

The Global Impact of COVID-19 and Strategies for Mitigation and Suppression

Dr Patrick Walker on behalf of the Imperial COVID-19 response team
WHO Collaborating Centre for Infectious Disease Modelling
MRC Centre for Global Infectious Disease Analysis

Severity of COVID-19 infection

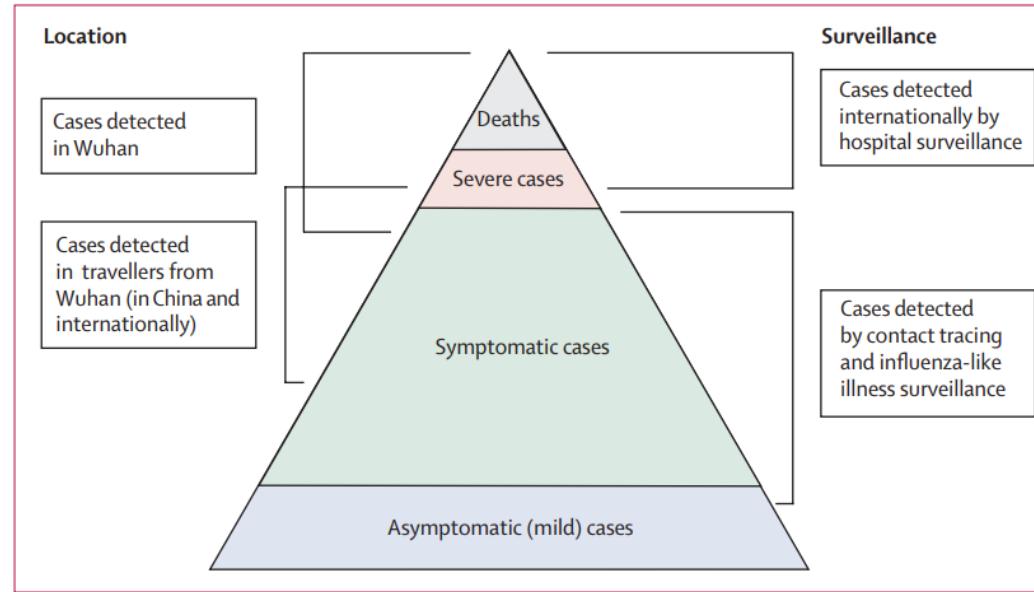
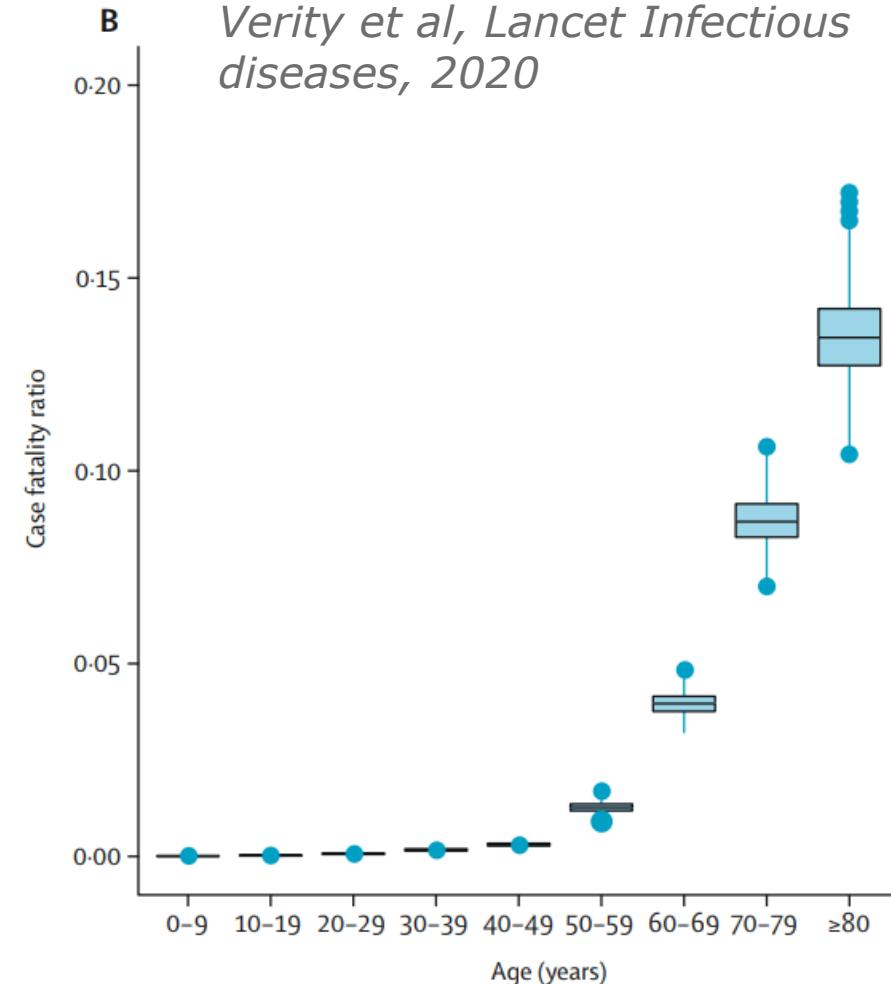


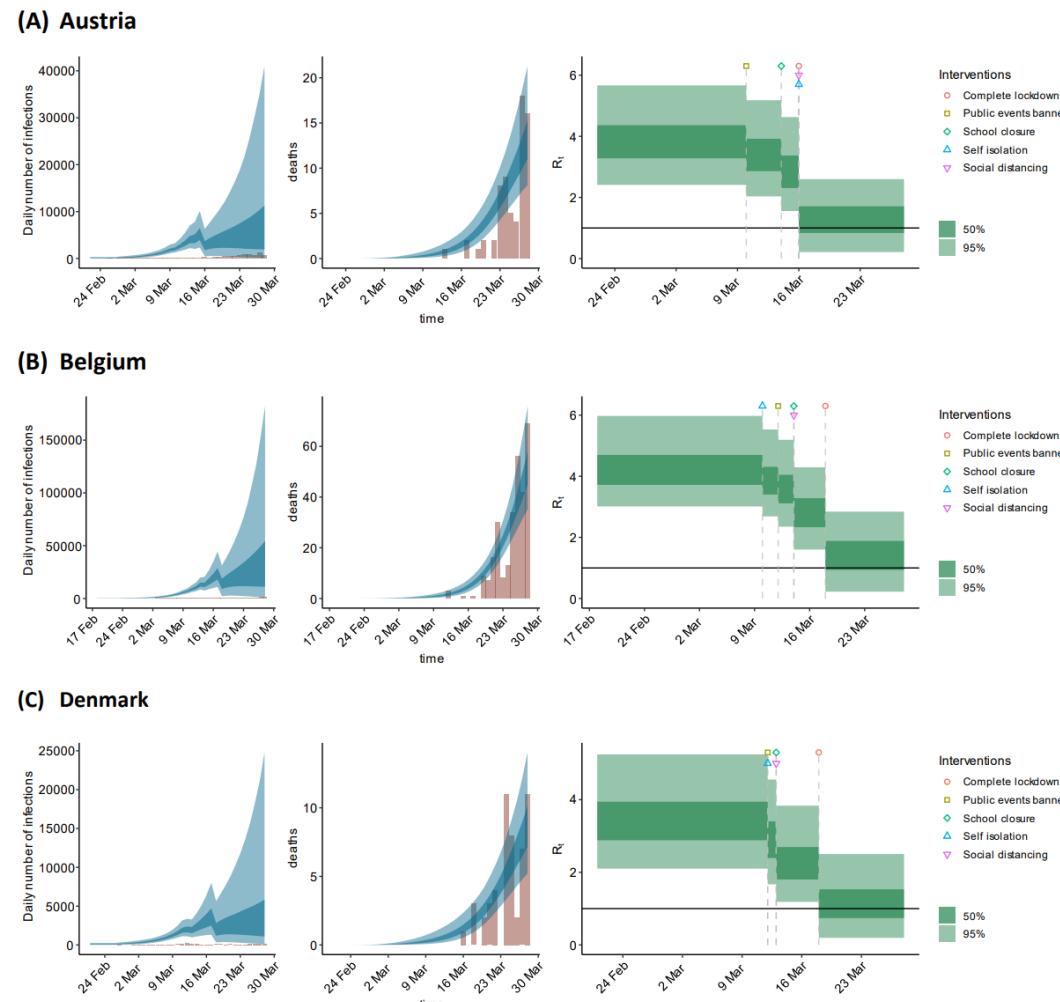
Figure 1: Spectrum of COVID-19 cases

- A newly emerged disease: a lot to learn, not much time or data with which to learn it
- Clear patterns of severity by age
- Some relevant comorbidities are well characterised (CVD, COPD, diabetes etc.)



Transmissibility and current stage of the pandemic

- Spread within Europe consistent with a highly infectious disease ($R_0 \sim 3-4$)
- Healthcare systems placed under severe strain
 - High demand for hospital and ICU beds, oxygen and mechanical ventilation
 - High infection/self-isolation rates in health workers
- NPIs: stringent social distancing measures (“Lockdown”) which are now showing impact

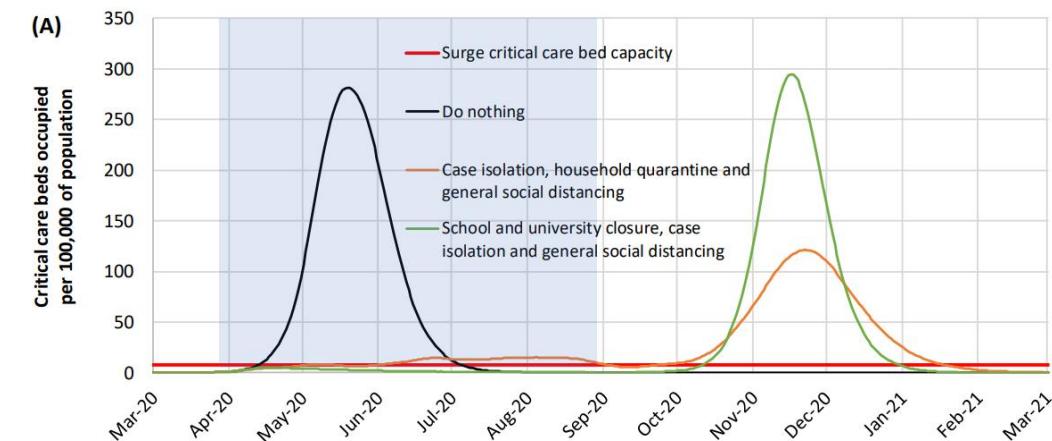
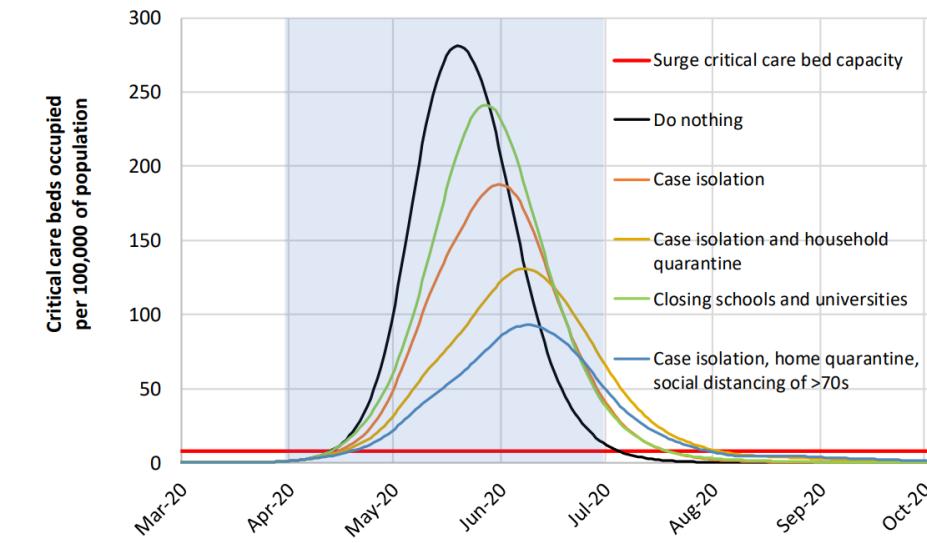


Flaxman et al, Imperial COVID-19 report 13, 2020
 Updated estimates available:

<https://imperialcollegelondon.github.io/covid19estimates/#/>

Role of modelling

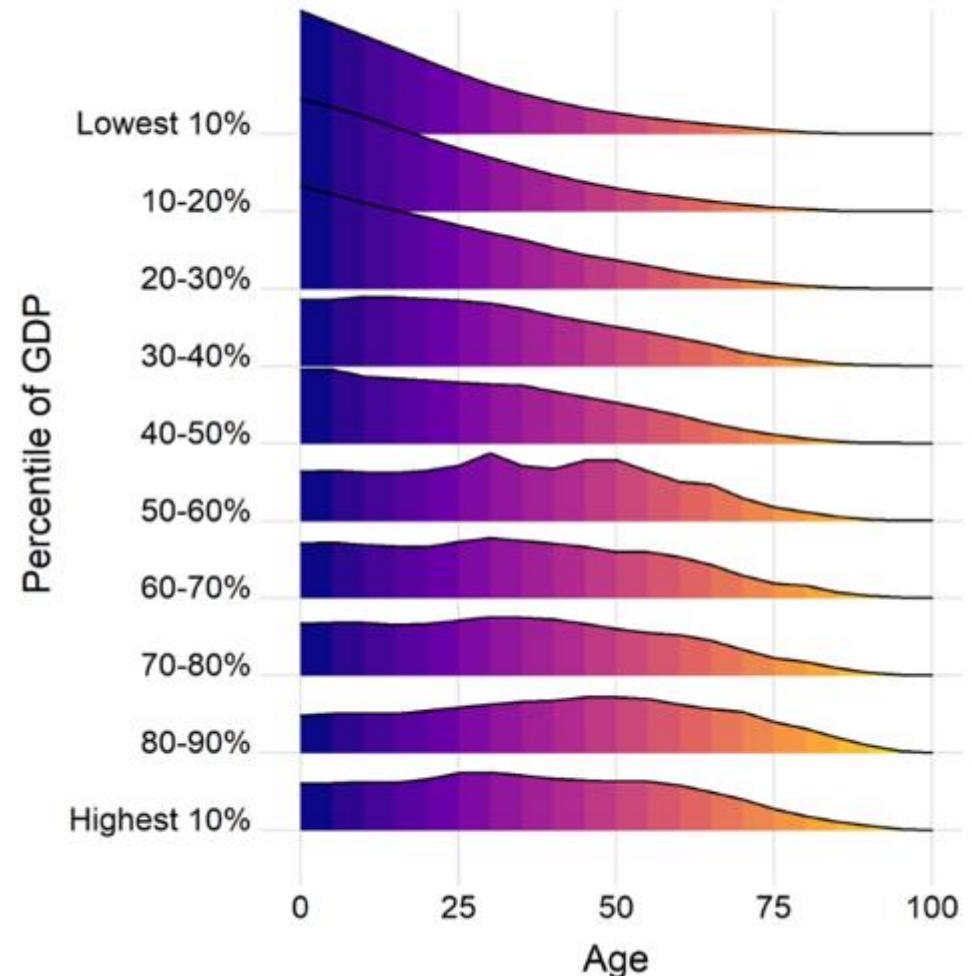
- Modelling has been a central element used by high-income countries to help guide strategies to mitigate or suppress COVID-19 transmission
- A tool to project what logically may occur in different scenarios in terms of spread, mortality and health system impact given available data
- Most countries lack in-country modelling resources but all are faced by similar questions about how to respond to COVID-19
- What can we say that's useful given time-critical demand?



Ferguson et al, Imperial COVID-19 report 9, 2020
Available: <https://www.imperial.ac.uk/media/imperial-college/medicine/mrc-gida/2020-03-16-COVID19-Report-9.pdf>

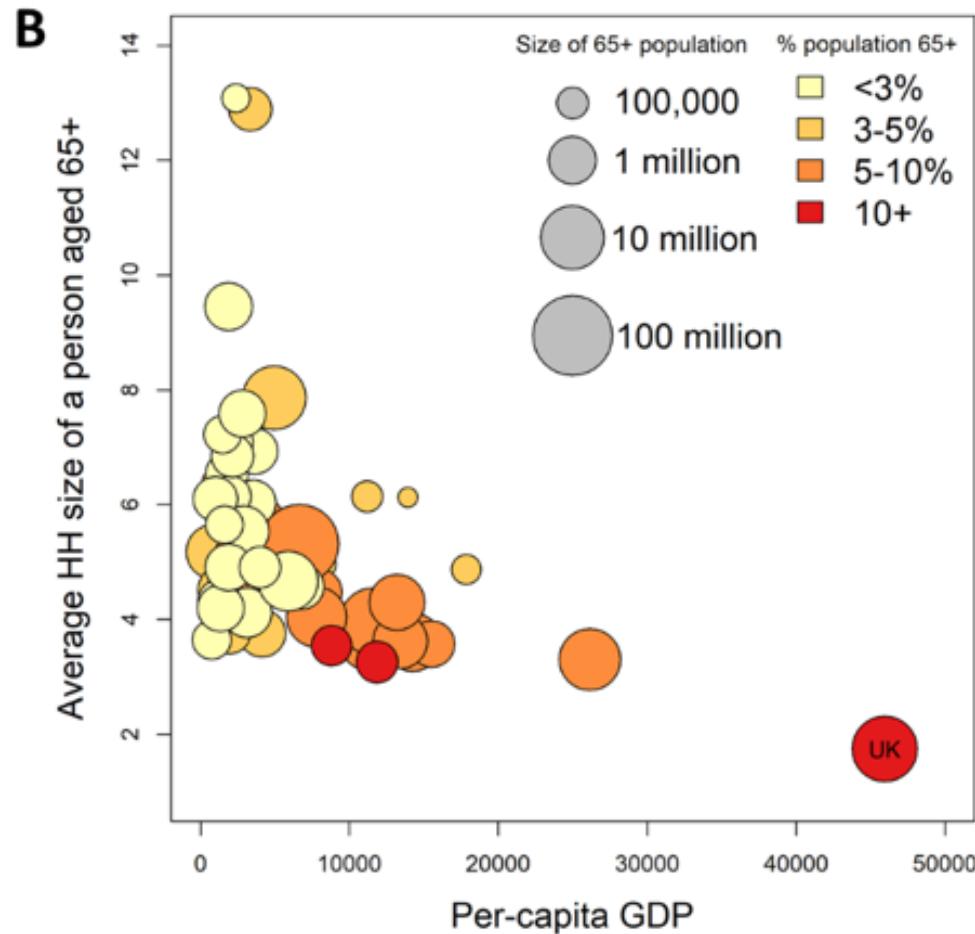
Same pathogen, different contexts...

- We suggest 5 main factors likely to drive differences in COVID-19 impact in countries across the range of income:
(in order of appearance not necessarily importance)
 1. Demographic patterns relevant to severity of infection (e.g. age and sex)
 2. Societal structure relevant to social contact patterns and ability to modify them.
 3. Patterns of relevant comorbidities (including those not well understood)
 4. Health system strength and capacity
 5. Social and economic vulnerability to impact of NPIs



Demographics and social structure

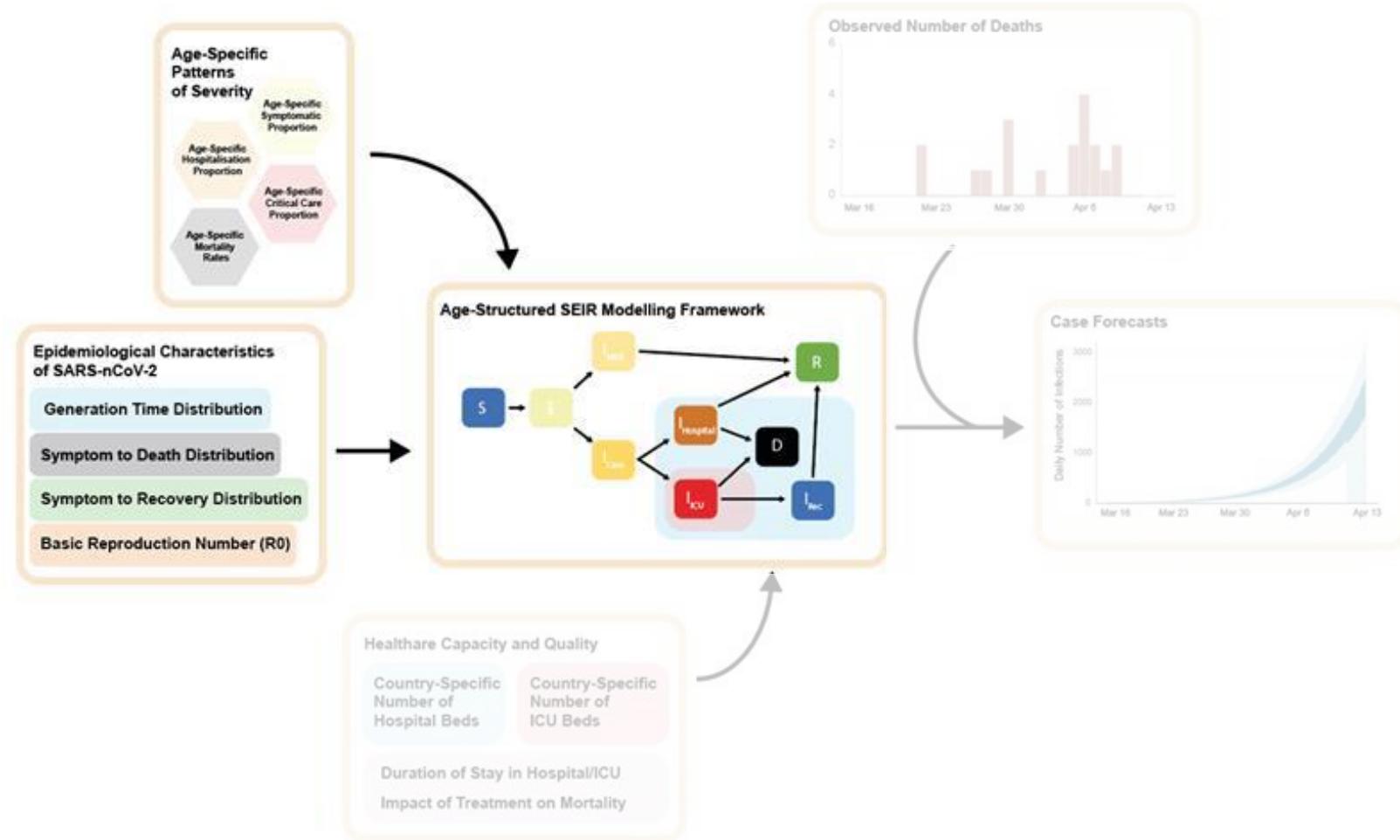
- Higher income countries have higher % of population in older age groups where infection most likely to be severe
- However, older people make fewer social contacts ('social isolation of elderly') and younger people (school-aged children and younger adults) have the most.
- Limited data from LMICs but suggest show much smaller drop off (if any) in contact rates with age
 - Older people live in much larger households
 - Different patterns of school and work serve to distribute contacts more evenly



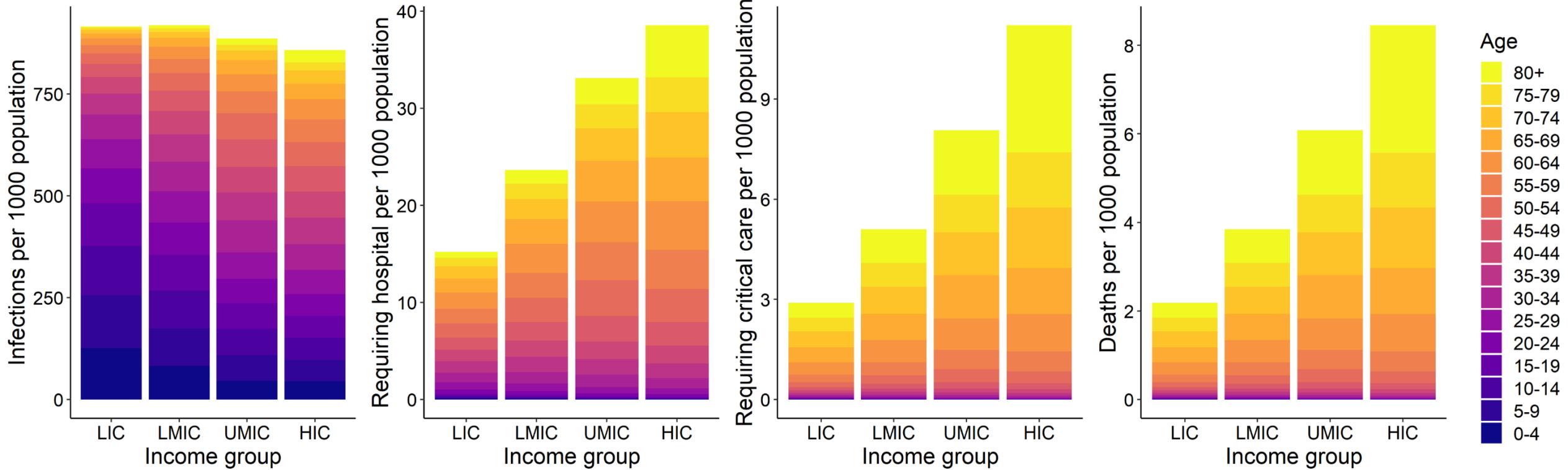
Fewer older people in LMICs but disease more likely to spread to them: what's the trade-off?

Modelling framework for estimating global impact

- Developed a relatively simple model framework capable of capturing key dynamics of more sophisticated Imperial micro-simulation
- Inputs:
 - Key epidemiological parameters determining spread and severity
 - Demographics
 - Contact structure

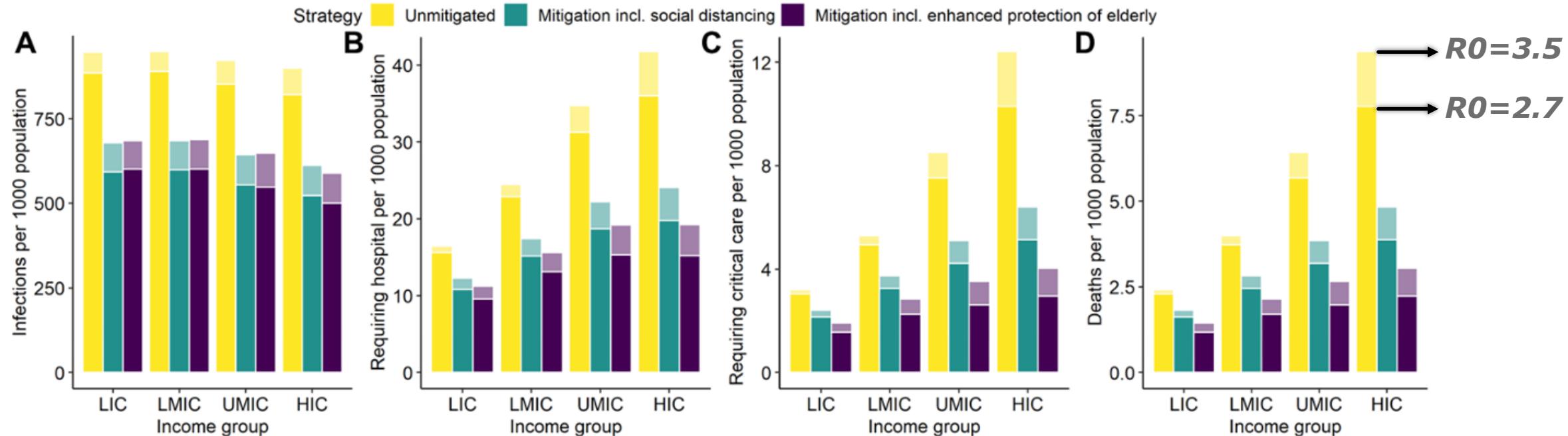


Unmitigated impact by income level



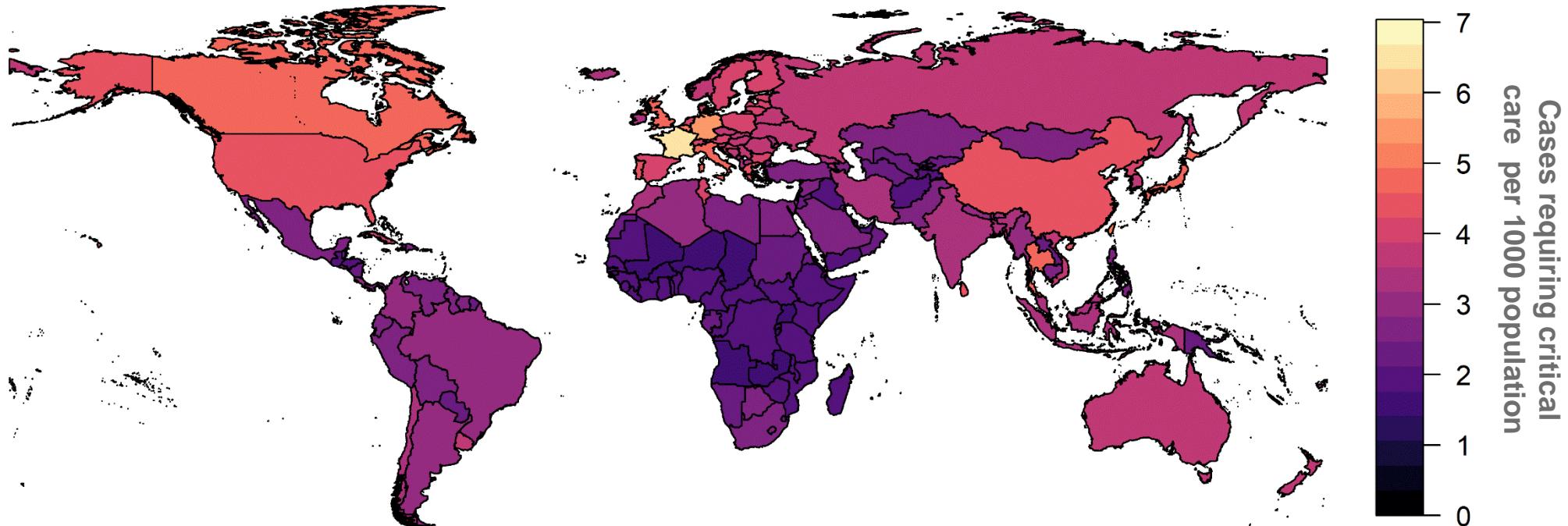
- Would suggest that for the same overall access to care LMICs would be less affected on a per-capita basis *but clearly access to care is going to differ considerably (more on this later)...*

Mitigation strategies..



- If unable to suppress infection until a vaccine, reduction in contact rates, particularly older people, will reduce burden: reduces amount of ‘overshoot’ once sufficient herd immunity has been achieved.
- Estimate appox. 50% reduction (40 million to 20 million deaths globally) but proportionally lower impact in lower income settings driven by relative ease at which infection likely to spread to older members of population
- Easy to reduce contact rates in a model but harder to predict how this is best achieved in practice and likely to vary considerably across all countries...

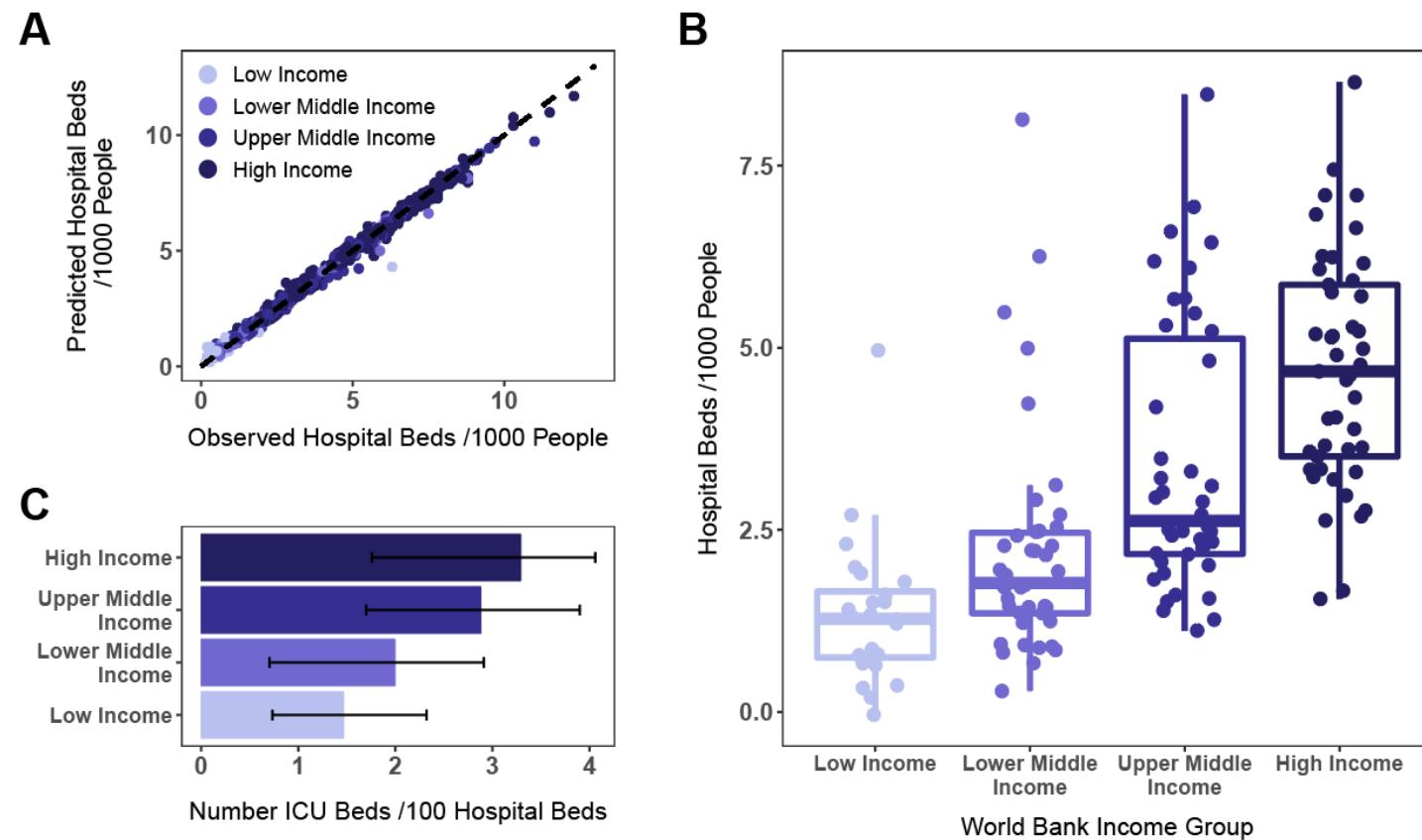
Healthcare demand with 'optimal' mitigation



- Still project lower healthcare demand in lower income settings on a per-person basis
- How does this correspond to healthcare supply?

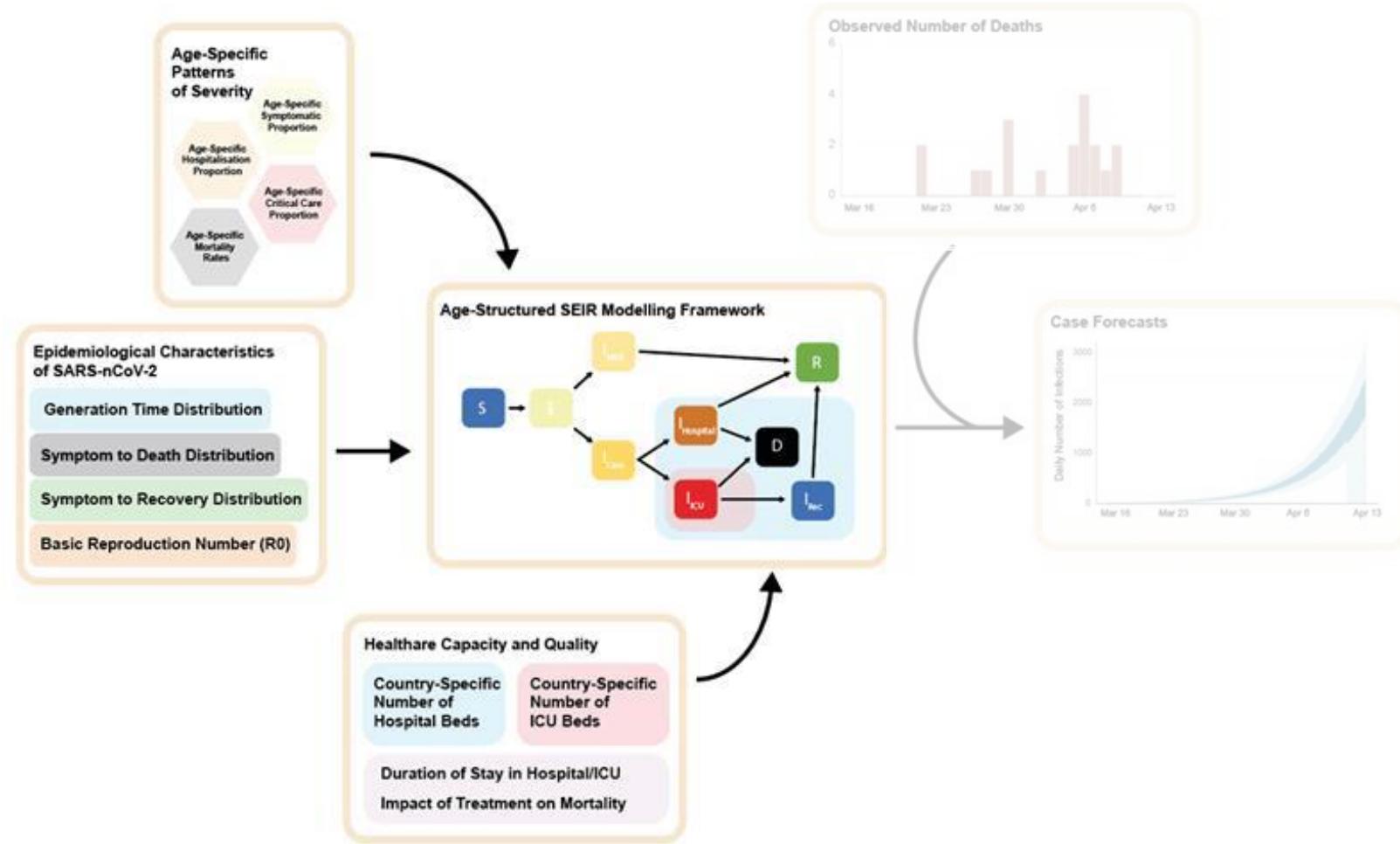
Healthcare supply and income are correlated

- Both the availability of hospital beds and extent to which they can provide adequate care for severe COVID-19 patients is substantially lower in lower-income settings
- Smaller proportion of hospitals have intensive care units (ICUs), much lower provision of high pressure oxygen.
- Often near, or even complete, absence of mechanical ventilators currently saving lives of those with severe disease in HICs. In LICs % fatality in such cases will be very high.



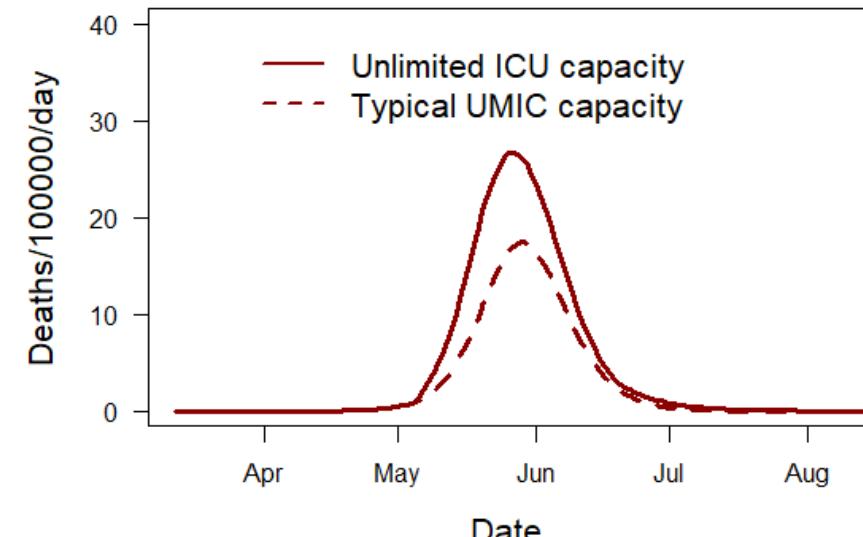
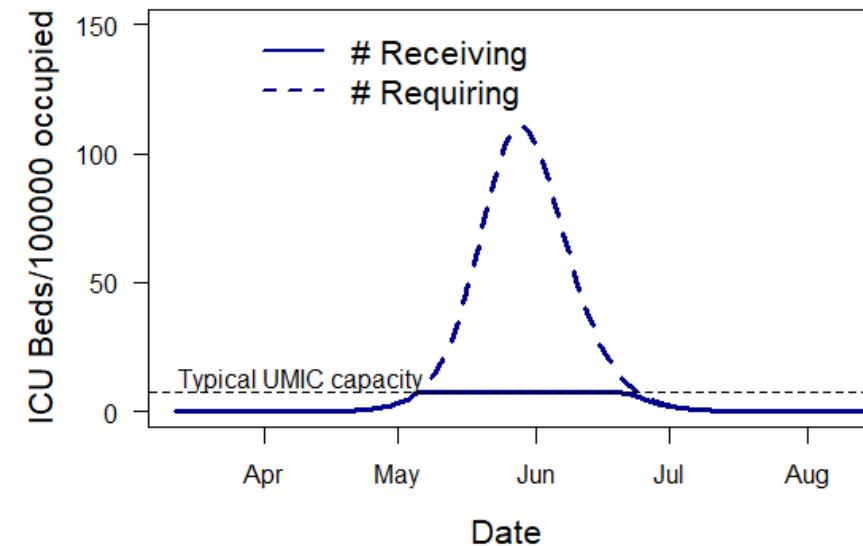
Modelling framework for estimating global impact

- Developed a relatively simple model framework capable of capturing key dynamics of more sophisticated Imperial micro-simulation
- Inputs:
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 - Healthcare capacity and impact of treatment (or its absence)



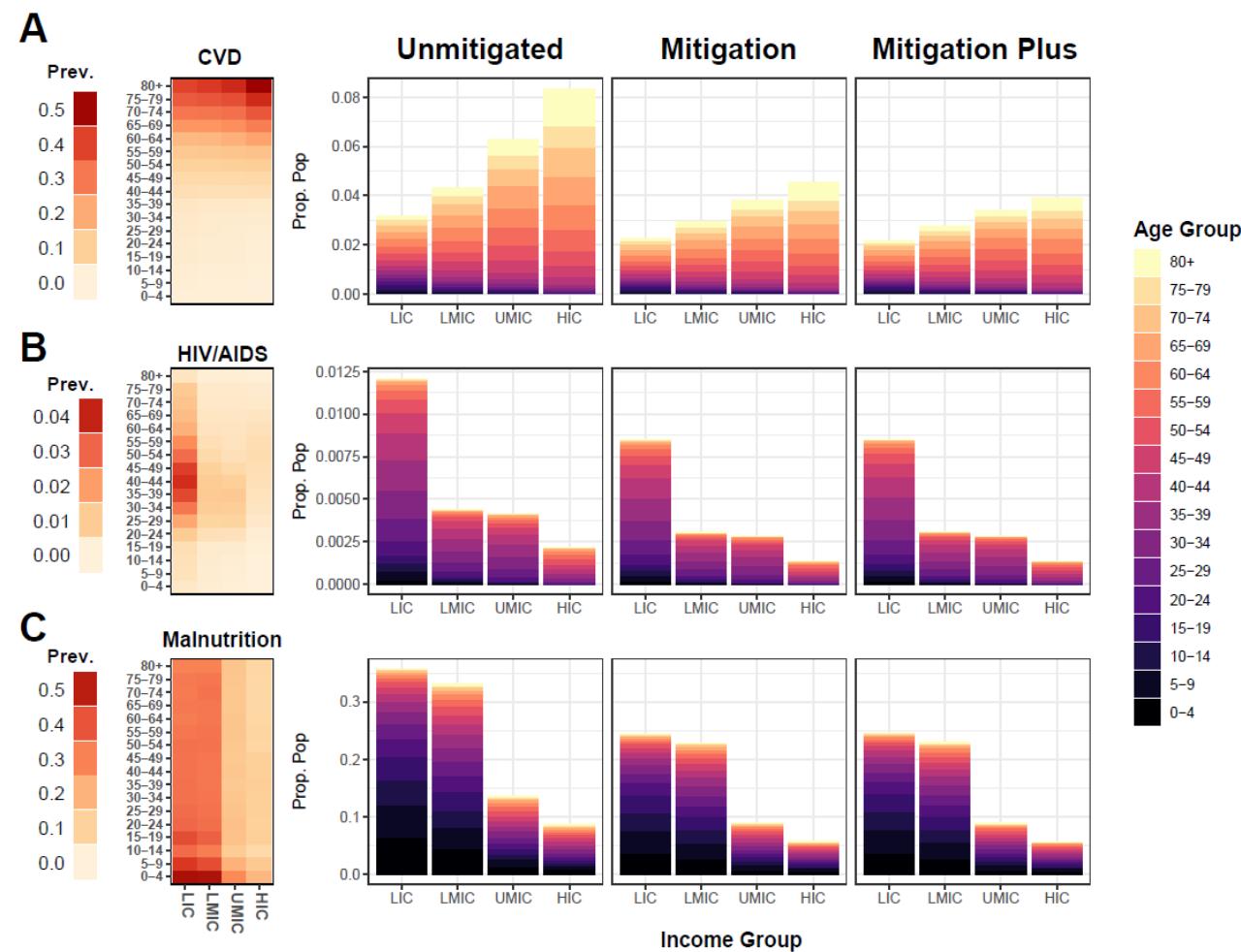
Large additional ‘preventable’ direct burden in LMIC

- Seeking expert opinion on some key parameters..
- Quantitative results for projections of additional burden are provisional
- Qualitative results are likely to be very robust to uncertainty: additional burden in people who would be saved by mechanical ventilation will be high in LMICs
- Likely to increase the % mortality in younger ages and push estimates of per-capita mortality in mitigation scenarios in LMICs towards that in HICs.

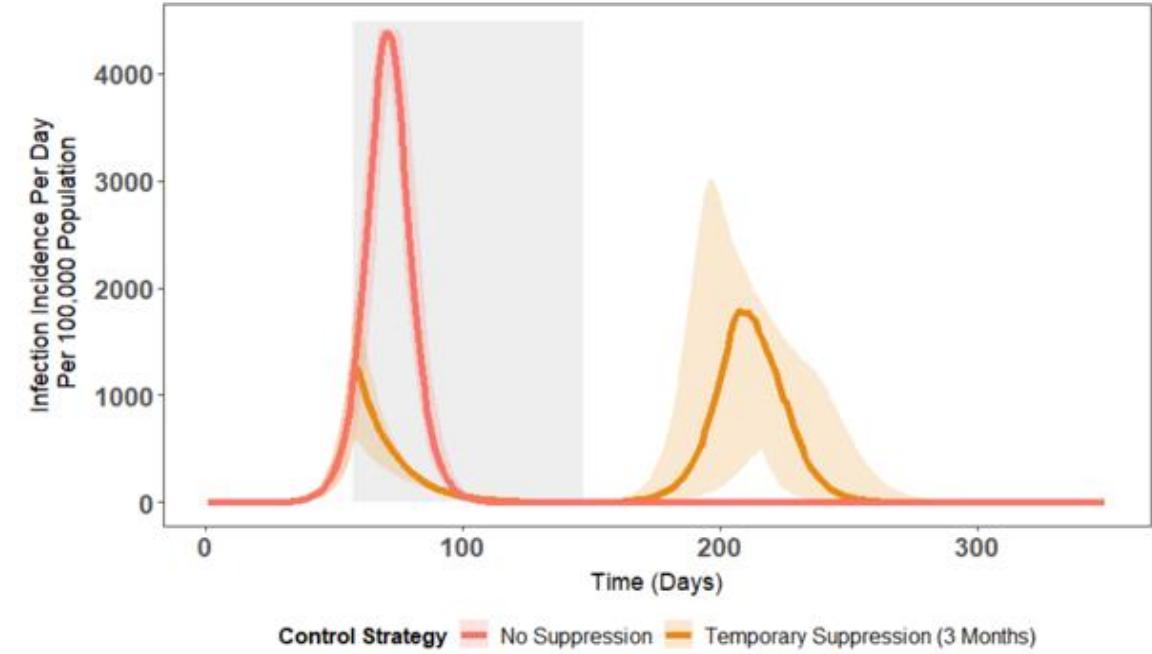
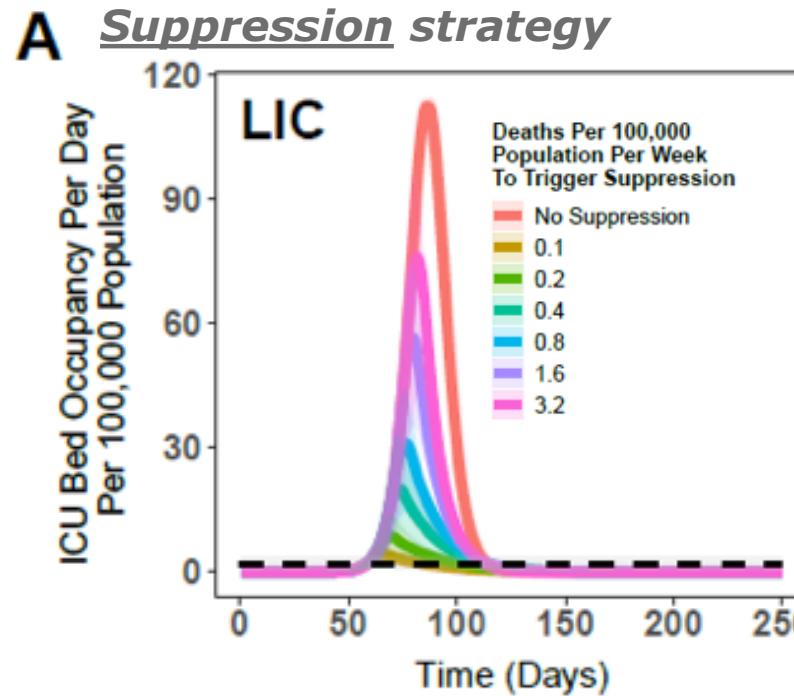


What is a relevant comorbidity?

- Many of the important comorbidities identified so far are more prevalent in HICs
- Predominantly due to their correlation with age but also some impact of lifestyle factors and survivorship with comorbidities outside of pandemic (e.g. lower availability of heart bypasses in LMICs)
- Many reasons for concerns about other potential comorbidities that are more prevalent and have lower age-distributions
- Harder to define most vulnerable (etc. for shielding strategies) in LMICs



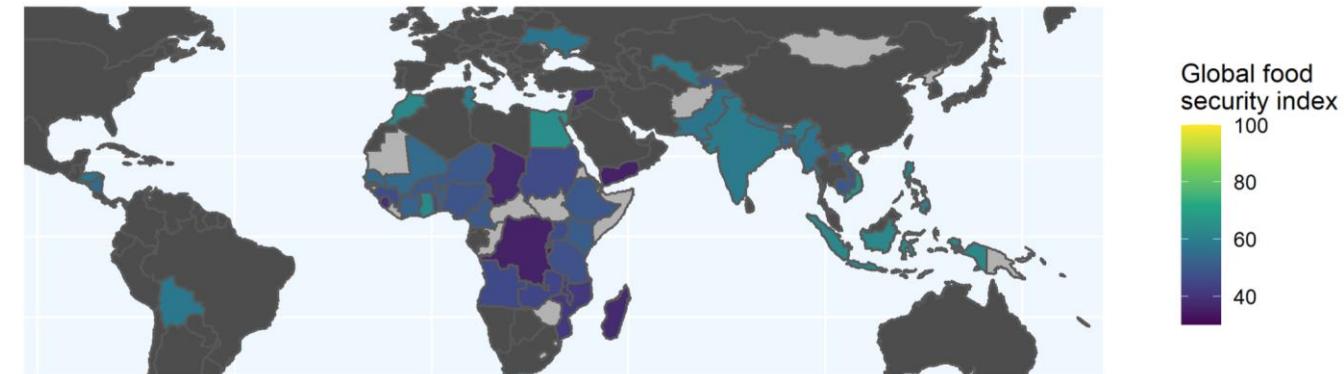
COVID-19 poses a problem with no easy solutions



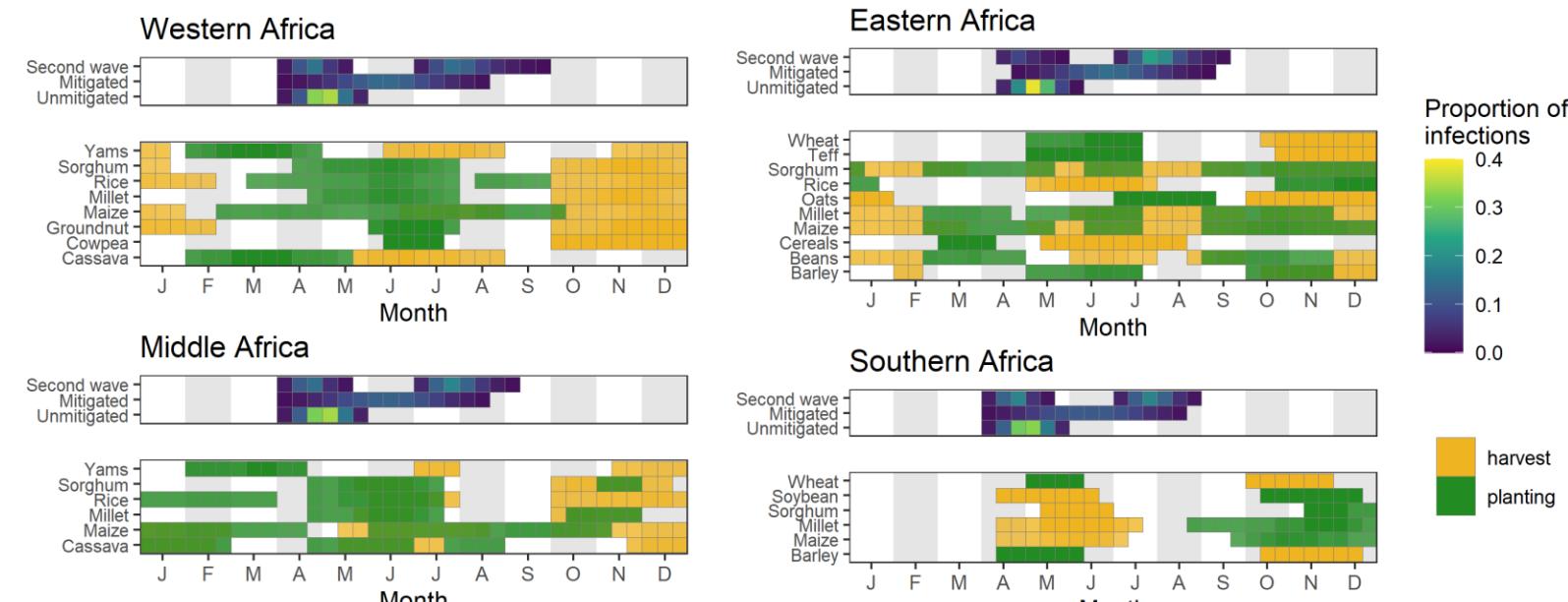
- Unless infection is suppressed all countries likely to experience heavy burden and have health systems rapidly overwhelmed
- However, in absence of intensive testing approaches requiring capacity most LMICs countries lack, short-term suppression with “Lockdown” NPIs risk second waves and limited long-term impact if they subsequently return to previous levels of social contact.
- Particularly the case in countries lacking ‘surge’ capacity to build healthcare capacity whilst lockdown in place.

Indirect effect of both COVID-19 and suppression likely to be higher in LMICs

- Lower income settings are more vulnerable to disruption e.g. to supply chain and ability to earn – will be affected both by the direct effects of virus and social distancing measures



- Need to consider that interventions, whilst reducing impact, may extend or delay the peak

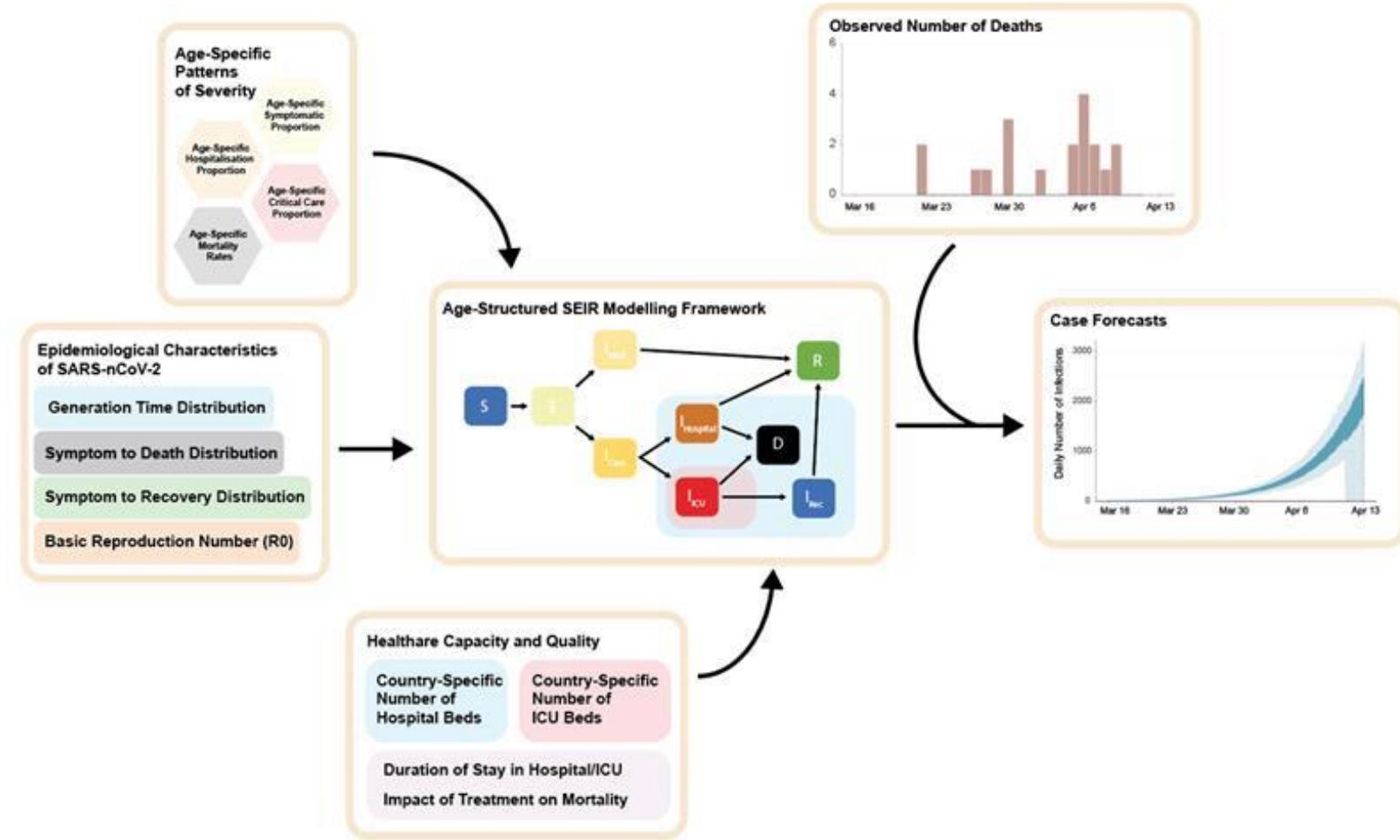


- Impact of scenarios will vary by region: e.g. where epidemic or to timings of NPIs coincide with key periods in staple crop calendar

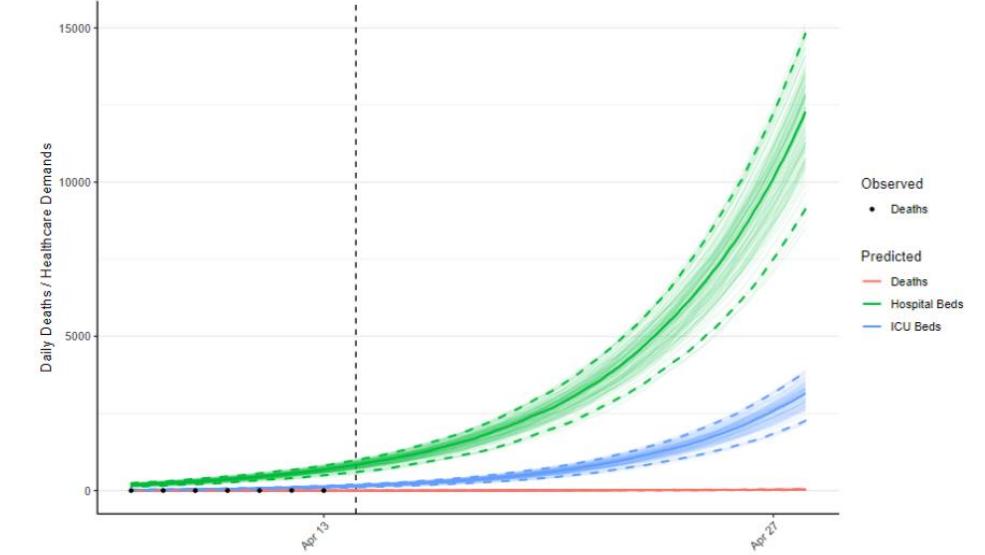
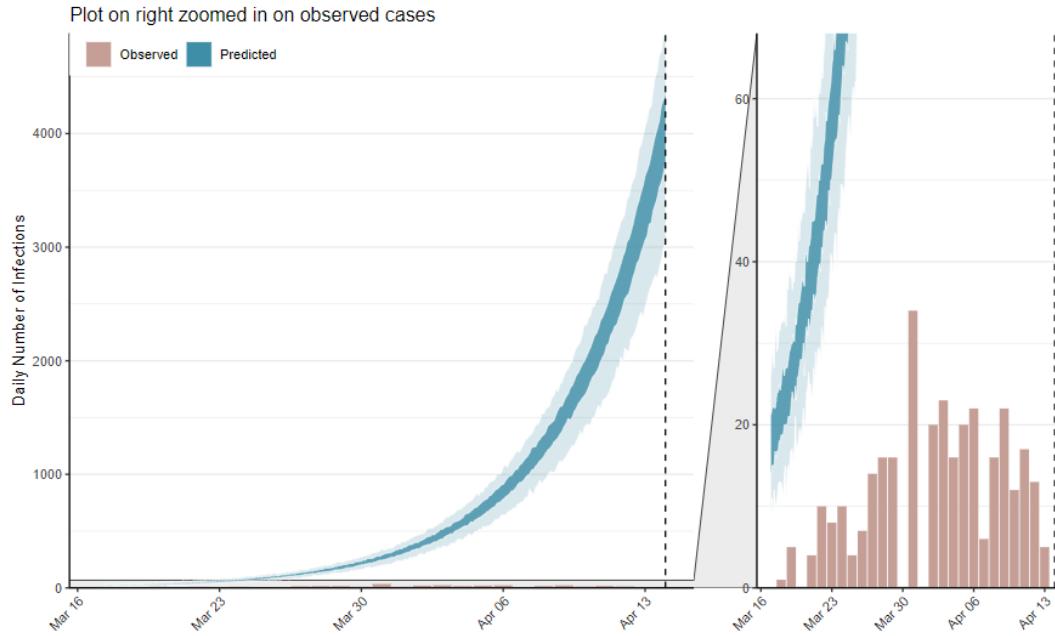
- The majority of countries are still at quite an early stage of the pandemic – approximately 80% have yet to report 100 deaths due to COVID-19
- Case reporting systems will vary widely in the % of cases they identify and this will change rapidly over time (e.g. as cases and surveillance effort moves from travellers to locally acquired infection)
- Deaths likely to provide the most reliable indicator of trends but only ~0.5% of infections lead to death and deaths only likely to occur ~23 days after infection
-> 1 death equates to approximately x current infections on average

Modelling framework for estimating global impact

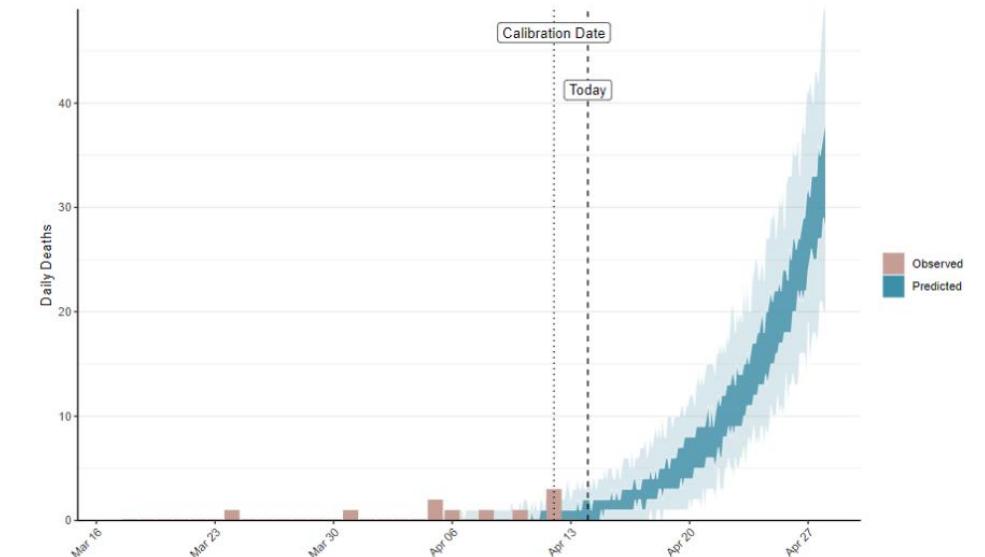
- Developed a relatively simple model framework capable of capturing key dynamics of more sophisticated Imperial micro-simulation
- Inputs:
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 - Demographics
 - Contact structure
 - Healthcare capacity and impact of treatment (or its absence)
 - Data on current observed trends in deaths by country



Short-term forecasts of healthcare demand



The predicted daily death count is shown in the final figure.



- Aim to place current observed deaths within LMICs in correct context in terms of likely magnitude of ongoing spread and demand for healthcare in coming weeks (to be iterated continuously as more data comes available)

<https://mrc-ide.github.io/global-lmic-reports/>

(To be launched in coming days)

Conclusions

- Many LMICs yet to see mortality on the same scale currently seen in some countries but prudent to assume this is primarily due to being at an earlier stage in their respective epidemics
- All countries are at very high risk of seeing large-scale epidemics that are likely to threaten or overwhelm health systems if not suppressed in coming weeks and months leading to significant excess morbidity
- LMIC economies more vulnerable to indirect effects of non-pharmaceutical interventions (e.g. “lockdown”). However, lockdown if applied temporarily comes with high risk of a second wave.
- Shielding most vulnerable (e.g. elderly) will reduce burden but unanswered questions about what makes people vulnerable to severe disease outside of HICs (e.g. other infections, malnutrition)
- *Difficult decisions need to be made and rapidly but any reductions in contact rates that are achieved and sustained towards mitigation will have a large impact (though are unlikely to be able to prevent the pandemic causing a severe acute health impact)*

Acknowledgements

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