

Models for Vulnerable Settings: Hazard Assessment, Analysis and Planning

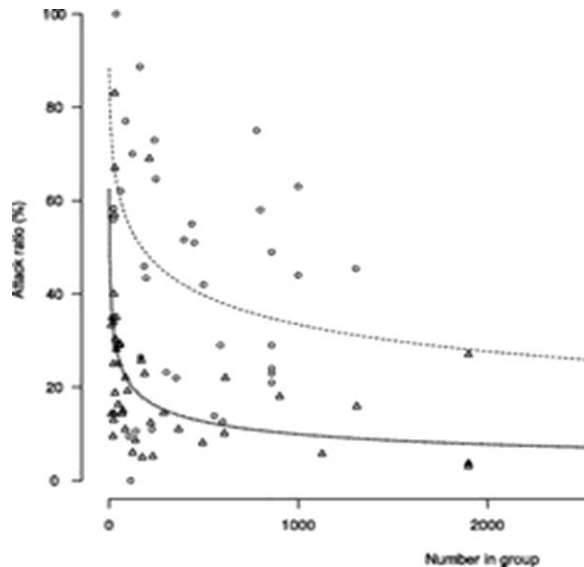
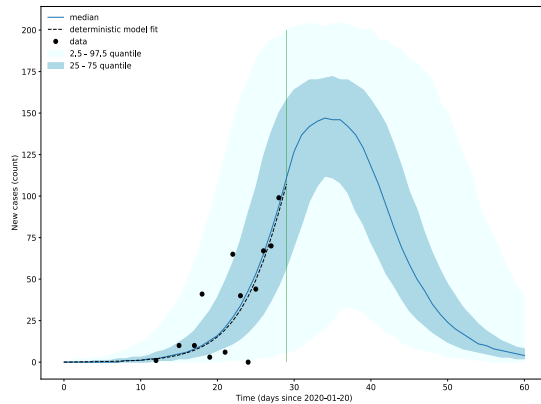
Ian Hall

Dept. of Mathematics, UK Health Security Agency,
PROTECT and JUNIPER

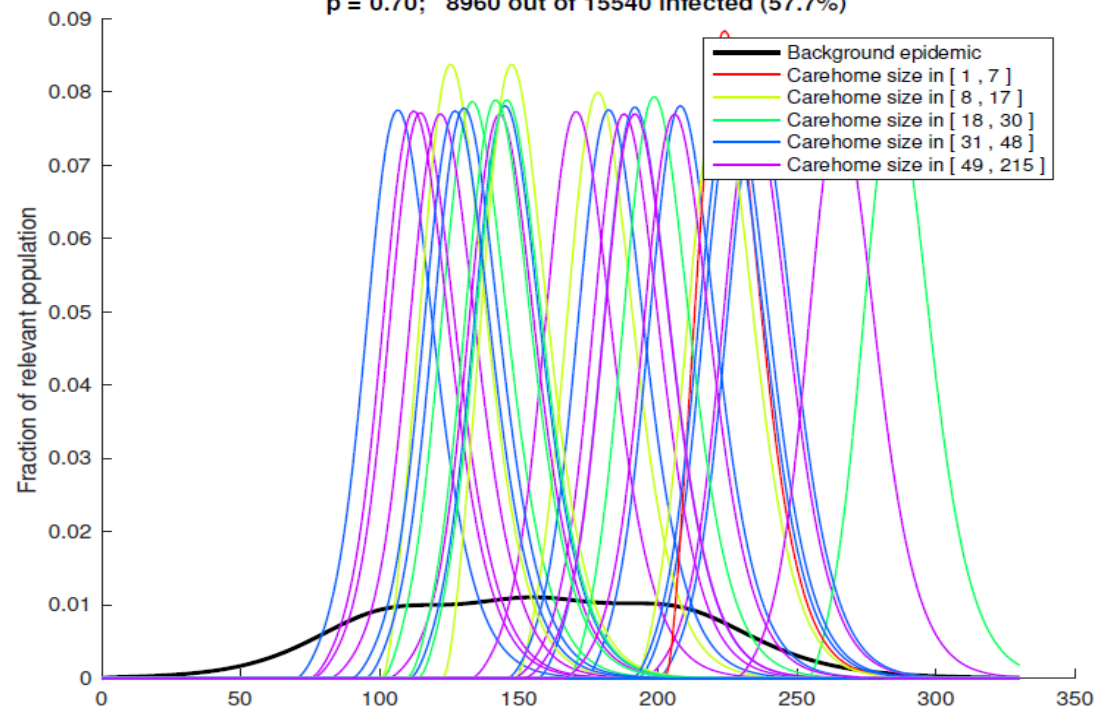
June 2022

Enclosed Societies

Pre-pandemic and early pandemic work

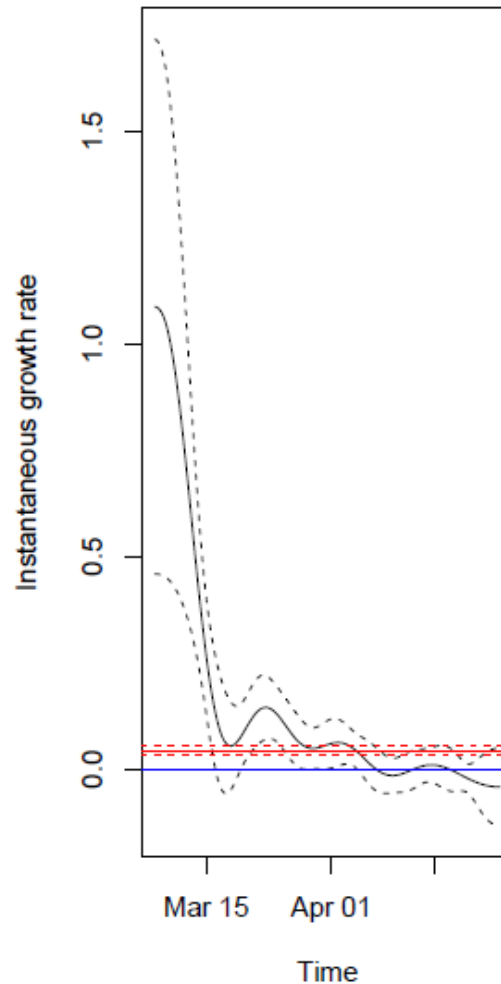
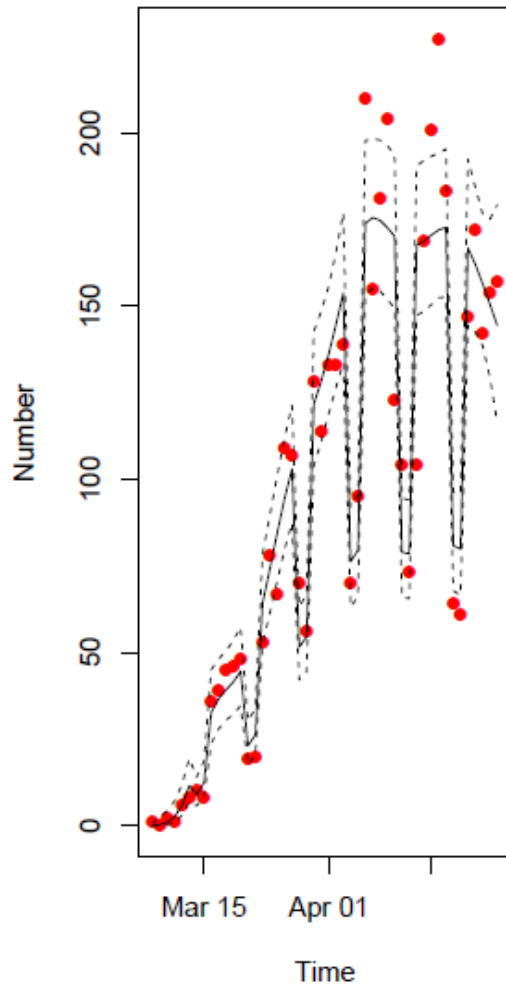


Background ($R_0 = 1.50$) and 50 random carehomes ($R_C = 3.00$) epidemics
 $p = 0.70$; 8960 out of 15540 infected (57.7%)



Effect of "cocooning" on numbers in hospitals and deaths (457271 vulnerable people)
 (reducing risk of introduction in carehomes)

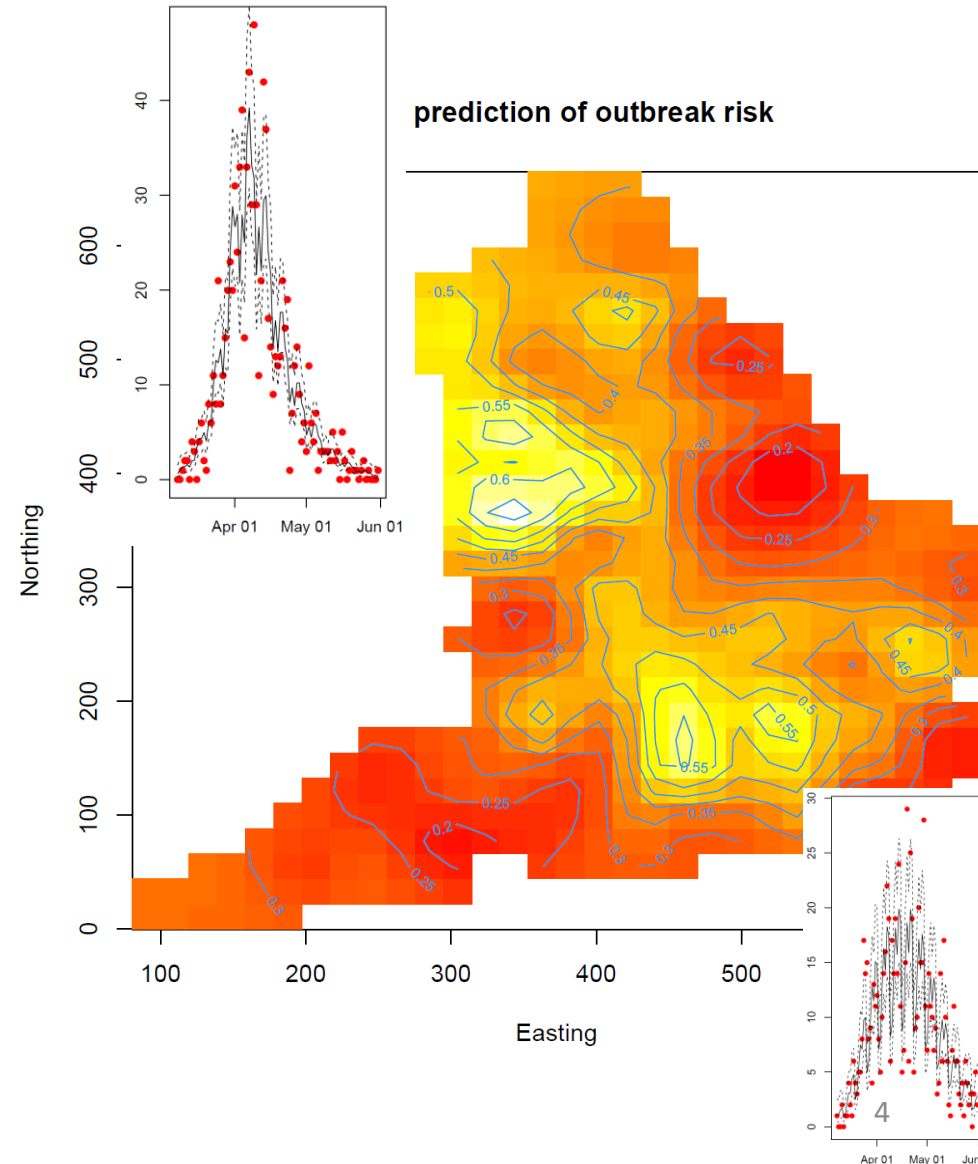
Reported outbreaks over time



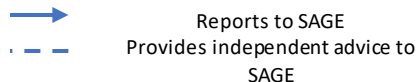
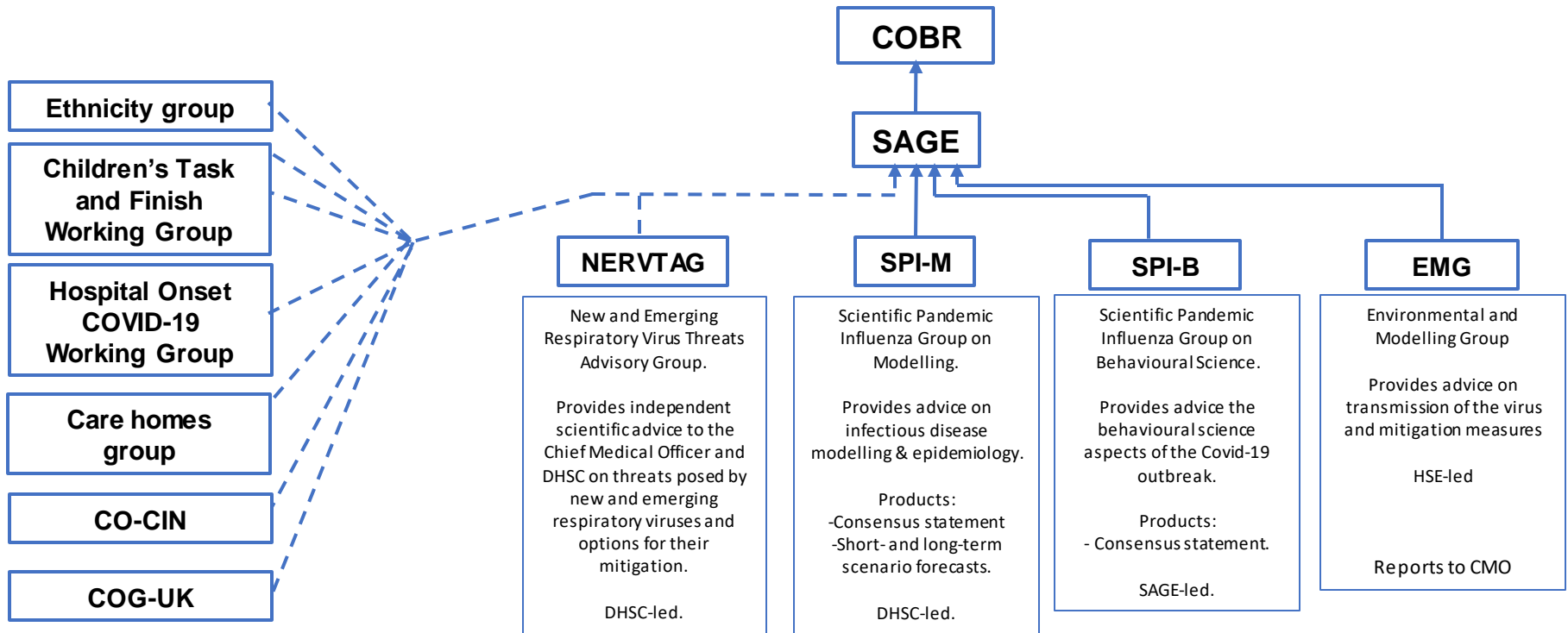
- There are $N=15517$ care homes in England
- Steady state of 190 outbreaks per day possible.
- With a 5 day generation time and 4 generations of disease and 14 day observation then...
- $P=0.41$

Methods/Results - Spatial distribution

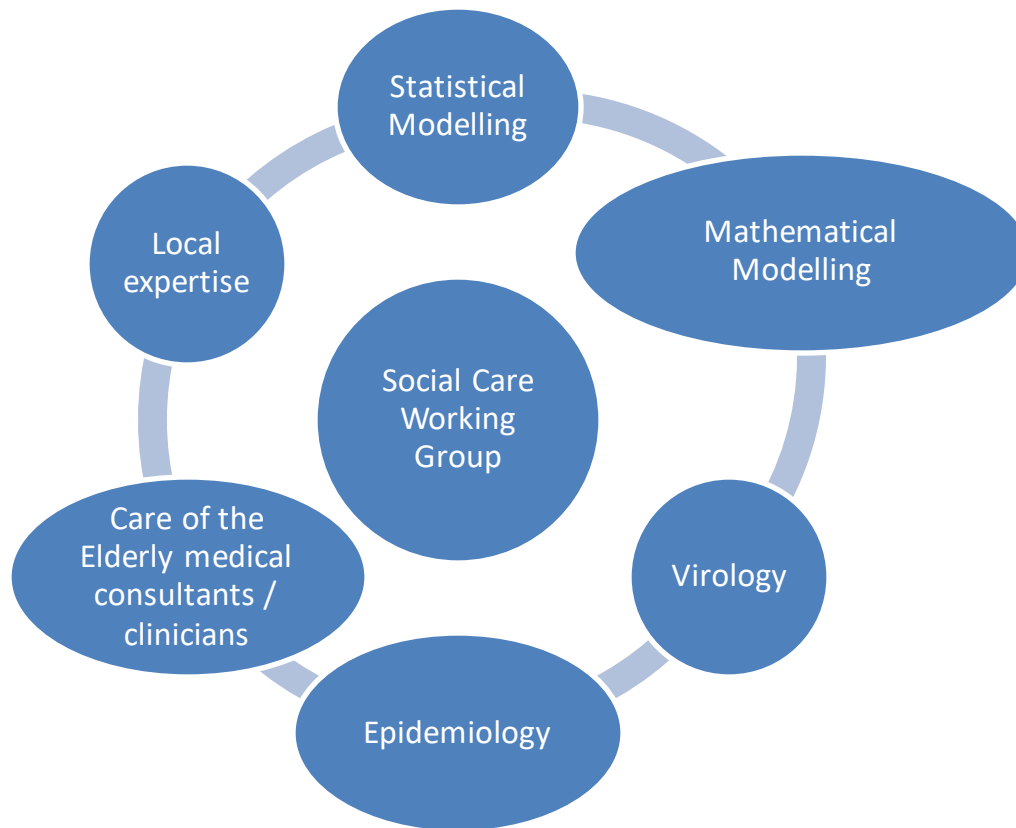
- Presence/absence of outbreaks
- Aims to support decision making of DPHs
 - Should they test care homes near current outbreaks
 - Or randomly in space.
- 32% National average (at time)
- Use GAM (Gaussian Process) with binomial family



Groups feeding into SAGE



Sage Social Care Working Group – Core group & Expertise

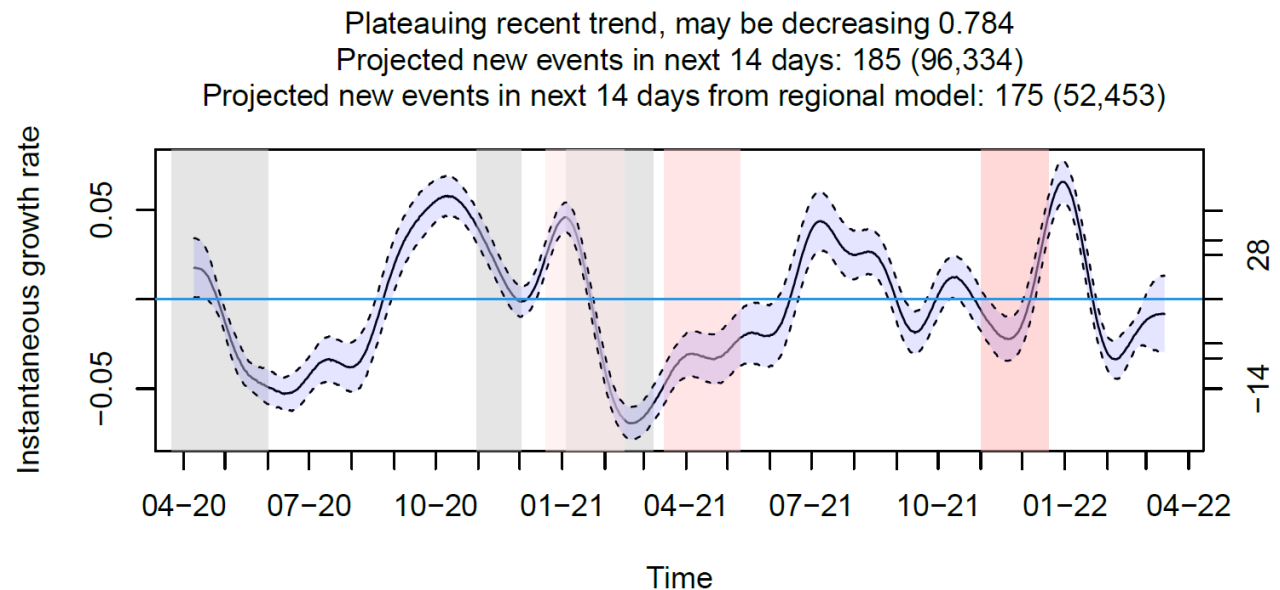
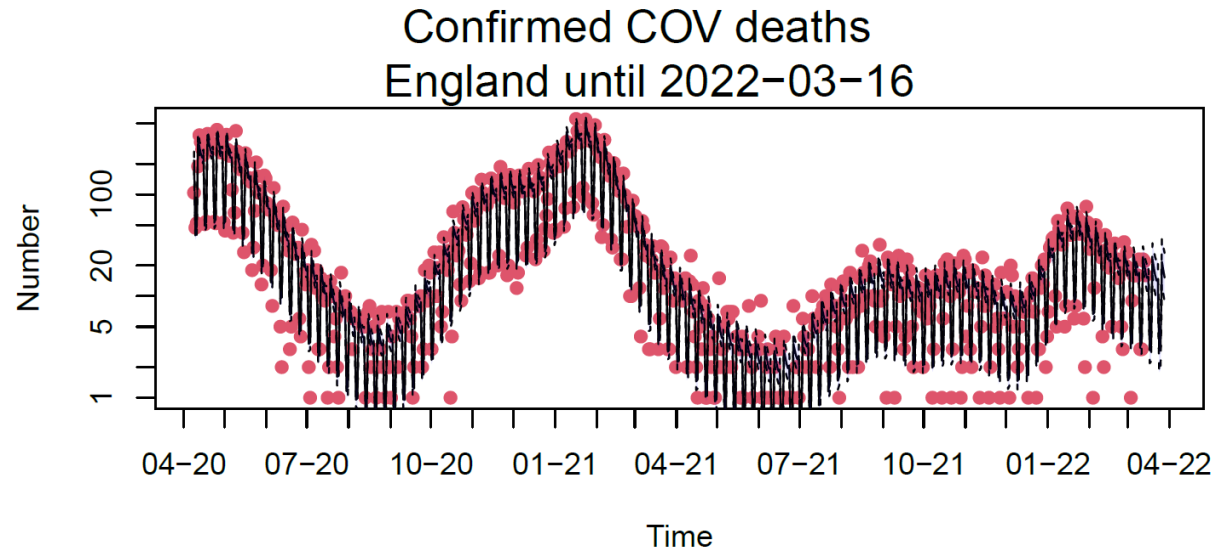


- **April 2020:** Group started as 'Sage Care Home Working Group'
- **September 2020:** Wider remit, clearly defined core members & new Terms of Reference.

What we delivered...

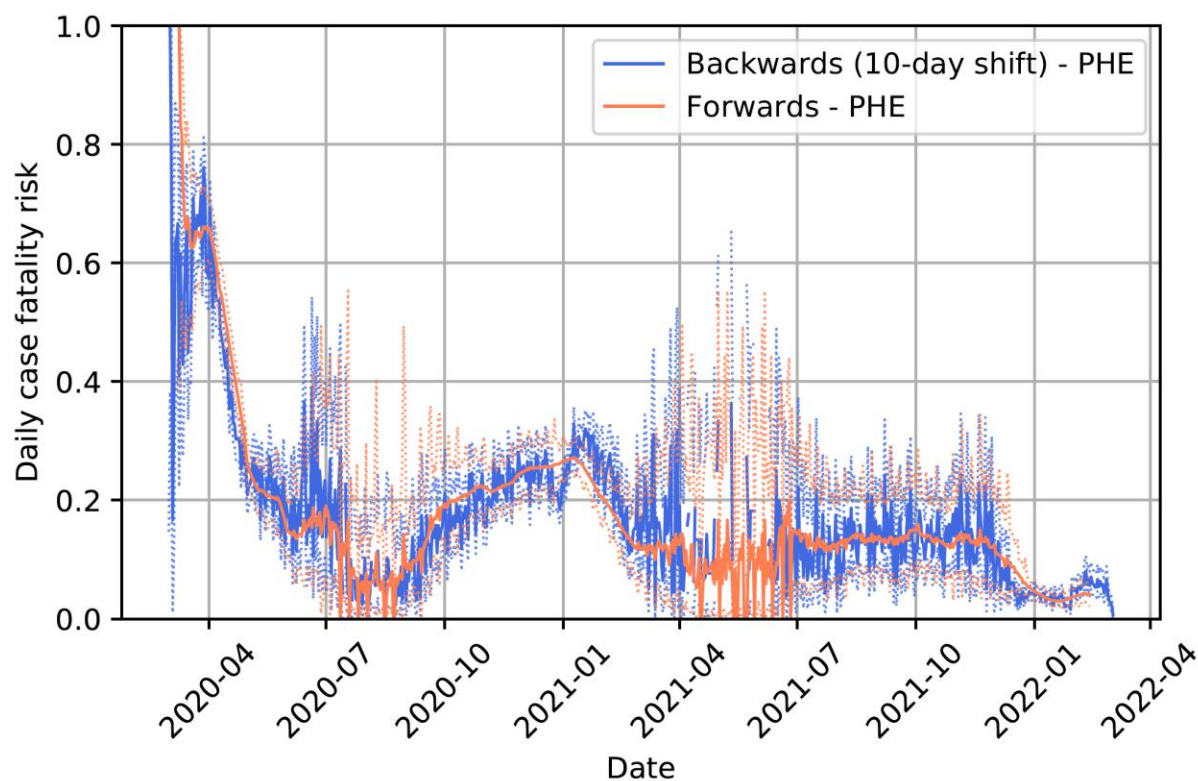
- <https://www.gov.uk/government/publications/care-homes-analysis-12-may-2020>
- 20200923 Review of evidence SCWG SAGE October 2020
- 2021103 SCWG Consensus Statement on Visitor Policies
- 20201221 SAGE Care subgroup Chair December Summary Note for Policy on Testing
- SCWG: Estimating the minimum level of vaccine coverage in care home settings, March 2021 - GOV.UK (www.gov.uk)
- SCWG: What are the appropriate mitigations to deploy in care homes in the context of the post vaccination risk landscape?, 26 May 2021 - GOV.UK
- SCWG Chairs: Summary of role of shielding, 20 December 2021 - GOV.UK (www.gov.uk)
- [2202.07325] Novel methods for estimating the instantaneous and overall COVID-19 case fatality risk among care home residents in England (arxiv.org)
- Epidemiological modelling in refugee and internally displaced people settlements: challenges and ways forward (bmj.com)
- Excess mortality for care home residents during the first 23 weeks of the COVID-19 pandemic in England: a national cohort study | SpringerLink
- [2110.06193] EpiBeds: Data informed modelling of the COVID-19 hospital burden in England (arxiv.org)
- A number of outputs in Philosophical Transactions of the Royal Society B 376 (1829) a special issue on Pandemic modelling response
- JMT reports, SPIM-O consensus statements, NRP consensus statements + supporting papers

Forecasting



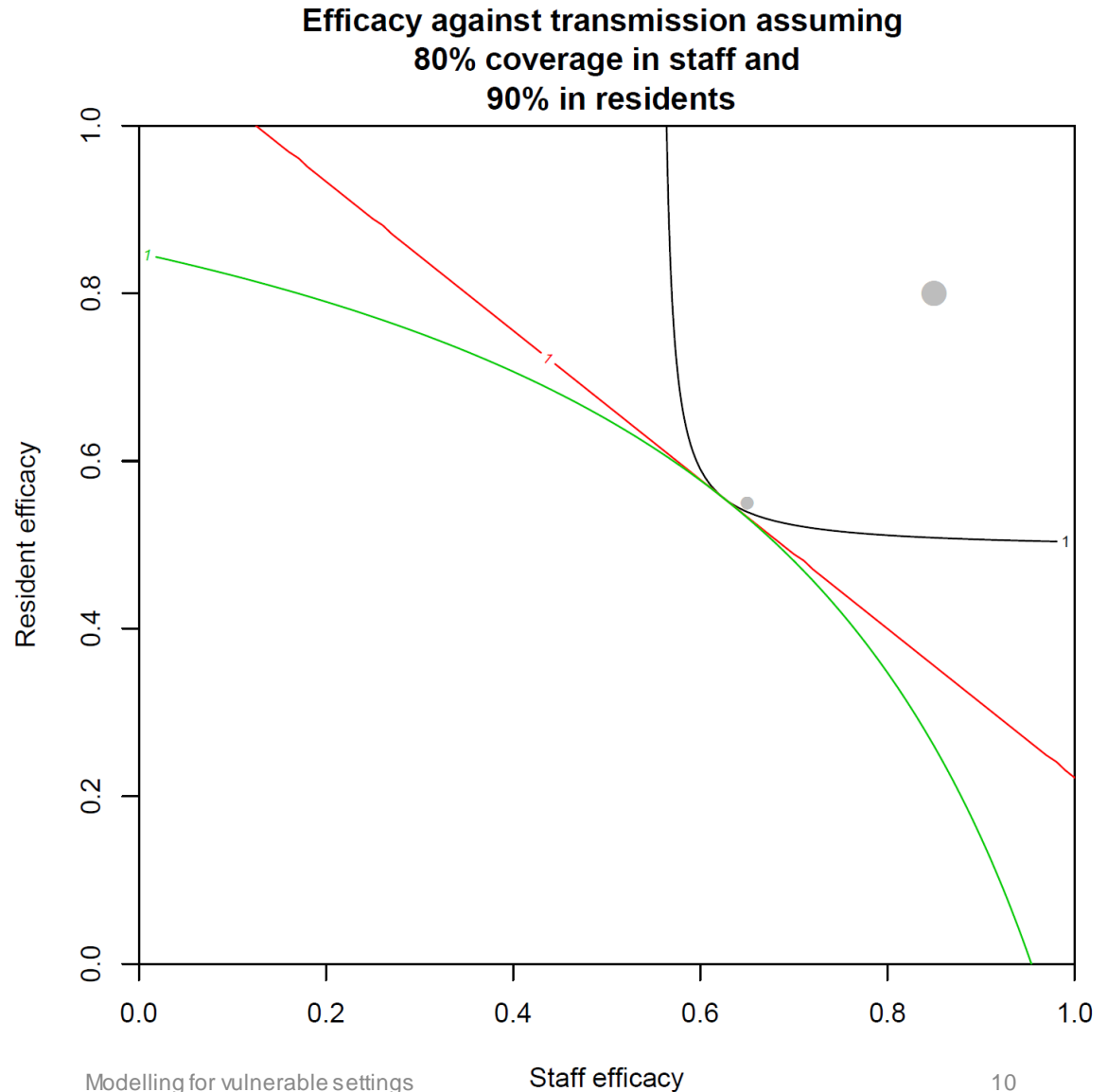
Case fatality ratio within care homes

- Uses CQC death notifications and P1 and P2 positive tests matched to care home location and age
- Allows for delay from positive test to death
- Gives 14% CFR in 'stable' data period with appropriate age filters
- Evidence of spatial variation (NE higher and London lower)
- Highly variable



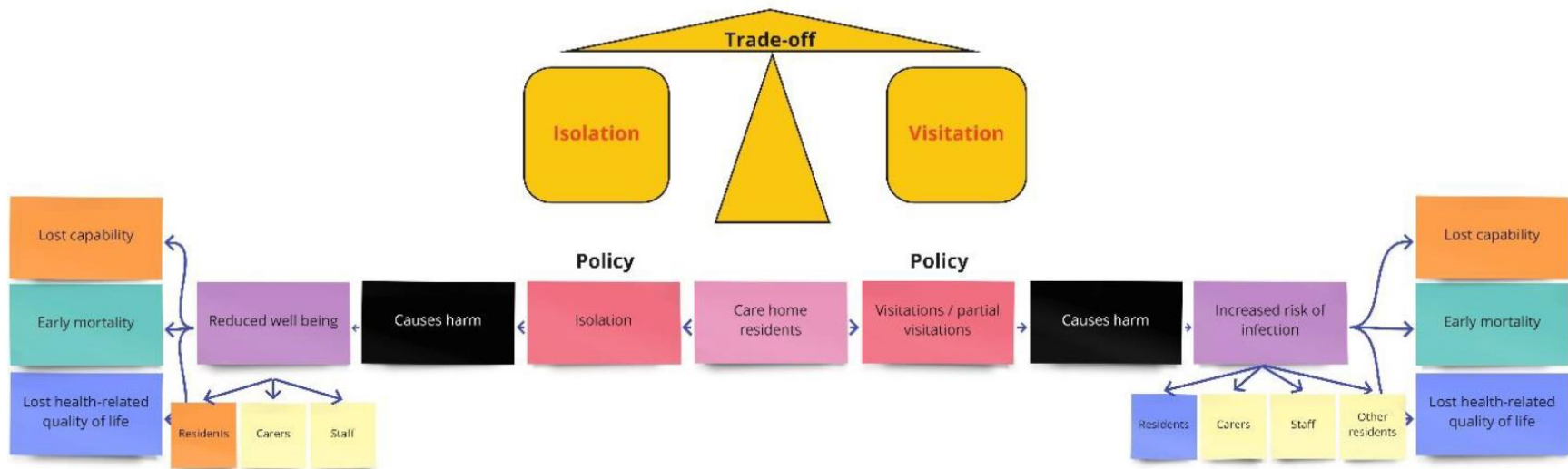
Vaccine impact

- Assume given coverage levels
- The simple 2 group mixing model can be used to show efficacy rates required to achieve control.
- This is sensitive to assumptions on vaccine efficacy and mixing patterns.

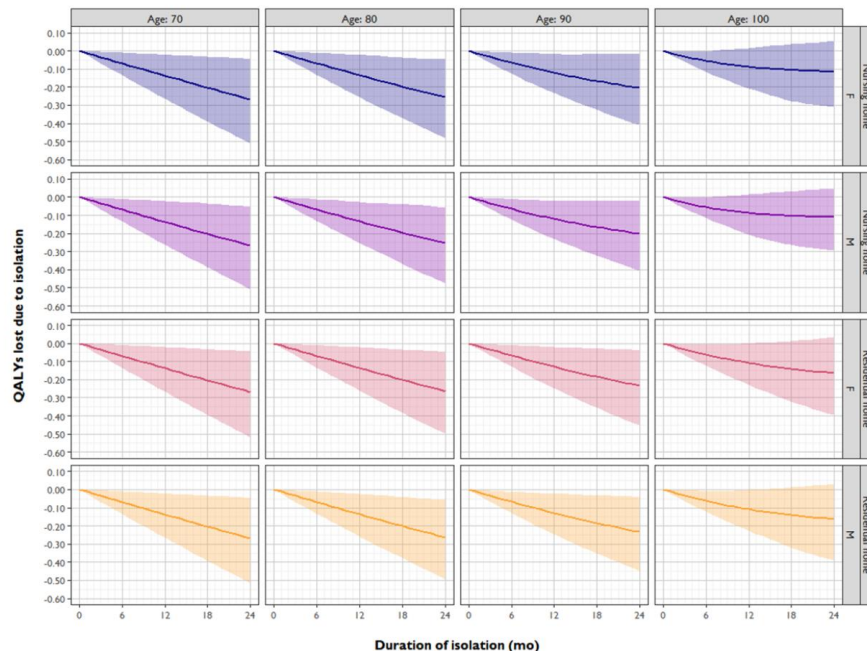


How do we create a visitor policy that is safe but enables residents to see their family? Alexander Thompson

- Potential harm caused by isolation
- Homes in different areas of high / low prevalence
- Each individual and family member may have a different view on safety vs quality of life.



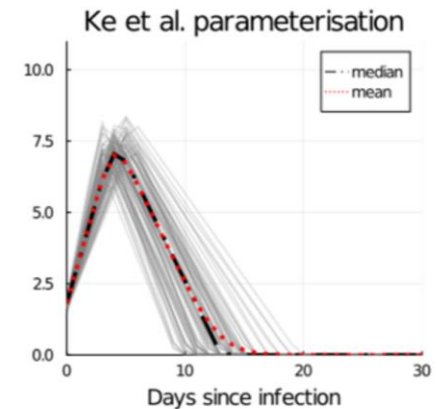
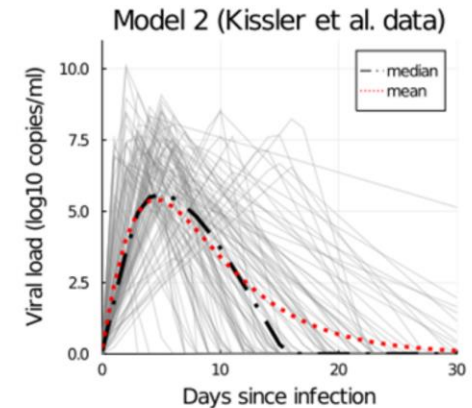
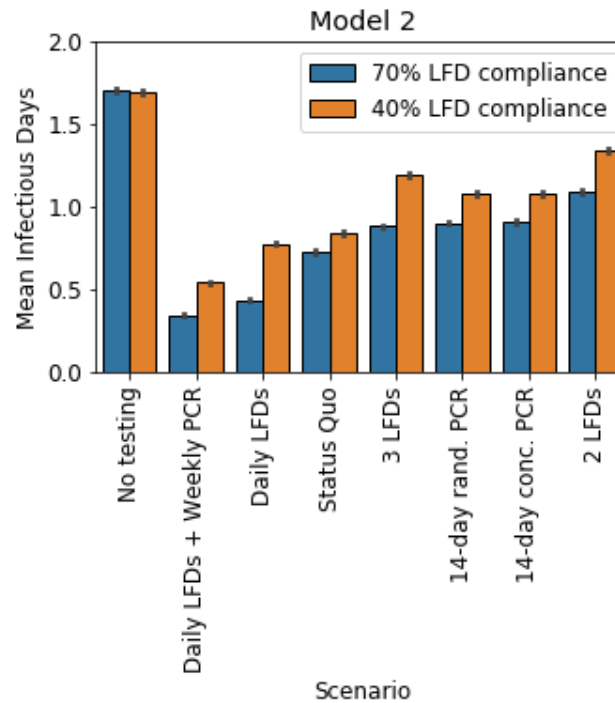
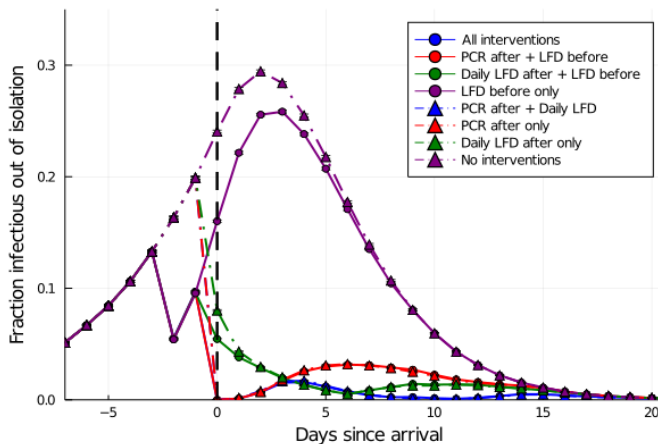
Quality adjusted Life Years...



But does the QALY capture necessary impacts on wider wellbeing and health (ASCOT).

Need to integrate with epidemic models

Viral-load-based models

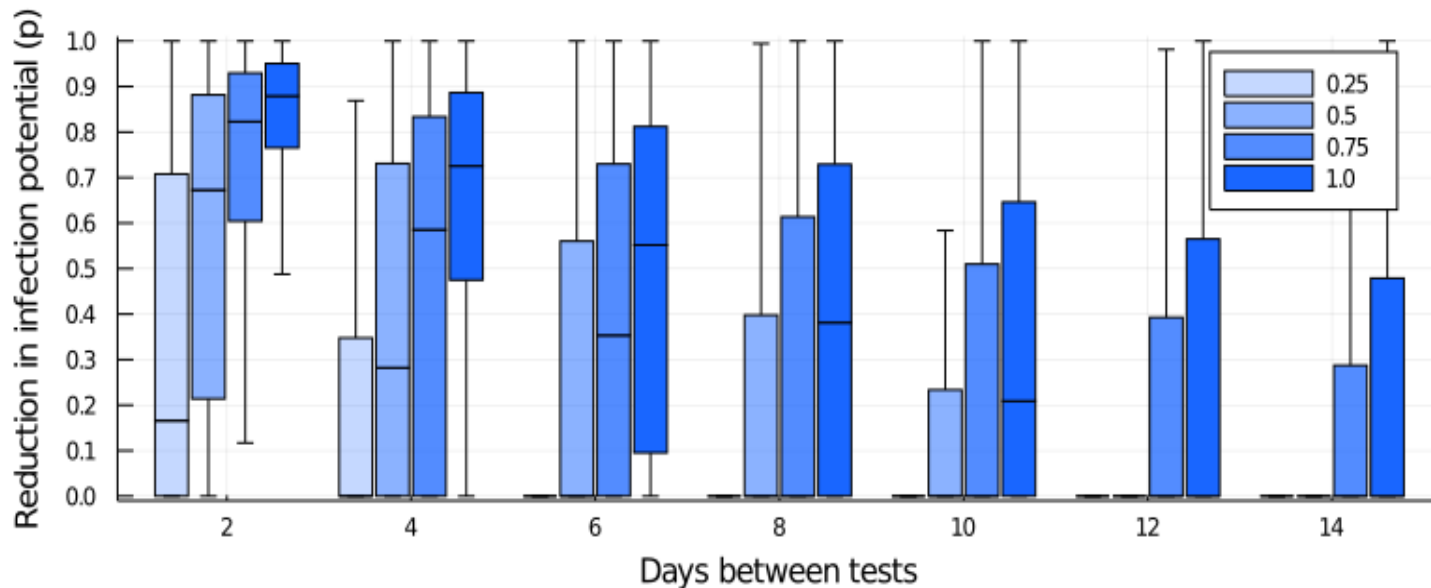


Ke, R et al. 'Daily sampling of early SARS-CoV-2 infection reveals substantial heterogeneity in infectiousness', Medrxiv2021.

Kissler, S. M. et al PLOS Biology 19(7), e3001333. 2021

Testing

- Behaviour and acceptance is critical to efficacy for testing.
- Sensitivity and specificity vary over time



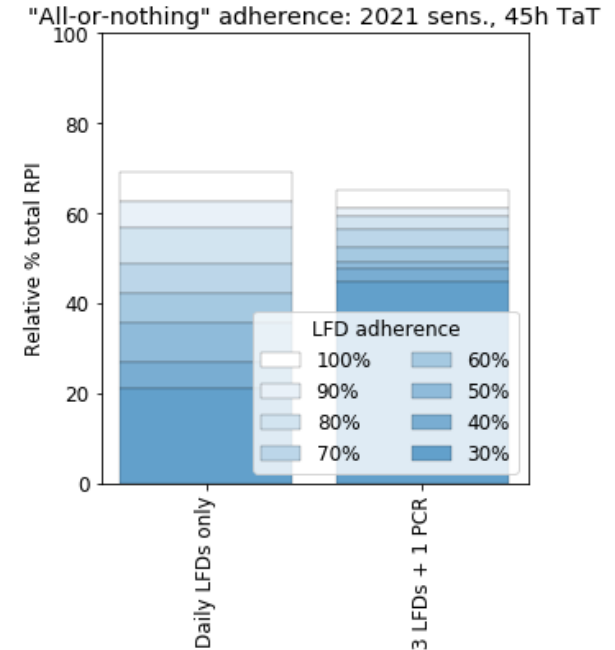
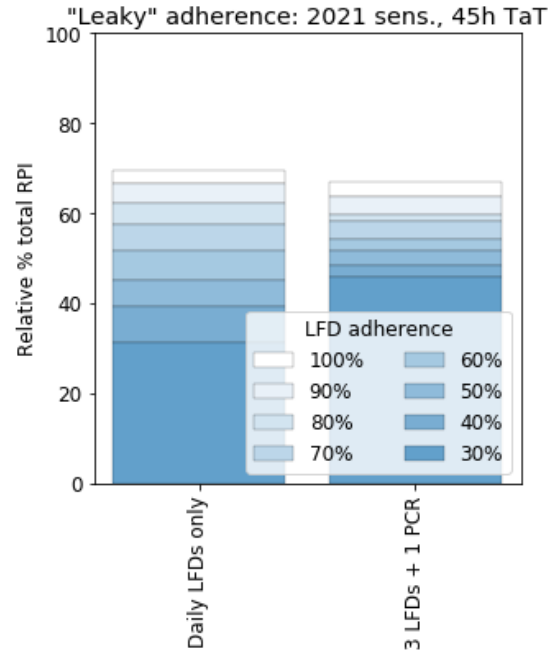
The role of adherence

Type of adherence matters:

Leaky: Everyone takes next test with same probability

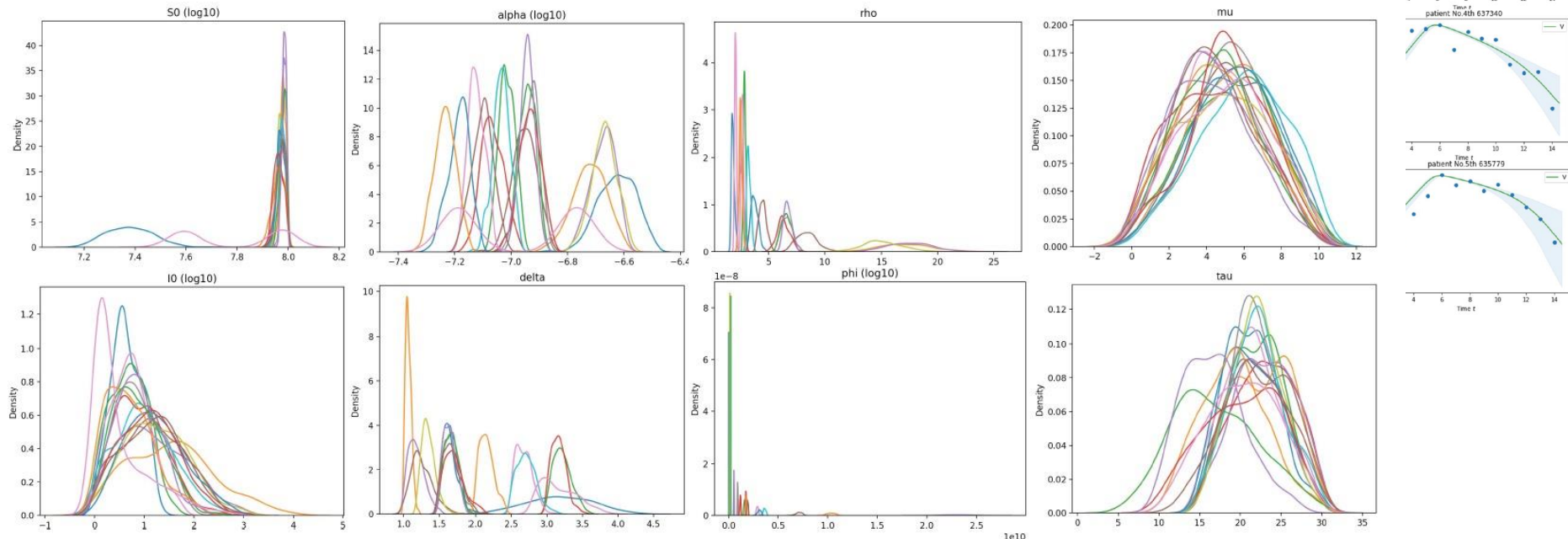
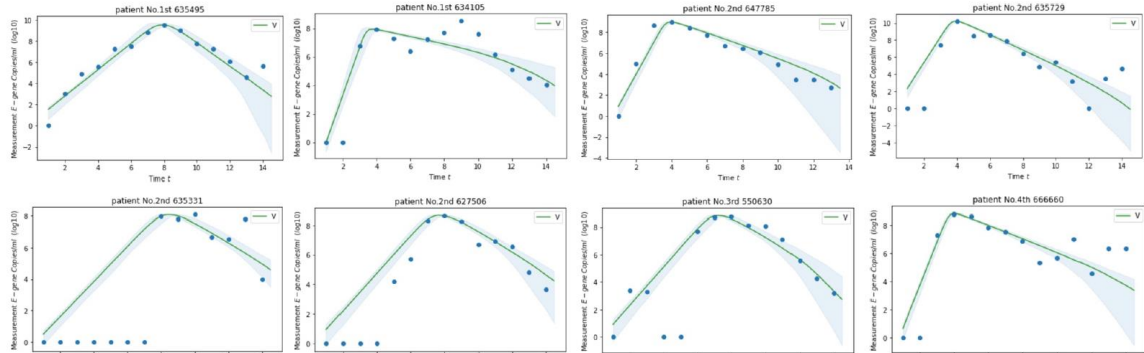
AoN: Fraction of people do all tests, fraction do none

Strategies with high frequency are most affected by this difference

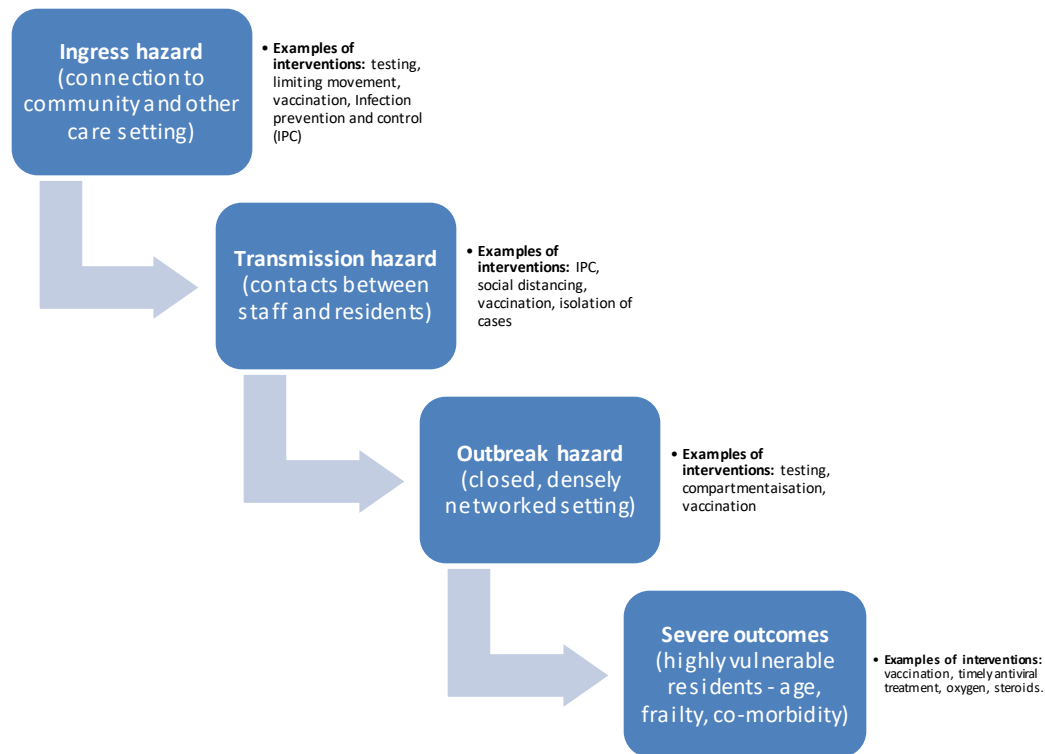


In host modelling Results (UoM)

credit interval for simplified model.



Hazard assessment



Complex mitigation parameter space

Ingress

- Vaccination of residents, staff and visitors
- Isolate or cohort infectious or potentially infectious residents
- Avoid symptomatic people visiting
- Financial support for staff to isolate
- Test residents on admission and on return from hospital, test visitors and staff
- Avoid cross-deployment of staff, limit or stop inward/outward visits, accommodate staff separately from family

Transmission

- Vaccination of residents, staff and visitors
- Isolate or cohort people with symptoms or confirmed infection
- Optimize ventilation
- PPE
- Financial support for staff to isolate
- Facilities to reduce fomite transfer (e.g. laundries) and quarantine materials and equipment
- Test residents on admission and on return from hospital, test staff and visitors
- Mask use by staff and visitors
- Social distancing where possible, limit close interactions between residents, limit visitor numbers

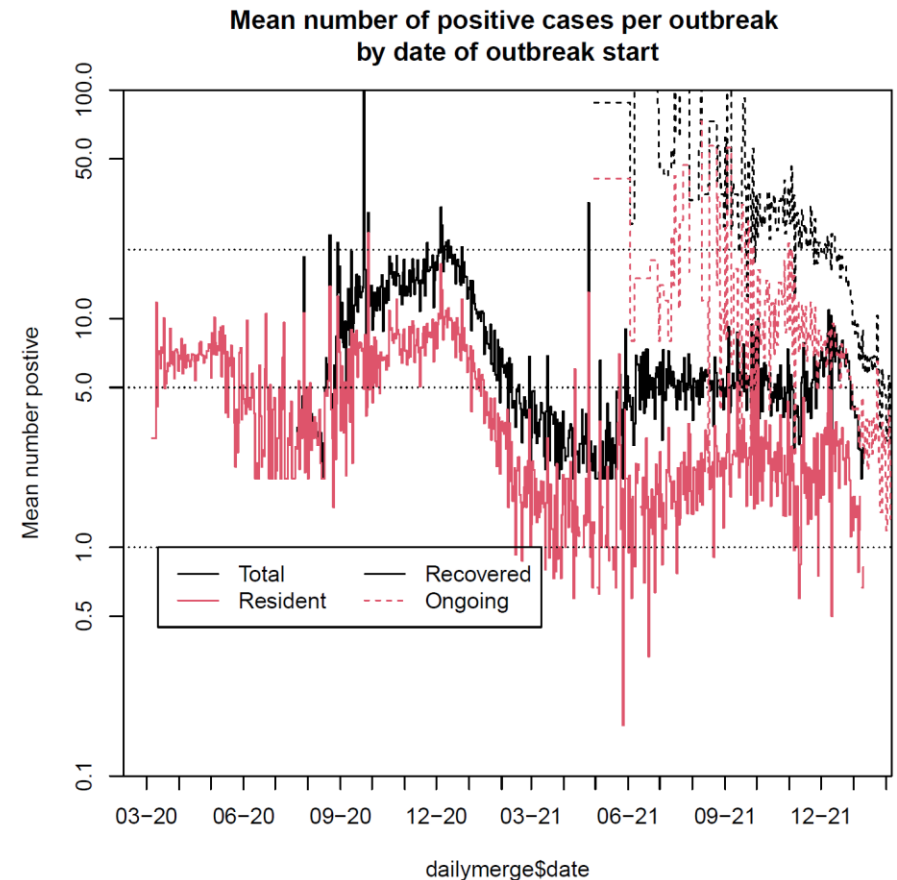
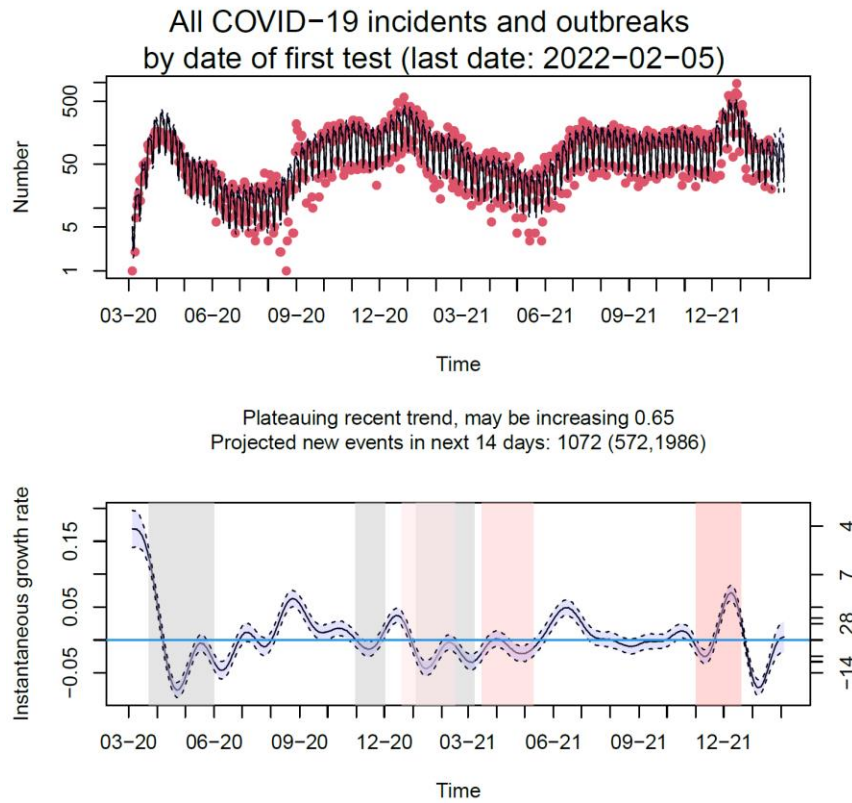
Size of outbreaks

- Vaccination of residents, staff and visitors
- Isolate or cohort infectious residents
- Cohort staff to infected/uninfected residents
- Financial support for staff to isolate
- Social distancing where possible, limit interactions between residents
- Repeat rounds of testing to determine whether onward transmission still occurring, further limit visitor numbers

Severe outcomes

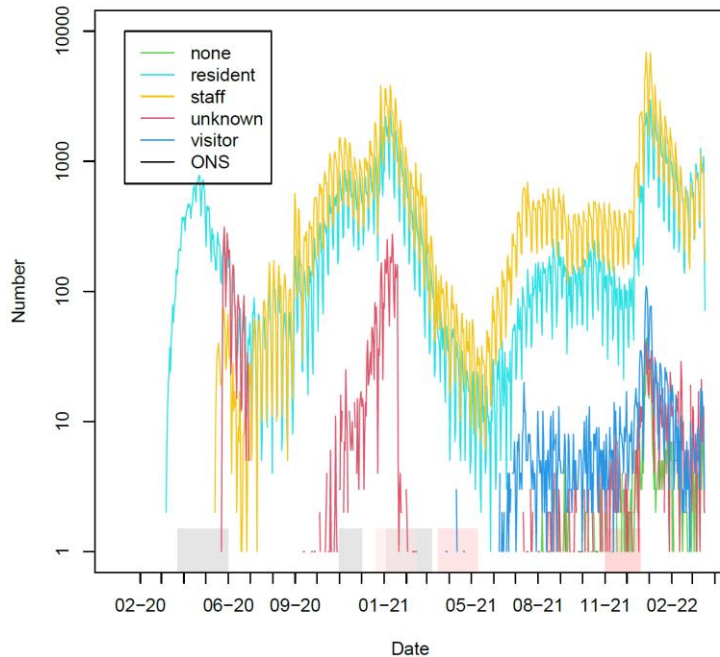
- Vaccination of residents, staff & visitors.
- Antiviral treatment for residents and staff with infection
- Supportive care in the care home including oxygen, fluids, and steroids
- Admission to hospital if appropriate
- Rehabilitation and management of long COVID

Transmission

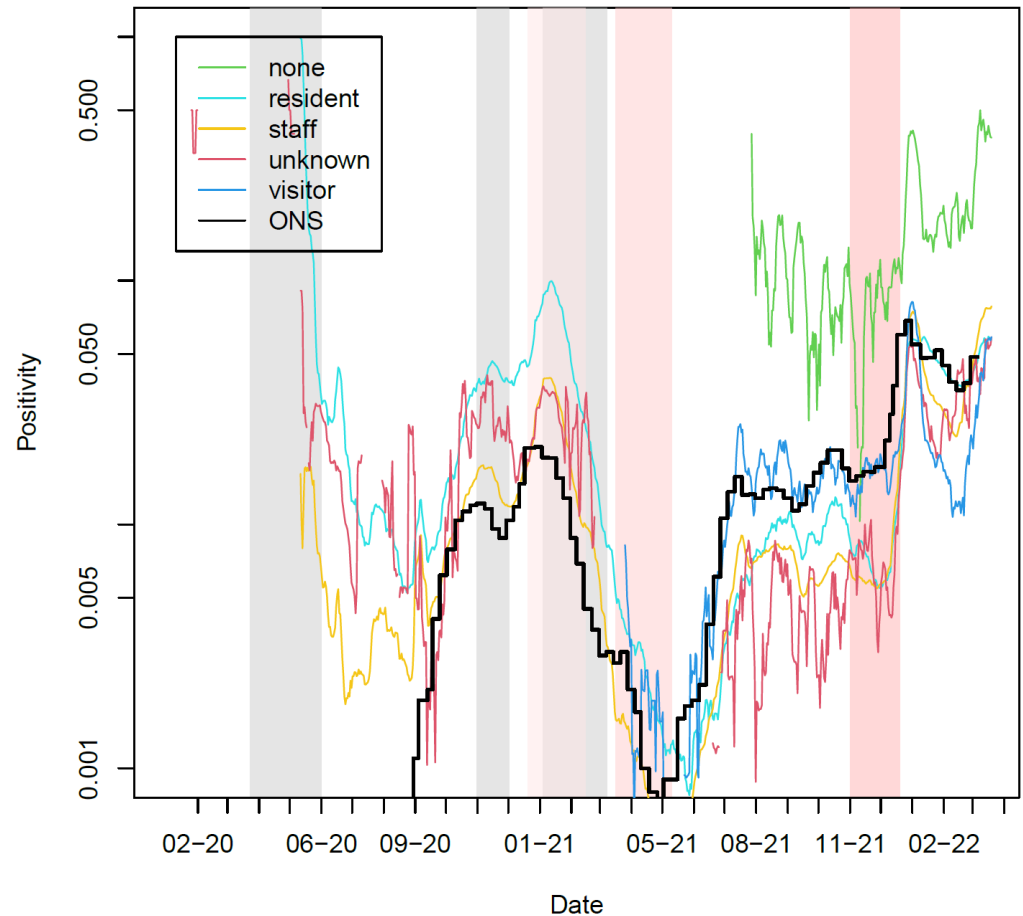


Correlation with ONS CIS

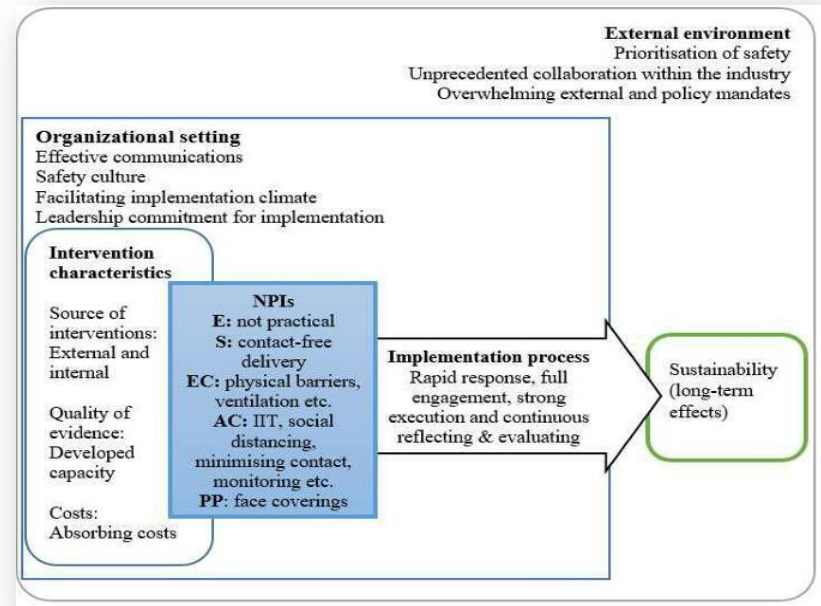
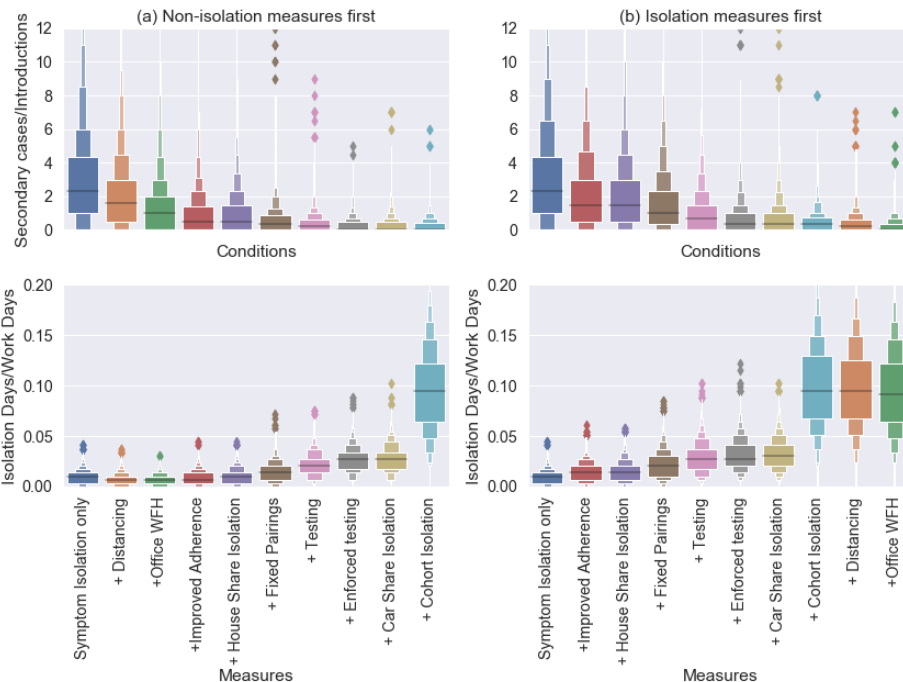
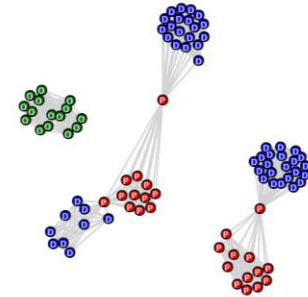
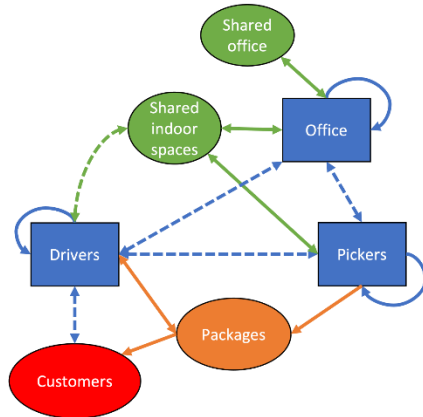
Positive cases



Positivity rates compared with ONS CIS



Agility and vulnerability: the UK logistics sector in the face of the COVID-19 pandemic



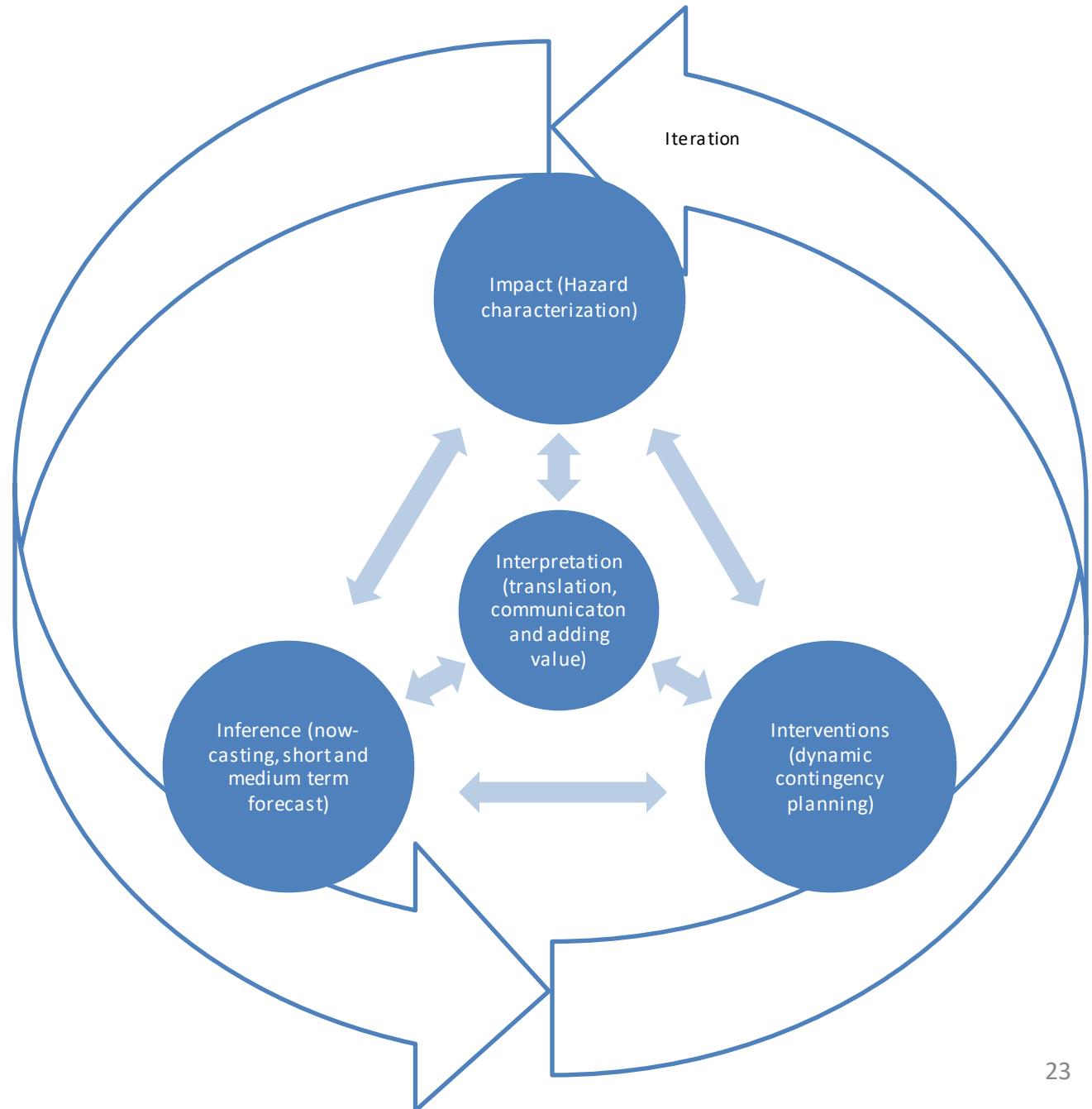
Key Publications

<https://doi.org/10.1101/2022.03.17.22272414>
<https://doi.org/10.1101/2022.01.28.22270013>

Summary

- Data was weak...
- ... better now but not perfect (Social Care episode statistics!!!).
- Hard to evaluate specific interventions
- Eager to build in future research and look at acceptability
- Home care and other settings critical.
- Staff data linked to workplaces adds value.
- Timescales for reporting are short and language for translation needs care – work with policy teams

Future work model??



Acknowledgements

Data: UKHSA, DHSC and CQC

- University of Manchester COVID-19 Modelling group (co-leads: Thomas House + Lorenzo Pellis; Luke Webb for spatial modelling; Chris Overton for CFR; Heather Riley extending model; Alex Thompson for health economics work; Carl Whitfield testing efficacy)
- DHSC analytical teams (Aikaterini Giannadou, Leo Hawthorne and Jenny Neuburger)
- SAGE Care Home Sub-group (Steve Willner, secretariat; Eamonn O'Moore/Jenny Harries/Charlotte Watts, co-chair). All participants who have been brilliant and engaged
- MoJ Science team (Oscar O'Mara and Shannon Nolan)
- Gig worker project: Hua Wei, Sarah Daniels, Carl A. Whitfield, Yang Han, David W. Denning, Ian Hall, Martyn Regan, Arpana Verma and Martie van Tongeren

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- UKHSA (Covid19 joint modelling team + ASC team)
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- NIHR / EPSRC / MRC / UKRI / DTRA

