



UNIVERSITY OF LEEDS

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Why a fresher perspective is needed on childhood COVID-19

Prof Stephen Griffin

TAPAS International Seminar Series, 20th
November 2023

Views expressed herein are my own



Synopsis

We remain amidst an ongoing SARS-CoV2 pandemic

Children ARE at risk from acute SARS-CoV2 infection

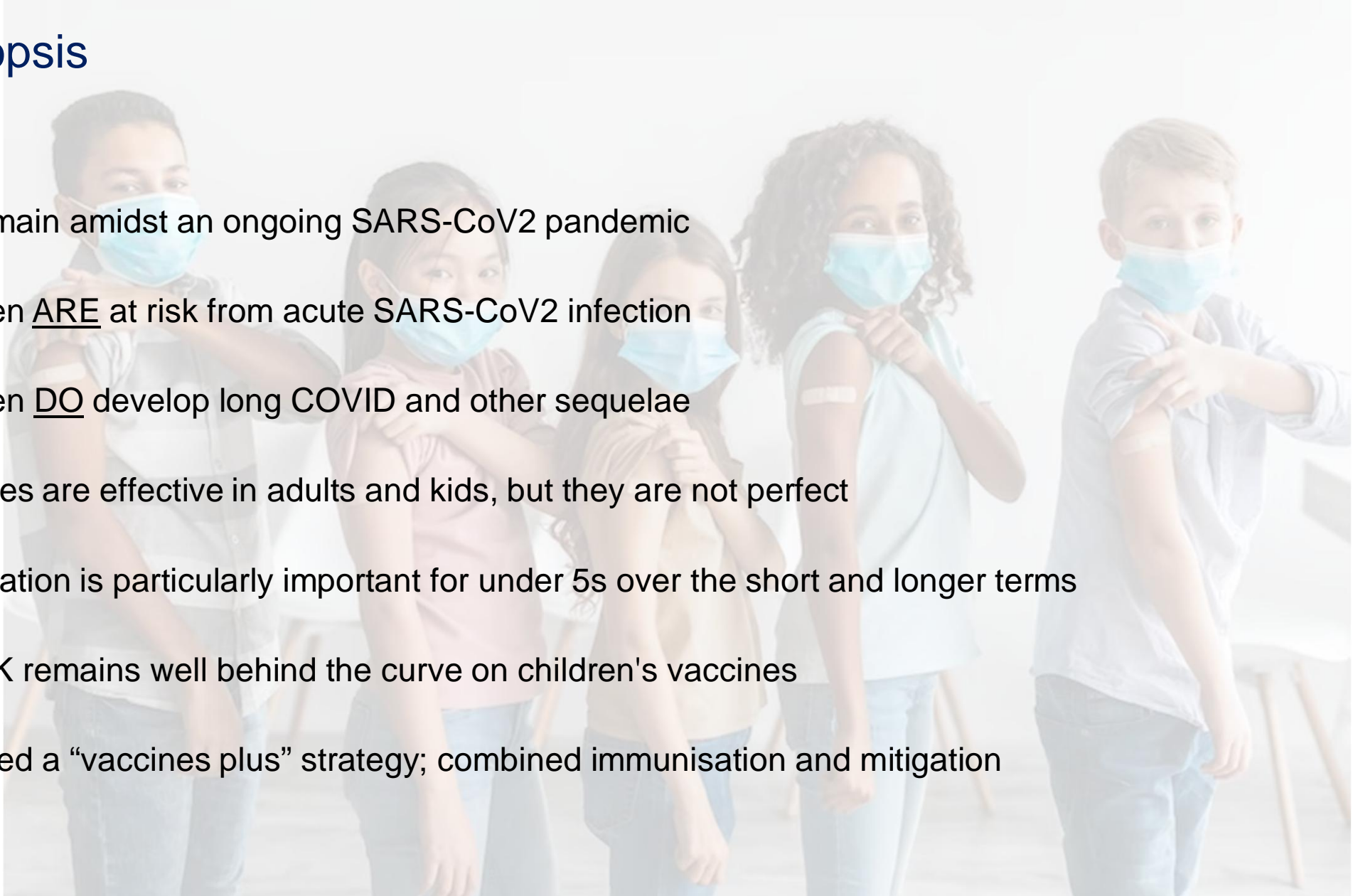
Children DO develop long COVID and other sequelae

Vaccines are effective in adults and kids, but they are not perfect

Vaccination is particularly important for under 5s over the short and longer terms

The UK remains well behind the curve on children's vaccines

We need a “vaccines plus” strategy; combined immunisation and mitigation



Coronavirus Disease 2019: the long and the short of it...

Manifestations associated with COVID-19

Systemic

- Inflammation
- Coagulation
- Cytokine storm
- Lymphopenia

Endocrine

- Hyperglycaemia

Hepatic

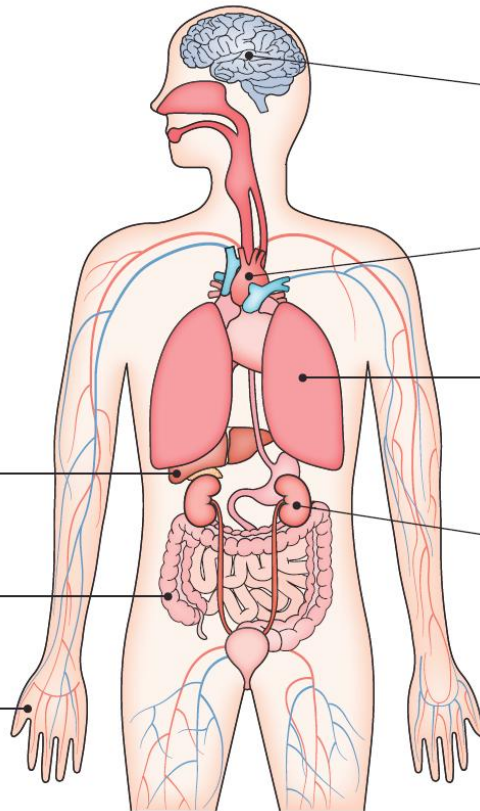
- Elevated transaminases

Gastrointestinal

- Diarrhoea

Skin

- Urticaria
- Rash
- Perio-like lesions



Neurological

- Ageusia; anosmia, myasthenia
- Encephalopathy, Guillain-Barré

Cardiac

- Myocarditis
- Arrhythmia

Pulmonary

- Pneumonia
- Acute respiratory distress syndrome (ARDS)

Renal

- Acute kidney injury

Thrombo-embolism

- Pulmonary embolism
- Deep vein thrombosis

SYSTEMIC

- Fatigue
- Post-exertional malaise

NEUROPSYCHIATRIC

- Anxiety
- Depression
- Insomnia
- Brain fog (impaired attention, concentration, memory)

PULMONARY

- Dyspnea (breathlessness)
- Ground glass opacities (signs of fibrosis and inflammation)
- Hypoxemia (low blood oxygen)
- Reduced diffusion capacity (inefficient transfer of gas from lungs to blood)

ENDOCRINE

- Diabetic ketoacidosis (high levels of ketones make blood too acidic)
- Mild thyroiditis (inflammation of thyroid gland)

GASTROINTESTINAL

- Diarrhea
- Loss of appetite

HEMATOLOGIC

- Thrombosis (blood clots)

EARS-NOSE-THROAT

- Sore throat
- Dry cough

CARDIOVASCULAR

- Nonspecific chest pain
- Myocarditis (inflammation of heart muscle)
- Palpitations
- High heart rate

RENAL

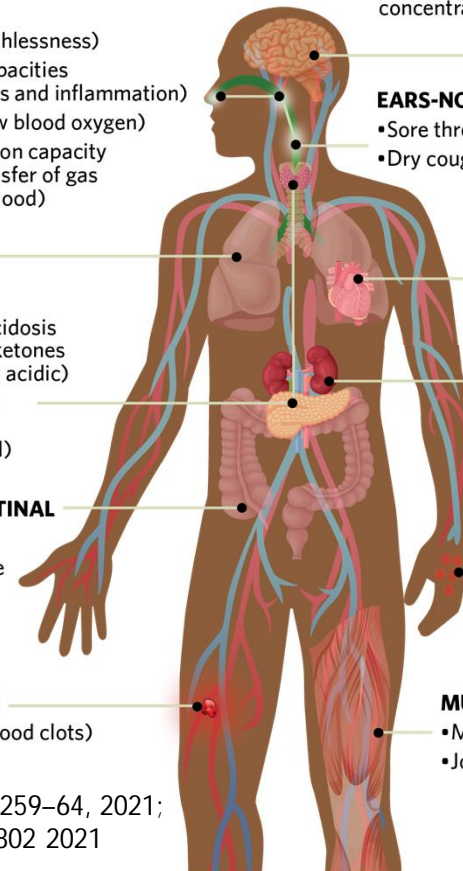
- Acute kidney injury (sudden inability to filter)

DERMATOLOGIC

- Alopecia (hair loss)
- Rashes

MUSCULOSKELETAL

- Muscle ache
- Joint Pain

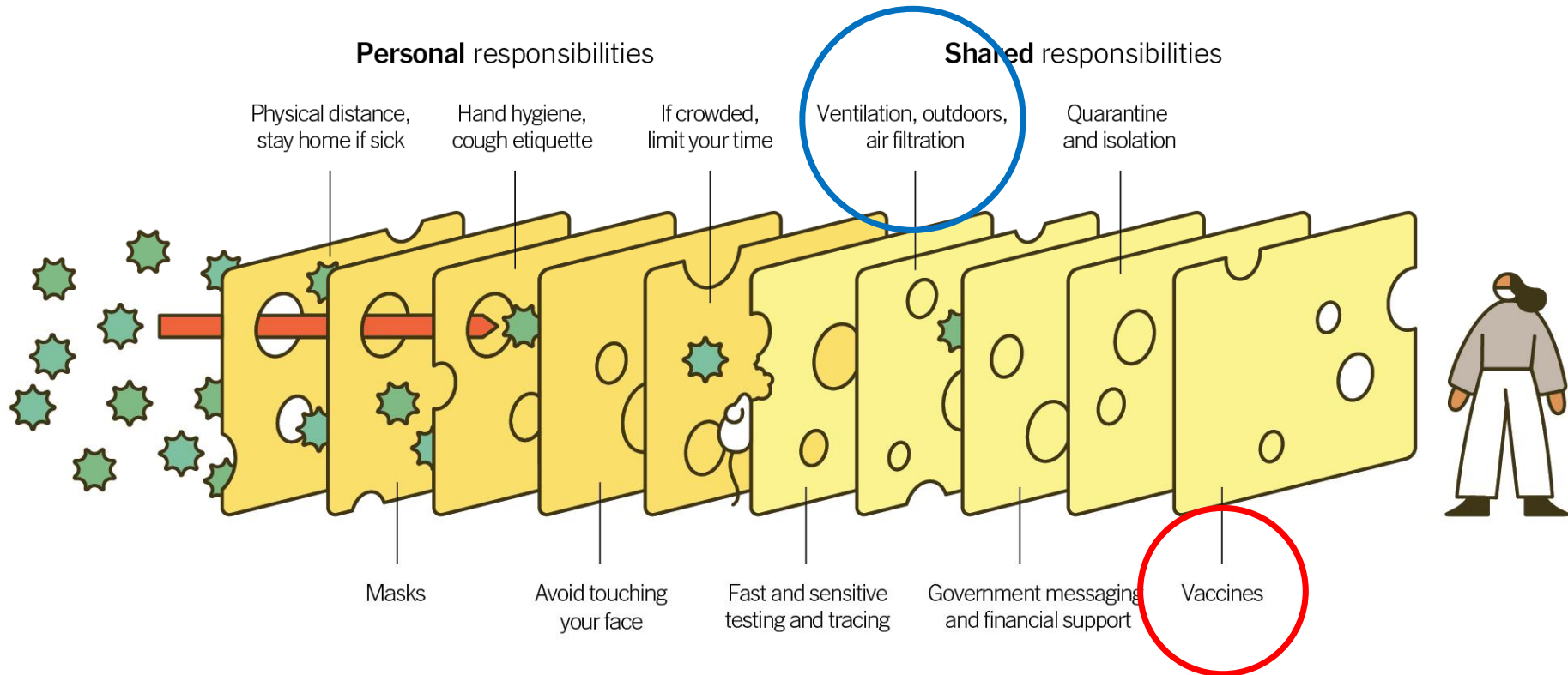


NAT MED, 27:601–15, 2021; NATURE, 594:259–64, 2021;
MEDRXIV, DOI:10.1101/2020.12.24.20248802 2021

We are running out of cheese...

Multiple Layers Improve Success

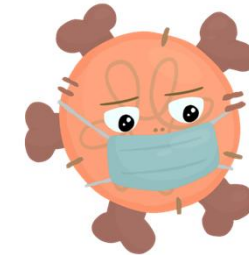
The Swiss Cheese Respiratory Pandemic Defense recognizes that no single intervention is perfect at preventing the spread of the coronavirus. Each intervention (layer) has holes.



Source: Adapted from Ian M. Mackay (virologydownunder.com) and James T. Reason. Illustration by Rose Wong

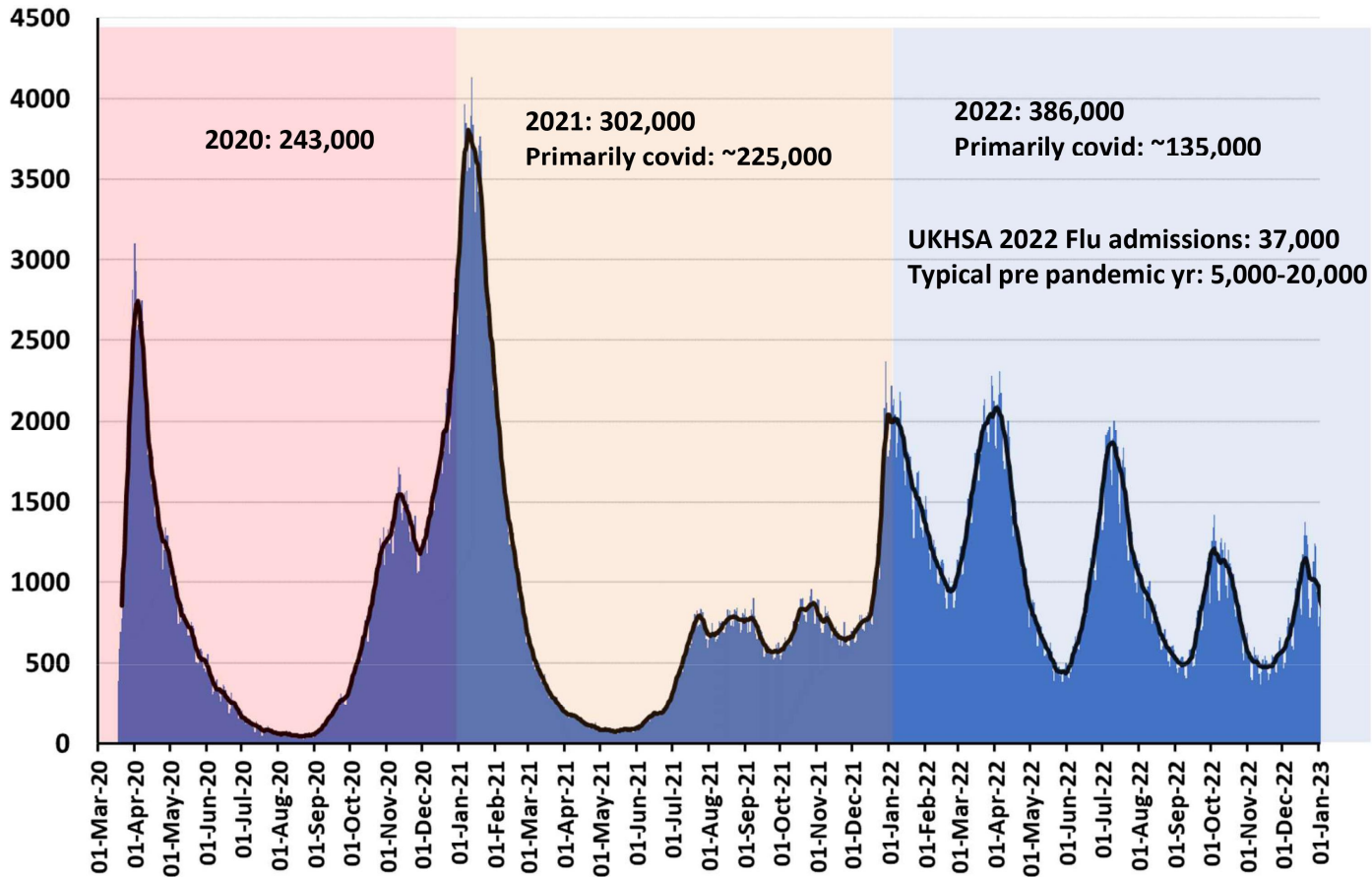
The ongoing SARS-CoV2 pandemic in the UK

I'm still here



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The Independent SAGE • Following the science

Number of daily hospital admissions with Covid in England to 1 Jan 2023



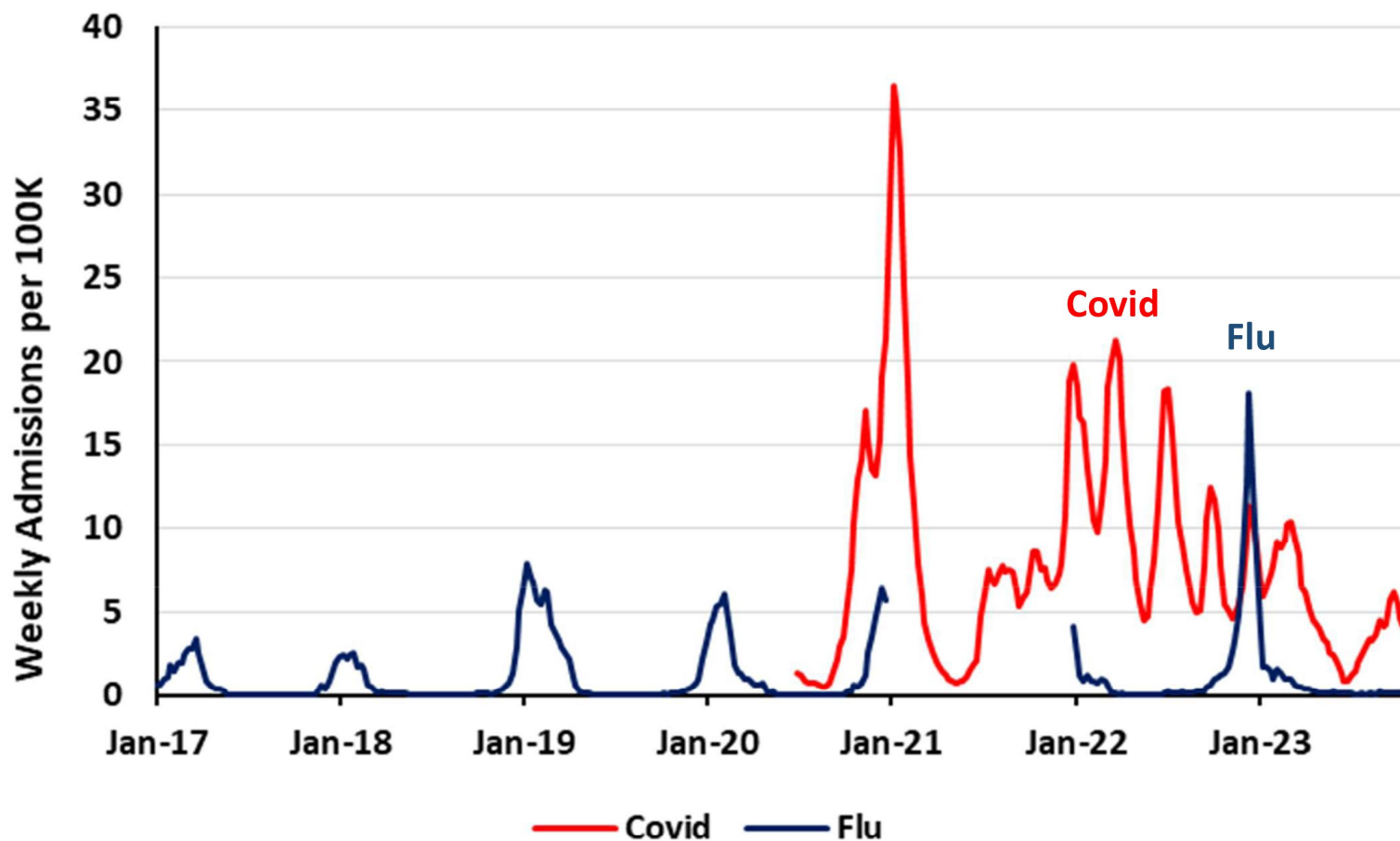
2023: 118479 up to 25th August

Data from <https://www.england.nhs.uk/statistics/statistical-work-areas/covid-19-hospital-activity/>

Independent SAGE slides H/T:
Prof Christina Pagel
Dr Kit Yates
Dr Duncan Robertson
Bob Hawkins

Weekly Influenza and Covid Hospital Admission Rate (per 100K) for England: Jan 1 2017 – Nov 12 2023

(Source: Weekly National Influenza and COVID-19 Surveillance Data Report)



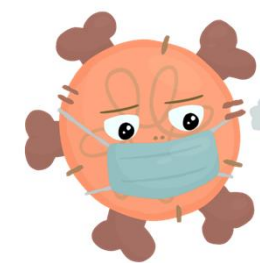
12-Nov

<https://www.gov.uk/government/statistics/national-flu-and-covid-19-surveillance-reports-2023-to-2024-season>

Thanks to Bob Hawkins for the slide

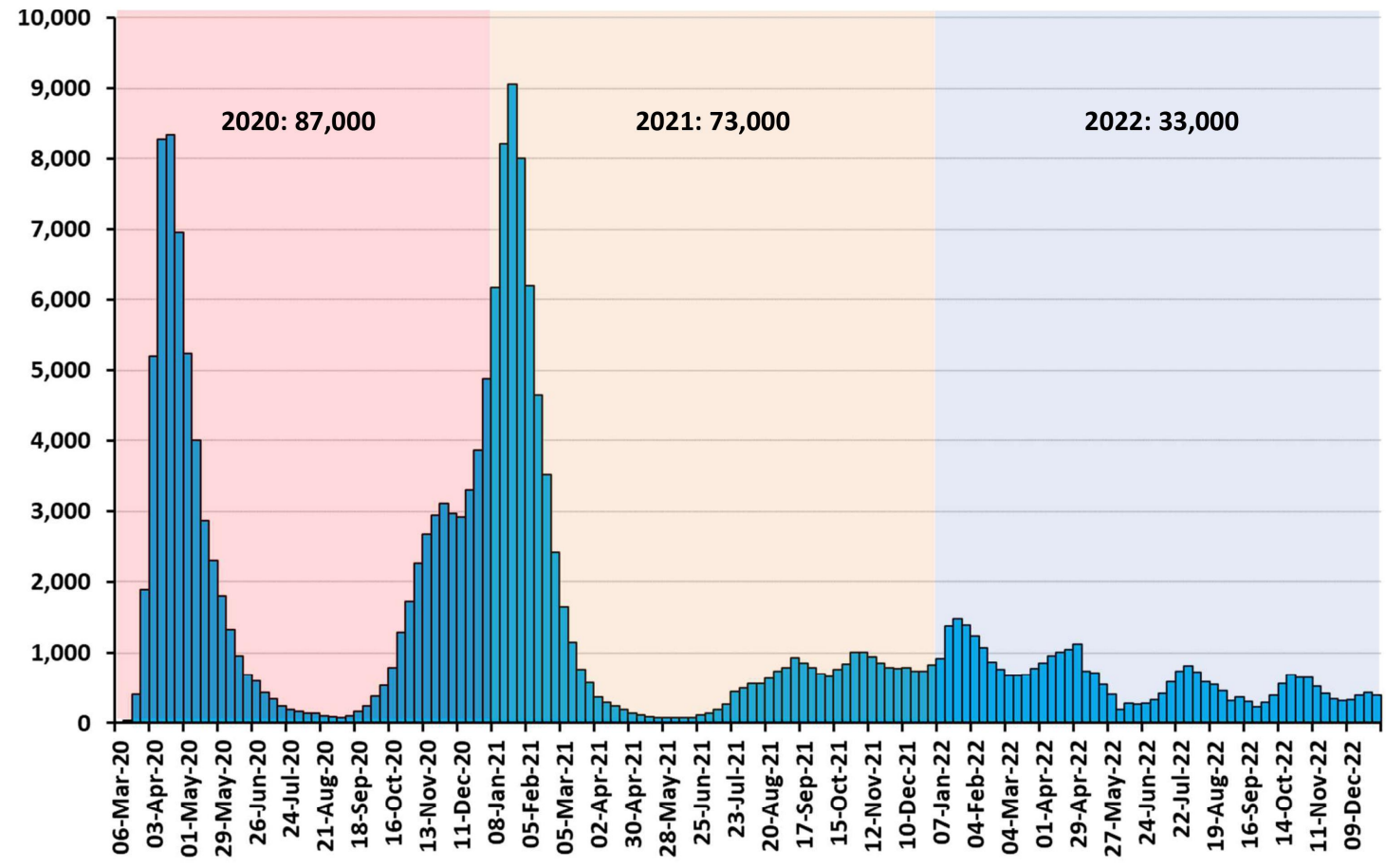
The ongoing SARS-CoV2 pandemic in the UK

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Number of deaths **involving** Covid on the **death certificate** by week registered in England to 30 December 2022

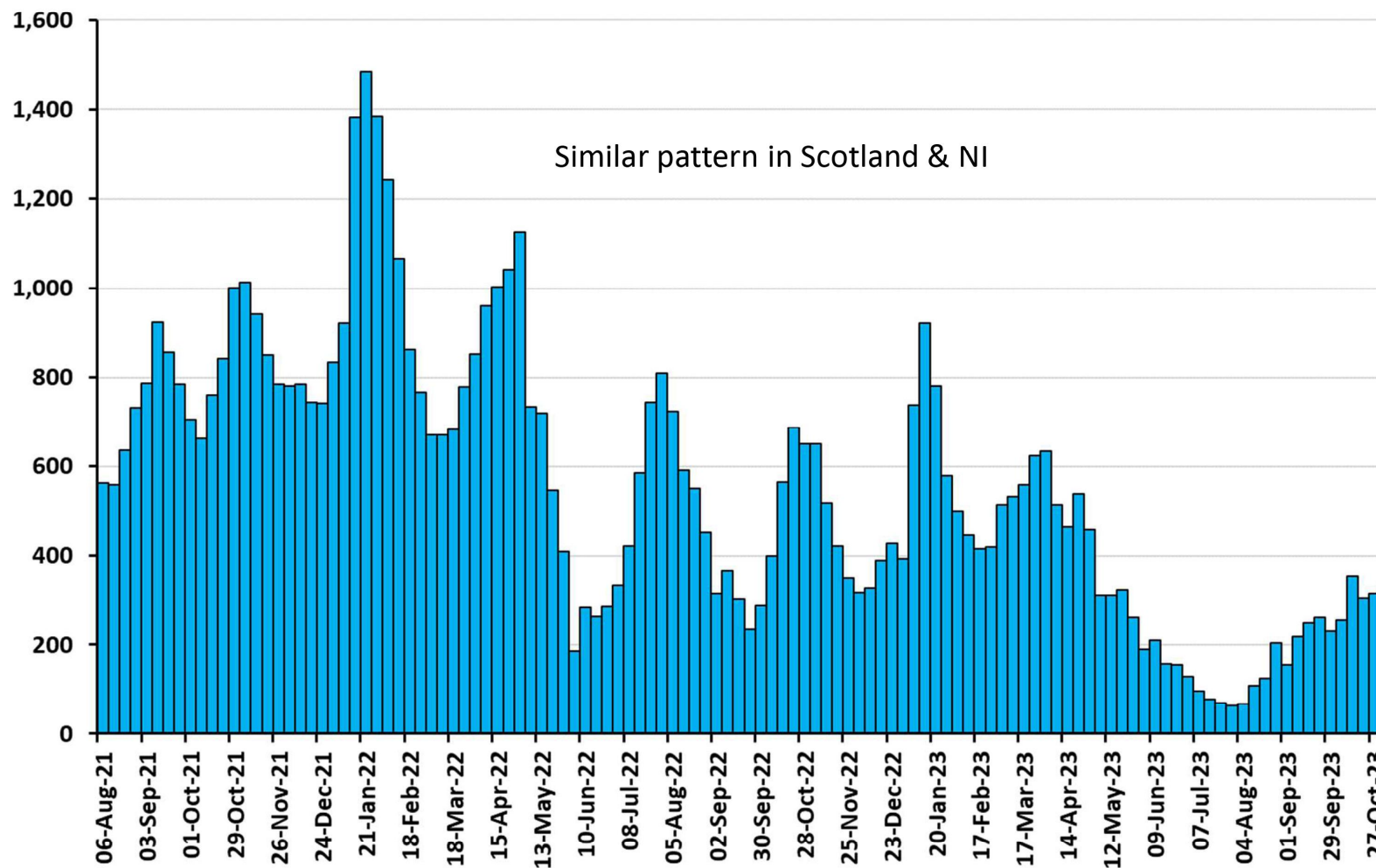


Data from :
England and Wales: www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregisteredweeklyinenglandandwalesprovisional/latest

2023: >16K up to 1st November

60-70% have COVID as main underlying cause

Number of deaths with Covid on the **death certificate** by week registered in England and Wales July 2021 to 3 Nov 2023



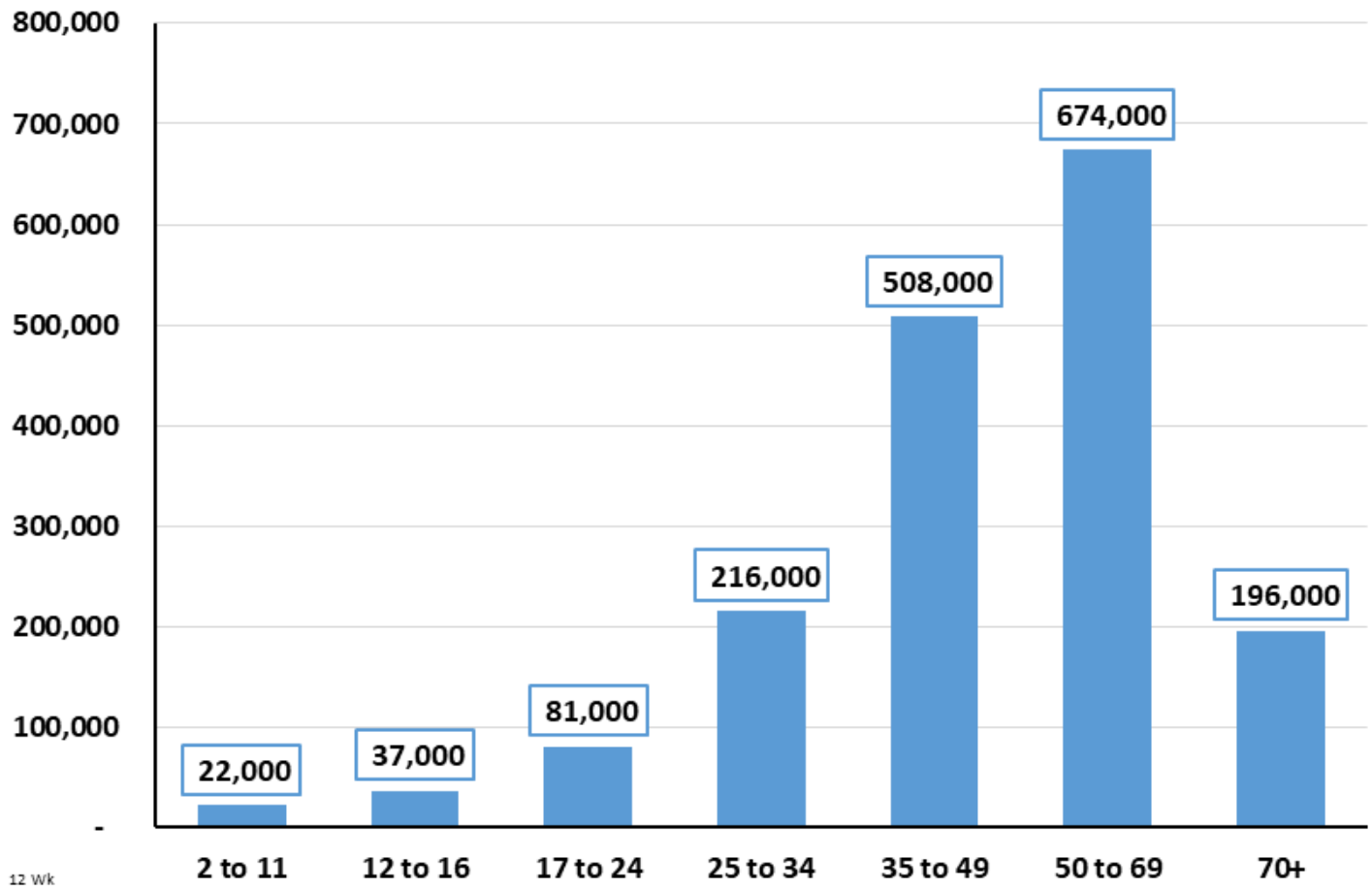
Data from :
England and Wales: www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregisteredweeklyinenglandandwalesprovisional/latest

The ongoing SARS-CoV2 pandemic in the UK

I'm still here



Number of People Living with Self-Reported Long Covid 12 Weeks after Infection in the UK by Age: Feb 5 - Mar 5, 2023 (Source: ONS Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK Reports)



12 Wk

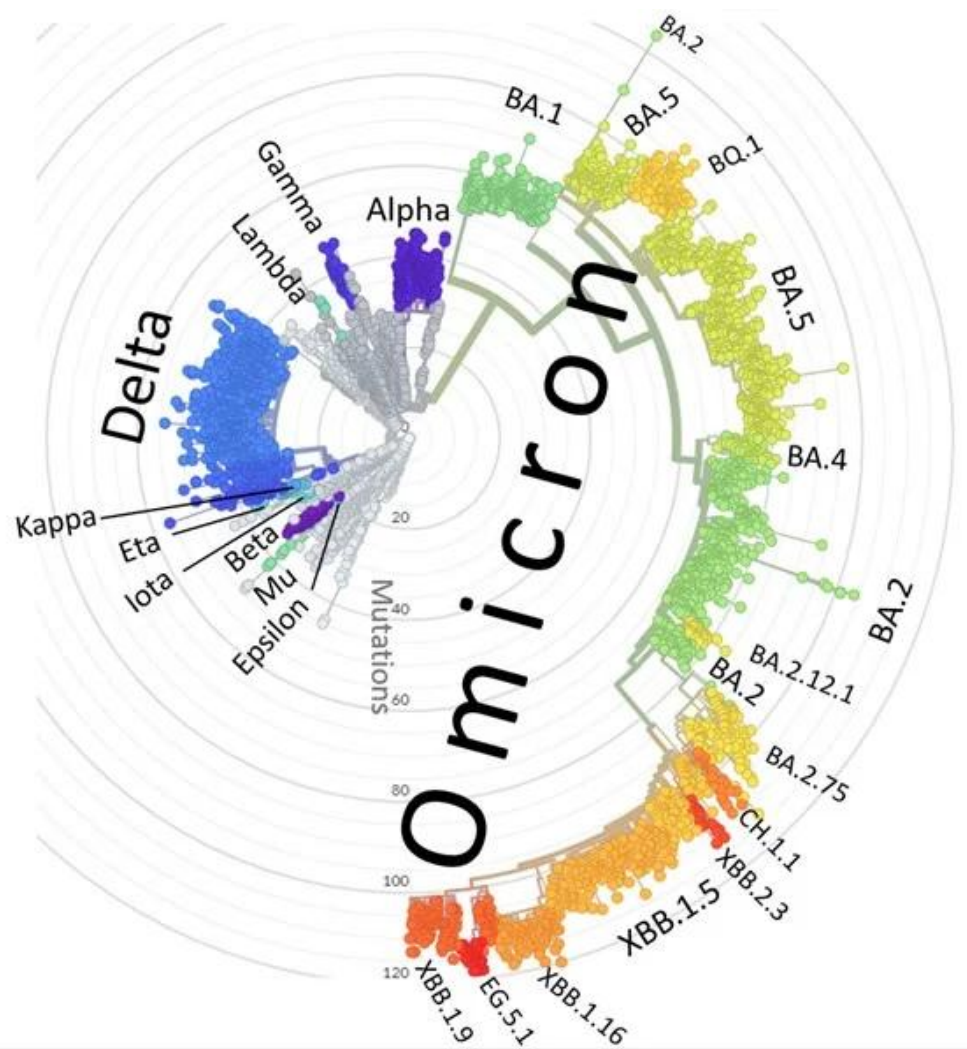
At least 17mn people in Europe have had long Covid, says WHO

Women twice as likely as men to suffer condition associated with cognitive problems and fatigue, modelling shows

Long Covid is typically defined as symptoms experienced for 12 weeks or more after a Covid-19 diagnosis © Miguel Medina/AFP/Getty Images

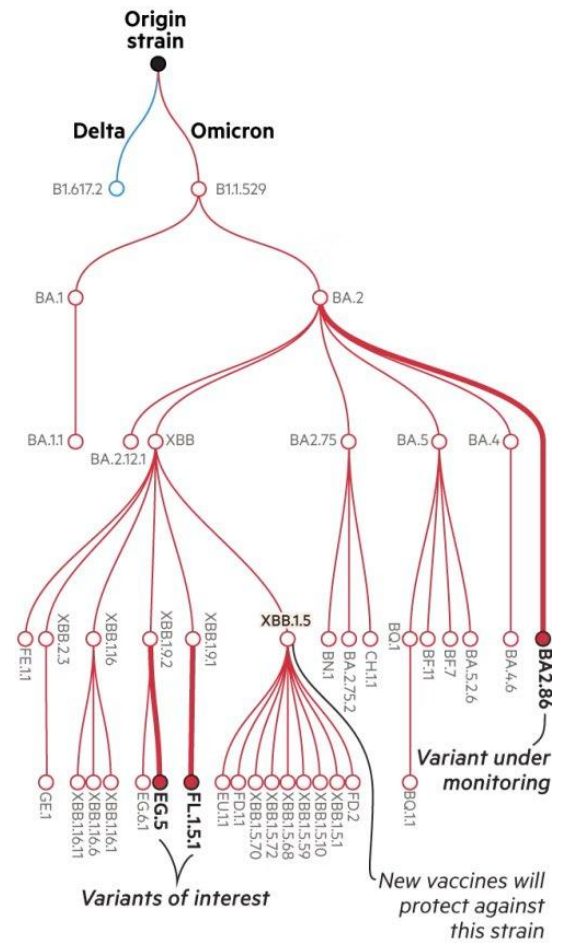
Independent SAGE slides H/T:
Prof Christina Pagel
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Dr Duncan Robertson
Bob Hawkins

SARS-CoV2 evolution and variants



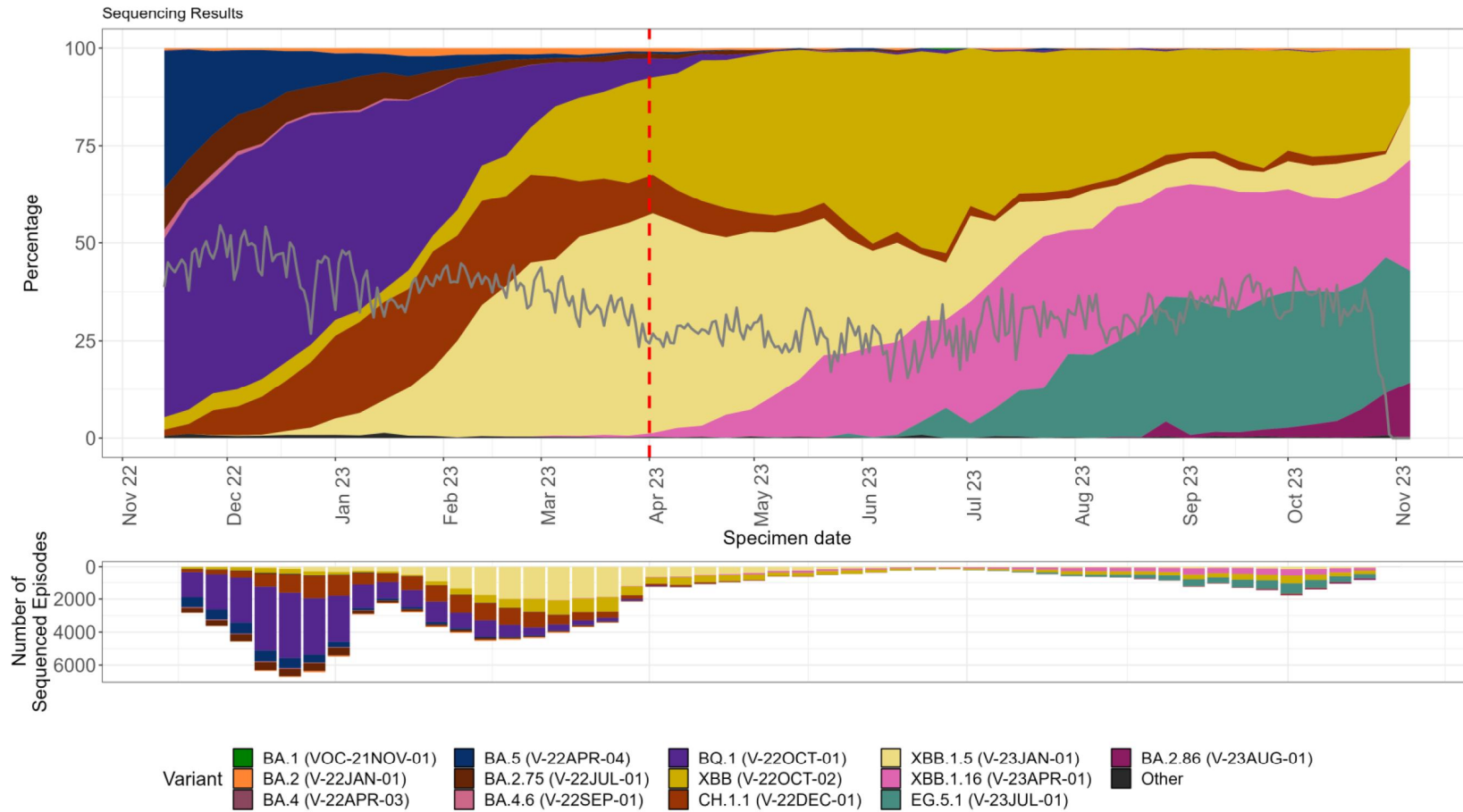
The US is monitoring several new subvariants of Omicron

Covid-19 variant lineage



Sources: Centers for Disease Control and Prevention; FT research © FT

Figure 13: Prevalence of SARS-CoV-2 variants amongst available sequences cases for England from 7 November 2022 to 12 November 2023

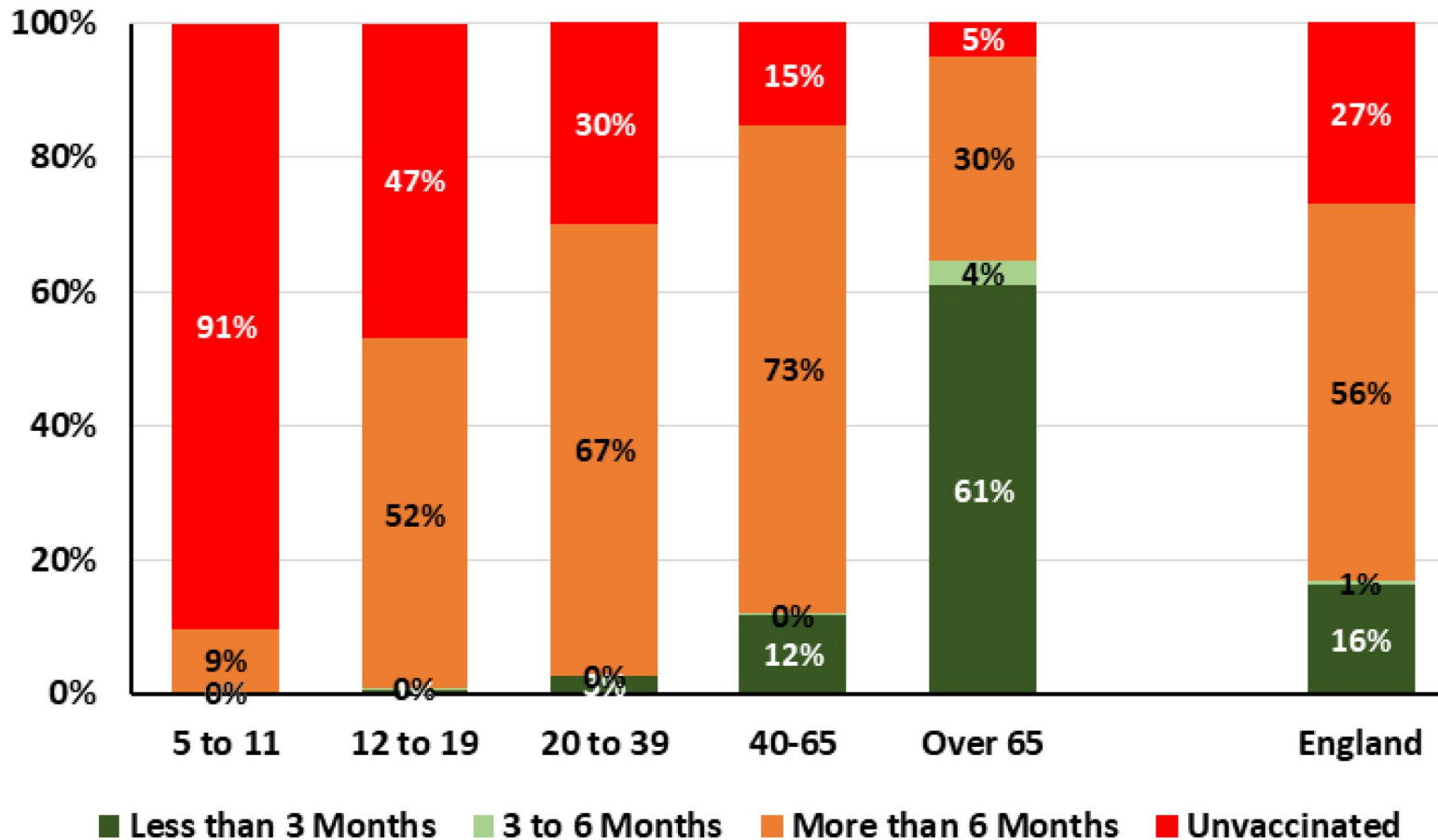


The grey line indicates proportion of cases sequenced.

The vertical dashed line (red) in April 2023 denotes changes in PCR testing in social care and hospital settings.

Percent Vaccinated by Age Group in the Last 3 Months, 3 to 6 Months, More than 6 Months, and Unvaccinated: England – Oct 29, 2023

(Source: National Influenza and COVID-19 Surveillance Data Report based on NIMS Population Estimates)



(All)

<https://www.gov.uk/government/statistics/national-flu-and-covid-19-surveillance-reports-2023-to-2024-season>



UK to offer low-dose Covid vaccine to almost six million five to 11-year-olds

Sajid Javid says the offer of vaccines will be made on a "non-urgent" basis, and is "not as important as the offer to adults and vulnerable younger people"

bbc.in/34Jlk76



16 Feb 2022

'Perfectly reasonable' to not vaccinate young children, says JCVI member

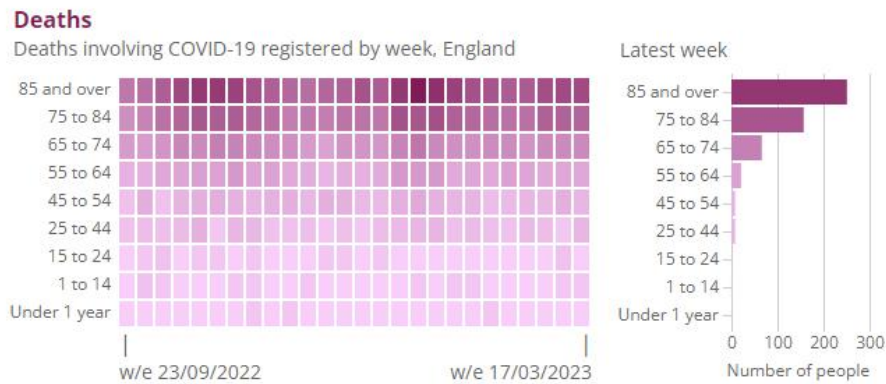


We're joined by Professor Adam Finn, who is on the Government's Joint Committee on Vaccination and Immunisation.

SARS-CoV2 infection of CYP

Deaths by age

Deaths remain highest for those aged 85 years and over

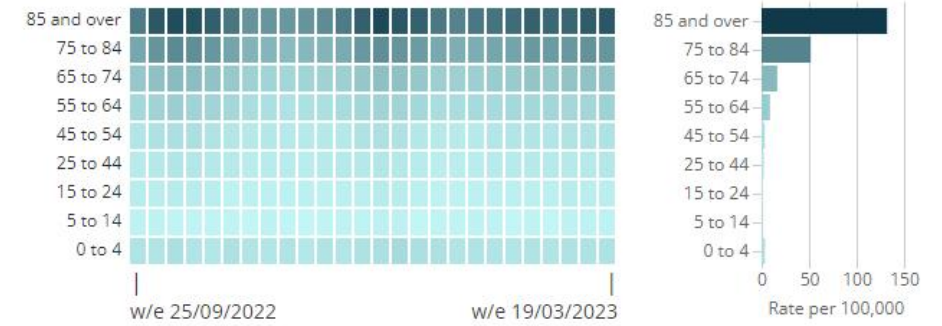


Source: Deaths registered weekly from the Office for National Statistics

Hospital admissions remain highest for those aged 85 years and over

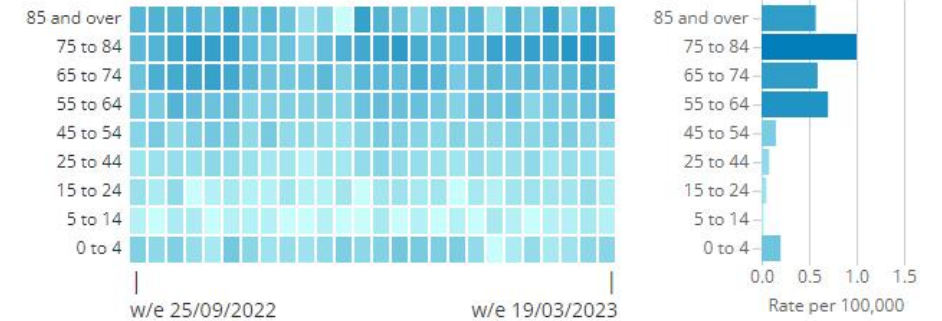
Overall hospital admissions

Weekly COVID-19 positive hospital admission rates per 100,000 people, England



Intensive care unit (ICU) and high dependency unit (HDU) admissions

Weekly COVID-19 positive ICU/HDU admission rates per 100,000 people, England

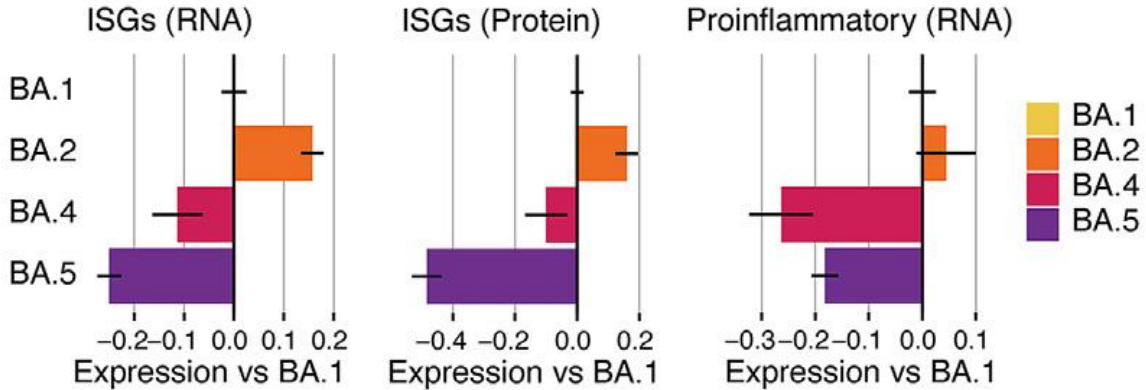
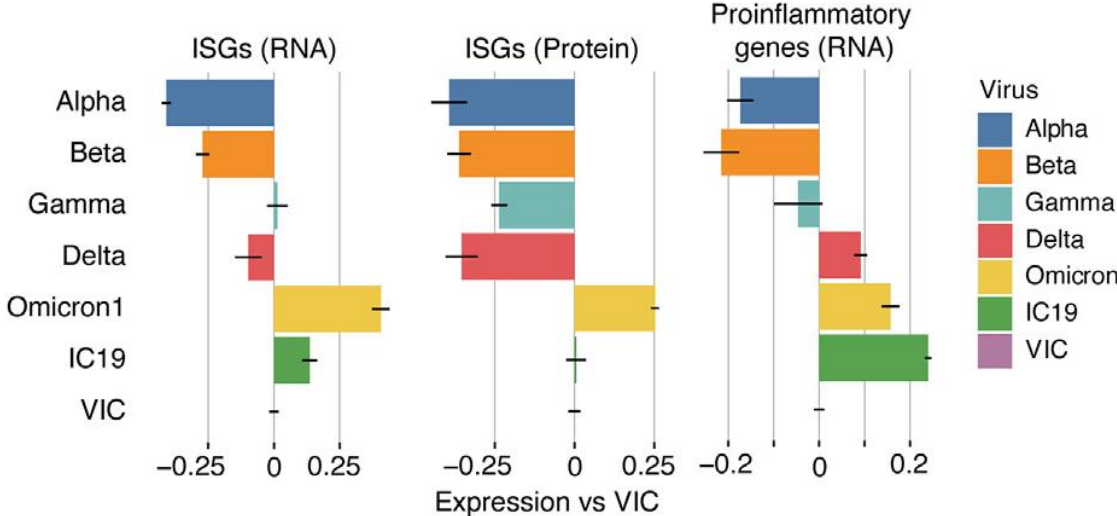


Source: Severe Acute Respiratory Infection Watch surveillance system from the UK Health Security Agency

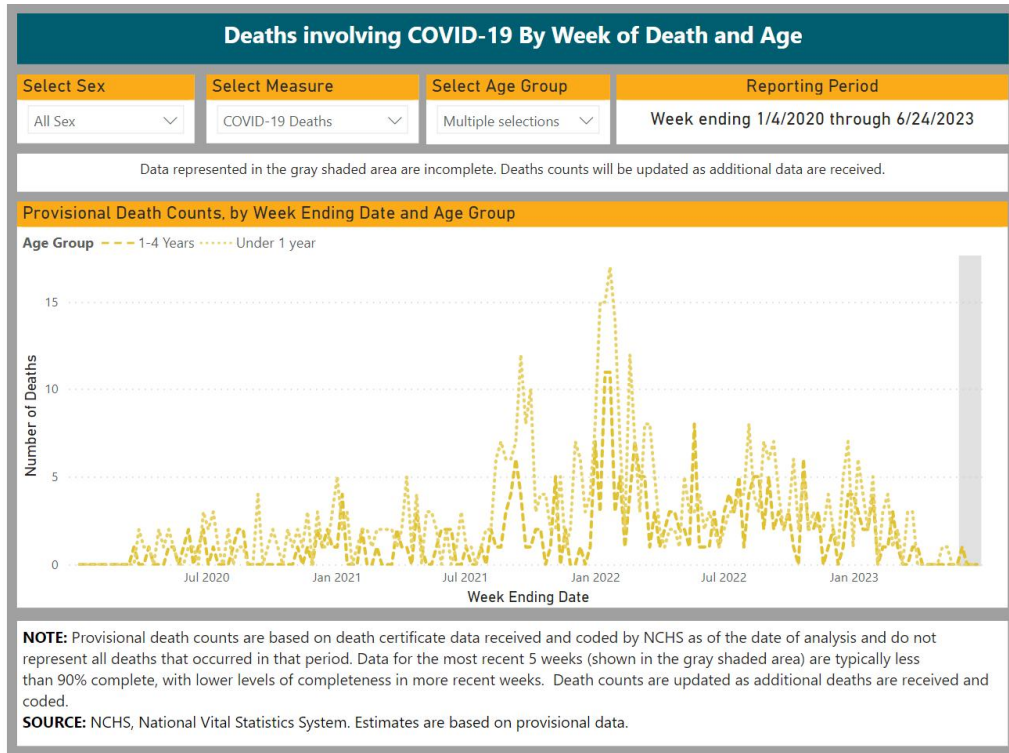
Why is SARS-CoV2 infection of CYP usually less severe vs adults?

- **No differences** in household transmission, ACE2 expression, antibodies vs other CoVs, or viral load compared to adults
- Hospitalised kids tend to have less robust memory T cell responses, lower neutralising/Fc- γ -receptor activating antibodies
- Age-dependent decrease in interferon γ and IL-17 production
- Stronger mucosal innate (and adaptive memory post-vaccine) responses, confirmed by comparative RNA Seq/cytokine measurement vs adults
- Possibly a narrower, less cytotoxic, adaptive response post-seroconversion (doesn't always follow infection)
- Vaccines effective and protect vs. MIS-C (PIMS-TS)

Will CYP innate responses remain protective?

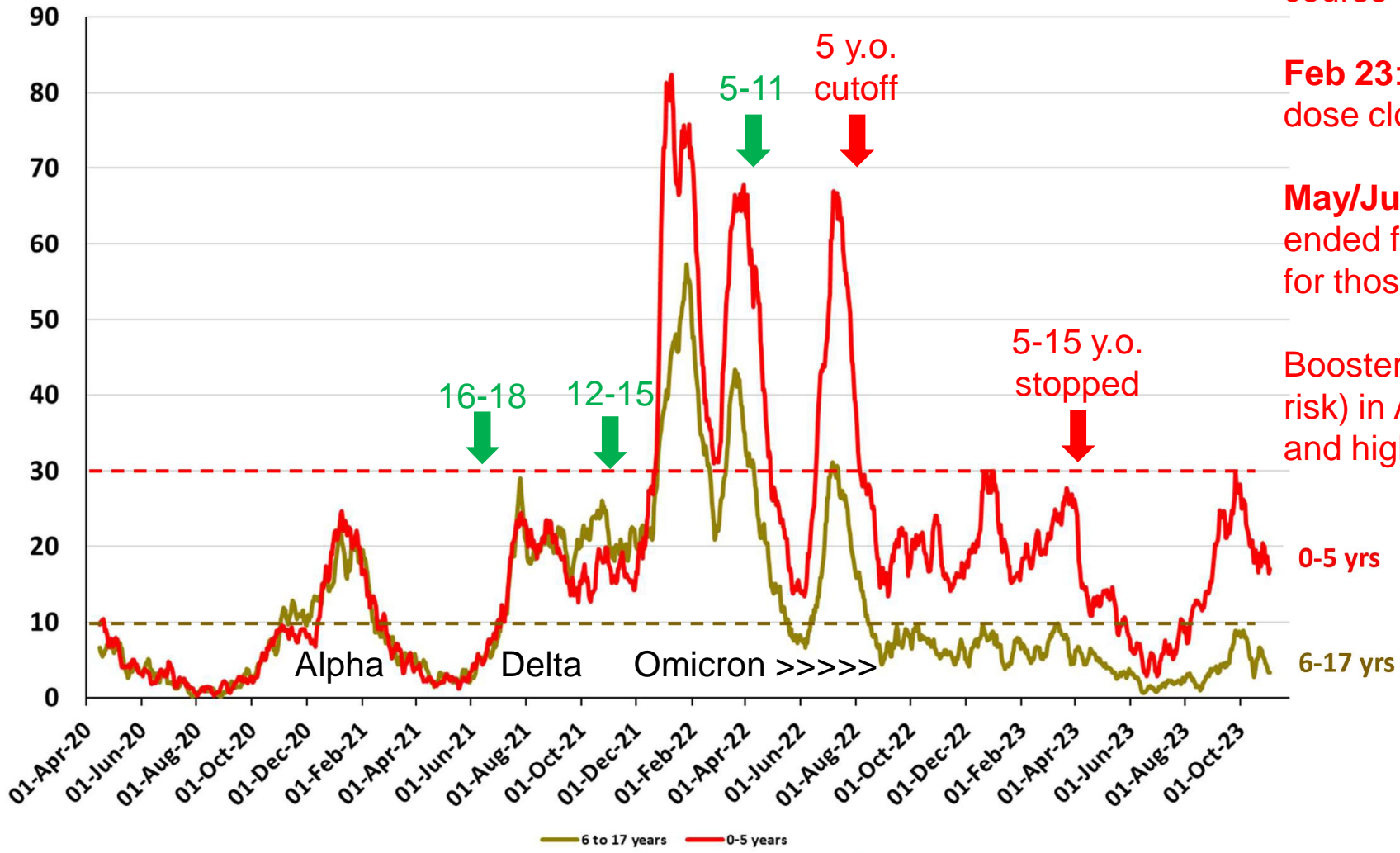


SARS-CoV2 infection of CYP, globally...(data up to Sep'22)



- US >1200 CYP had lost their lives due to COVID, ~same as annual deaths from all other vaccine-preventable deaths (~300/yr)
- UNICEF estimated ~17000 lives lost, half in under 10s
- WHO estimates based upon prevalence and COVID excess deaths up to 60,000 deaths in CYP
- Hence, COVID equivalent to Hib meningitis and almost as high as measles

7-day average of Covid hospital admissions in England per million population since Dec 2020 for under 18s



Data from <https://coronavirus.data.gov.uk/>

Aug 22: kids turning 5 no longer eligible for primary vaccine course

Feb 23: The 2021 third/booster dose closed for 16-49 y.o.

May/June 23 Primary courses ended for all 16-49 y.o. except for those in "high risk" groups

Boosters (spring for VERY high risk) in Autumn 2023 for >65s and high-risk patients

0-5 yrs

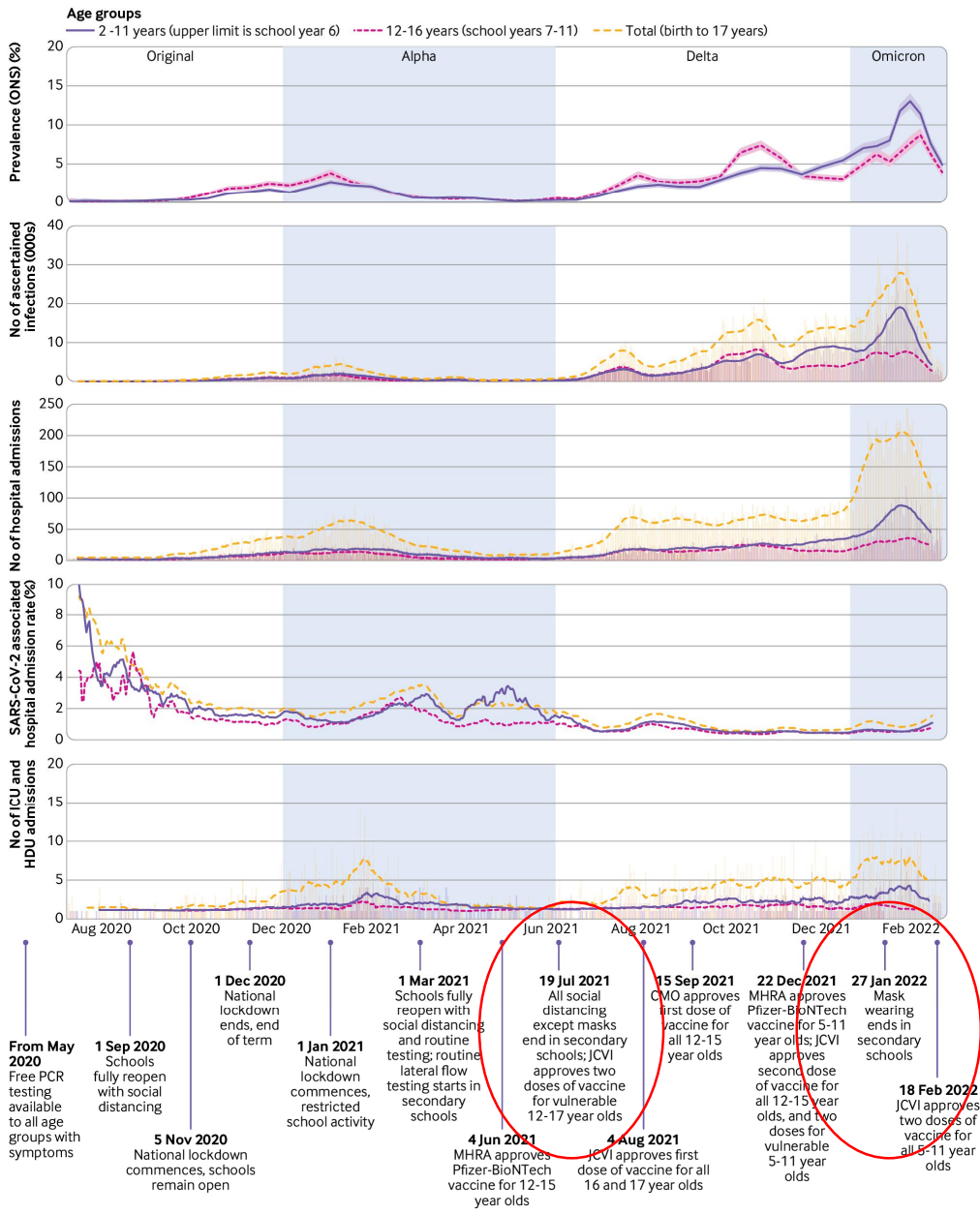
6-17 yrs

Hospital admissions linked to SARS-CoV-2 infection in children and adolescents: cohort study of 3.2 million first ascertained infections in England

Harrison Wilde,^{1,2} Christopher Tomlinson,^{2,3,4} Bilal A Mateen,^{2,4,5} David Selby,^{6,7} Hari Krishnan Kanthimathinathan,⁸ Padmanabhan Ramnarayan,⁹ Pascale Du Pre,¹⁰ Mae Johnson,¹⁰ Nazima Pathan,¹¹ Arturo Gonzalez-Izquierdo,² Alvina G Lai,² Deepthi Gurdasani,^{12,13} Christina Pagel,¹⁴ Spiros Denaxas,^{2,4} Sebastian Vollmer,^{6,7} Katherine Brown,^{15,10} on behalf of the CVD-COVID-UK/COVID-IMPACT consortium



Removal of mitigations coincided with emergence of Omicron (BA.1, BA.2) and before 5-11 permitted to be vaccinated

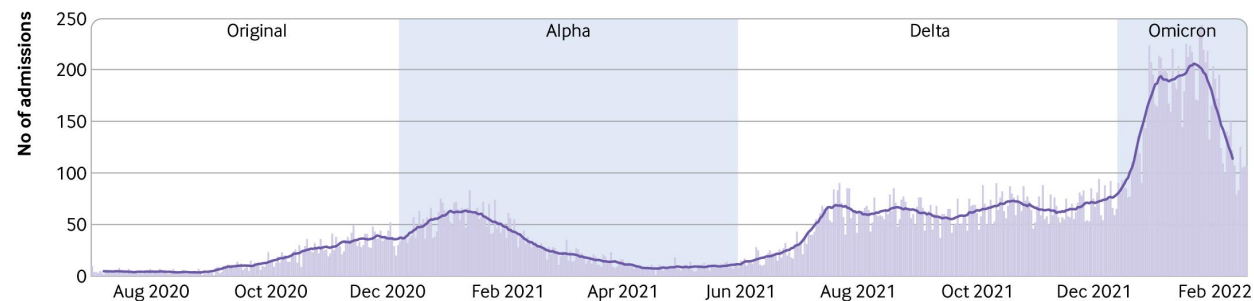
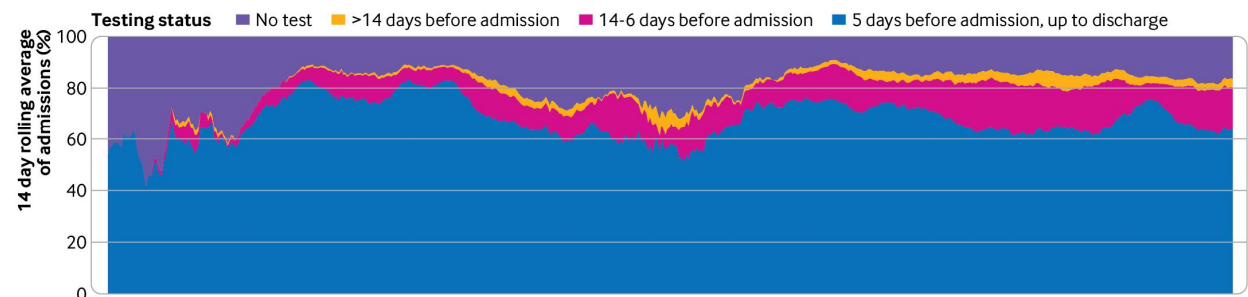
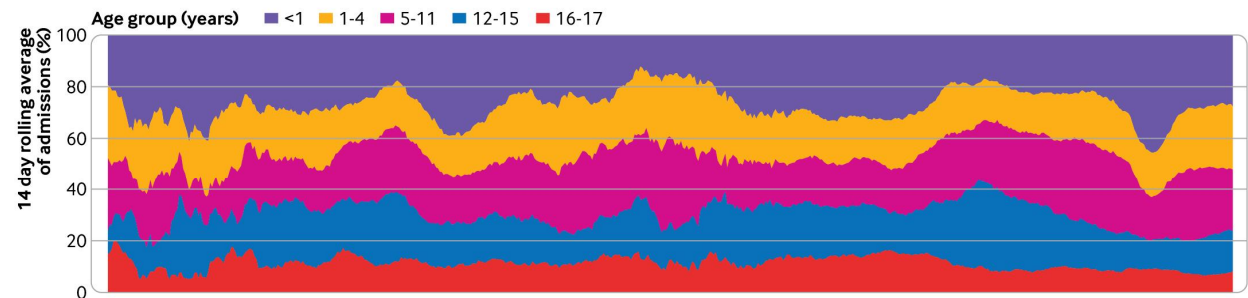
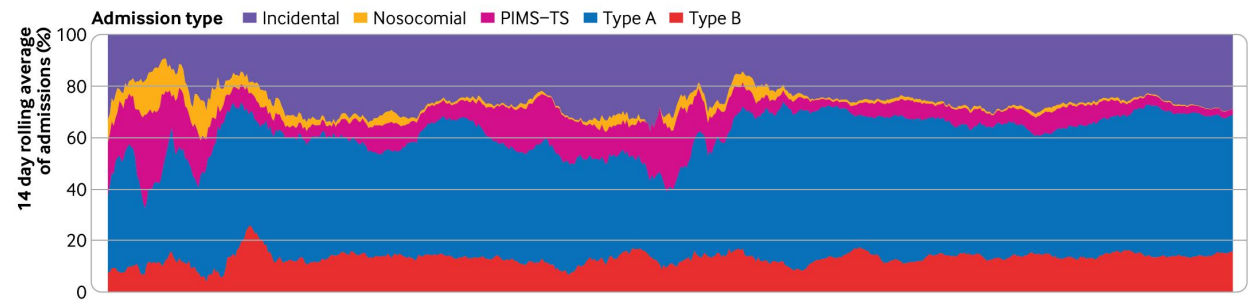


Hospital admissions linked to SARS-CoV-2 infection in children and adolescents: cohort study of 3.2 million first ascertained infections in England

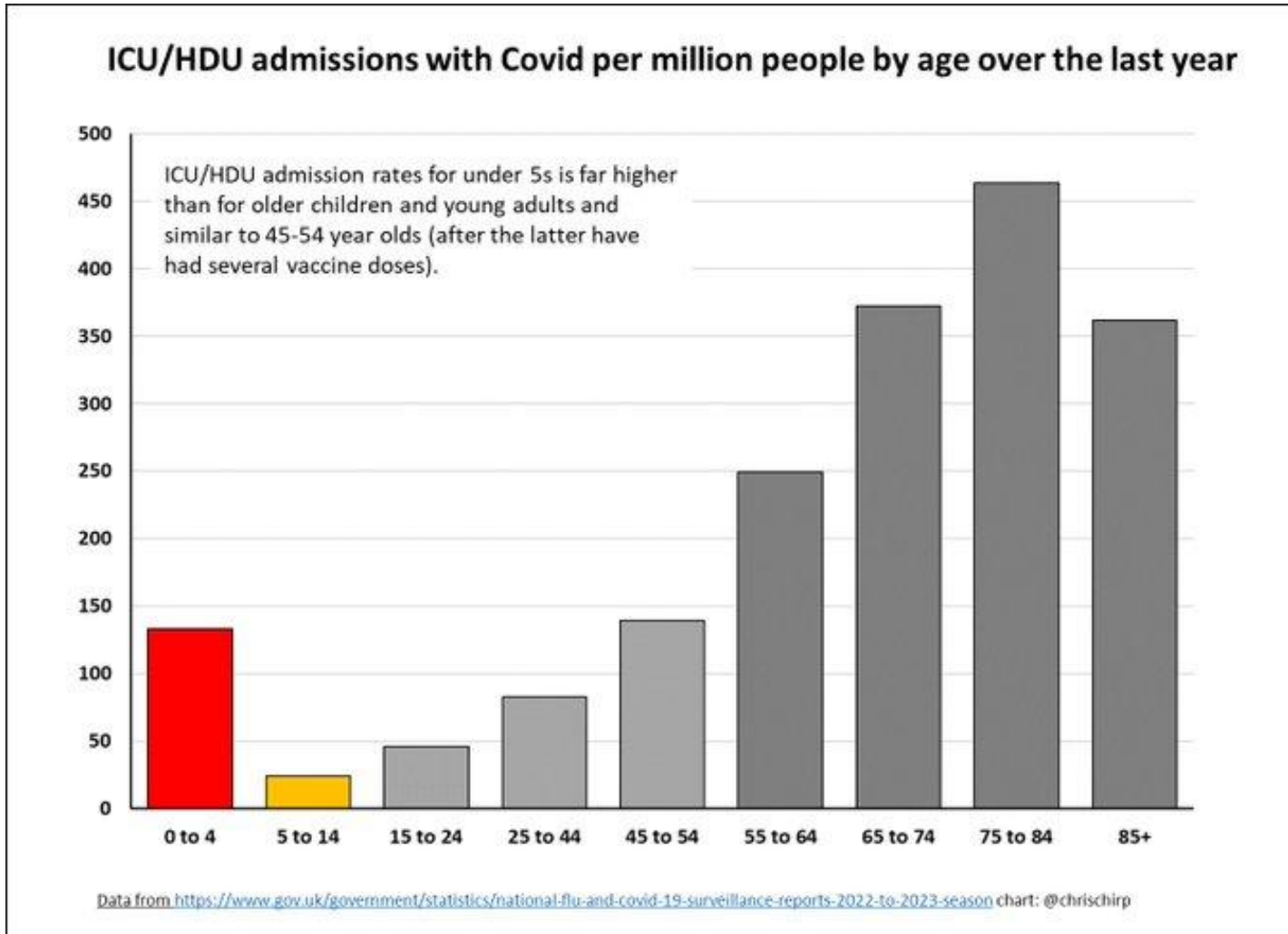
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Around half of admissions in under 5's, incidental COVID minor component

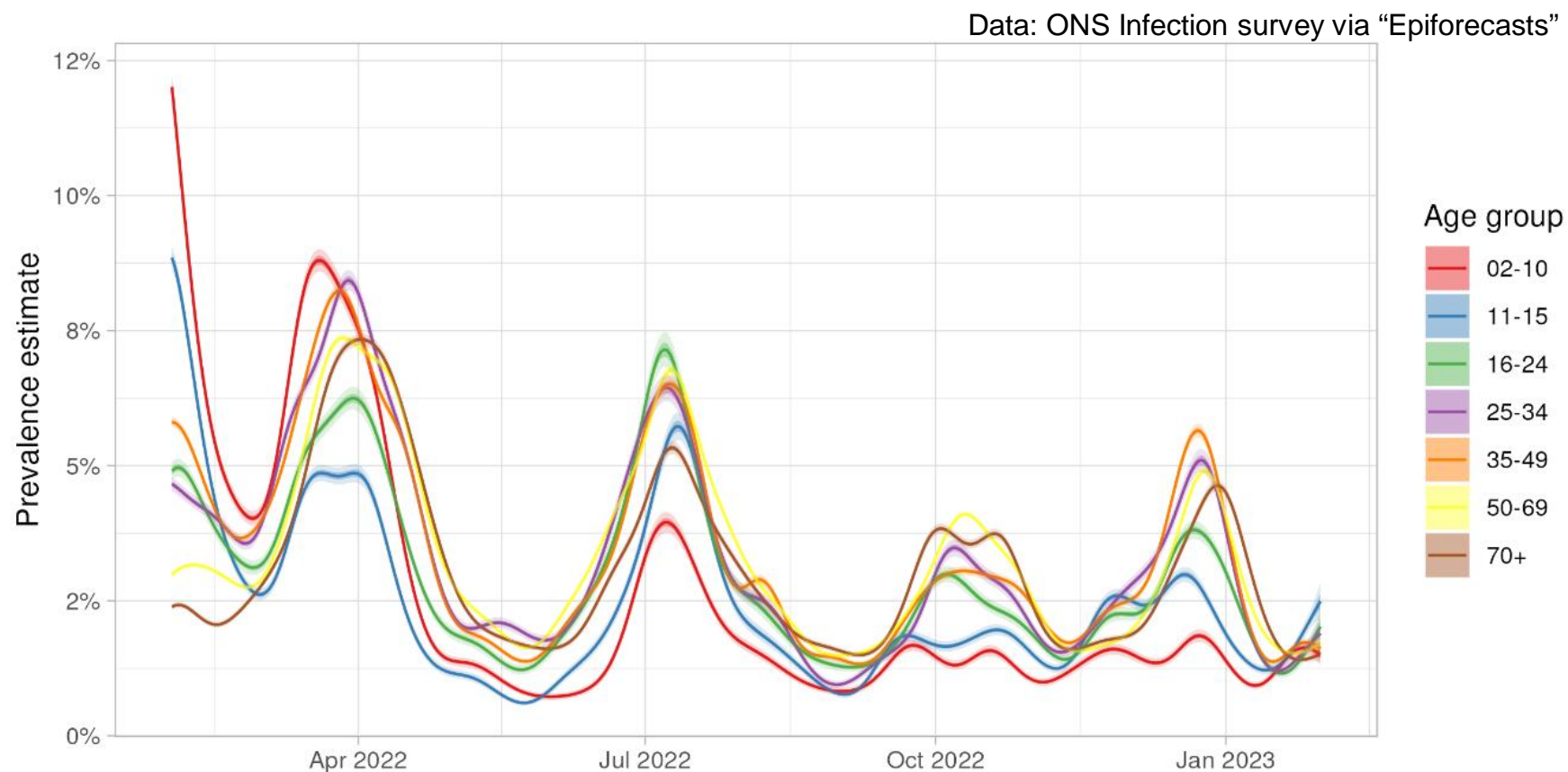


A U-shaped curve of clinical risk for COVID



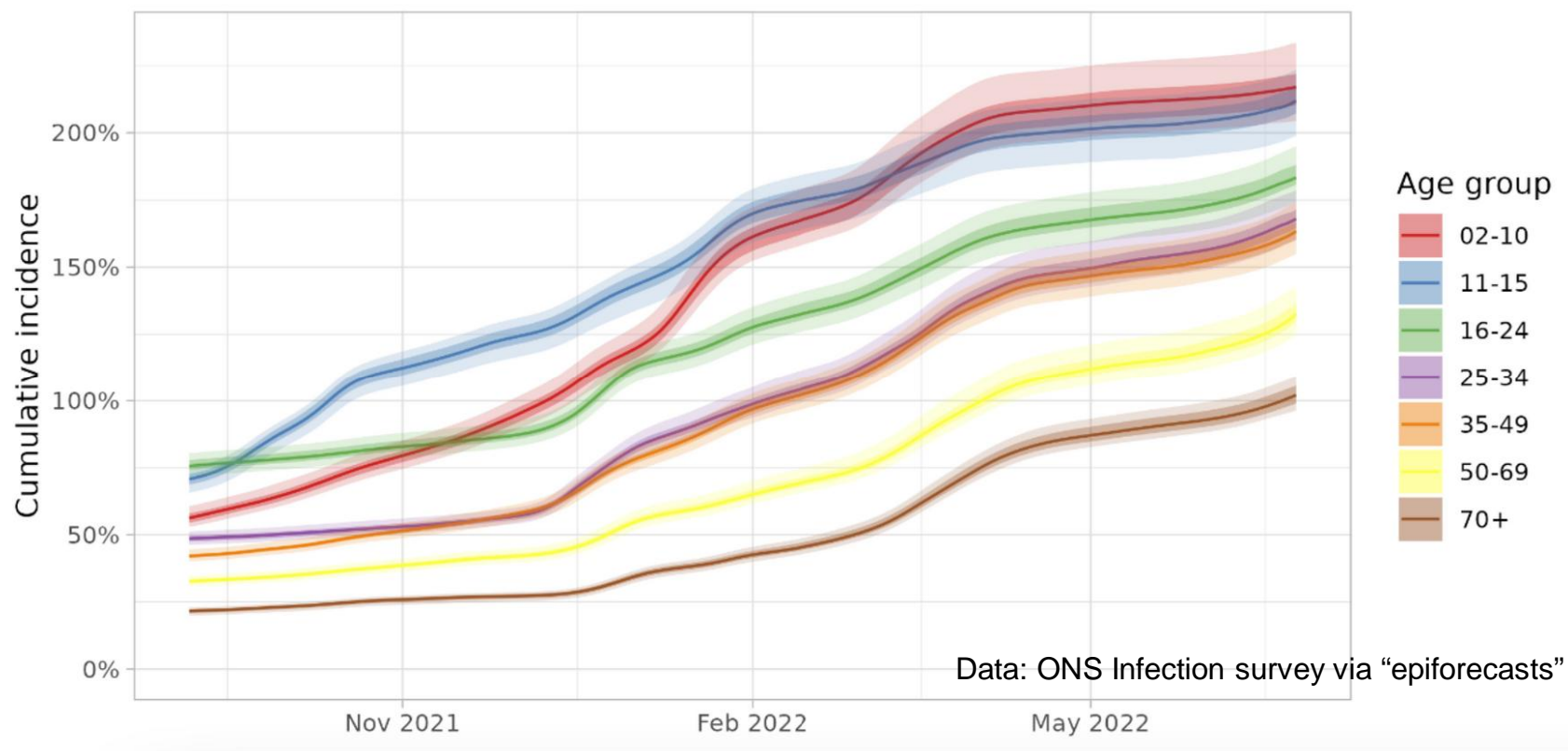
A small % of a very large number (~15M CYP) is still a large number!!!

What does this mean in terms of children being exposed to infection?



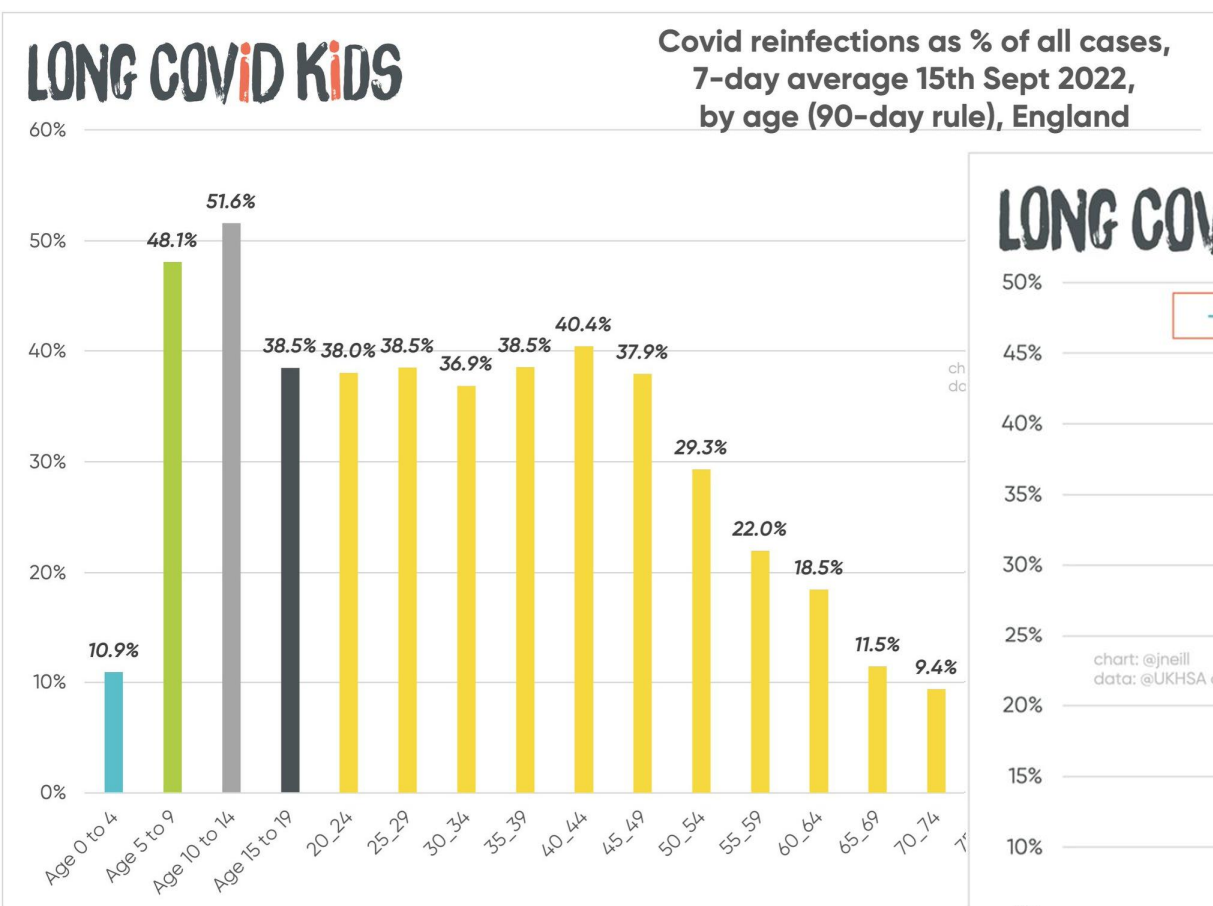
Infections in younger age groups falling with successive Omicron waves...infection-induced immunity? What would Jenner say?!

What does this mean in terms of children being exposed to infection?

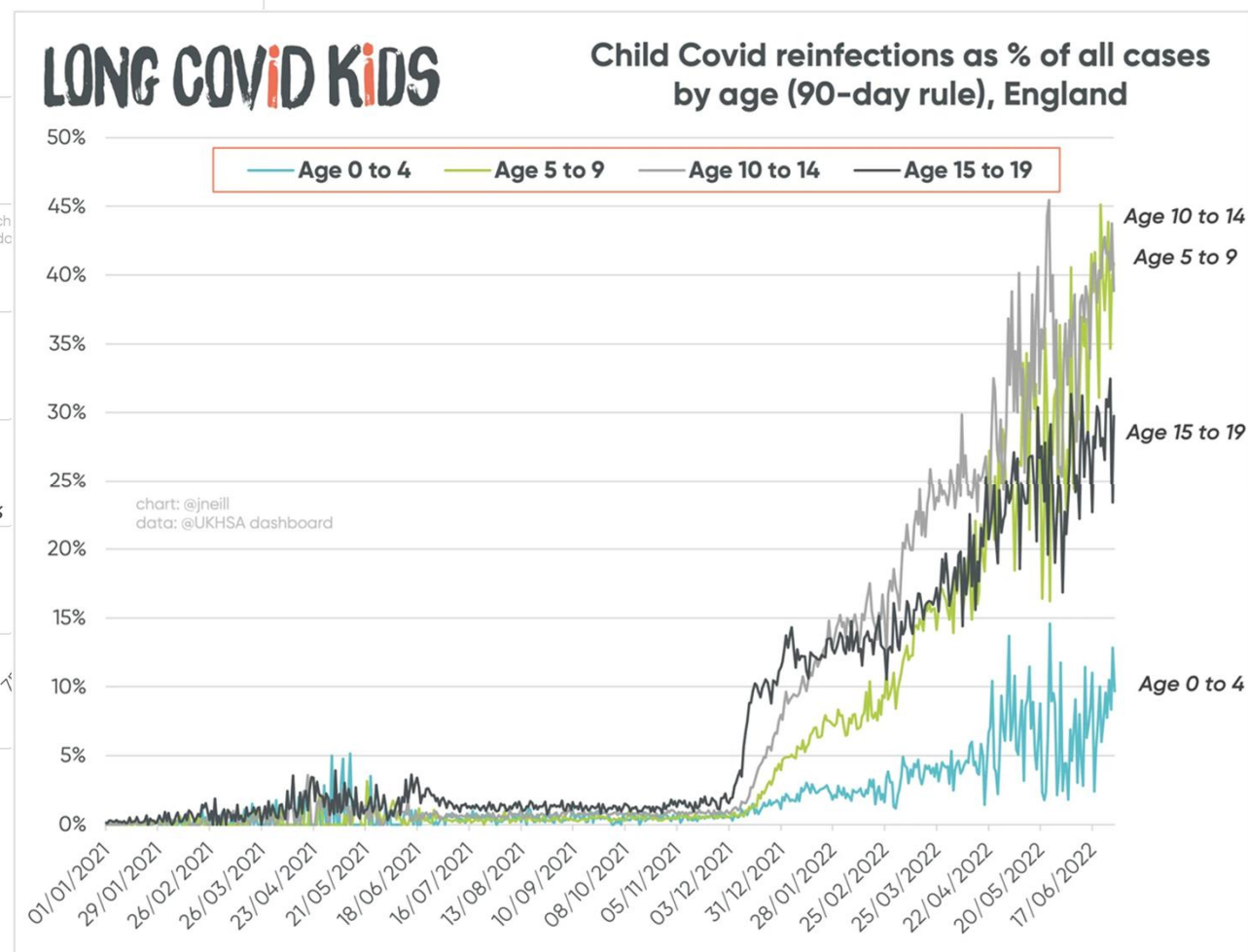


Younger age groups have accumulated enough infections for all to have had COVID twice, compared to once for >70s. Jenner would be fuming...

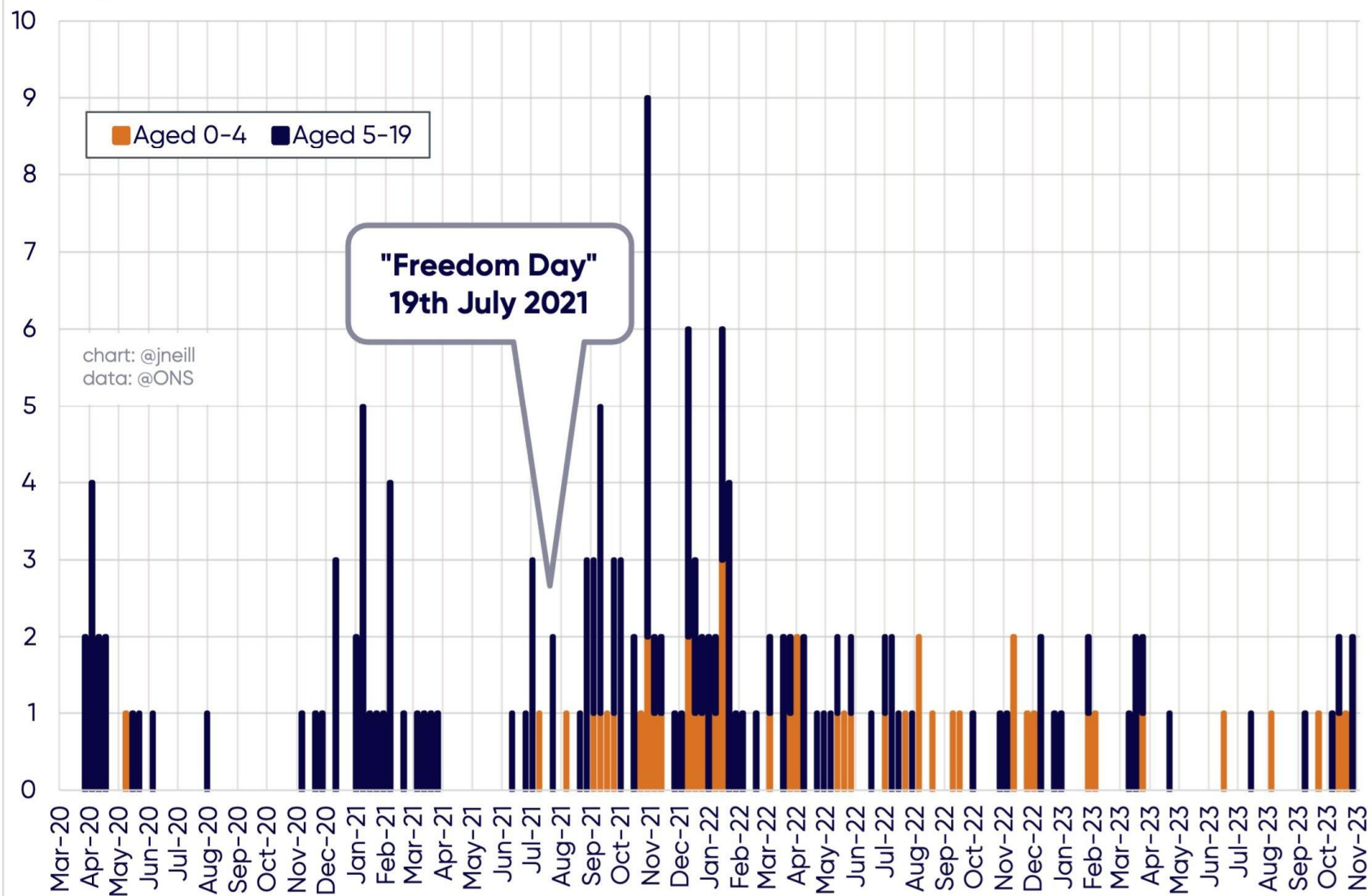
Which children are being infected more than once?



Reinfections are predominantly in primary and secondary school kids...likely an underestimate during Omicron era...

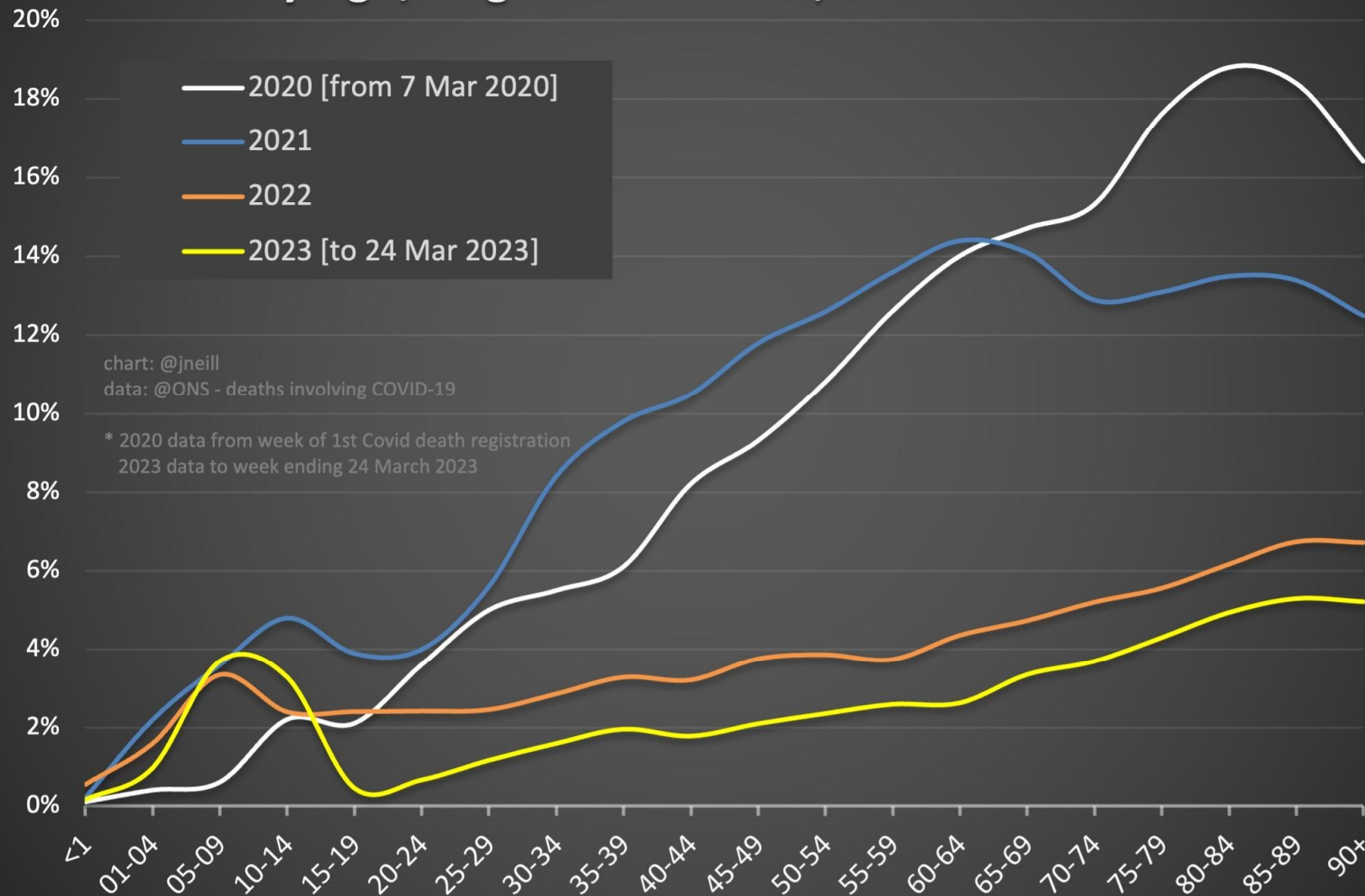


Weekly child & young people Covid deaths Aged 0-19, England & Wales, date of occurrence

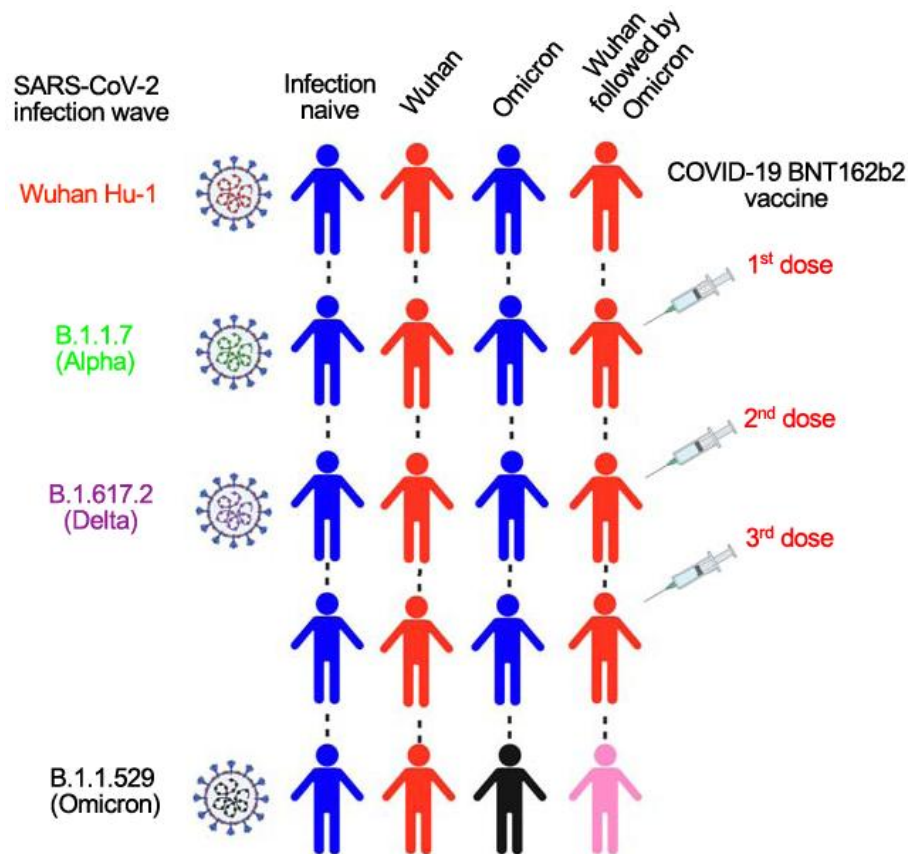


- Children & young people rarely die
- ONS listed COVID as **5th highest cause of death** for females aged 5-19 in 2022
- Most child COVID-19 deaths during the Delta & Omicron waves
- **170 certificated deaths** registered by ONS in the UK since 2020, ~70% underlying cause
- Lag as child deaths are subject to coroner's inquiry
- 72% do **NOT** involve "underlying conditions"
- ~18 children/year die from flu (ONS Nomis age 0-19 to 2020). We vaccinate children against influenza

Covid deaths as % of total deaths By age, England & Wales, 2020 - 2023*



But, if kids have been infected, they're protected, right?



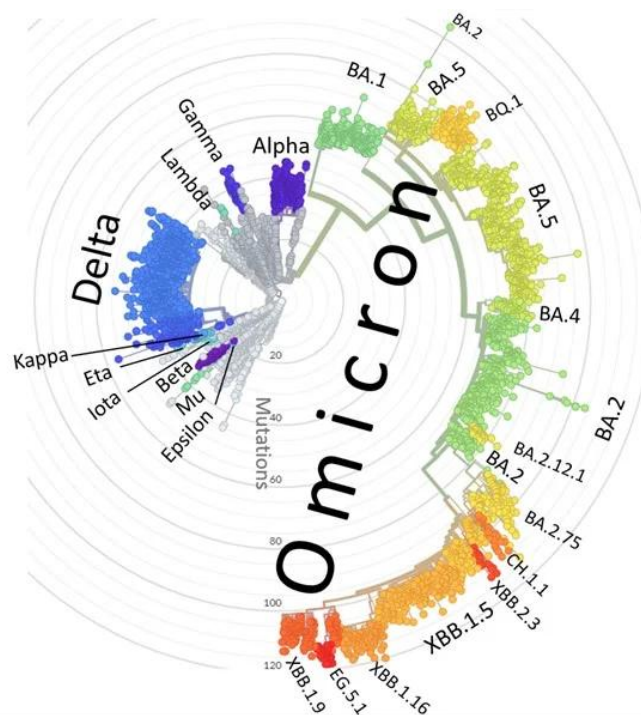
RESEARCH ARTICLE

CORONAVIRUS

Immune boosting by B.1.1.529 (Omicron) depends on previous SARS-CoV-2 exposure

Catherine J. Reynolds^{1†}, Corinna Pade^{2†}, Joseph M. Gibbons^{2†}, Ashley D. Otter^{3†}, Kai-Min Lin¹, Diana Muñoz Sandoval¹, Franziska P. Pieper³, David K. Butler¹, Siyi Liu¹, George Joy⁴, Nasim Forooghi⁴, Thomas A. Treibel^{4,5}, Charlotte Manisty^{4,5}, James C. Moon^{4,5}, COVIDsortium Investigators[§], COVIDsortium Immune Correlates Network[§], Amanda Semper³, Tim Brooks³, Áine McKnight^{2†}, Daniel M. Altmann^{6†}, Rosemary J. Boyton^{1,7*†}

Reynolds et al., Science 377, eabq1841 (2022) 15 July 2022

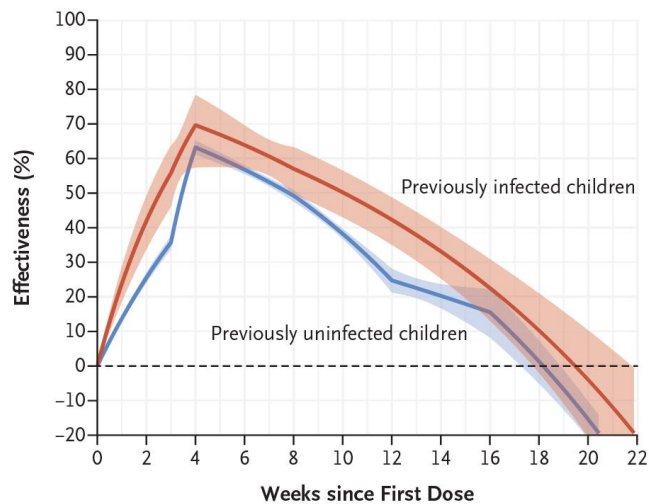


Omicron is **similar enough** to previous viruses that it triggers existing vaccine/infection induced antibody responses, yet it is also **different enough** that those responses don't work well...This is known as "original antigenic sin", or "immune imprinting"...hence, infection-induced "herd immunity" has not, and will not happen while prevalence and diversity exists as it does now...

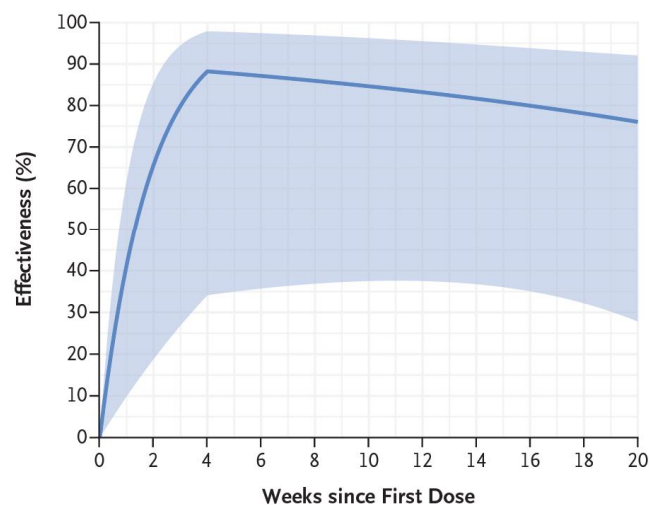
Vaccine versus infection-induced immunity in children

5-11 y.o. +/- 1 or 2 doses (paediatric) of Pfizer vaccine

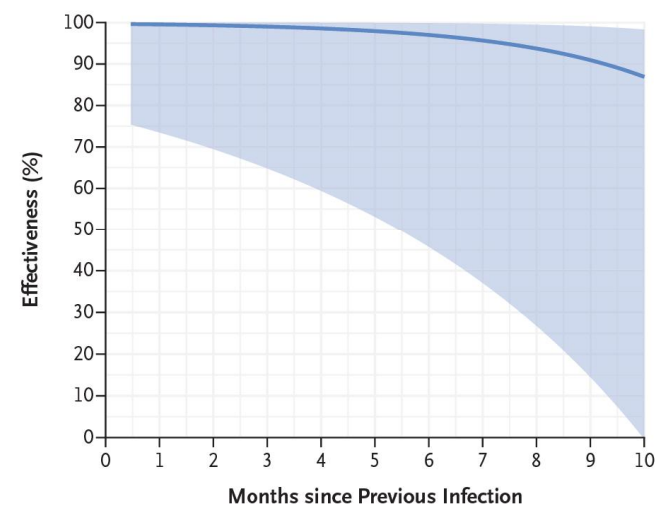
B Effectiveness of BNT162b2 against Infection, According to Previous Infection Status



E Effectiveness of BNT162b2 against Hospitalization



F Effectiveness of Previous Infection against Hospitalization Due to Reinfection



So, infection is better, right?!

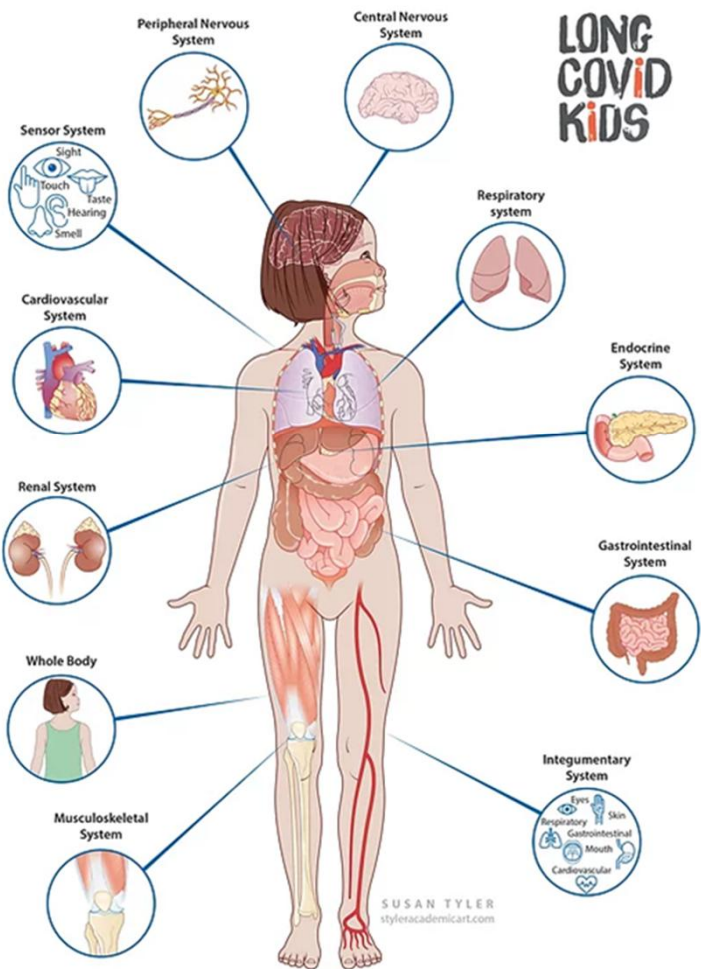
Wrong:

- 193K infections, 309 hospitalised, 7 died
- 273k vaccinees, 15 hospitalised, 0 died
- Lower kids dose, 3 needed for max protection in adults
- Protection vs severe disease better than vs infection
- Omicron is highly antibody evasive...



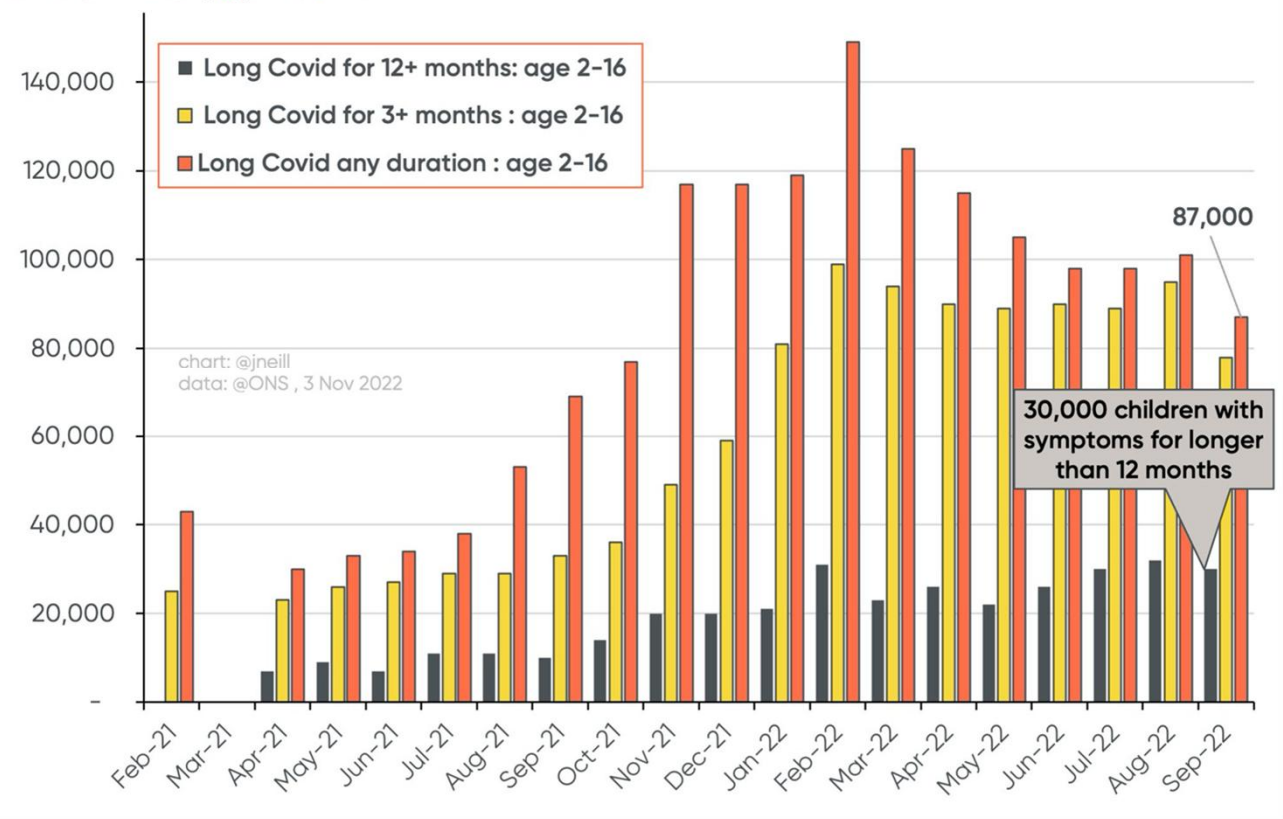
“The rapid decline in protection against omicron infection that was conferred by vaccination and previous infection provides support for booster vaccination.”

LONG COVID KIDS



LONG COVID KIDS

Children with Long Covid (UK, ONS)



LONG COVID KIDS



- Extreme exhaustion
- Dizziness
- Rashes
- Cognitive Issues
- Headaches / Sickness or nausea
- Pain
- Stomach pain or upset
- PESE
- Mood changes
- Tics
- Neuropsychiatric symptoms (altered mood, regression, OCD, anxiety)
- Muscle and joint pain or swelling
- Breathlessness



LONG
COVID
KIDS

LONG COVID: 'THE ELEPHANT IN THE ROOM.'
HOW DO CHILDREN DESCRIBE THEIR LONG COVID?

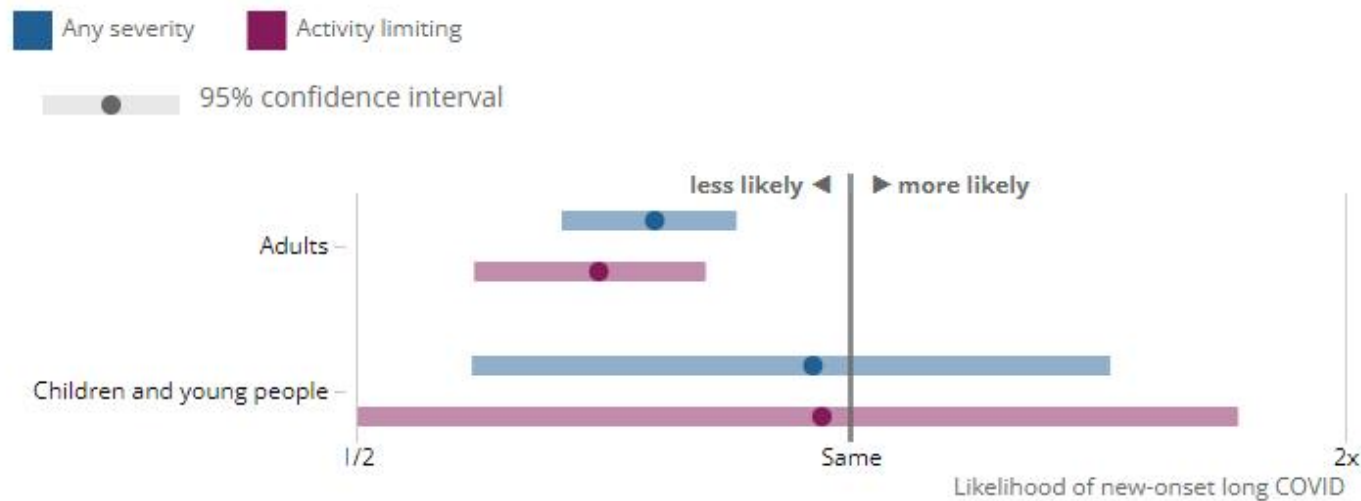
www.longcovidkids.org



Impact of reinfections on Long COVID...

Figure 1: The adjusted odds of new-onset, self-reported long COVID were 28% lower in adults following a second coronavirus (COVID-19) infection, compared with a first infection

Adjusted odds ratios for new-onset, self-reported long COVID 12 to 20 weeks after a second COVID-19 infection, compared with a first infection, in adults (aged 16 years and over) and children and young people (aged 2 to 15 years), UK: 1 November 2021 to 8 October 2022



Source: Office for National Statistics – Coronavirus (COVID-19) Infection Survey

Impact of reinfections on Long COVID...

LONG COVID KIDS

Reinfection causes a recurrence of Long Covid in 58% of children who were in recovery or remission.

This is similar to all respondents including adults



Reinfections in Long Covid Survey Aug 2022
Long Covid Support / Long Covid Kids

82% of child respondents first got Long Covid after their 1st infection
17% after their 2nd infection and 1% after their 3rd infection

This is similar to all respondents including adults.



Reinfections in Long Covid Survey Aug 2022
Long Covid Support / Long Covid Kids

Reinfection worsens the symptoms of Long Covid in the majority of children who are still symptomatic



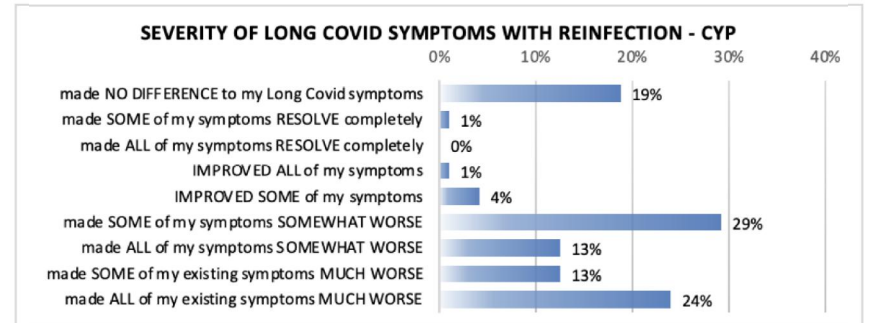
Reinfections in Long Covid Survey Aug 2022
Long Covid Support / Long Covid Kids

The science behind COVID-19 Research summary COVID-19 Explainer

New survey suggests reinfection worsens Long COVID

Survey indicates that getting reinfected worsens symptoms of Long COVID or triggers a recurrence of symptoms in people who have recovered.

15 September 2022 - 2 min read - by [Peta Joy](#)



LONG COVID KIDS

Impact of vaccination on Long COVID...

PLOS MEDICINE

RESEARCH ARTICLE

Post-COVID-19-associated morbid children, adolescents, and adults: cohort study including more than individuals with COVID-19 in Germ

Conclusions

In this retrospective matched cohort study, we observed significant new onset morbidity in children, adolescents, and adults across 13 prespecified diagnosis/symptom complexes, following COVID-19 infection. These findings expand the existing available evidence on post-COVID-19 conditions in younger age groups and confirm previous findings in adults.

CONCLUSIONS Current studies suggest that covid-19 vaccines might have protective and therapeutic effects on long covid. More robust comparative observational studies and trials are needed, however, to clearly determine the effectiveness of vaccines in preventing and treating long covid.

CONCLUSION In this study, covid-19 vaccination reduced the severity of symptoms and the effect of long covid on patients' social, professional, and family lives at 120 days in those with persistent symptoms of infection.

OPEN ACCESS

ORIG

bmjmedicine

Effect of covid-19 vaccination on long covid: system review

Oyungerel Byambasuren ¹, Paulina Stehlik ¹, Justin Clark ¹, Kylie A Paul Glasziou ¹

 Check for updates

OPEN ACCESS

ORIGINAL RESEARCH

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Efficacy of first dose of covid-19 vaccine versus no on symptoms of patients with long covid: target based on ComPaRe e-cohort

Viet-Thi Tran ^{1,2}, Elodie Perrodeau,² Julia Saldanha,³ Isabelle Pane,² Phil

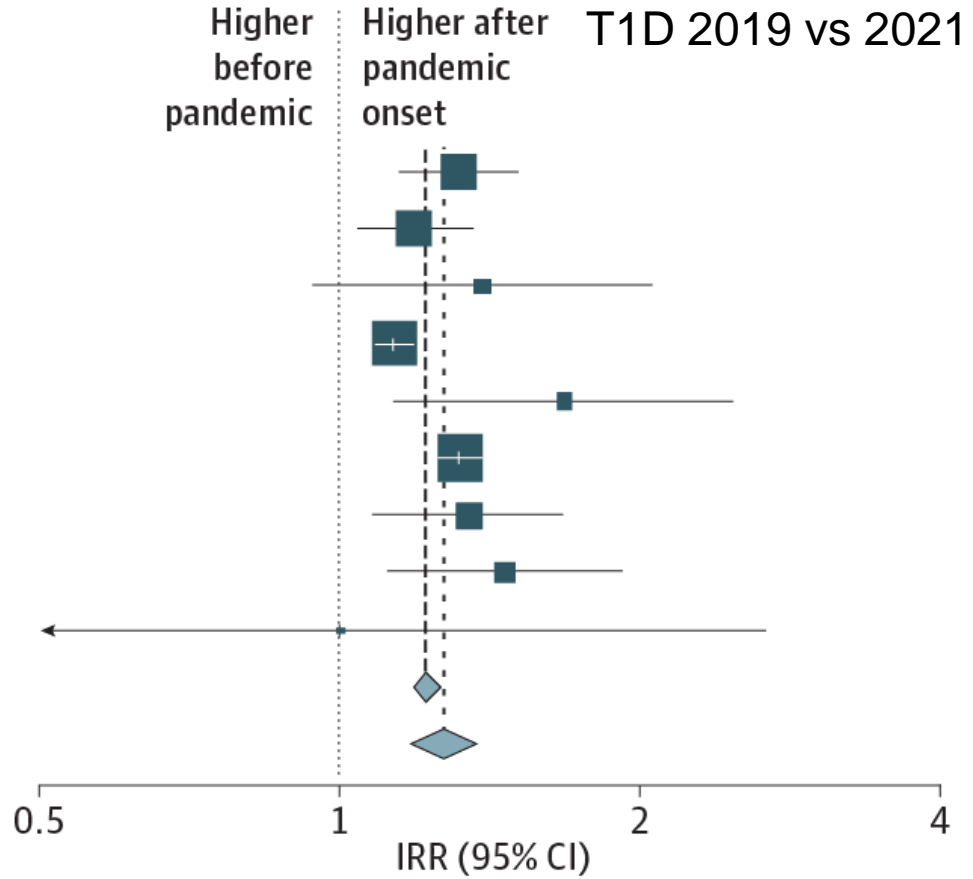
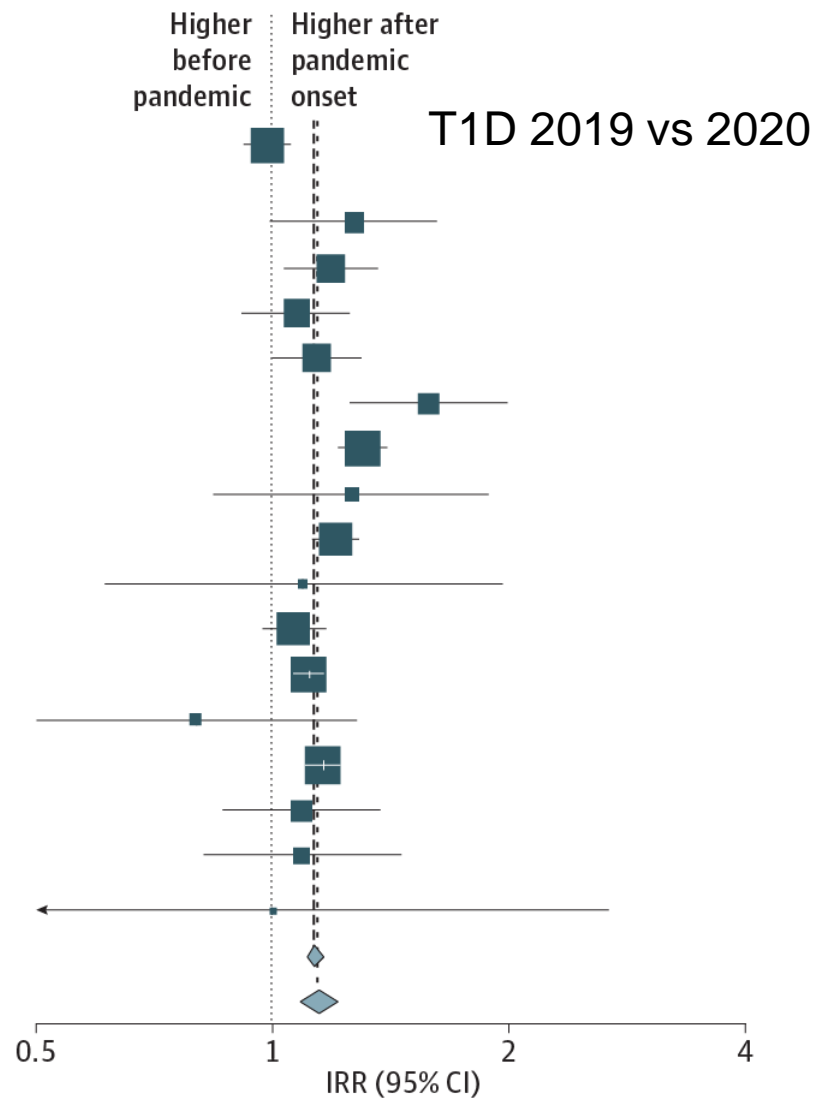
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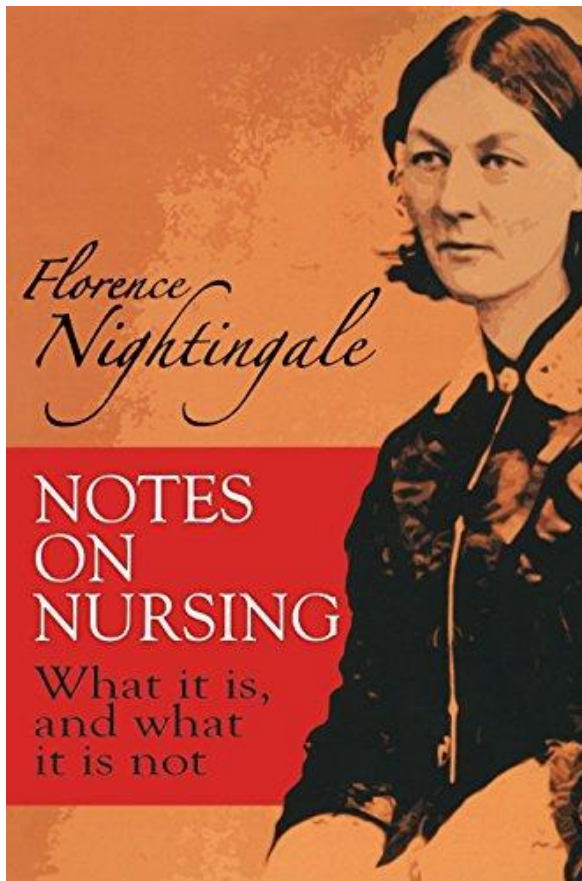
Original Investigation | Pediatrics

Incidence of Diabetes in Children and Adolescents During the COVID-19 Pandemic A Systematic Review and Meta-Analysis

Daniel D'Souza, BHSc; Jessica Empringham, MD; Petros Pechlivanoglou, PhD; Elizabeth M. Uleryk, MLS; Eyal Cohen, MD, MSc; Rayzel Shulman, MD, PhD



We should NOT need a pandemic to reinforce the importance of cleaning the air...



It is quite necessary, nevertheless, to lay down such a principle, because the actual mortality *in* hospitals, especially in those of large crowded cities, is very much higher than any calculation founded on the mortality of the same class of diseases among patients treated *out of* hospital would lead us to expect. The

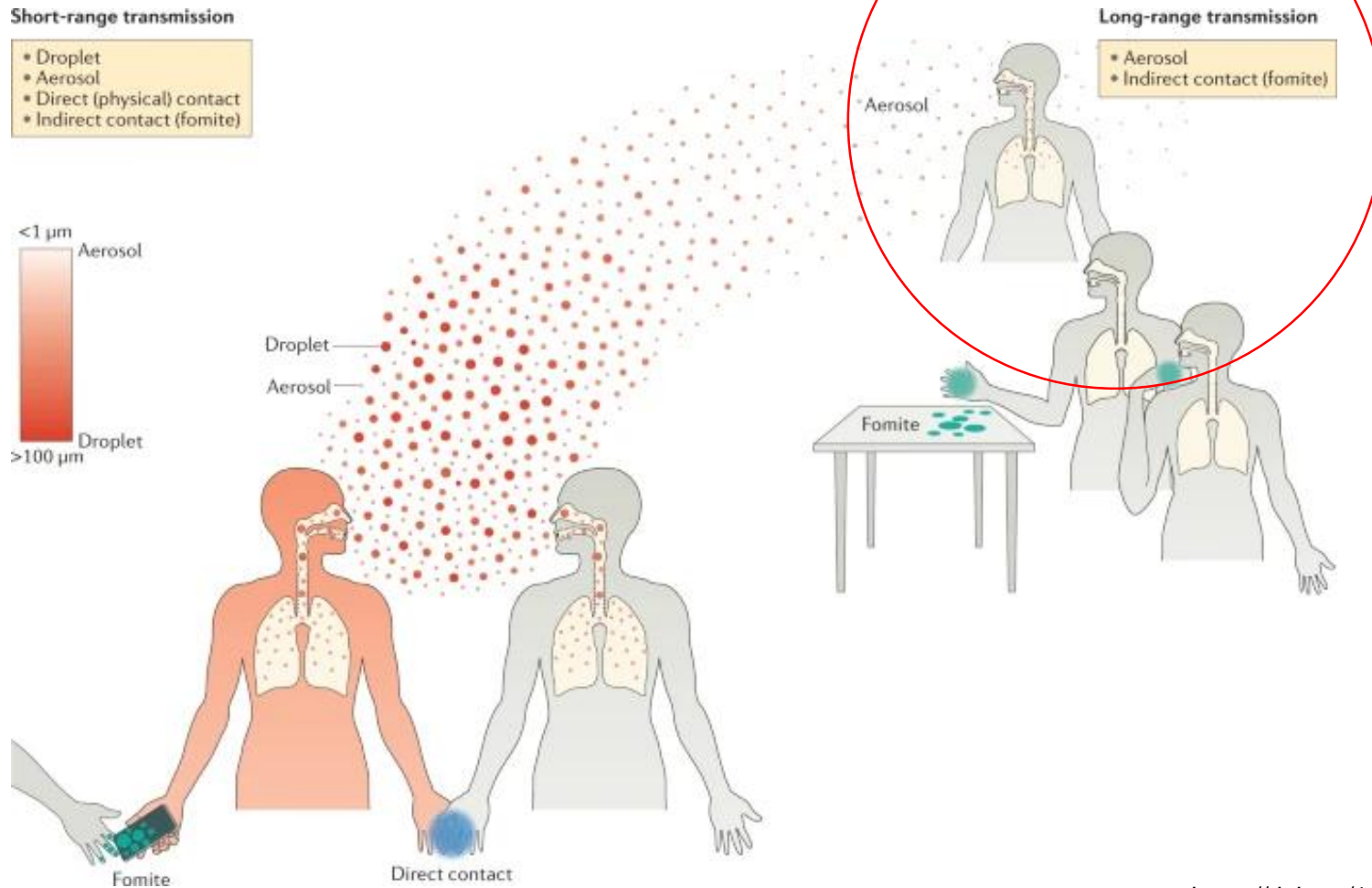
I. VENTILATION AND WARMING.

The very first canon of nursing, the first and the last thing upon which a nurse's attention must be fixed, the first essential to the patient, without which all the rest you can do for him is as nothing, with which I had almost said you may leave all the rest alone, is this: TO KEEP THE AIR HE BREATHES AS PURE AS THE EXTERNAL AIR, WITHOUT CHILLING HIM. Yet what is so little attended to? Even

water-closet, or even, as I myself have had sorrowful experience, from open sewers loaded with filth; and with this the patient's room or ward is aired, as it is called—poisoned, it should rather be said. Always air from the air without, and that, too, through those windows, through which the air comes freshest. From a closed

First rule of nursing, to keep the air within as pure as the air without.

Mitigations & protections, NOT restrictions...



We know what to do, but it isn't "normal"



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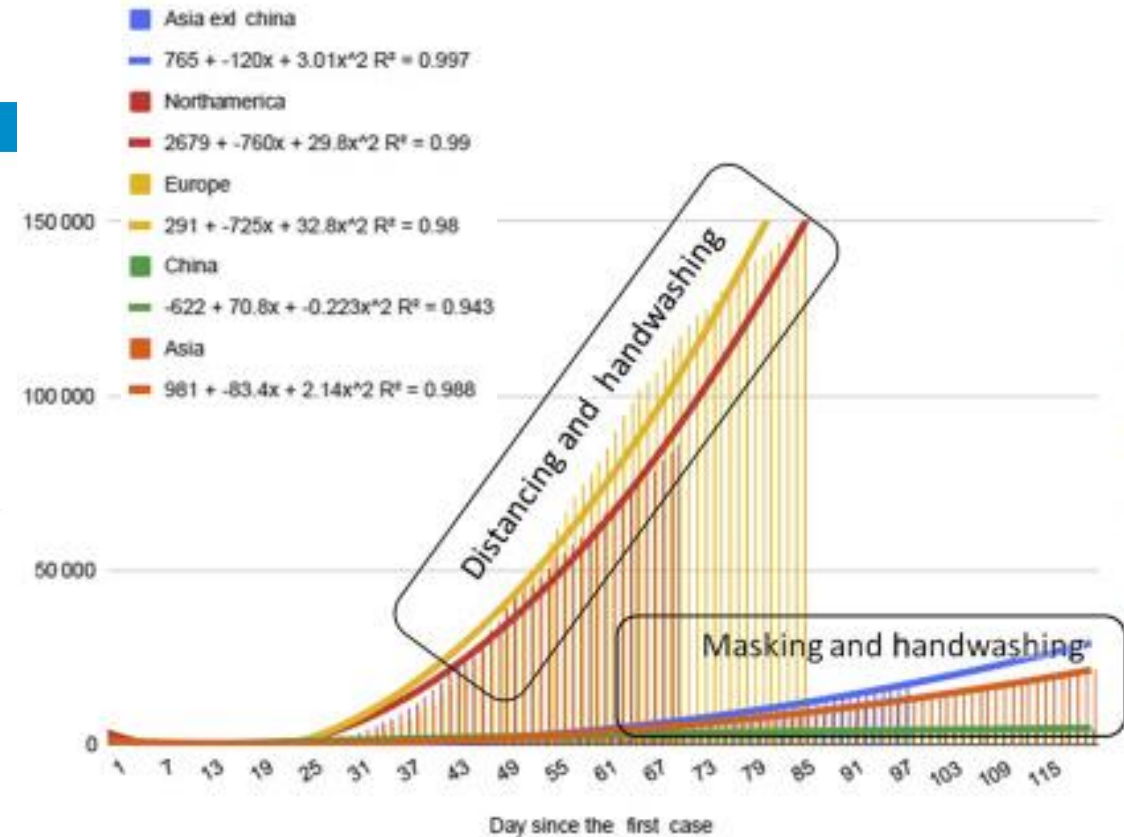
Home / News / Intensified public health measures help control MERS-CoV outbreak in the Republic of Korea

Intensified public health measures help control MERS-CoV outbreak in the Republic of Korea

28 July 2015 | News release | Manila



The Republic of Korea's Minister of Health and Welfare, Moon Hyungpyo, and Dr Keiji Fukuda, World Health Organization Assistant Director General, Health Security

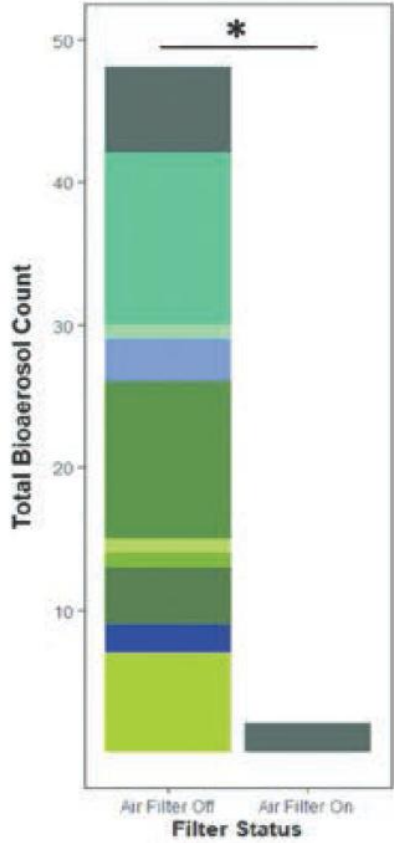


Mitigations & protections, NOT restrictions...

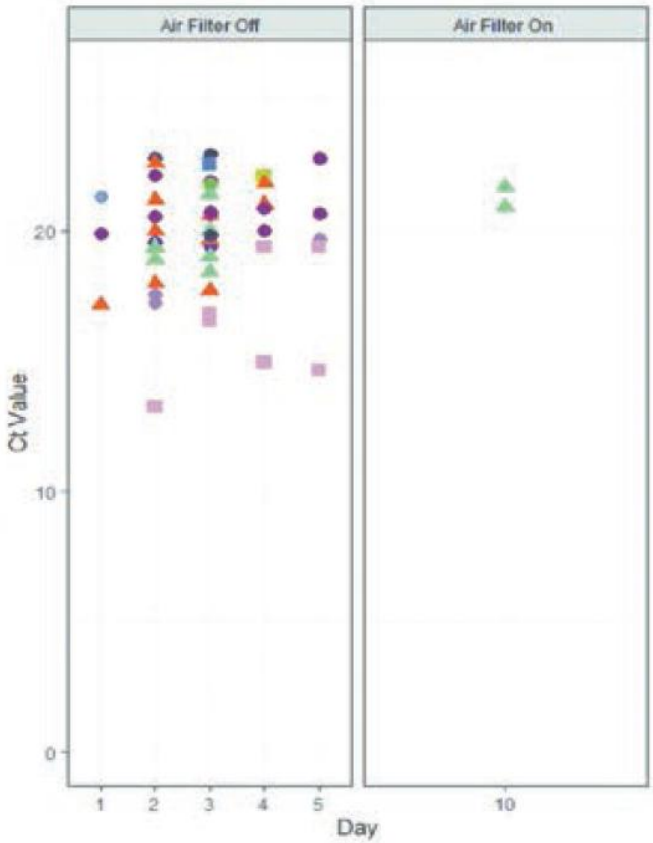
Clinical Infectious Diseases
BRIEF REPORT

The Removal of Airborne Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and Other Microbial Bioaerosols by Air Filtration on Coronavirus Disease 2019 (COVID-19) Surge Units

Andrew Conway Morris,^{1,2a} Katherine Sharrocks,^{3a} Rachel Bousfield,^{3,4a} Leanne Kermack,^{5a} Mailis Maes,⁵ Ellen Higginson,⁵ Sally Forrest,⁵ Joana Pereira-Dias,⁵ Claire Cormie,⁵ Tim Old,⁵ Sophie Brooks,⁵ Islam Hamed,¹ Alicia Koenig,¹ Andrew Turner,⁶ Paul White,^{6,7} R. Andres Floto,^{8,9} Gordon Dougan,⁵ Effrossyni Gkrania-Klotsas,^{3a} Theodore Gouliouris,^{3,4b} Stephen Baker,⁵ and Vilas Navapurkar^{1,5}



- Candida spp.
- CoN Staph
- E. coli
- E. faecalis
- Fungal 18S
- HPIV3
- HSV1
- P. mirabilis
- S. epidermidis
- SARS-CoV-2

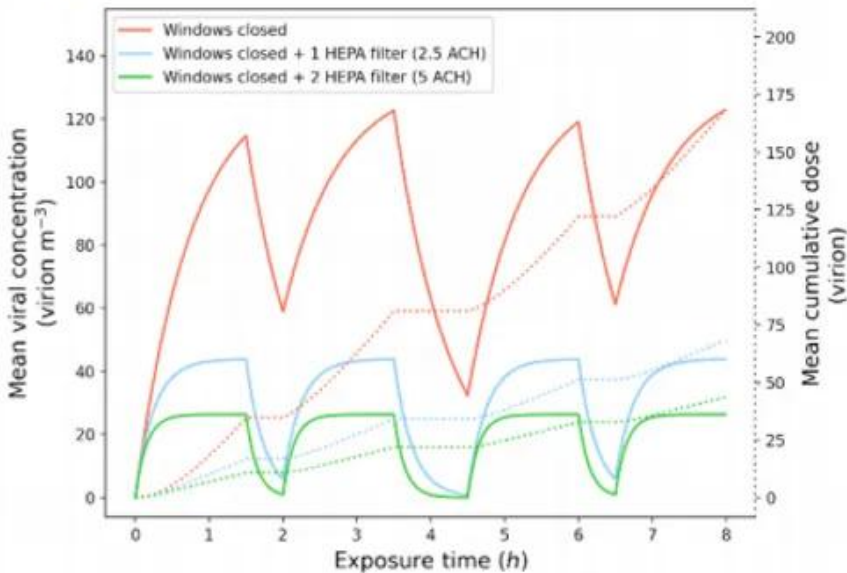


- Bacteria
- Fungi
- Virus
- Candida spp.
- CoN Staph
- E. coli
- E. faecalis
- Fungal 18S
- HPIV3
- HSV1
- P. mirabilis
- S. epidermidis
- SARS-CoV-2

SARS-CoV-2 aerosol transmission in schools: the effectiveness of different interventions

Jennifer Villers^{a*}, Andre Henriques^{b*}, Serafina Calarco^c, Markus Rognlien^d, Nicolas Mounet^b, James Devine^b, Gabriella Azzopardi^b, Philip Elson^b, Marco Andreini^b, Nicola Tarocco^b, Claudia Vassella^e, Olivia Keiser^f

(a)



Evaluation of a Commercial Air Filter for Removal of Viruses from the Air

P. ROELANTS, B. BOON, AND W. LHOEST

Recherche et Industrie Thérapeutiques, R.I.T., Rixensart, Belgium

Received for publication 14 June 1968

The effectiveness of a commercial absolute air filter for removal of viruses from air was tested with an actinophage, under the usual conditions of a laminar airflow clean room. A new method of dry phage dispersion is described. The filter showed an average reduction of 99.996% of airborne actinophage.

@CarlvKeirsbilck

micron infective and antigenic material. Electrostatic or high efficiency particulate air (HEPA) filters are recommended for home use. The HEPA filtration of all fresh air will protect against effects of air pollution and pollen induced bronchospasm. The HEPA filtration of all recirculated air is the epidemiological key to halting aerosol transmission of viral induced infection, allergy, and asthma among human hosts sharing a closed environment. The use of HEPA filters in buses, trains, airplanes, and automobiles is suggested.

1972

Air Pollution Abstracts, Volume 4, Nrs 7-12. Environmental Protection Agency (US). Air Pollution Control Office.

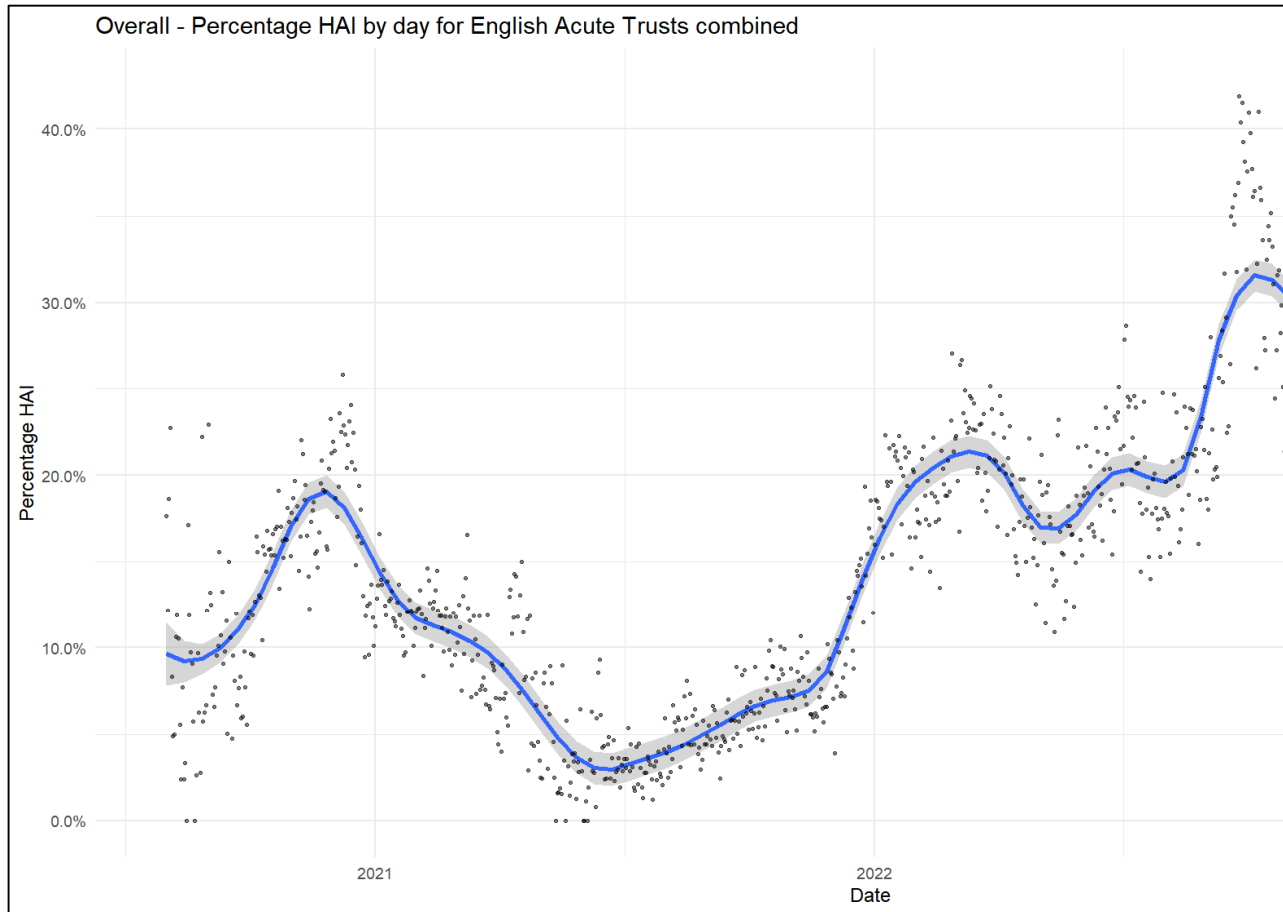
AIR POLLUTION ABSTRACTS, NOVEMBER 1973

The photochemical smog episode of the Moriguchi Junior High School in October 1973 was investigated by student groups.

A lack of mitigations in healthcare settings...



UNIVERSITY OF LEEDS



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Shropshire NHS trust criticised for no Covid testing letter

11 October

Coronavirus



Impact on health care access

(Source: Clinically Vulnerable Families, Survey Oct 2022)

A donut chart with a light blue outer ring and a dark purple inner ring. The inner ring is mostly filled, with a small dark purple segment missing at the top. The number '91%' is written in large white font across the center of the chart.

91%

**of Clinically Vulnerable people
have or would **delay / cancel**
medical appointments due to
high Covid risks.**

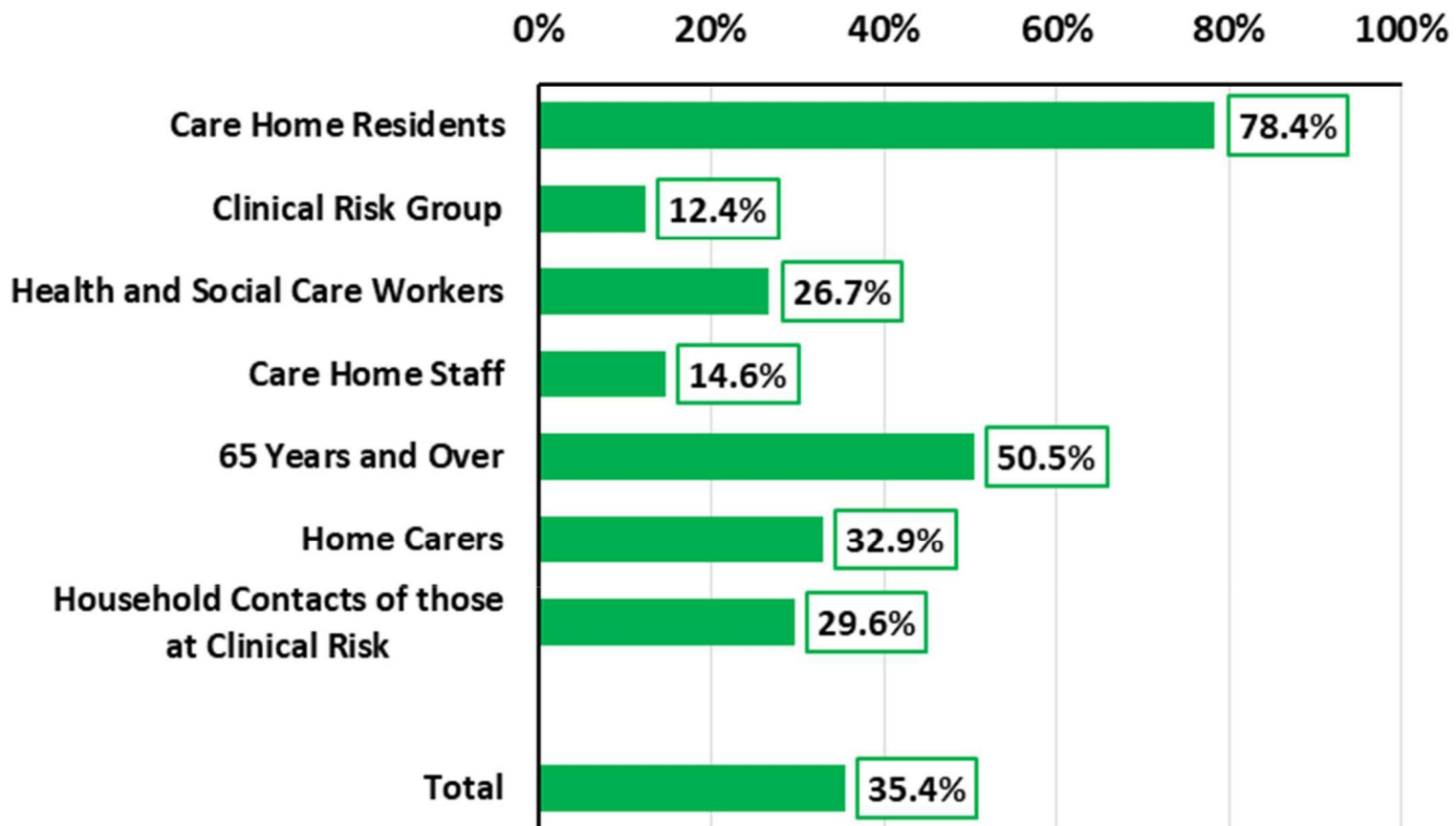
[Poll of 450 Clinically
Vulnerable people
October 2022]

**Clinically
Vulnerable
Families**



Autumn 2023 Vaccine Coverage of Eligible Cohorts Wales: 9 Nov 2023

(Source: Wales Weekly Covid Vaccination Surveillance Report)



Wales: Autumn 2023 Estimated Coverage

09-Nov

<https://www2.nphs.wales.nhs.uk/CommunitySurveillanceDocs.nsf>

Thanks to Bob Hawkins for the slide

Summary – We must vaccinate children and mitigate risks



- The pandemic may continue for years, ignoring this fact has an ongoing human cost
- Children remain a major source of transmission, but also are themselves vulnerable to COVID
- We cannot predict SARS-CoV2 evolution...pi???
- The highest risk from acute infection is usually (not always) the first
- Under 5's are exposed to a lesser extent compared to primary & secondary pupils
- Vaccines are safe and effective at the population level
- Vaccines protect against long COVID, sequelae?
- Future vaccines may
 - Provide pan-variant protection
 - Be better at preventing transmission

Thank you...



Prof Christina Pagel



Dr Kit Yates



Sammie McFarland



Nathalie Pearson



James Neill

Bob Hawkins

LONG COVID KIDS

- Created by parents and professionals whose children are living with Long Covid the Support Guide is a comprehensive pack containing evidence-based resources and information for parents, families, children, young people, school staff, education, health and social care professionals.
- Free to download from www.longcovidkids.org
- Available to buy in our online shop

