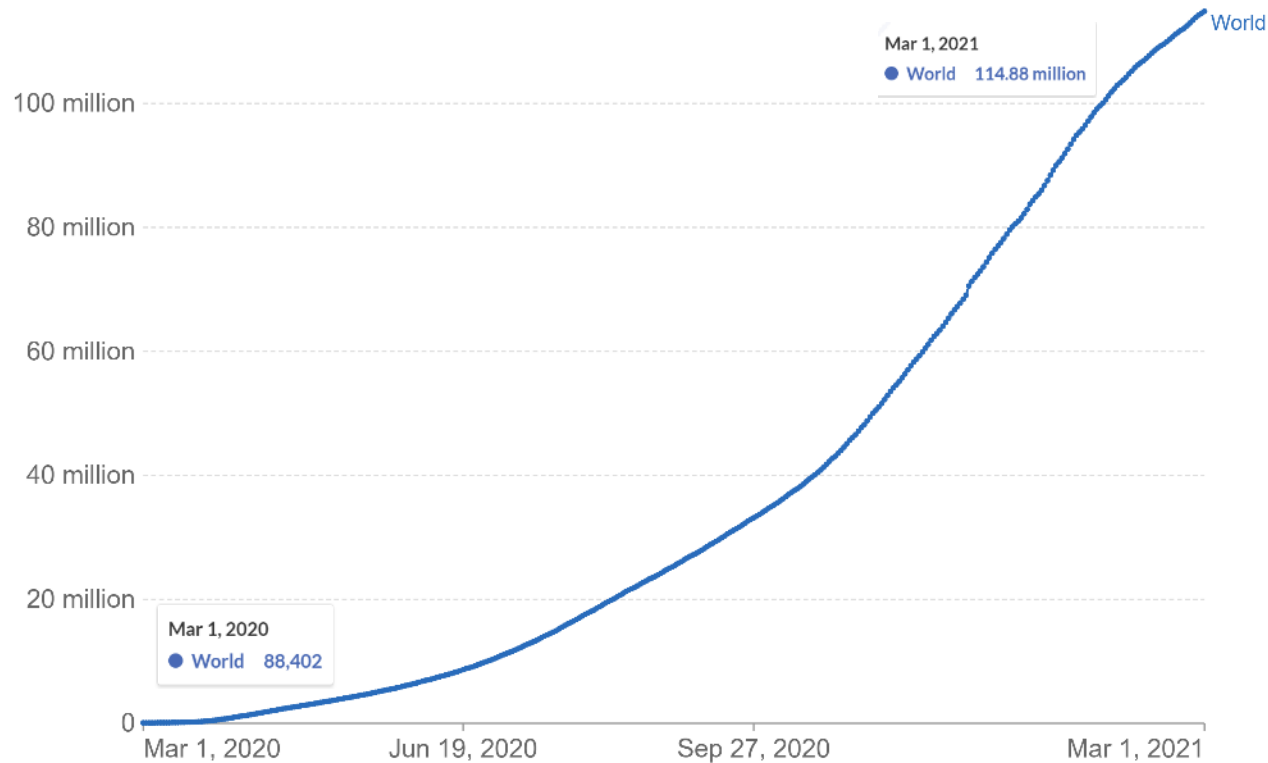


The initial problem → Pandemic Emergency

Rapid spread of Covid-19 → pressure on hospitals

Cumulative confirmed COVID-19 cases

Due to limited testing, the number of confirmed cases is lower than the true number of infections.



Many with severe disease

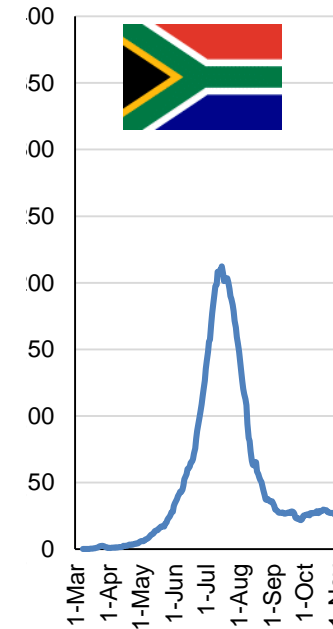
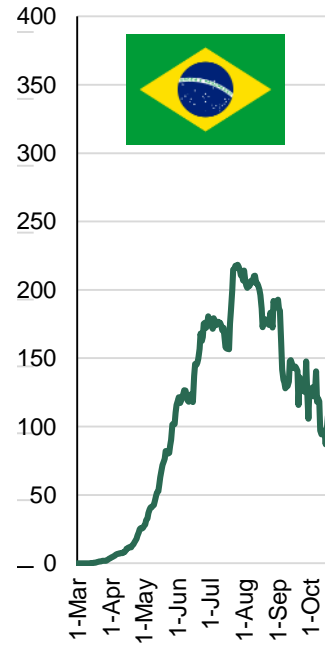
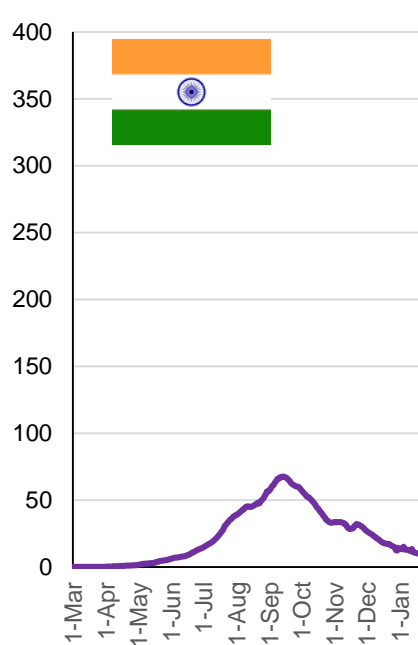
↑↑ % acute respiratory illness



Pandemic emergencies in countries in 1st waves

Covid-19 surges due to the initial (D614G) variant in India, Brazil & SA

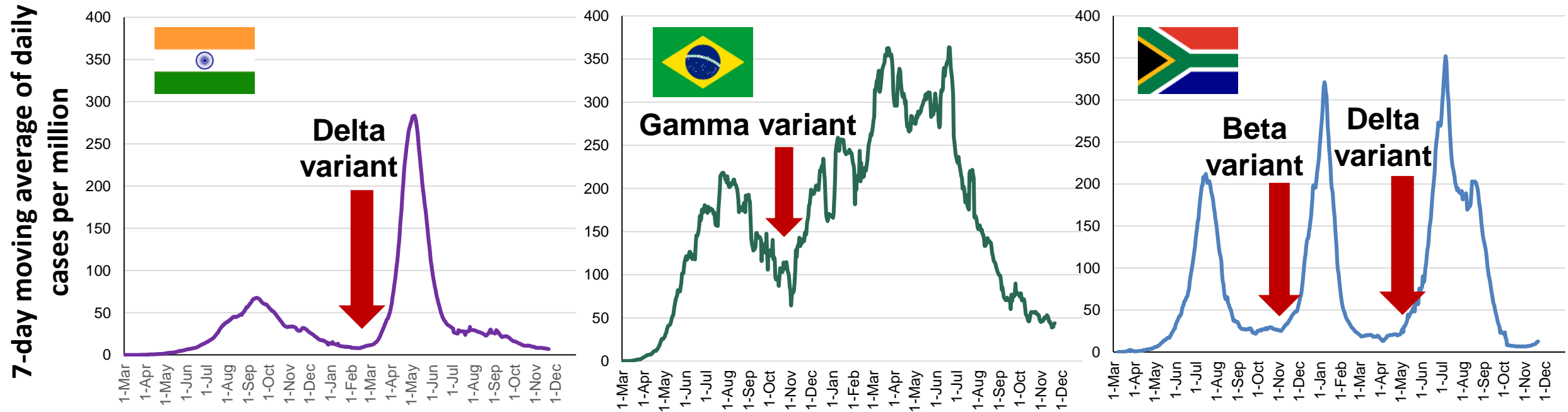
7-day moving average of daily cases per million



Source: *Our World in Data*

Variants of concern changed the endgame

Repeat surges due to variants of concern in India, Brazil & SA

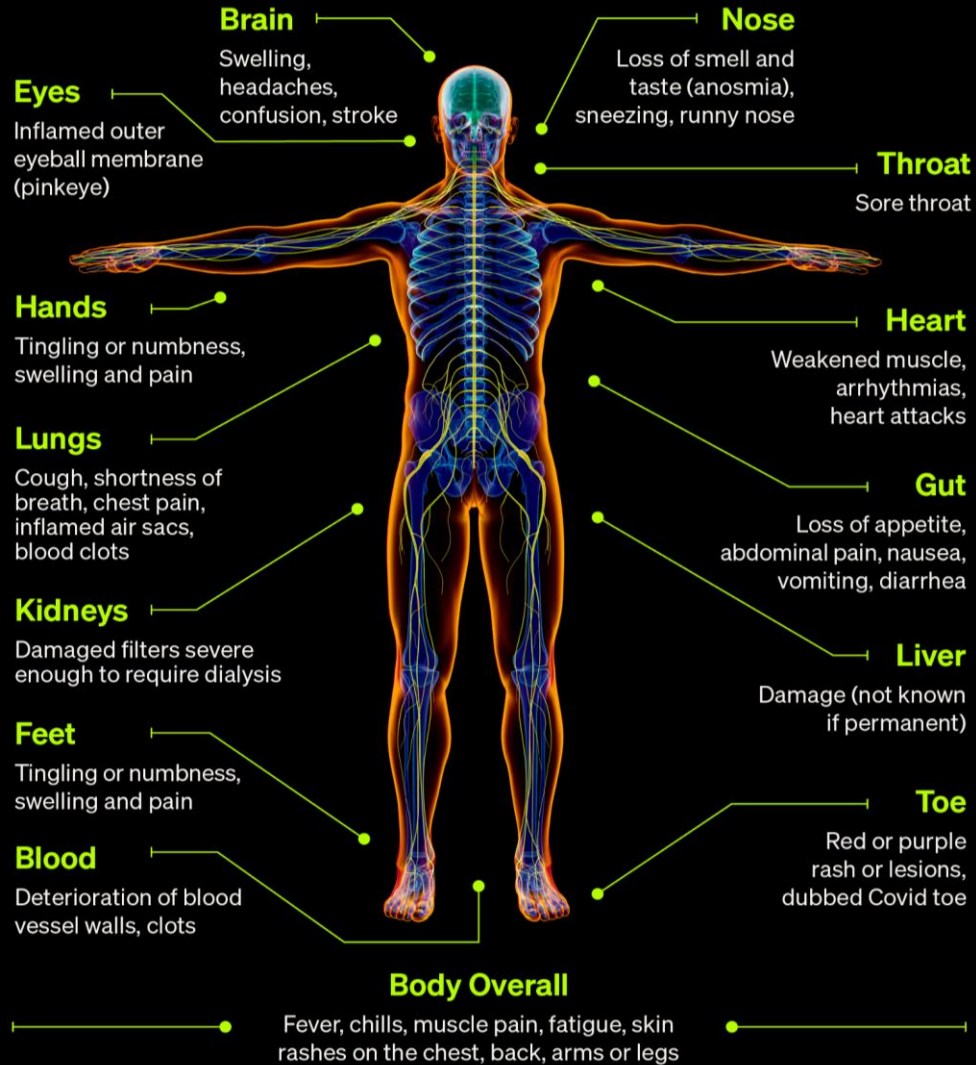


Due mainly to vaccines / natural / hybrid immunity → waves of acute clinical respiratory infection are now smaller

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People with Covid-19 might experience no symptoms, or just one or a few of these, or several in severe cases.



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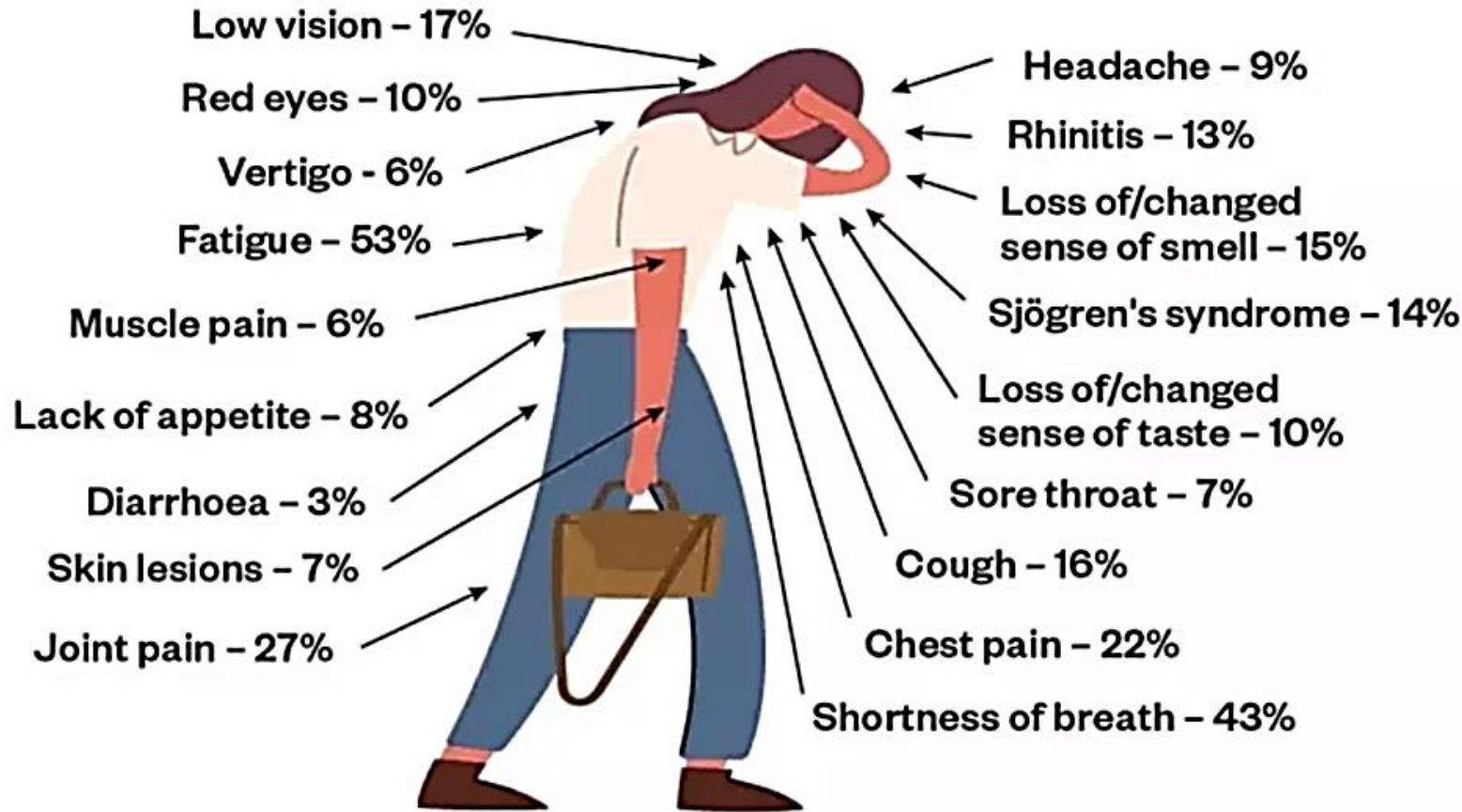
Every Covid-19 Symptom We Know About Right Now, From Head to Toe

The most perplexing things about a disease that has proved vexing, deadly, and 'unprecedented in many ways'

Ee+

SOURCES: Stanford University; Johns Hopkins University; Baylor College of Medicine Medical Center; Cleveland Clinic; Harvard University; Science Magazine; CDC; Mahalia Desruisseaux, MD, Yale University; Robert Salata, MD, Case Western Reserve University

Long COVID-19 “brain fog” – The next wave



- Study of a cohort of 3762 people in 56 countries
- Time to recovery in >90% exceeded 8 months
- Most frequent symptoms after 6 months:
 - Fatigue
 - post-exertional malaise
 - cognitive dysfunction & memory problems

Long-term impact of Covid-19 on heart disease

nature
medicine

Long-term cardiovascular outcomes of COVID-19

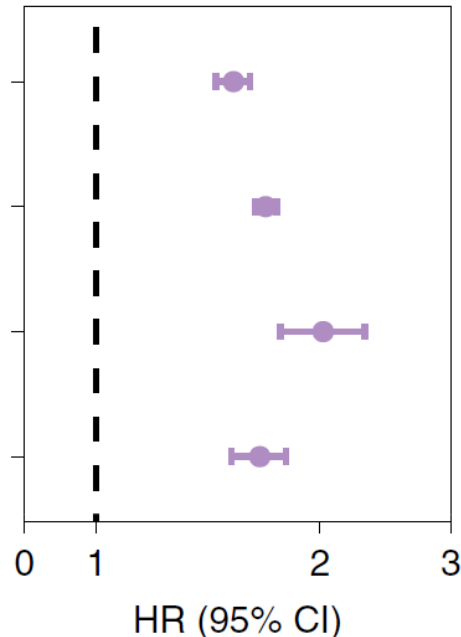
Yan Xie ^{1,2,3}, Evan Xu ^{1,4}, Benjamin Bowe^{1,2} and Ziyad Al-Aly ^{1,2,5,6,7} 

Cerebrovascular disorders

Dysrhythmia

Inflammatory heart disease

Ischemic heart disease



- **>50% ↑ risk of heart disease - from stroke to heart attacks & myocarditis 1 year later**
- **↑ risk in asymptomatic, mild & severe Covid-19**
- **↑ risk regardless of cardiac risk factors... (age, weight, etc)**

153,760 Covid-19+ compared to 5 million current & historical controls

High new diabetes risk months after Covid-19

THE LANCET Risks and burdens of incident diabetes in long COVID:
a cohort study
Yan Xie, Ziyad Al-Aly

- 181,280 Covid+ participants
- Post-acute Covid-19: ↑ *risk of new diabetes diagnoses & anti-hyperglycaemics*
- Increased diabetes risk worst in those with severe acute Covid-19



Covid-19 increases risk of mental health disorders

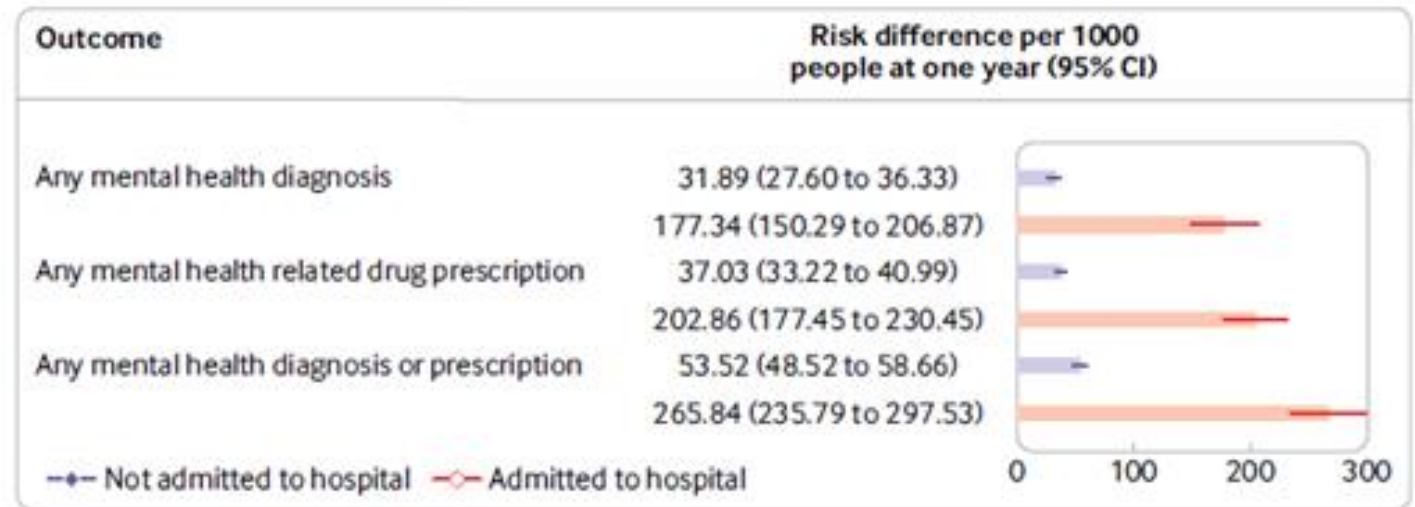
thebmj

Risks of mental health outcomes in people with covid-19: cohort study

Yan Xie, Evan Xu, Ziyad Al-Aly

Increased risk of:

- anxiety disorders (35% higher)
- depressive disorders (39% higher)
- neurocognitive decline (↑80%)
- sleep disorders (41% higher)



Mental health diagnoses increased by 60%

Even Mild COVID-19 May Change the Brain

Jennifer Abbasi

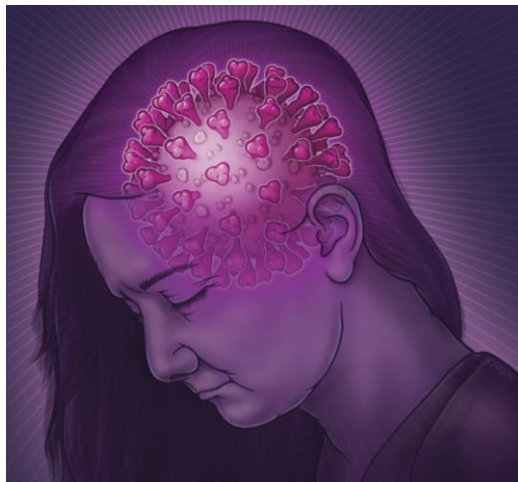
nature

SARS-CoV-2 is associated with changes in brain structure in UK Biobank

[Gwenaëlle Douaud](#) , [Soojin Lee](#), [Fidel Alfaro-Almagro](#), [Christoph Arthofer](#), [Chaoyue Wang](#), [Paul](#)

[McCarthy](#), [Frederik Lange](#), [Jesper L. R. Andersson](#), [Ludovica Griffanti](#), [Eugene Duff](#), [Saad Ihabdi](#), [Bernd](#)

- 401+ and 384- UK brain scans from Biobank – 2 images in 5 mths
- Effects of SARS-CoV-2 infection:



- Smaller brain size
- ↓ in grey matter thickness – up to 2% loss
- Less able to complete complex tasks

Chronic / Long Covid: Impact on work functionality



Half a million UK workers drop out of workforce, citing long-term illness

Suban Abdulla



- Since 2019, many people dropped out of Britain's job market (mental health problems & long-term sickness)
- Problem getting worse over time

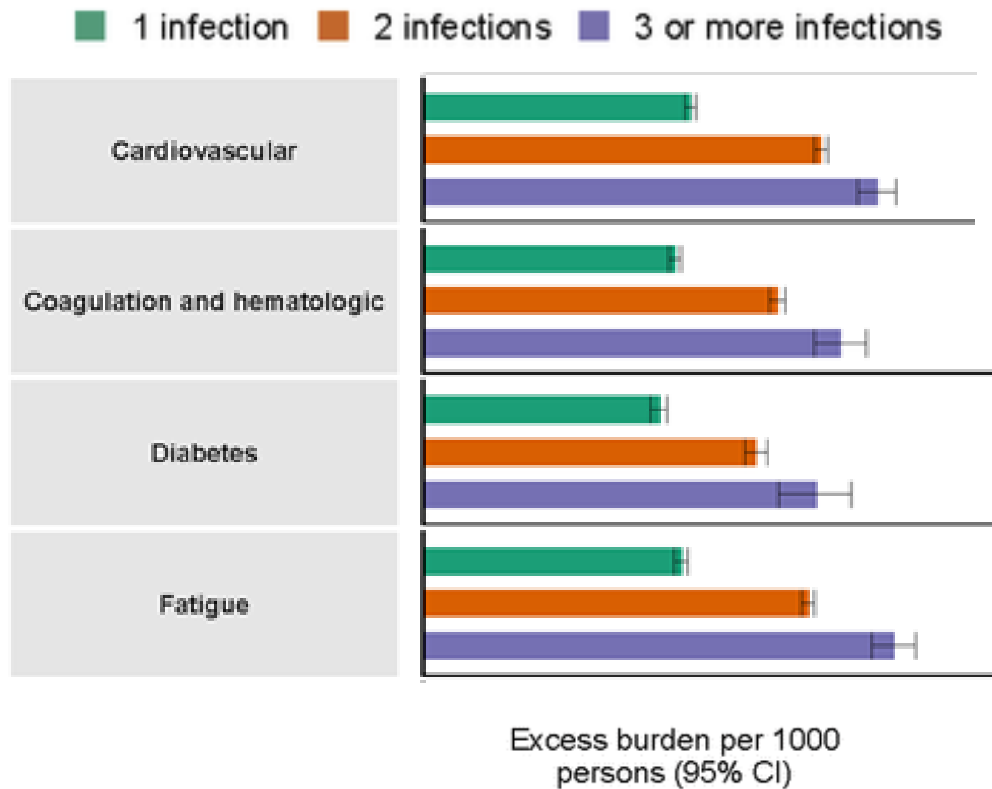
2019 → 2020 (~363,000) → 2022 (~2.5 million)

Covid-19's looming future wave

A Tsunami of chronic diseases

...while 600,000 reported clinical Covid-19 infections and unreported millions of asymptomatic infections are continuing to occur each day...
...and the possibility of yet more waves remains

Each additional infection makes Long Covid worse: SARS-CoV-2 re-infection is not harmless!



nature
portfolio
Preprint

Outcomes of SARS-CoV-2 Reinfection

Ziyad Al-Aly, Benjamin Bowe, Yan Xie

**Reinfection increases risk
of illness, hospitalisation &
all-cause mortality**

Figure: Cumulative risk & burden of sequelae in people with 1, 2 and 3 or more SARS-CoV-2 infections compared to non-infected controls

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...living smartly with the virus
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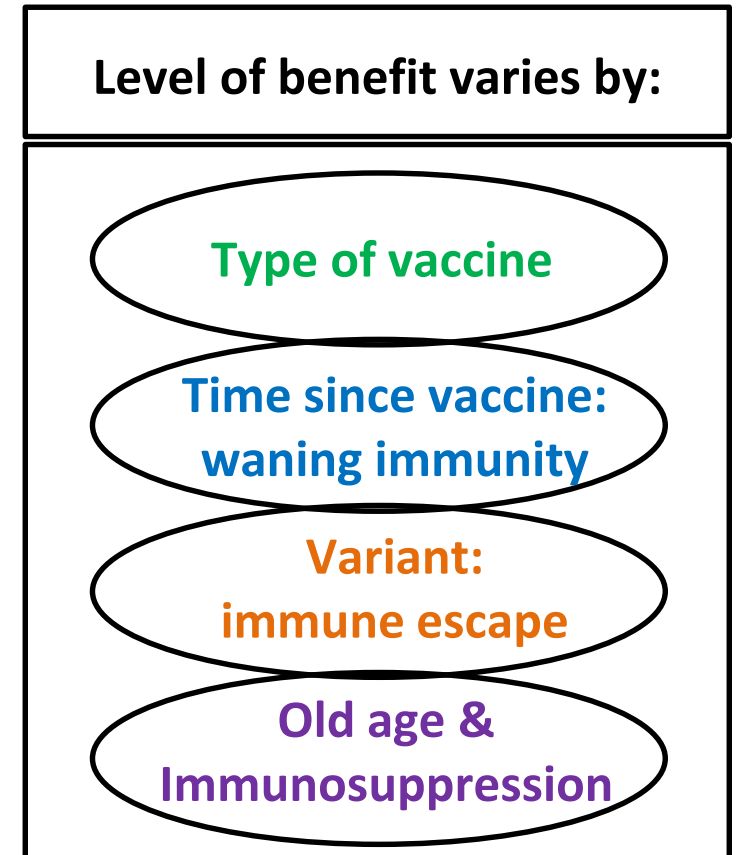
The 5 benefits of Covid-19 vaccines

- **Individual benefits:**

1. ↓ asymptomatic infections
2. ↓ clinically apparent infections
3. ↓ severity / hospitalisations / deaths
4. ↓ progression to long Covid

- **Community benefits:**

5. ↓ secondary attack rate to close contacts
 - ↓ infectious if infected when vaccinated
 - ↓ period of infectiousness when vaccinated



Vaccination reduces SARS-CoV-2 transmission

Science

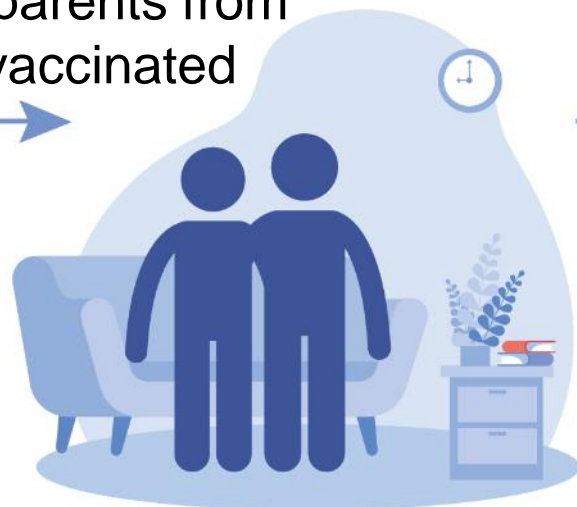
Indirect protection of children from SARS-CoV-2 infection through parental vaccination

Samah Hayek¹, Galit Shaham¹, Yatir Ben-Shlomo¹, Eldad Kepten¹, Noa Dagan^{1,2,3,4}, Daniel Nevo⁵, Marc Lipsitch⁶, Ben Y. Reis^{3,4,7}, Ran D. Balicer^{1,8}, Noam Barda^{2,1,3,4,*}

Direct Protection Effect

Protection of parents from having been vaccinated

94%



Indirect Protection of Household members


Reduction in Risk of transmission from infected parent to unvaccinated child

72%



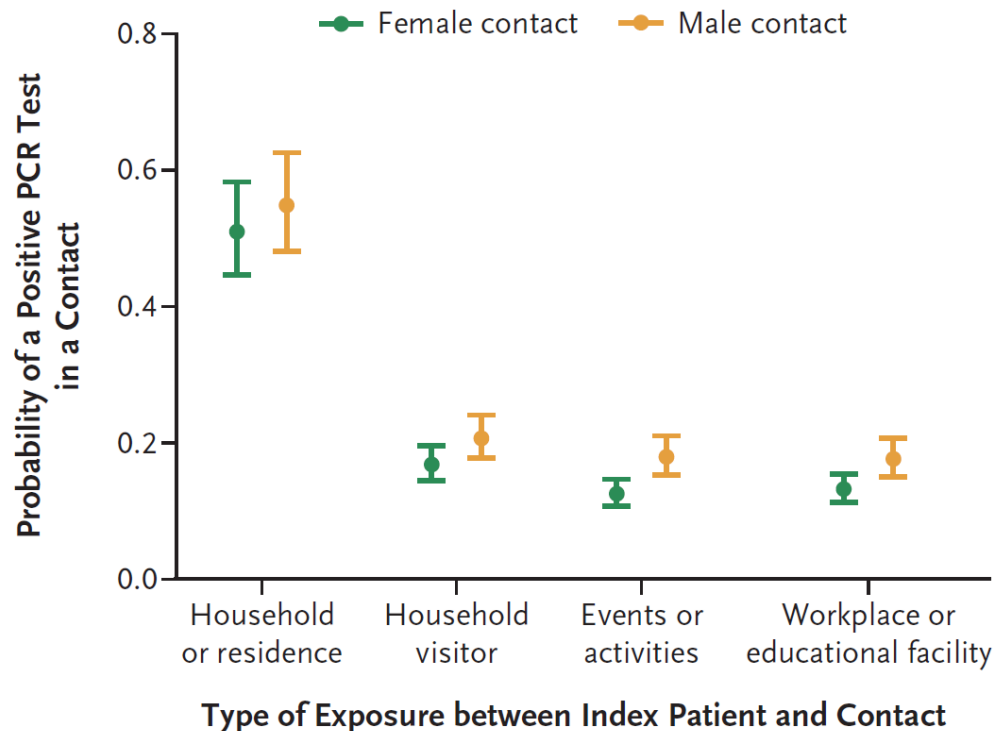
- Two-parent homes with at least one vaccine-ineligible child
- Children with vaccinated parents - 72% lower risk of getting infected

Vaccination reduced SARS-CoV-2 transmission to household & workplace contacts (in two variants)

 The NEW ENGLAND JOURNAL of MEDICINE

Effect of Covid-19 Vaccination on Transmission of Alpha and Delta Variants

David W. Eyre, B.M., B.Ch., D.Phil., Donald Taylor, M.Math., Mark Purver, Ph.D.,
David Chanman Ph.D. Tom Fowler Ph.D. Koen B. Pouwels Ph.D.



- **146,243 contacts of 108,498 index patients tested (37% were PCR+)**
- **Pfizer (X2) reduced infection by 68% in contacts compared to infections in contacts of unvaccinated**
- Vaccine → ↓ viral load - ↓ infectiousness

Outline

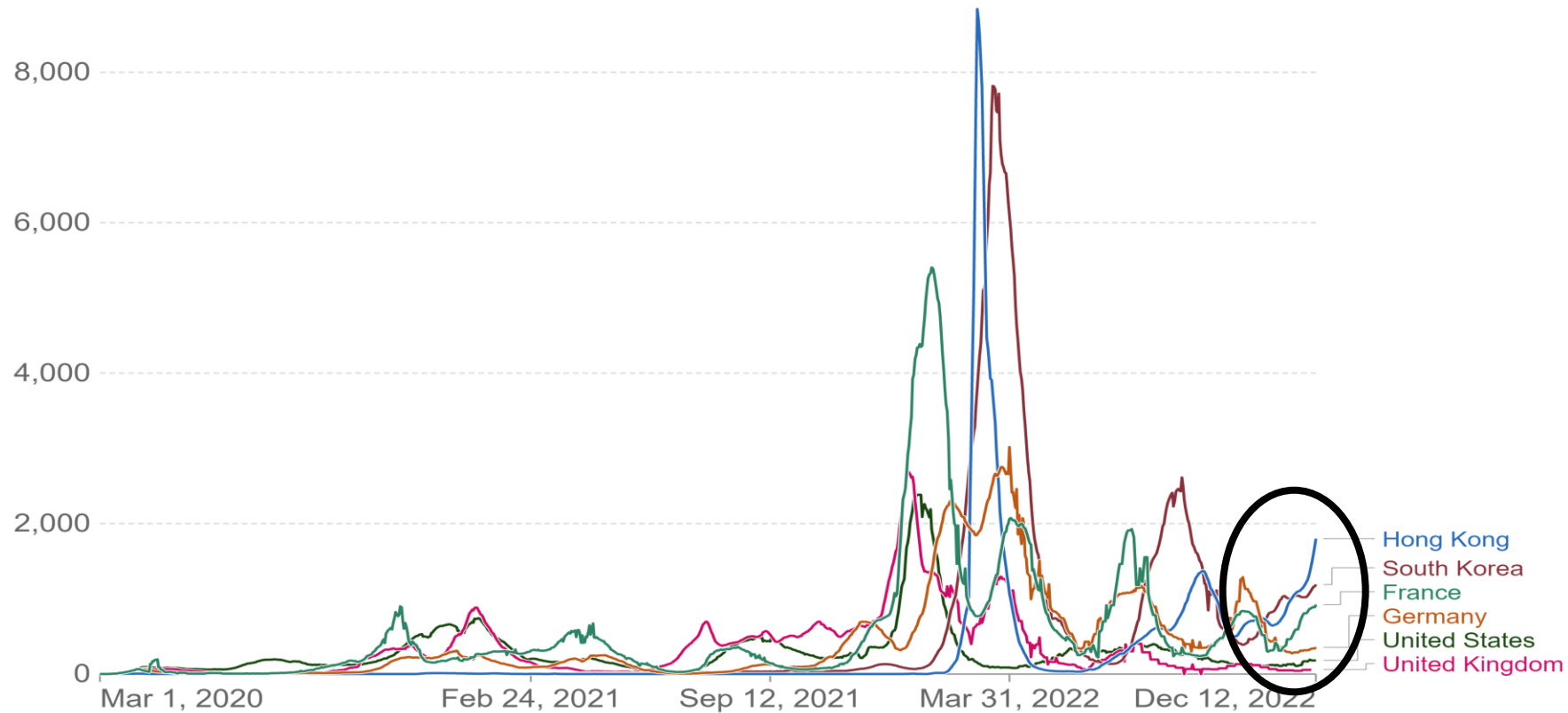
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We are still living in the midst of the pandemic...

Daily new confirmed COVID-19 cases per million people

7-day rolling average. Due to limited testing, the number of confirmed cases is lower than the true number of infections.

Our World
in Data



Source: Johns Hopkins University CSSE COVID-19 Data

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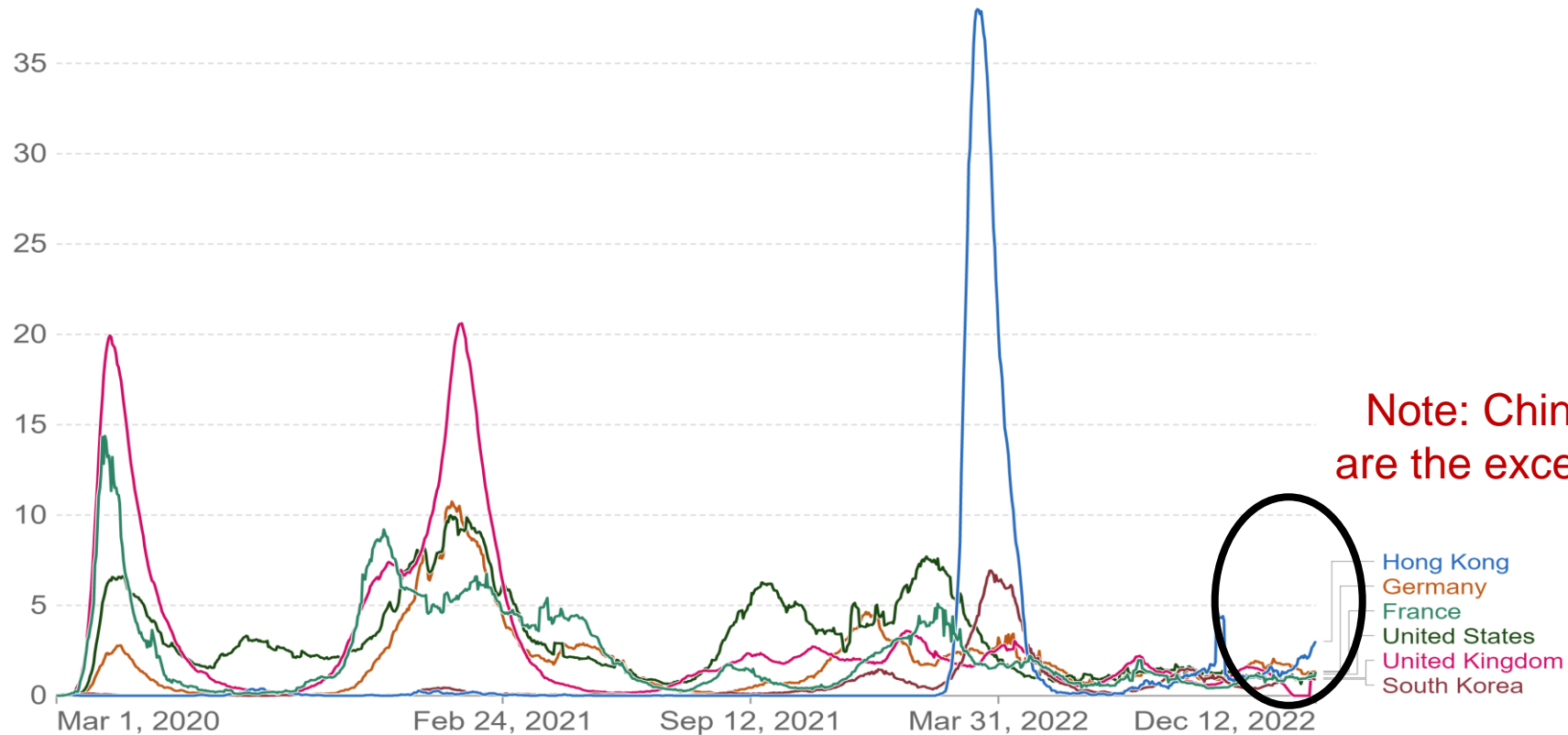
Data Source: Our World in Data

But, the pandemic emergency is receding as death and severe disease decline

Daily new confirmed COVID-19 deaths per million people

7-day rolling average. Due to varying protocols and challenges in the attribution of the cause of death, the number of confirmed deaths may not accurately represent the true number of deaths caused by COVID-19.

Our World
in Data

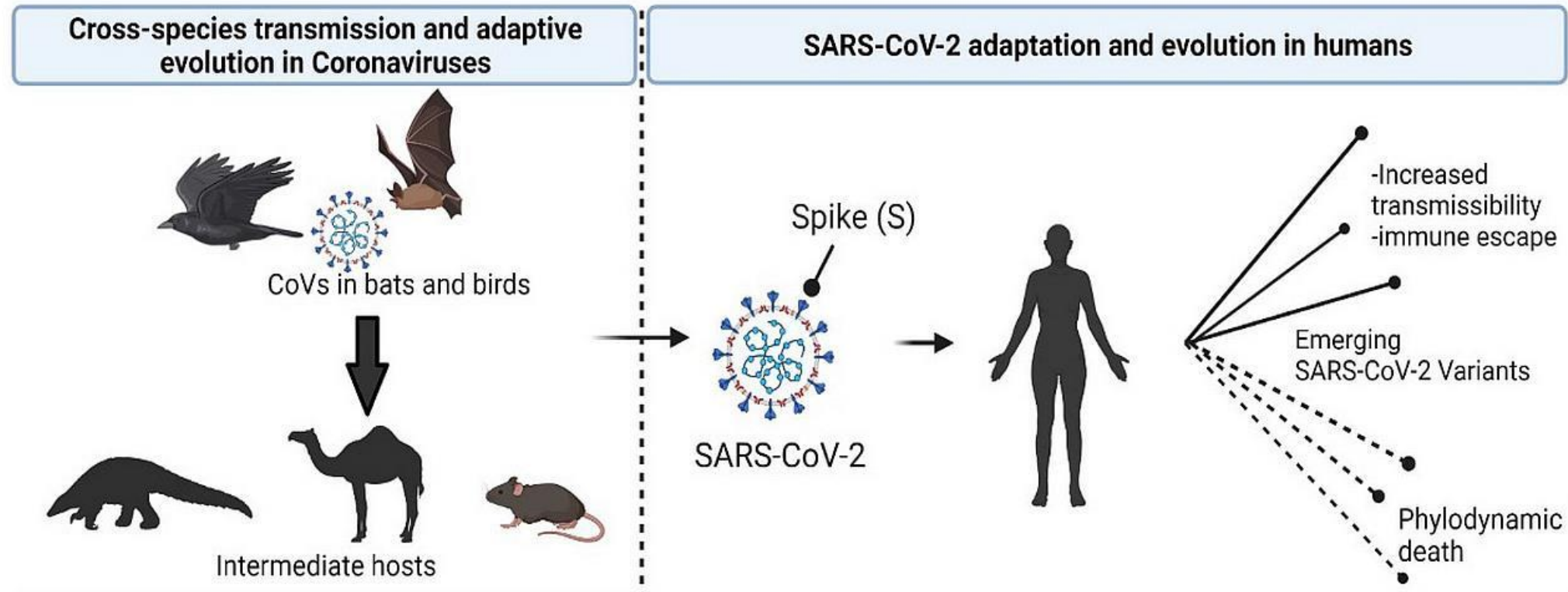


Note: China & Hong Kong are the exceptions at present

Source: Johns Hopkins University CSSE COVID-19 Data

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The virus will likely be with us for a very long time as it infects many animals as well

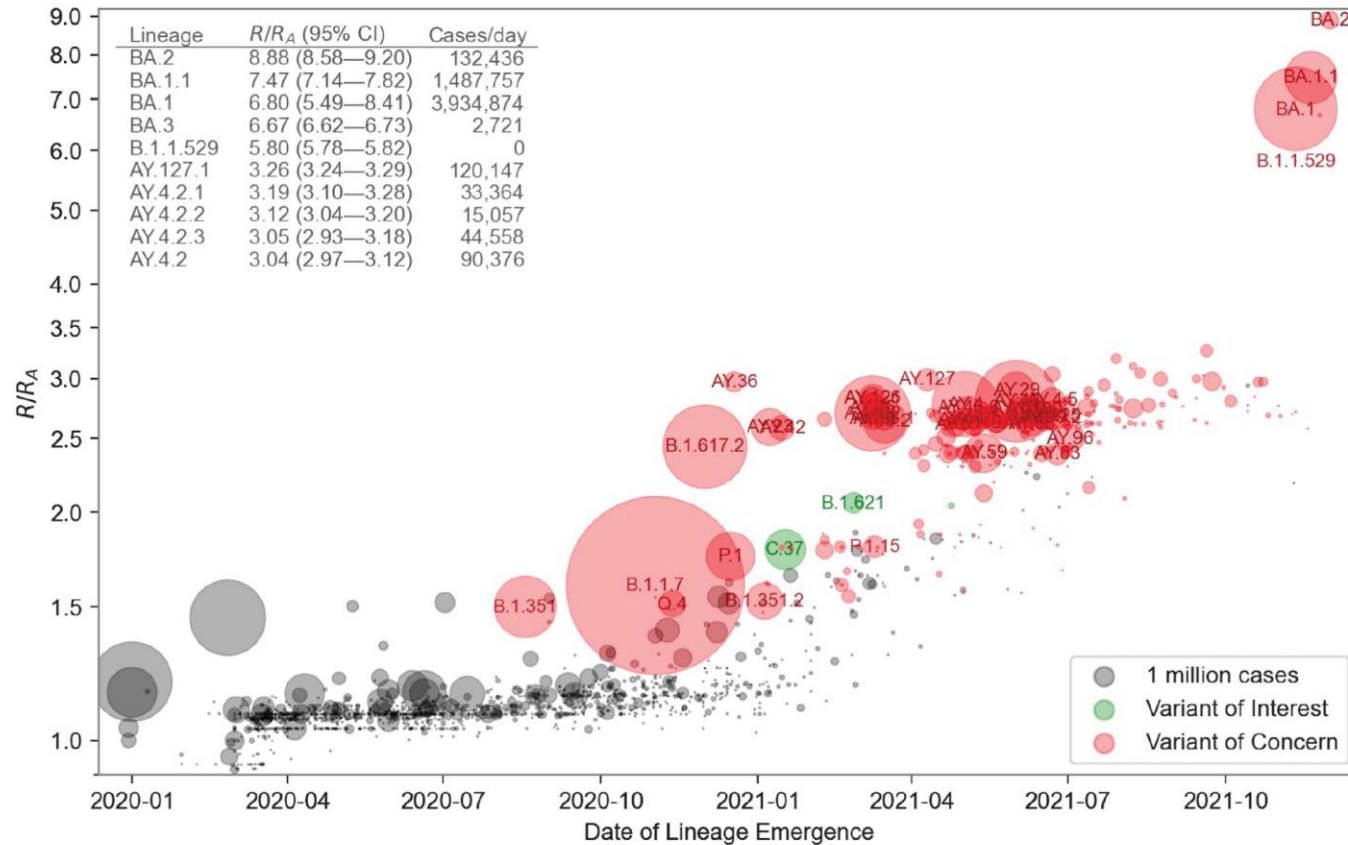


nature

CORONAVIRUS

Analysis of 6.4 million SARS-CoV-2 genomes identifies mutations associated with fitness

Fritz Obermeyer^{1,2,*}, Martin Jankowiak^{1,2}, Nikolaos Barkas¹, Stephen F. Schaffner^{1,3,4}, Jesse D. Duda¹, Leonid Vurkovatskiy⁵, Matteo Rocca⁵, Daniel I. Park¹, Mehrzad Rahadi¹



SARS-CoV-2 evolving to spread faster & more immune escape

New variants are more transmissible than original strain

- Alpha = 1.7 times faster**
- Beta = 1.6 times faster**
- Delta = 2.5 times faster**
- Omicron = 5.8 times faster**
- BA.2 = 8.9 times faster**

Fig. 1. Relative fitness versus date of lineage emergence. Circle size is proportional to cumulative case count inferred from lineage proportion estimates and confirmed case counts. The inset table lists the 10 fittest lineages inferred by the model. R/R_A is the fold increase in relative fitness over the Wuhan (A) lineage, assuming a fixed generation time of 5.5 days.

The ever-present risk of the next pandemic: New bat coronavirus in Russia resistant to vaccines

TIME

Scientists Find a New Coronavirus in Bats That Is
Resistant to Current Vaccines

ALICE PARK



- **Khosta-2 found in bats in Russia in 2020**
 - Can infect human cells and evades immunity from current Covid-19 vaccines
 - Attaches to ACE2 receptor
 - Thought not to cause serious disease
- **Potential to recombine → ↑ resistance to immunity and virulence**

5 elements of “*Living smartly with the virus*”

- 1. Be fully vaccinated**
- 2. Know level of community transmission – e.g. are cases rising?
- adjust your risk appetite accordingly**
- 3. Know the potential risky situations you may be entering
- know what you can do to mitigate that risk**
- 4. In essence, avoid poorly ventilated indoor spaces and if you have to go indoors, use a medical mask**
- 5. Do what you can to protect others (not just yourself)!**

The 3 Eras of the Covid-19 response: Adding “Test & Treat to [Vaccines + Public health measures]”

Era 1 - 2020

Public health measures



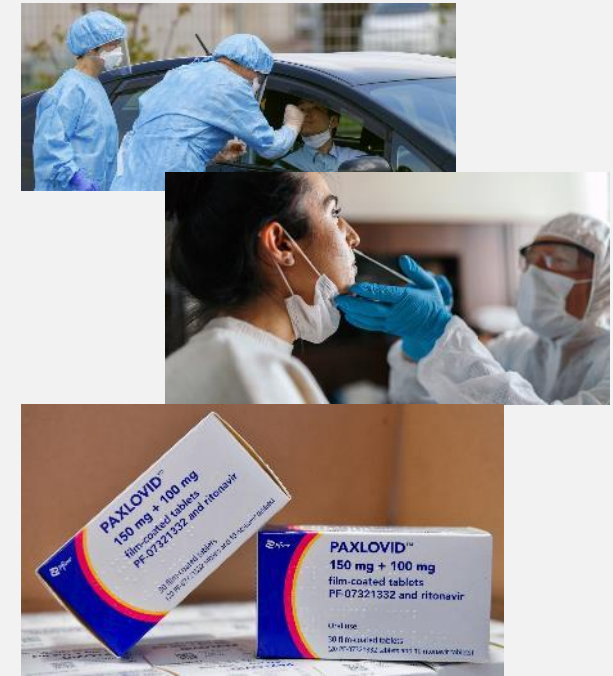
Era 2 - 2021

Vaccines & Variants



Era 3- 2022

Test & Treat



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A key Covid-19 lesson:

Failure to act with common purpose

1. Global threat → Global pandemic response

Cannot control a pandemic if countries pulling in different directions – there is no scenario where successful pandemic control is achieved by only some countries being able to control spread of the virus

2. Health threat → Health, Social & Political threat

Covid-19 exacerbated disparities, sowed divisions and undermined truth and science → undermined the response & social cohesion

3. Inequitable access to life-saving technology → ↑disability & deaths

Failed to make the tools to combat the pandemic equitably available – diagnostics, vaccines & treatments – where IP protections enabled corporates to determine who does & does not get vaccines ---- and now treatment too!

But, there are several positives & glimmers of hope from the global Covid-19 response, for example...

- **Covax: a far-sighted initiative for vaccine equity**
It has delivered over 1.8 billion Covid-19 vaccine doses
- **WHO mRNA Technology Transfer Hub: for poor countries to make vaccines**
It has produced its first mRNA vaccine candidate
- **African Union's 2020 Partnership Accelerate Covid-19 Testing (PACT)**
Pooled procurement of diagnostic kits when African countries could not get kits
Secured donations of millions of kits from Jack Ma Foundation, Mastercard & Germany
- **NGOs & good Samaritans: Thousands came forward to help those in need**
Provided food and support to those impacted financially by the lockdown in countries across the globe

A key lesson from HIV for Covid-19: Importance of mutual interdependence & shared responsibility



**HOW AIDS
CHANGED
EVERY
THING**

MDG 6: 15 YEARS, 15 LESSONS OF HOPE FROM THE AIDS RESPONSE

“The AIDS movement demonstrates that with a shared vision, shared responsibility and through global solidarity... ..we can change the course of history.”

– UNAIDS 2015

- **Shared responsibility:** An IP solution was found to share the benefits of ARVs - Markets were segmented and voluntary licences offered to generic manufacturers
Truvada ~\$33 /pill in USA but ~33 cents in South Africa
- **Global solidarity:** The wealthy provided the poor access to life-saving medication eg. Global Fund & PEPFAR
- **No-one is safe until everyone is safe!**