PROTECT
A COVID-19 National Core Study

The COVID-19 Infection Survey

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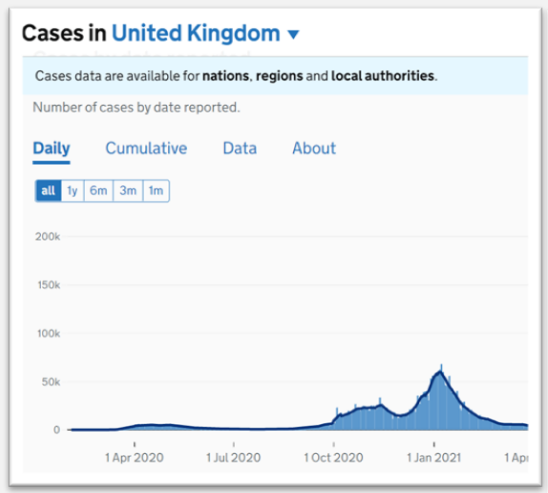
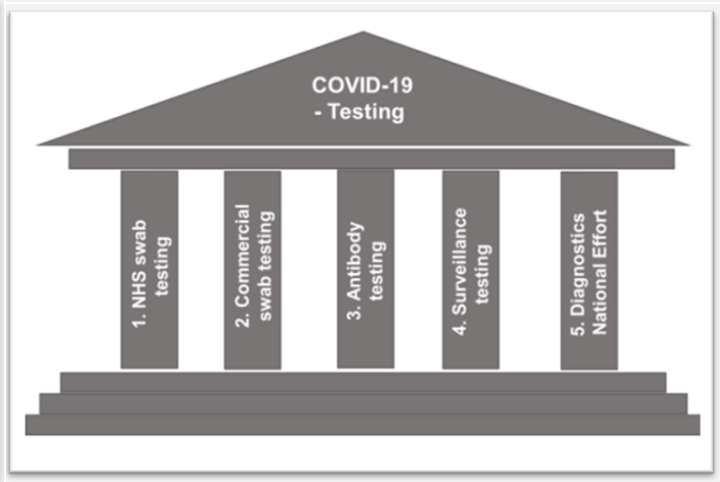
Office for National Statistics

Set up for timely, unbiased insight

- The current extent of both **symptomatic** and **asymptomatic** infection and transmission of COVID-19 in the UK needed to be tracked
- A large-scale community-based survey was commissioned
- The survey was set up in <10 days
- Field work started in England on 26th April 2020
- Since expanded to include whole UK

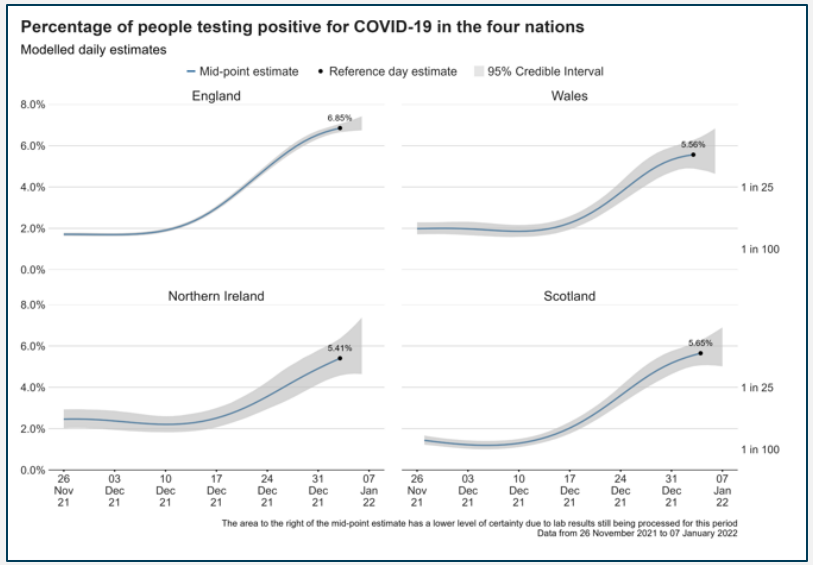




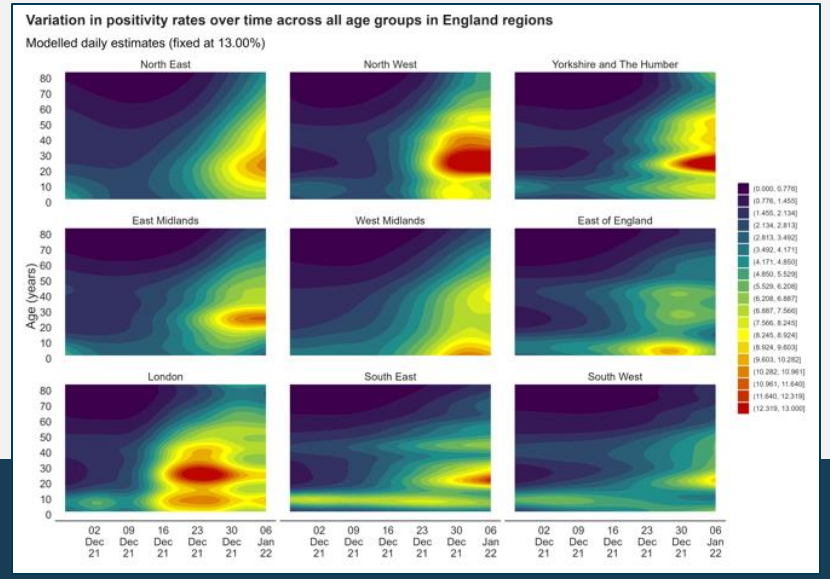
What data do we collect?

- **Prevalence and Incidence (Swab survey):**
  - People aged 2+ living in private households in England, Wales, Northern Ireland and Scotland
  - Participants are tested with PCR tests each week for the five weeks and then every month thereafter
- **Antibody survey**:
  - People aged 16+ living in private households. Recently expanded to those 8+
  - A smaller sample of participants are also selected for blood tests for COVID antibodies

Positivity by country

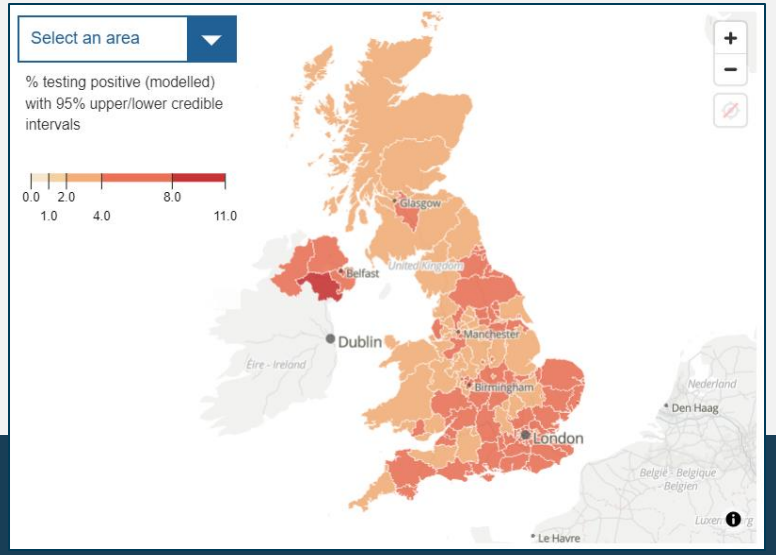


Positivity by age



Monitoring
Community
Prevalence

Regional and Subregional positivity



Incidence

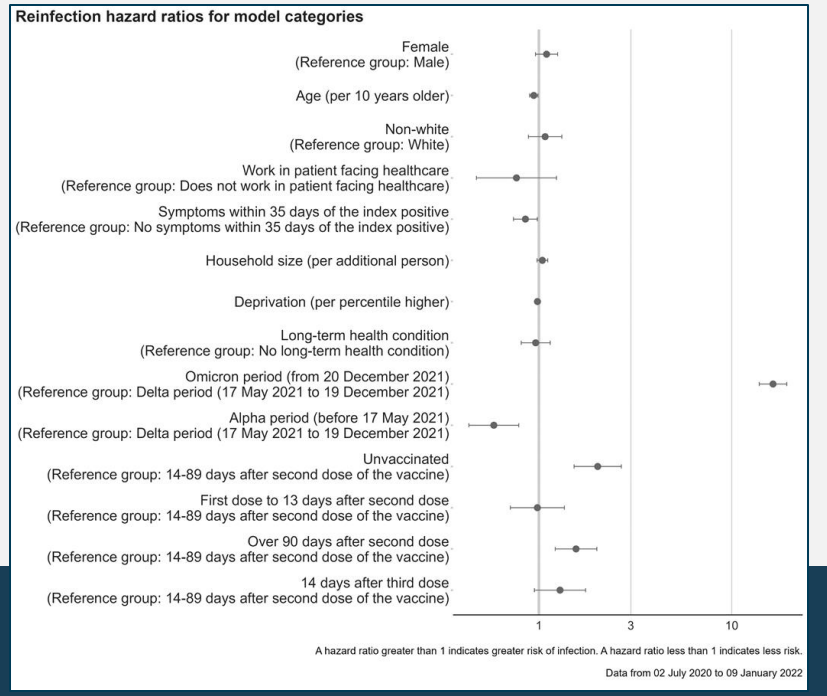
Table 2: Official estimates of incidence, UK countries

Estimated coronavirus (COVID-19) incidence rate per 10,000 people per day, based on nose and throat swabs, UK, 23 to 29 January 2022

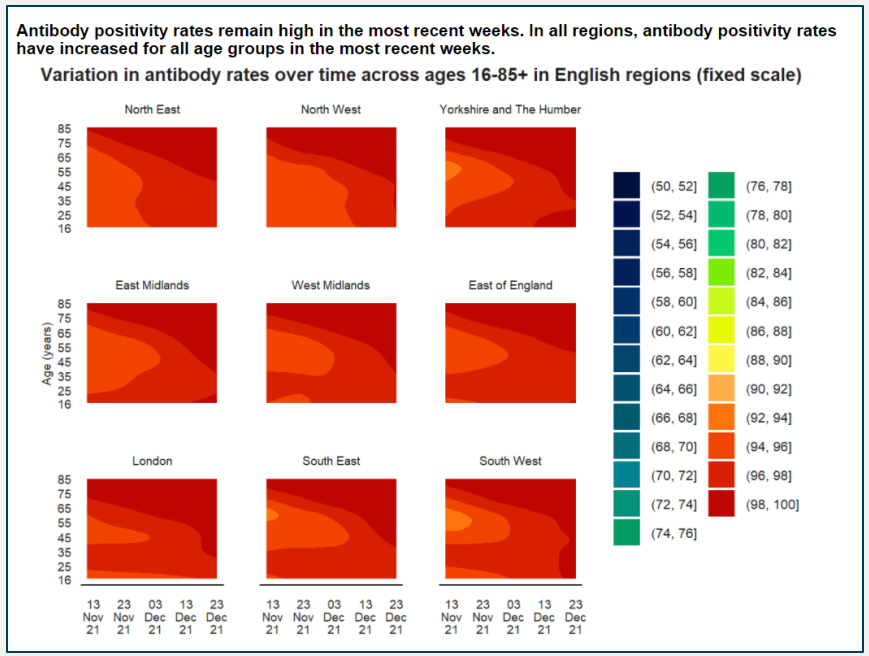
Country	Estimated COVID-19 incidence rate per 10,000 people per day	95% Lower credible interval	95% Upper credible interval
England	56.0	53.1	58.9
Wales	48.3	39.5	59.3
Northern Ireland	87.5	74.0	103.4
Scotland	40.2	33.0	47.9

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

Reinfections

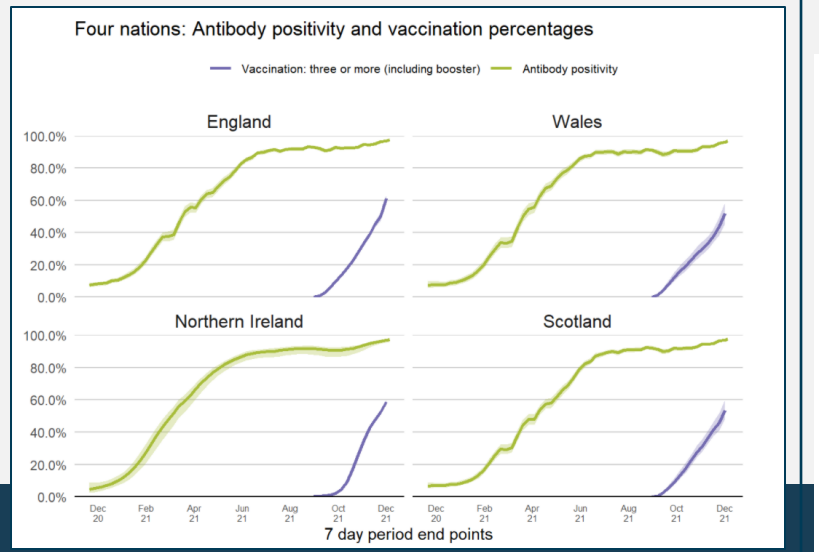


Monitoring antibody positivity

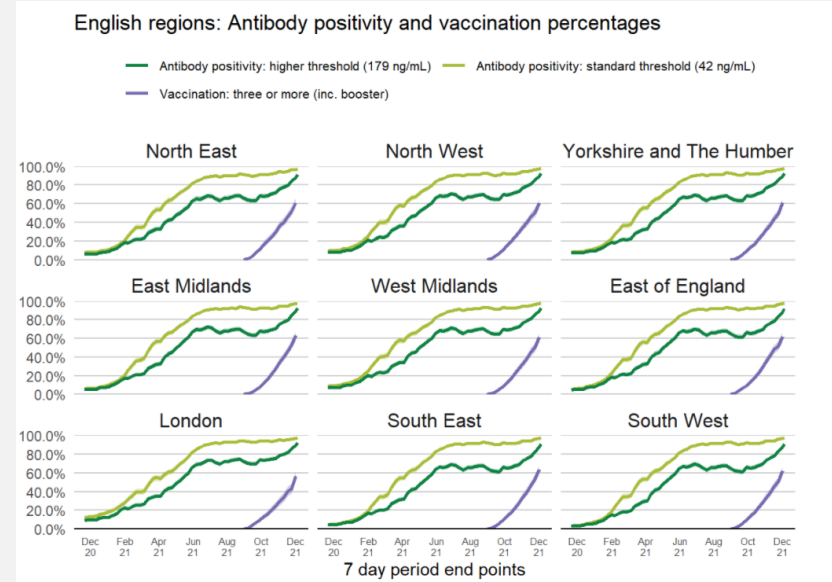


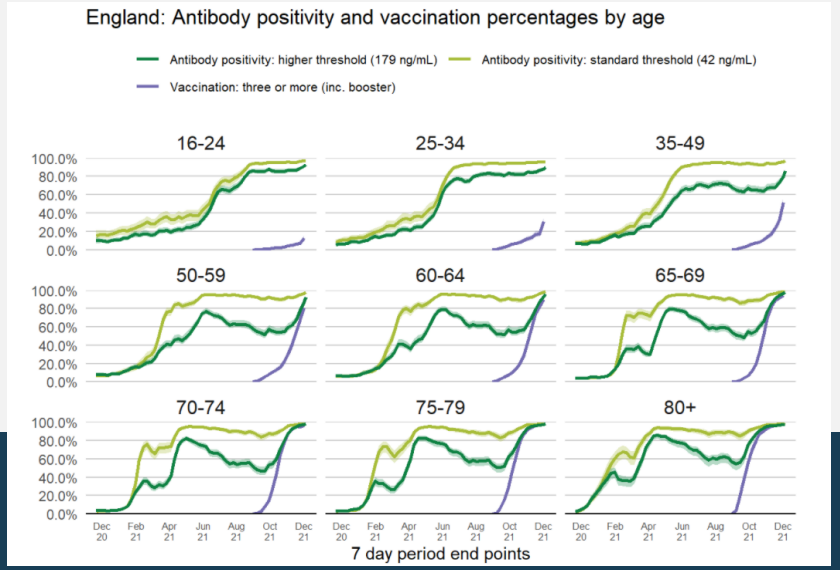
Antibodies, immunity and protection

Monitoring booster take up



Strong protection antibody thresholds





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New variants

December 2020 – Alpha

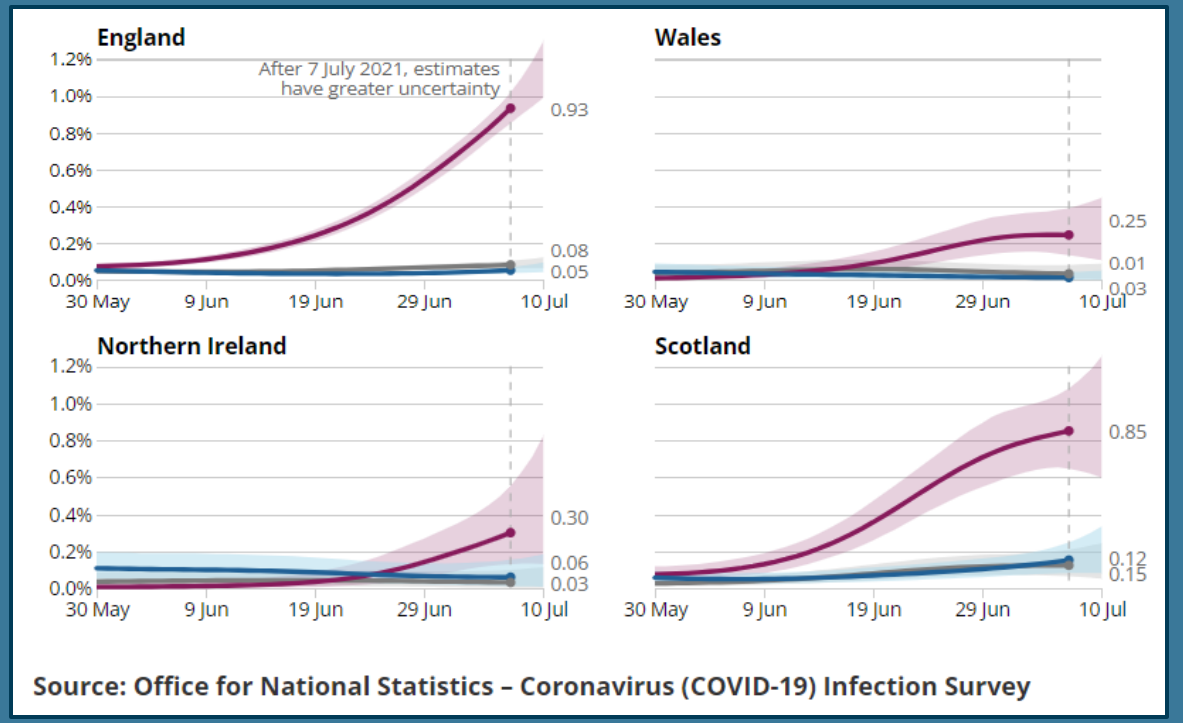
- Demonstrating the rise over the last weeks of December and into the New Year.

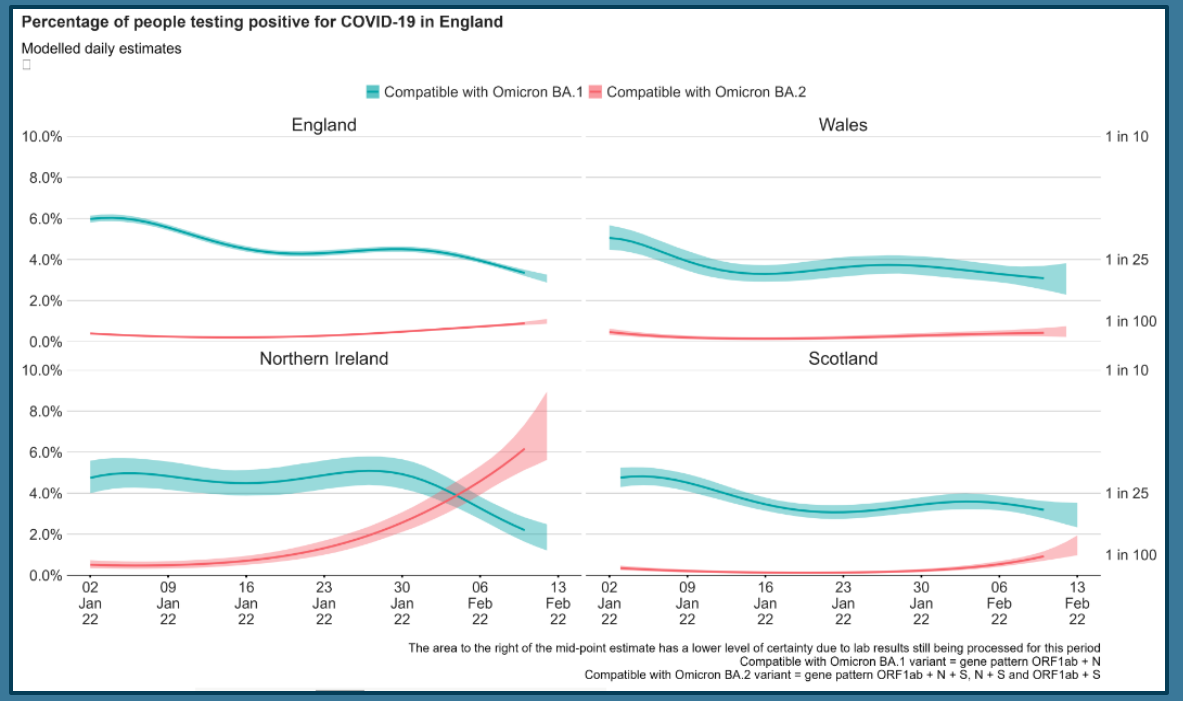
May 2021 – Delta

- Speed of domination across the UK

November/ December 2021 – Omicron

- Monitoring as it becomes dominant across the UK
- All positives are sequenced





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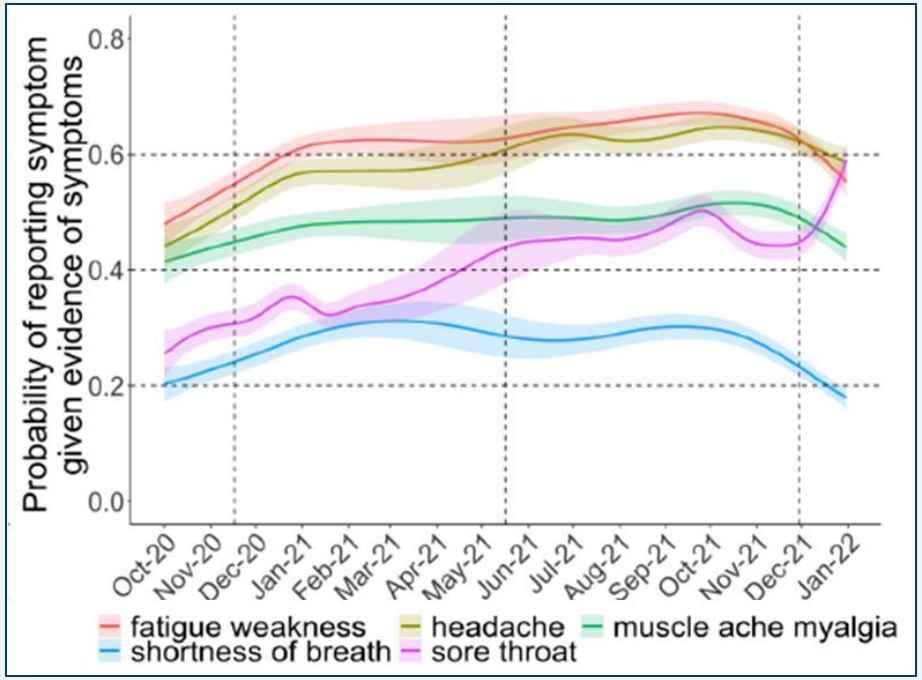
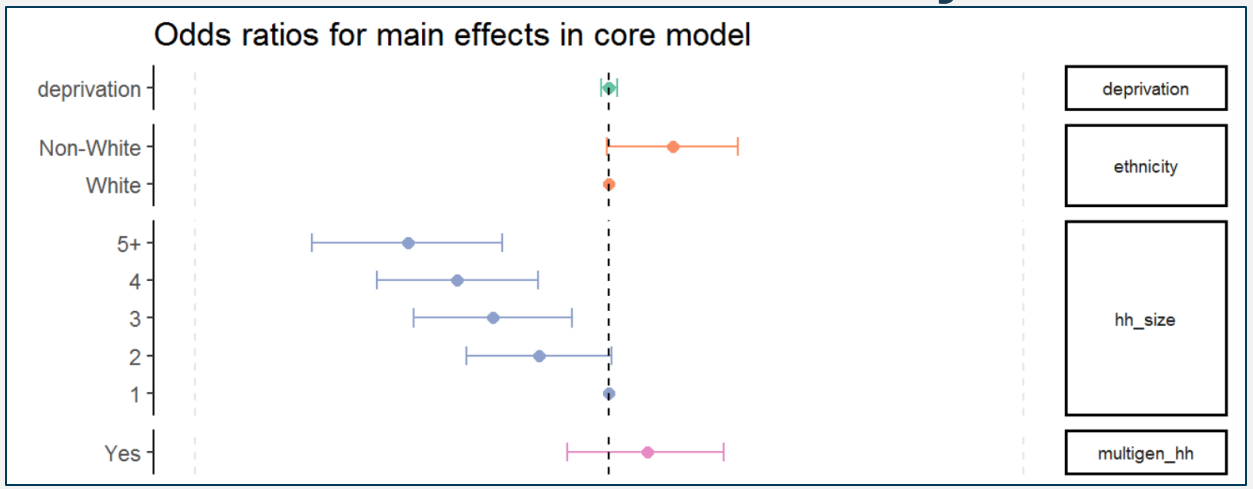
Bespoke Analysis

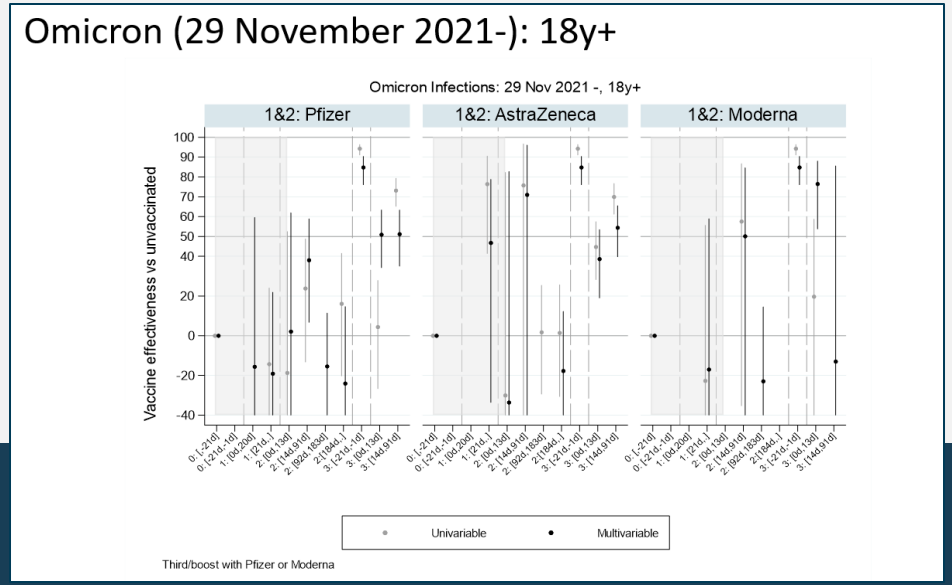
Symptoms of Omicron



Predictors of Positivity



Calculating VE for Omicron



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Predictors of Positivity

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Why have we developed this model?

1. To identify associations with current positivity at the individual level and in real-time, while controlling for other key characteristics.

2. To identify relationships between certain behaviours and positivity at the individual level.

3. To understand how the effects of different characteristics have changed over time.

What is the model?

- Specification:
  - Multiple logistic regression.
  - Based on 14-day periods.
  - Person level analysis with one case per participant.
  - UK population including all ages.

ELSEVIER

The Lancet Regional Health - Europe
Volume 13, February 2022, 100282

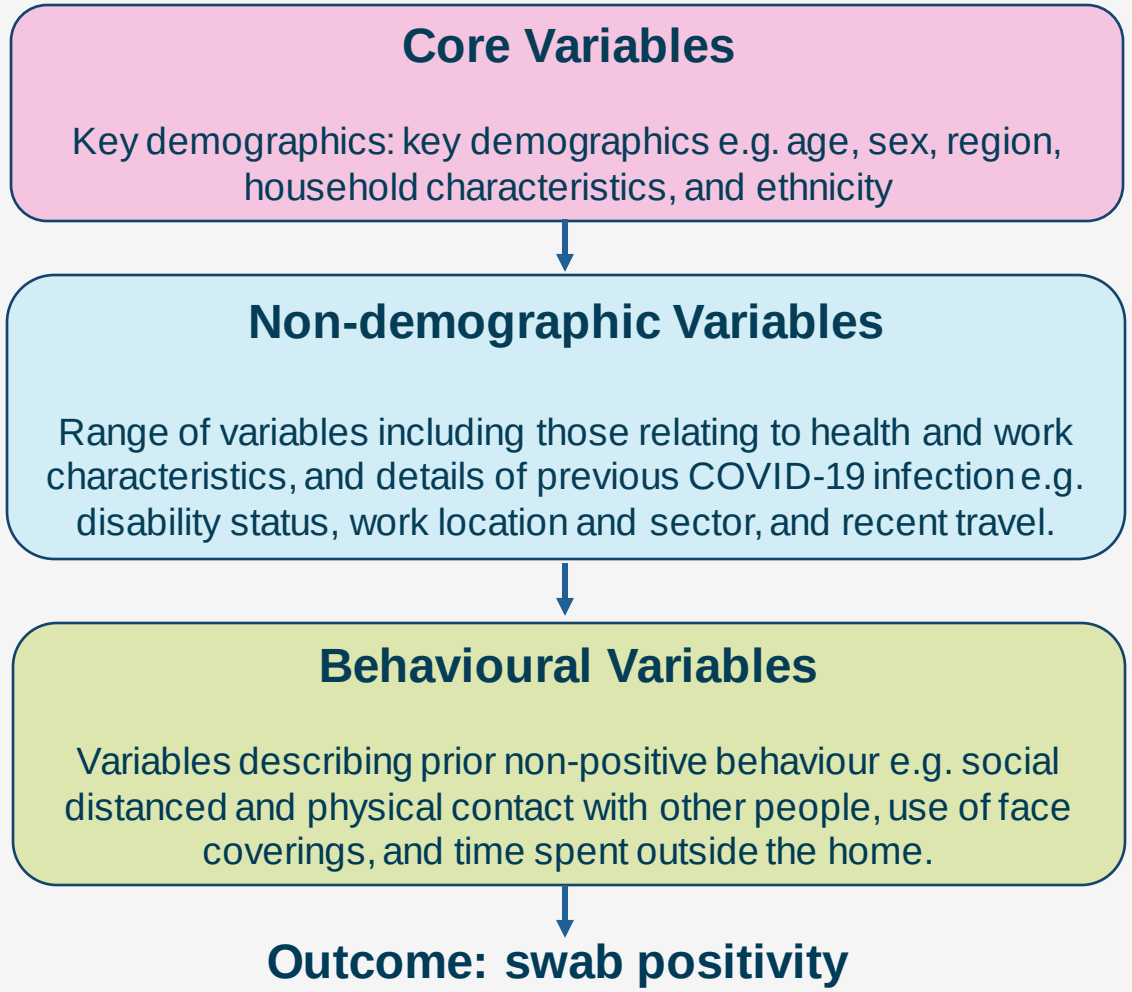
Articles

Monitoring populations at increased risk for SARS-CoV-2 infection in the community using population-level demographic and behavioural surveillance

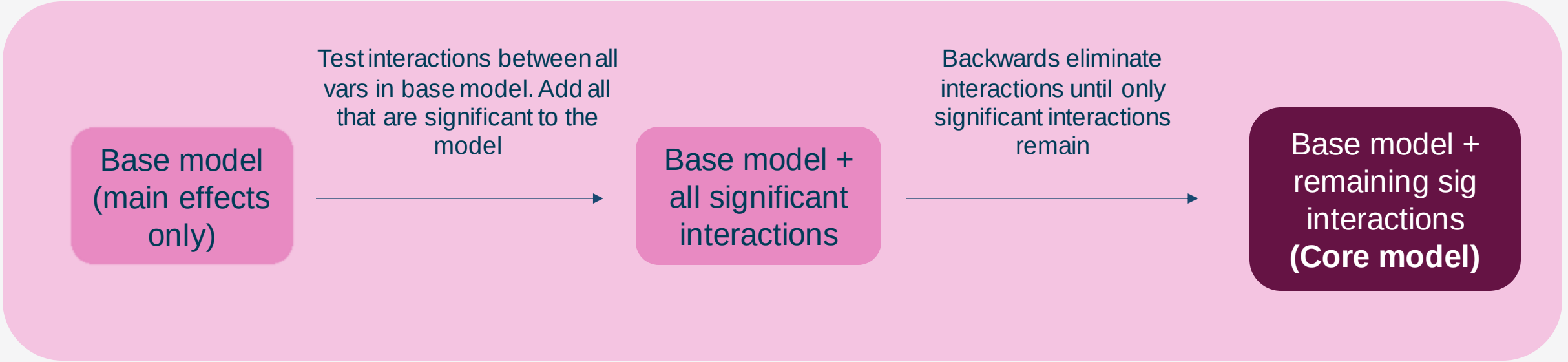
Emma Pritchard [a, b], Joel Jones [c], Karina-Doris Vihta [a, d], Nicole Stoesser [a, b, e, f], Prof Philippa C. Matthews [b, e, f], David W. Eyre [a, d, f, g], Thomas House [h, i], John I Bell [j], Prof John N Newton [k], Jeremy Farrar [l], Prof Derrick Crook [a, b, e, f], Susan Hopkins [a, m, n], Duncan Cook [c], Emma Rourke [c], Ruth Studley [c], Prof Ian Diamond [c], Prof Tim Peto [a, b, e, f], Koen B. Pouwels [a, o] … Prof A. Sarah Walker [a, b, e, p]

Variables and causal pathways

- Variables arranged into three groups based on a theoretical hierarchy of causality, articulated using directed acyclic graphs.
- Behavioural variables reflect prior non-positive behaviour only
  - Model uses the maximum reported behaviour in the 45 days prior to the visit and excludes participants without a negative swab test in the 10-45 days before their test.
  - This reduces reverse causality whereby a person changes their behaviour because they know or suspect they have COVID-19.



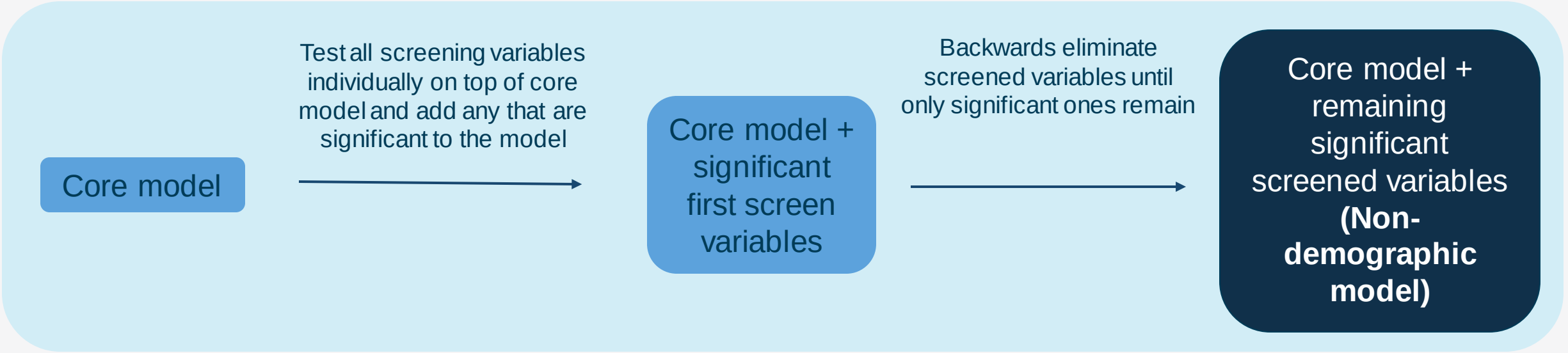
Step 1: Create the core model



Notes:

- Variables used at this stage are: age, region, sex, deprivation, urban/rural classification, multigenerational household, ethnicity, and household size.
- Threshold used for interaction significance is $p < 0.001$.
- Base model specification:
  - glm(formula = ever_positive ~ ns(age, knots = age_knots, Boundary.knots = age_boundary_knots) + region + sex + ethnicity + deprivation + hh_size + multigen_hh + urban_rural_class,
    family = "binomial",
    data = last_fort)

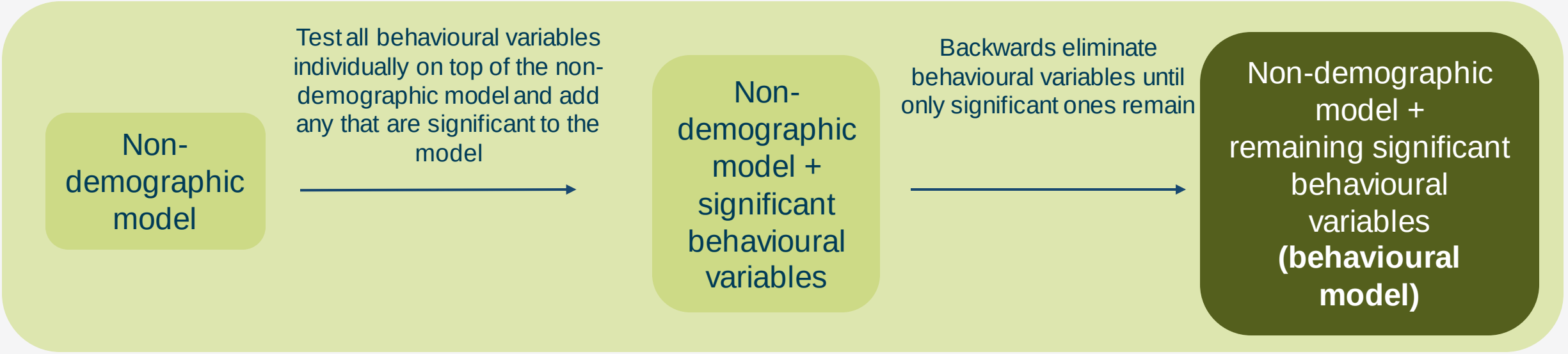
Step 2: Create the non-demographic model



Notes:

- Work status is also added to all models run at this stage, as a control.
- Threshold used for screening significance is $p<0.05$.
- When using backwards elimination, any collinear terms are also removed.

Step 3: Create the behavioural model



Notes:

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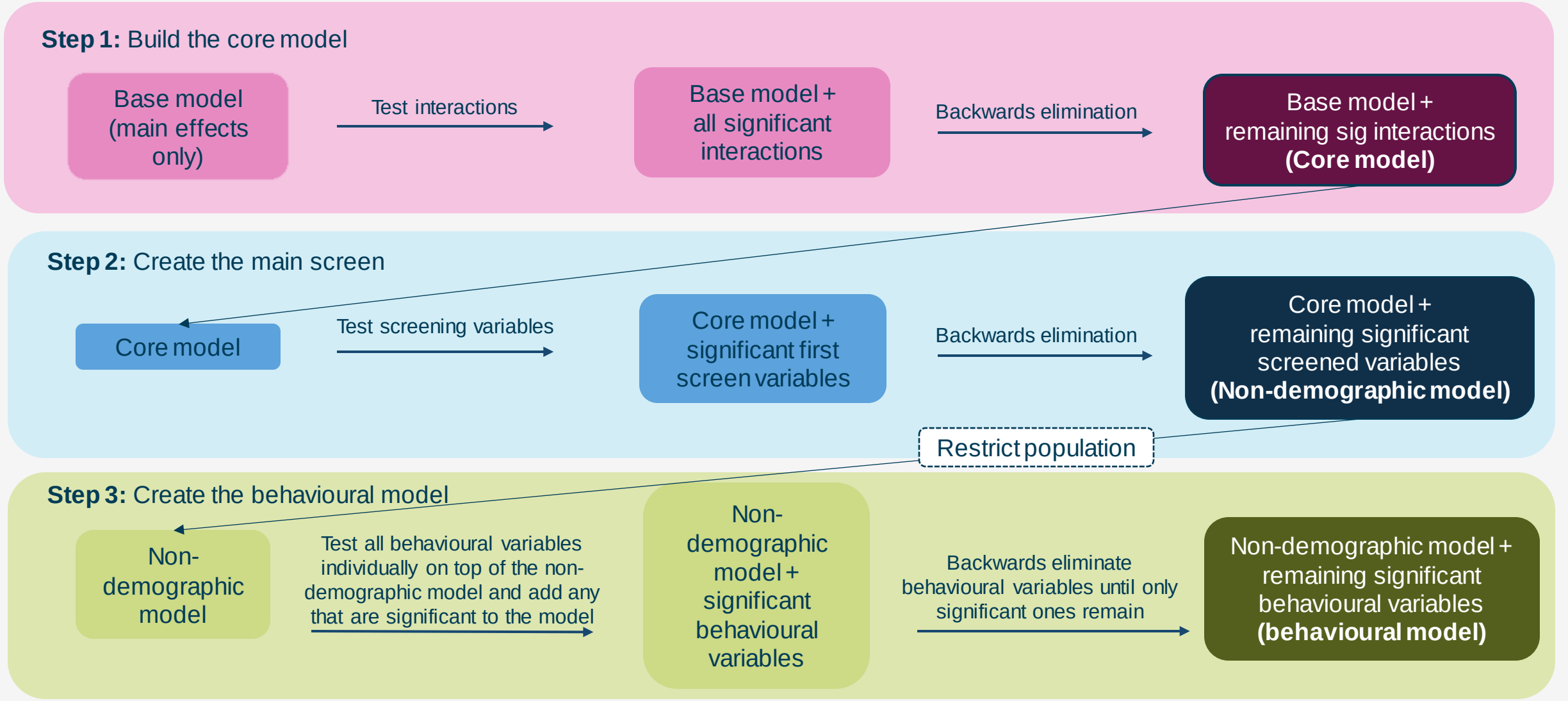
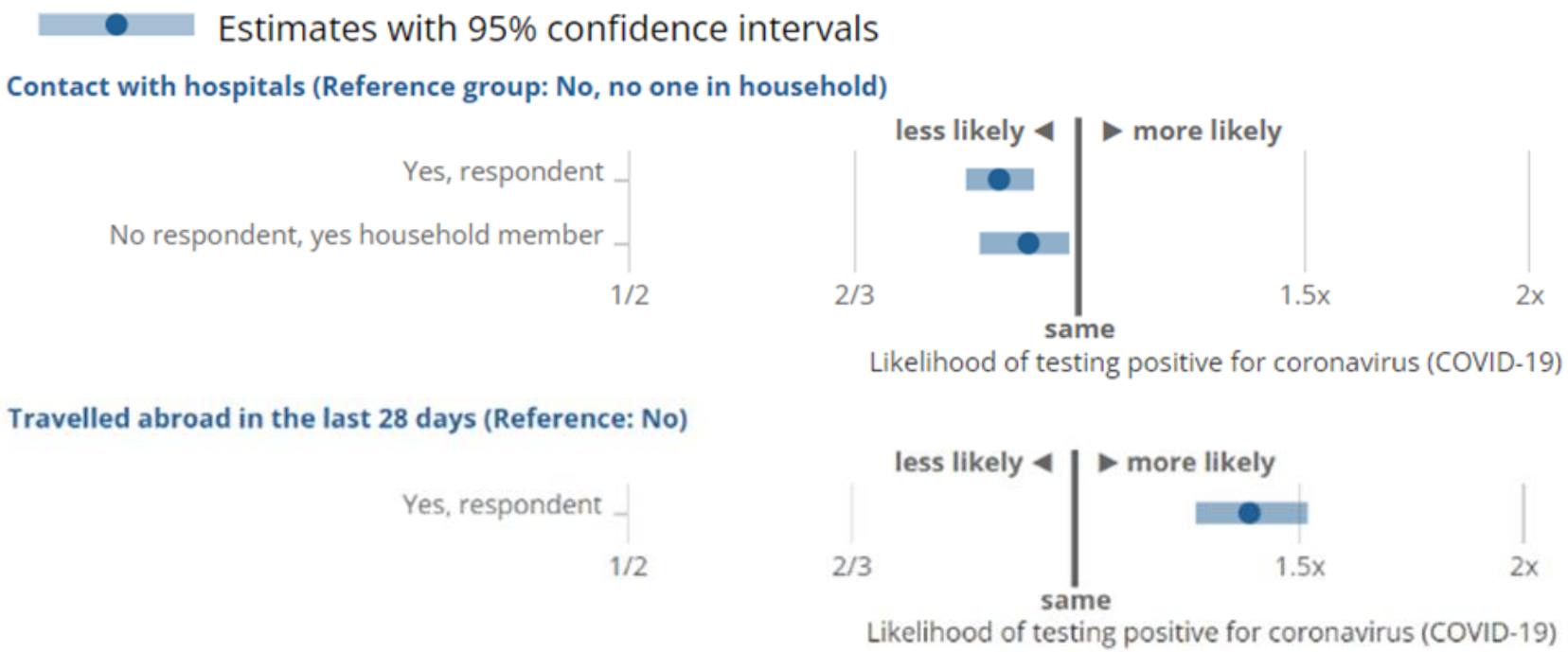

Step 1: Build the core model
Base model (main effects only)
Test interactions
Base model + all significant interactions
Backwards elimination
Base model + remaining sig interactions (Core model)
Step 2: Create the main screen
Core model
Test screening variables
Core model + significant first screen variables
Backwards elimination
Core model + remaining significant screened variables (Non-demographic model)
Restrict population
Step 3: Create the behavioural model
Non-demographic model
Test all behavioural variables individually on top of the non-demographic model and add any that are significant to the model
Non-demographic model + significant behavioural variables
Backwards eliminate behavioural variables until only significant ones remain
Non-demographic model + remaining significant behavioural variables (behavioural model)

A note on odds ratios

Estimated likelihood of testing positive for coronavirus on nose and throat swabs by work and living arrangements, UK, 27 February to 12 March 2022



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

Historical results

- We can also track our fortnightly results over time to identify trends – these are not published plots, but the underlying data may be found on the ONS website.

- We use this to compare changes in likelihood of testing positive against our latest positivity data and identify patterns that we might like to take a closer look at.

How to interpret these plots

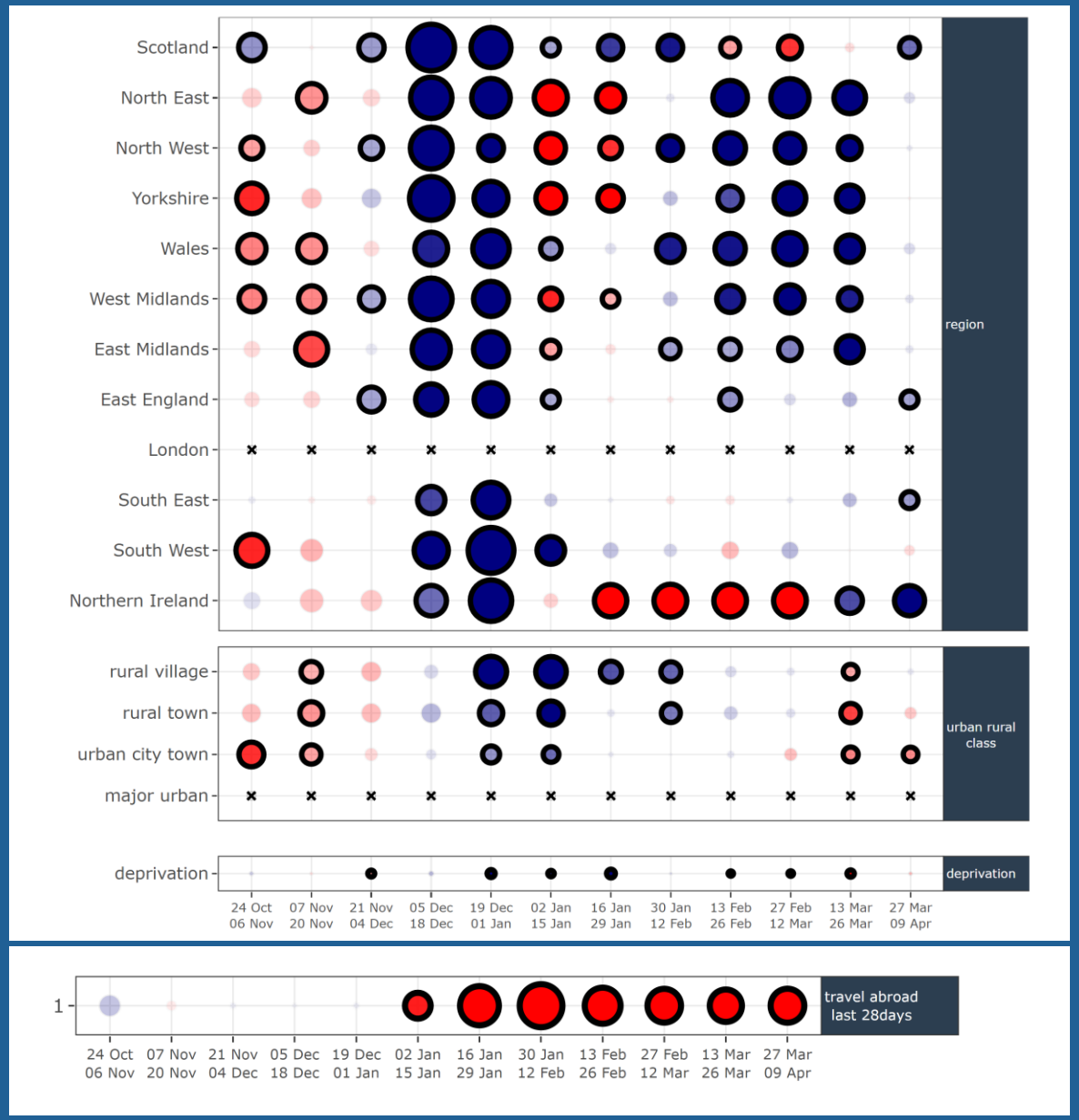
The size of the bubble represents the magnitude of the effect: **Bigger bubbles = Larger effects**

The colour of the bubble represents the direction of the effect:

Red = Positive (**more** likely to test positive)

Blue = Negative (**less** likely to test positive)

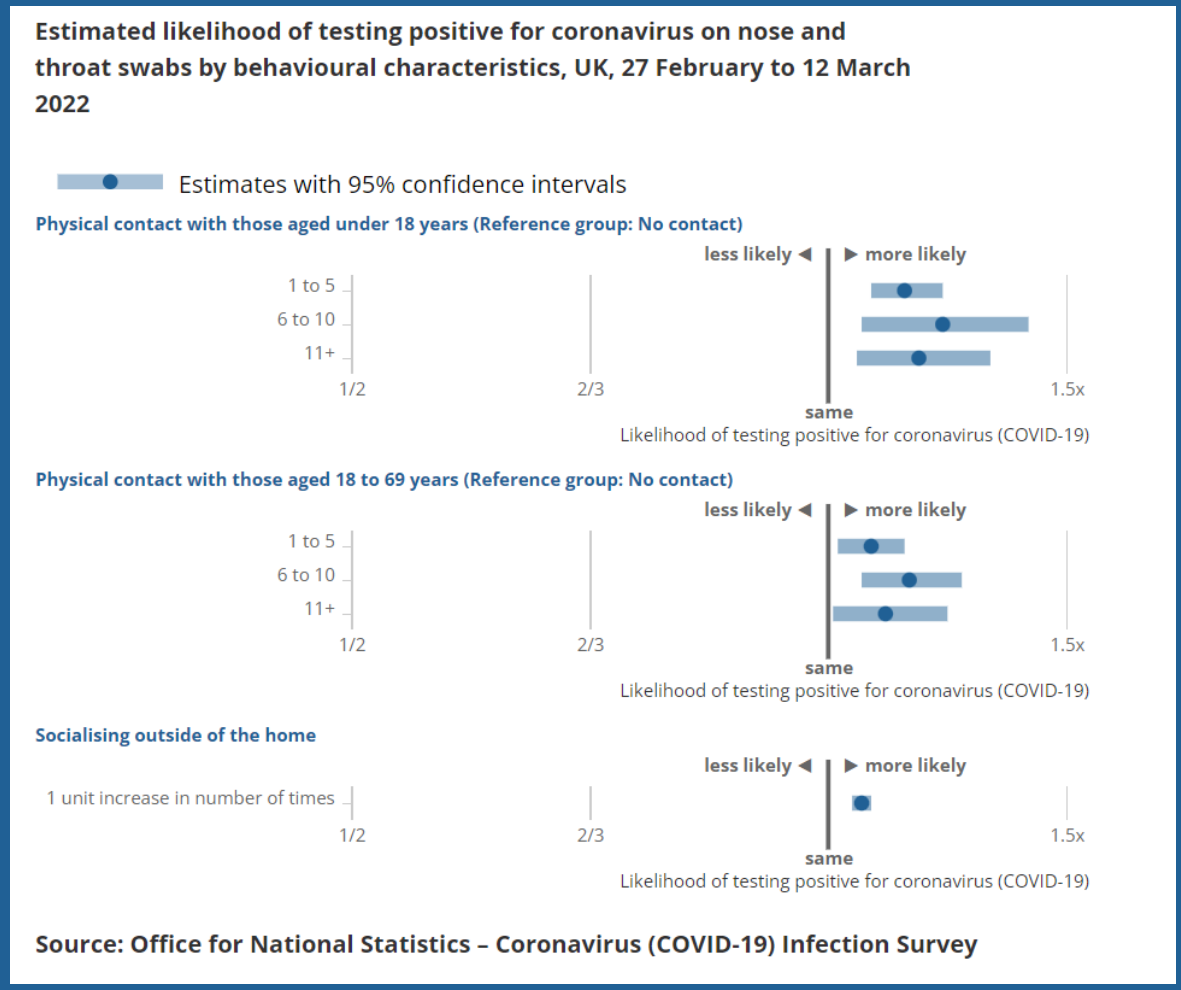
The strength of the colour represents significance: **Darker colours = More significant**



Behaviours

More likely to test positive include:

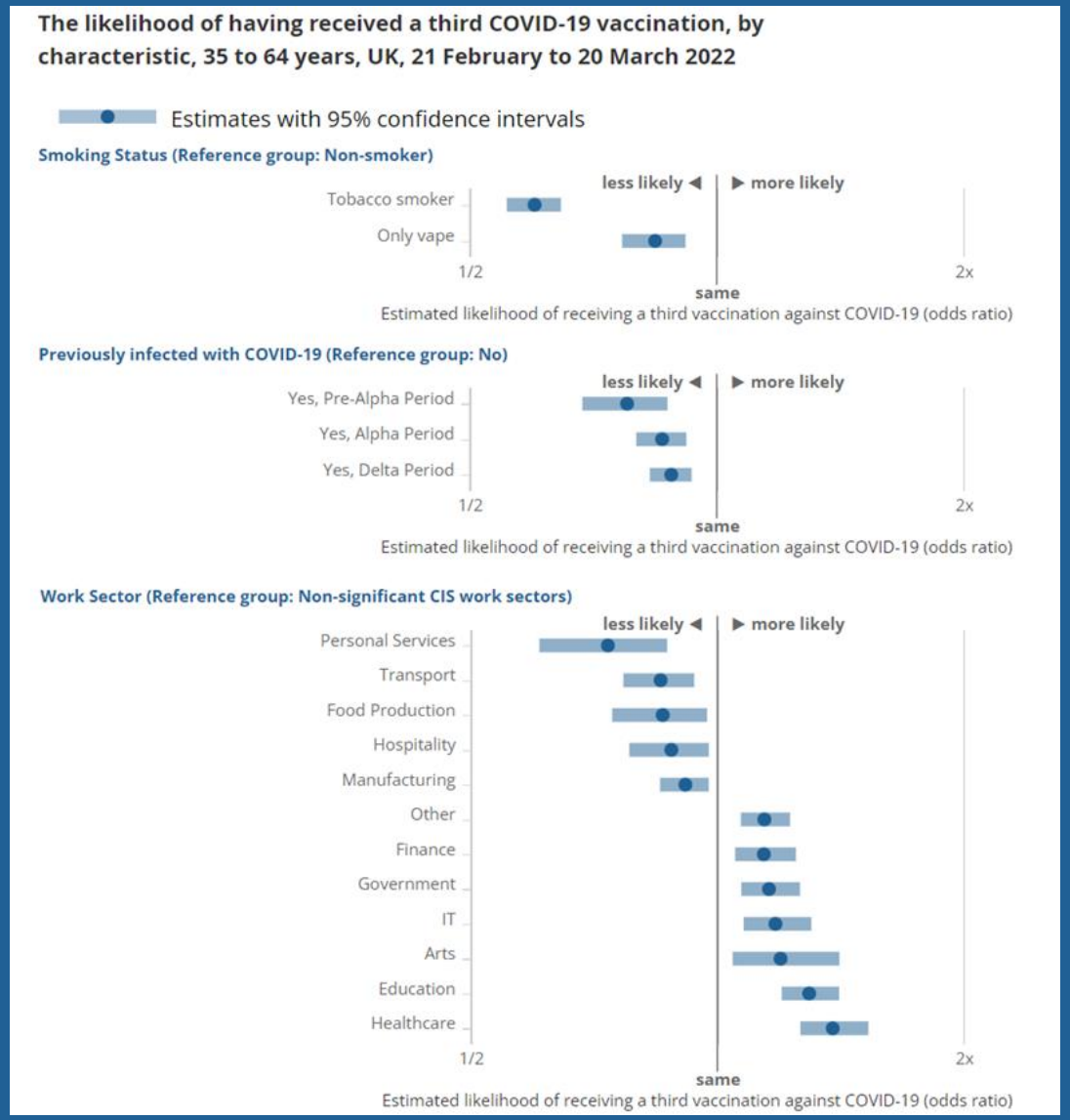
- Those reporting one or more physical contacts under the age of 18 years.
- Those reporting one or more physical contacts with 18-69-year-olds.
- Those who spent more time socialising outside their home.



Other iterations

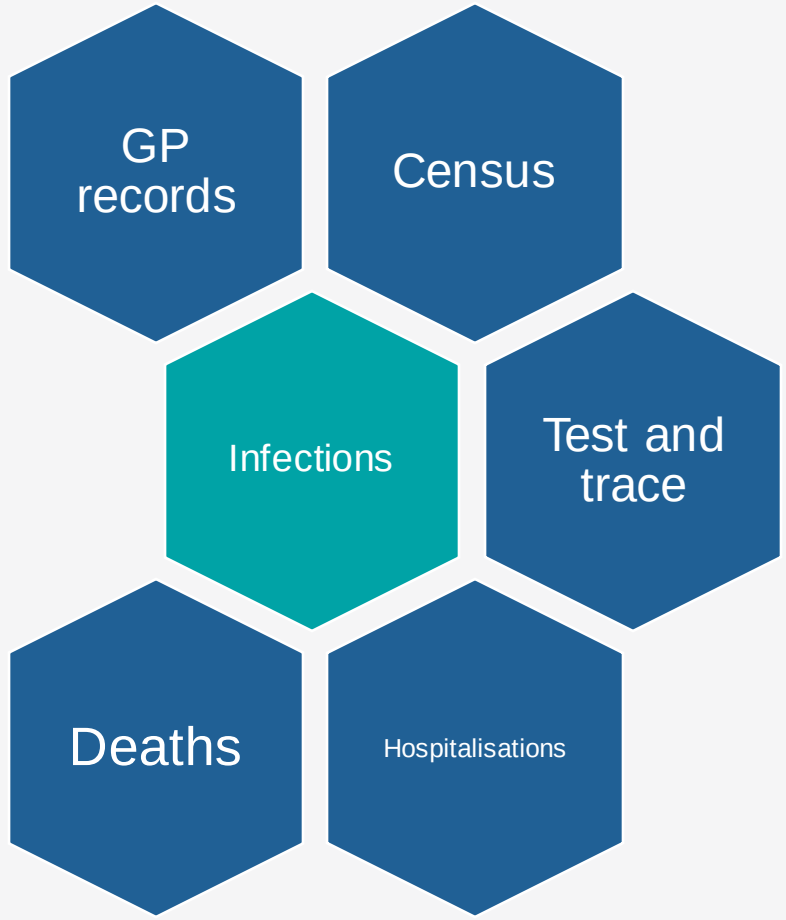
The approach used in this model has also been adapted to consider:

- Characteristics associated with first vaccination uptake.
- Characteristics associated with third vaccination update, among those eligible.
- Characteristics associated with testing positive for one COVID-19 variant compared to another.



The future

- Predictors of positivity is an example of a flexible model we can continue to adapt to respond to policy needs.
- As the approach to managing the pandemic adapts to the changing situation, so will the CIS.
- The survey design is moving to an innovative digital approach, ensuring value for money. We are also considering other efficiencies.
- We have an ambitious programme of future work, including:
  - Estimating population groups who has ever, or never, had Covid
  - Understanding duration of infection, redefining reinfection and revisiting vaccine effectiveness as a result of Omicron
  - Exploiting data linkage such as to Census 2021



Questions?

Contact us: infection.survey.analysis@ons.gov.uk