The impact of non-pharmaceutical interventions on COVID-19 transmission in Malawi

Tara Mangal* (ICL), Tim Hallett (ICL), Andrew Phillips (UCL), Tim Colbourn (UCL)

for Thanzi La Onse

Azra Ghani, Patrick Walker, Charlie Whittaker, Pete Winskill, OJ Watson

On behalf of the Imperial College COVID-19 Response Team

Objectives

1. Calculate infection fatality ratios for the Malawian population adjusted to match the age, sex and disease profiles of key comorbidities
    - HIV, TB, diabetes, CVD, COPD, malaria

2. Estimate the potential impact of mitigation strategies on SARS-CoV-2 spread
    - intervention bundles
    - individual interventions

3. Estimate the potential impact of face covering under different assumptions of efficacy and extent of proper use

Methods overview

- Uses the Imperial College London Global Impact of COVID-19 Model
- Details of the model: https://mrc-ide.github.io/squire/ along with access to the model code (https://www.imperial.ac.uk/media/imperial-college/medicine/mrc-gida/2020-03-26-COVID19-Report-12.pdf)
- The model is adapted to adjust for the underlying comorbidities in the Malawian population and estimated relative risks of disease severity given infection with SARS-CoV-2
- Hospital and ICU capacity for Malawi are included
- The interventions are applied once the death rate exceeds 1.0 per 100,000 population per week (trigger day)

Assumptions on R0

- Considerable uncertainty in R0 estimates

- Not an intrinsic property of the virus but dependent on environment and contact rates

- The slow increase in case numbers currently reported consistent with wide range of R0 values
  - Could be high (R0=3) and imperfect surveillance is missing some cases
  - Could be low (R0=1.5) due to the nature/number of contacts between people

- Tools developed by LSHTM and ICL allow users to vary R0 and see predicted spread of virus under range of intervention scenarios

- Here we'll assume R0=2.4

- Accepting that there is uncertainty but that the relative impact of the interventions will hold for a range of R0 values although the absolute levels of the peaks may differ

Age-distribution of infection fatality ratios in Malawi

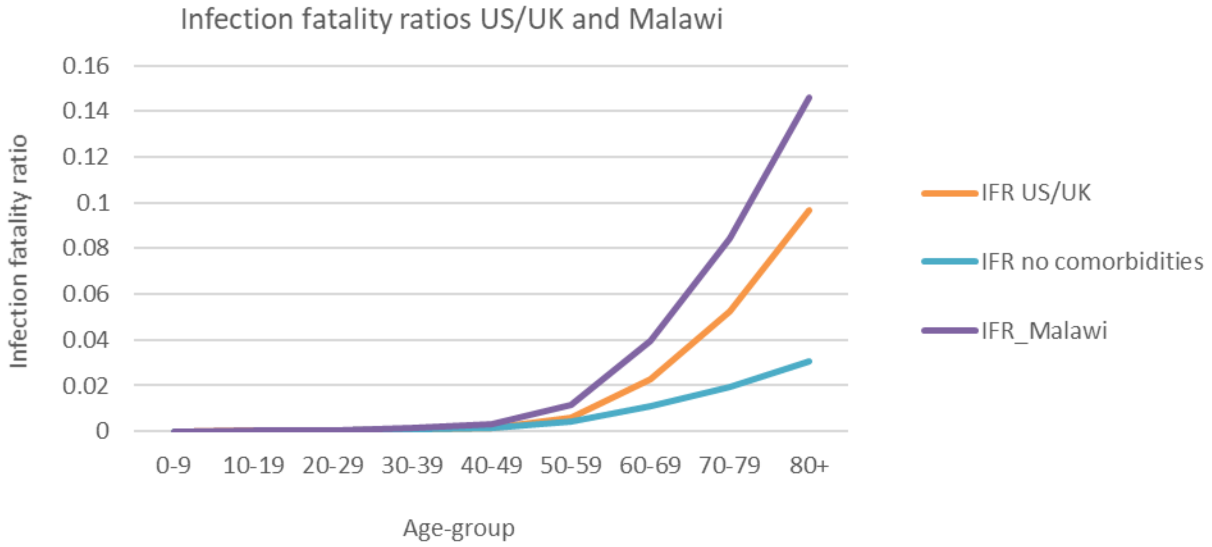
The proportion of COVID-19 cases in Malawi who would require hospitalisation were derived from high-income settings

The proportion requiring ICU was estimated using the comorbidity prevalence by age/sex in Malawi

The fatality ratio for severe/ICU cases in Malawi was fixed at 100%

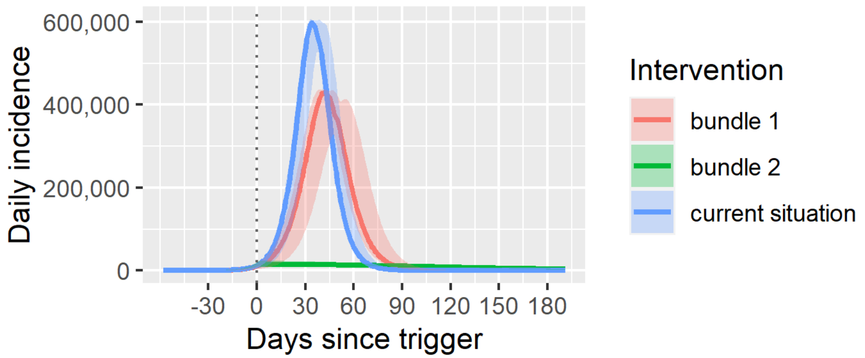
Condition	Relative risk severe disease
None	1
HIV	1.5
TB	1.5
NCD	3.4
COPD	2.7
Malaria	1.5

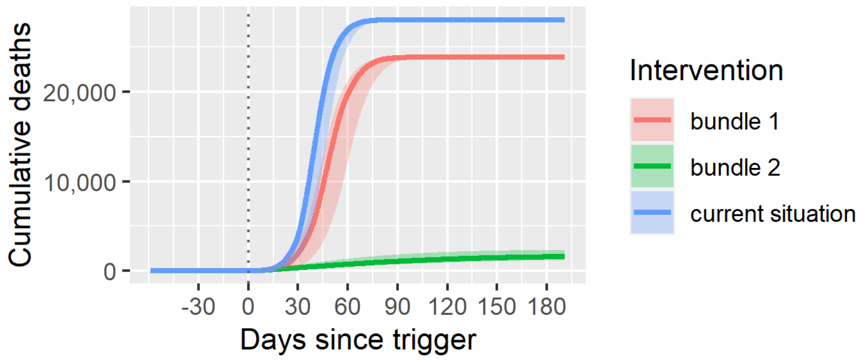
Age, years	Sex	Proportion requiring hospitalisation	Proportion hospitalised cases requiring ICU	Fatality rate for ICU cases	Infection fatality ratio
0-9	male	0.001	0.055	1	0.0001
10-19	male	0.003	0.054	1	0.0002
20-29	male	0.012	0.053	1	0.0006
30-39	male	0.032	0.052	1	0.0016
40-49	male	0.049	0.064	1	0.0031
50-59	male	0.102	0.114	1	0.0116
60-69	male	0.166	0.237	1	0.0394
70-79	male	0.243	0.348	1	0.0845
80+	male	0.273	0.534	1	0.1458



(*https://www.imperial.ac.uk/media/imperial-college/medicine/mrc-gida/2020-03-26-COVID19-Report-12.pdf)

Impact of two intervention bundles compared with the current situation



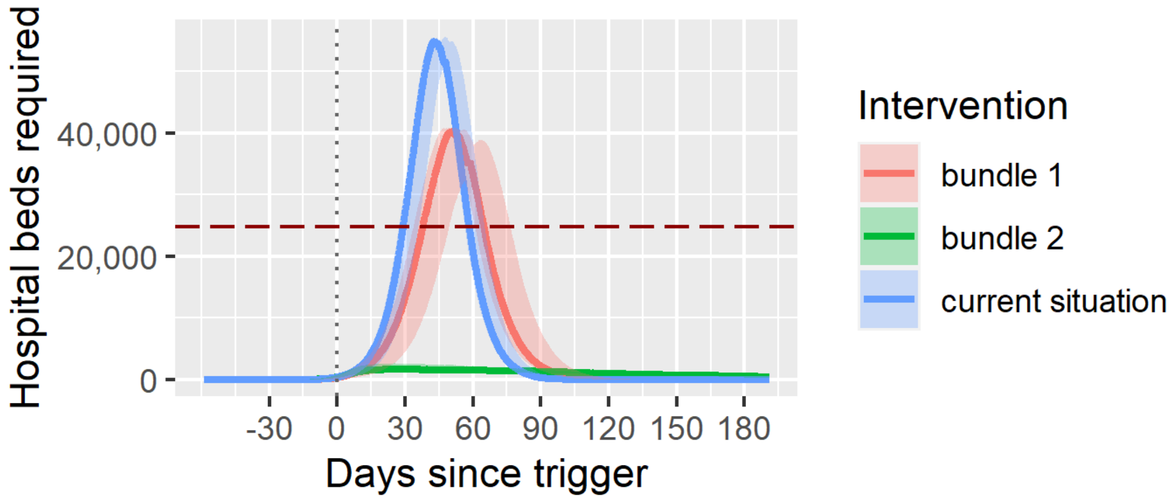


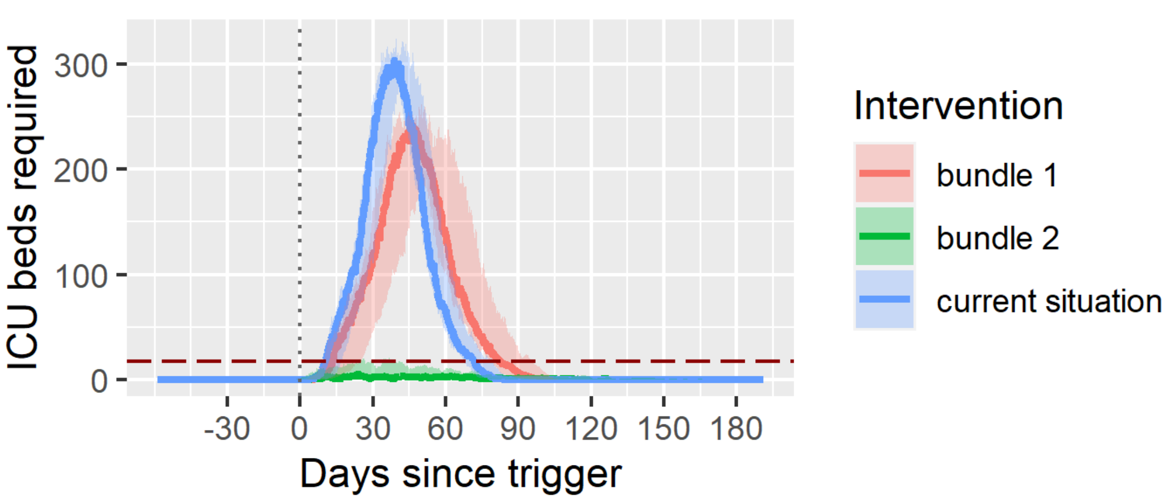
1. Current situation: Social distancing Rotational work schedules Max number in public transit vehicles Self-quarantine for returning individuals Restriction of gatherings to 100	reduction in *Rt* of 11%*
2. Bundle 1: The above, plus: Work from home if possible Limit movements to essential activities Maximum gatherings at 10 people	reduction in *Rt* of 16%*
3. Bundle 2 (“lockdown”): The above, plus: Shelter in place Restrict movements to essential activities Enforce social distancing in excepted businesses Prohibit public transportation Prohibit all gatherings outside HH	reduction in *Rt* to 1.

*Source: Flaxman, Seth, et al. (2020).

The trigger date corresponds with exceeding 1.0 deaths per 100,000 population per week (grey dashed vertical line)

Impact of two intervention bundles compared with the current situation

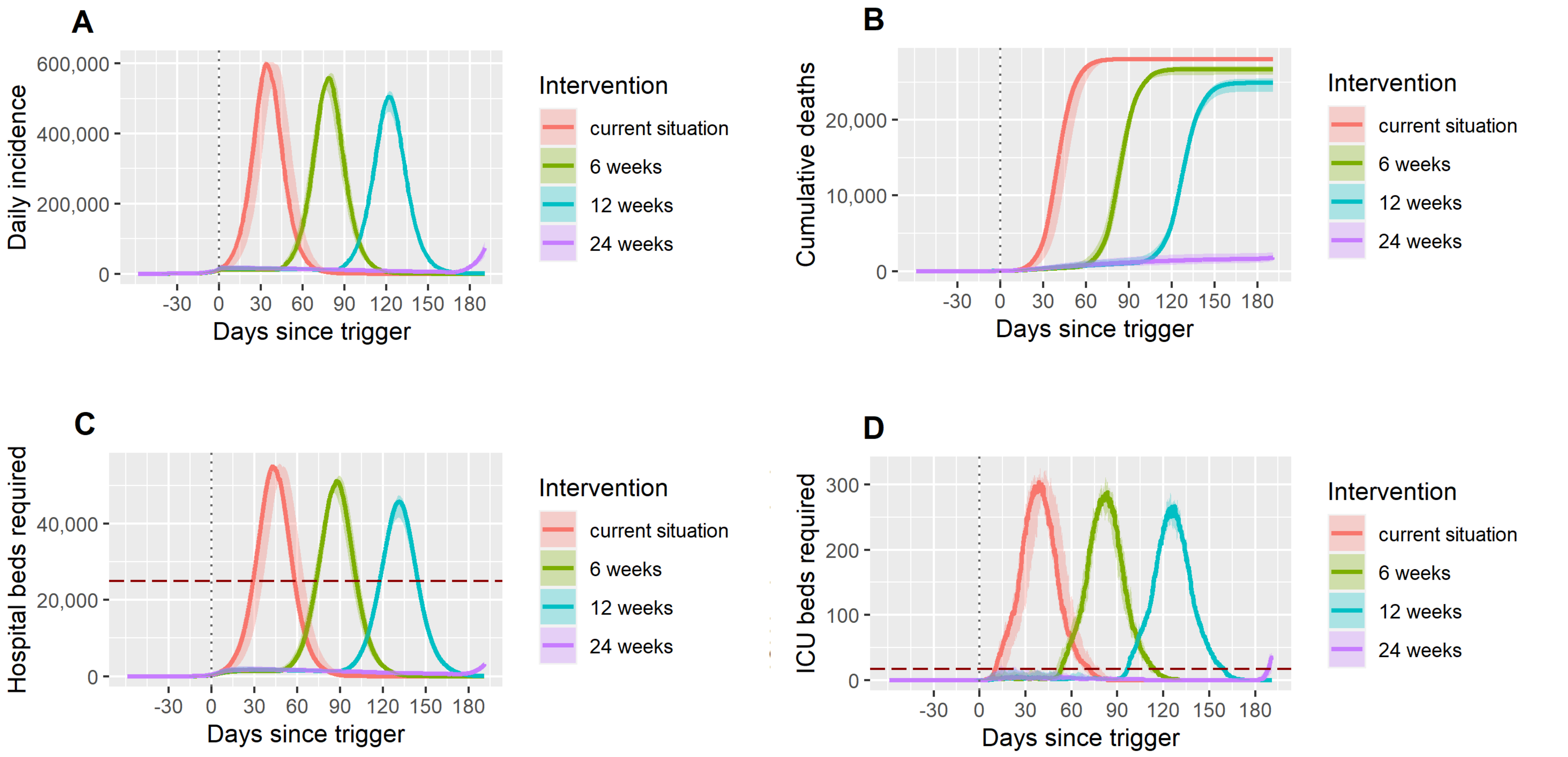




The trigger date corresponds with exceeding 1.0 deaths per 100,000 population per week (grey dashed vertical line)

The current hospital bed capacity and ICU bed capacity are shown in red dashed lines

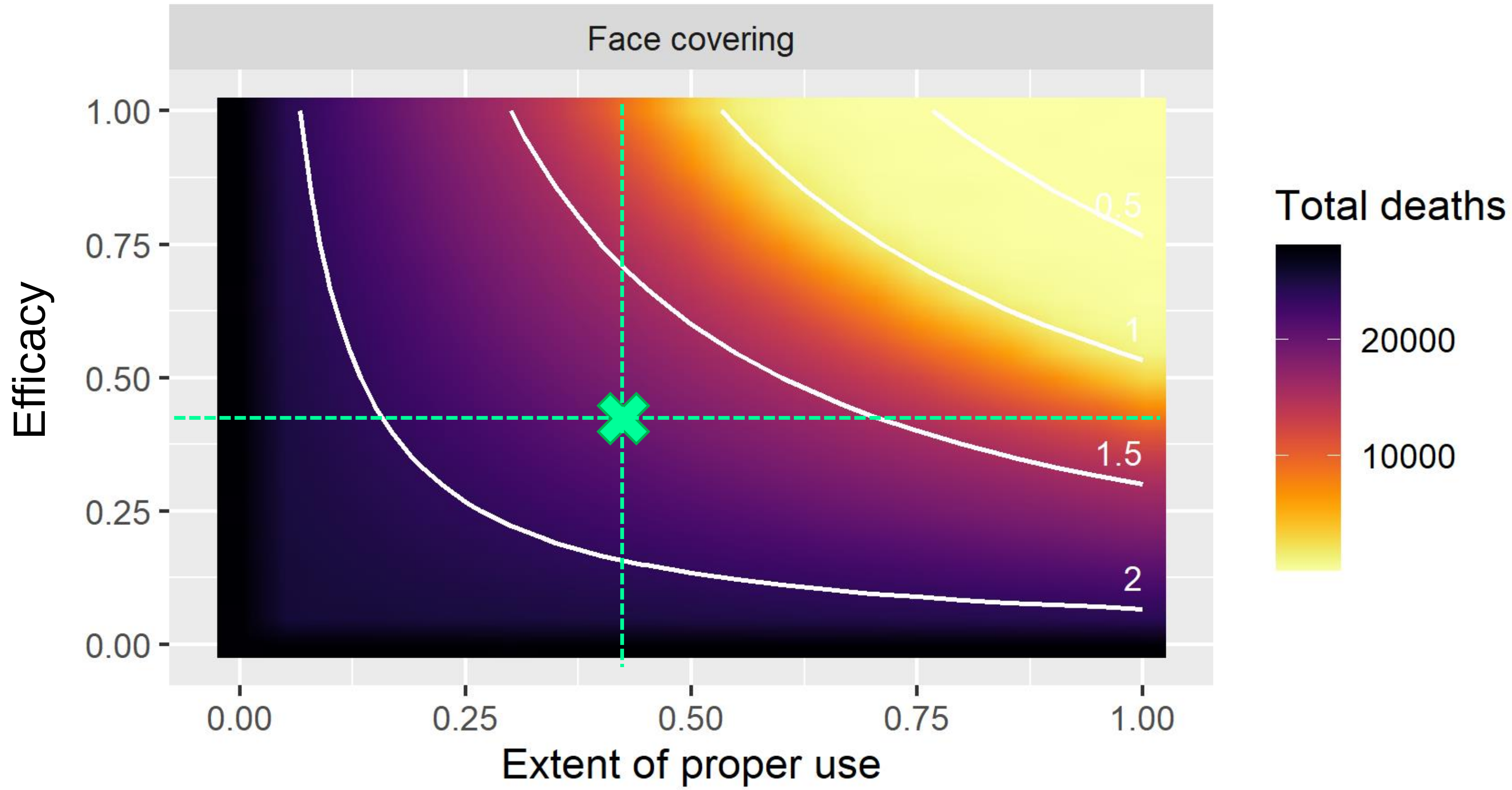
Impact of changing the duration of intervention bundle 2 (“lockdown”)



The trigger date corresponds with exceeding 1.0 deaths per 100,000 population per week (grey dashed vertical line) and continued for 6, 12 or 24 weeks.

The current hospital bed capacity and ICU bed capacity are shown in red dashed lines in figure C and D.

Impact of face covering on predicted numbers of deaths



Key messages (1)

- A younger age-structure and a lower level of the comorbidities thought to be most important may result in lower proportions of hospitalised cases requiring intensive care

- Without sufficient capacity to treat such cases, the expected infection fatality ratios are likely to be higher than in high income settings

- The findings are based on data as far as possible – but rely heavily on modelling assumptions
  - ICL, LSHTM and WHO AFRO models all use different assumptions
  - In an emerging pandemic, there will always be a lot of uncertainty
  - The relative findings of intervention impact should hold across different assumptions of R0

Key Messages (2)

- The most effective strategy for reducing transmission of COVID-19 is a combination of interventions (bundle 2: “lockdown”) which includes social distancing, restrictions on population movement, prohibition of public transport and face covering.

- Shielding of those at highest risk (≥60 years) in theory should significantly reduce deaths
  - **BUT is this feasible in this setting?**
  - The ICL model assumes a significant drop in contact rates with this strategy but the LSHTM model assumes very little impact
  - The reality is that this strategy will be difficult in practice, particularly in multigenerational households

- Strategies limited to minor changes in working practice and public transport would not be likely to have a major impact

Key Messages (3)

- The timing of introduction and the duration of interventions can have a significant impact; earlier interventions that last until there are pharmacological interventions would have the greatest impact but the feasibility and societal impact may render this impracticable

- The possibility of resurgence once interventions have been lifted is a significant concern, particularly for those highly effective interventions which would prevent herd immunity

- Modelling studies show testing and contact tracing could be sufficient to stop the epidemic if used by enough people (and in combination with other measures, e.g. social distancing) [Ferretti, Luca, et al. (2020)]

- Evidence suggests certain types of face covering reduce viral spread from infected persons if worn correctly

Acknowledgments

Thanzi la Onse team

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- Prof Andrew Phillips
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https://thanzi.org/

Imperial College London

MRC Centre for Global Infectious Disease Analysis, Imperial College London

Imperial College COVID-19 Response Team

https://www.imperial.ac.uk/mrc-global-infectious-disease-analysis/covid-19/

COVID-19 Scenario Analysis Tool

https://covidsim.org/v1.20200506/?place=Malawi

LSHTM: https://cmmid.github.io/topics/covid19/

Partners

East, Central and Southern Africa Health Community — Fostering Regional Cooperation for Better Health

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