The impact of adding school closure to other social distance measures

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Summary
- Adding school closure to the existing package of interventions is likely to further reduce deaths by around 9%.
- Closing schools now or after Easter makes little difference to the overall impact as case numbers are low at present.
- Compensating behaviour, whereby some children are looked after by elderly individuals reduces the impact of the policy, but is highly unlikely to negate the overall beneficial impact of school closure.

Aim
To assess the potential additional impact of adding school closure either immediately or after the Easter break to the mixed package of interventions announced on 16th March 2020.

Methods
We use the LSHTM age-structured stochastic transmission dynamic model. We used a county-level model (London boroughs are treated separately), and aggregated the data to the national level. Model results are for England. We assume that 50% of cases of any age are asymptomatic. Counties/boroughs, were seeded as before so that London boroughs were more likely to be seeded first and there was a roughly 30-35 day delay in peaks in an unmitigated epidemic. The seeding produced around 400-600 cases per day in London and similar numbers outside London on 16th March, which is roughly in line with the estimates from current nowcasting. Social distancing was put in place to capture those measures put in place on 16th March. This package of interventions are labelled "Intervention" in the figures and tables and they include:
1) Case-isolation, which reduces the transmission of clinical cases by 35%.
2) Cocooning of high risk individuals and those of the age of 70. We assume that 10% of adults under the age of 70 are high risk. Cocooning is assumed to result in a reduction in "Other" and "Work" contacts (as measured by POLYMOD) to 25% of their normal values
3) Home working: we assume reduces "Work" contacts by 30%, and "Travel" contacts by a similar amount.
4) A reduction in "Leisure" contacts by 75%.

NOTE: the model is compartmental in nature and not able to simulate household quarantine, so may underestimate the impact of the package of measures revealed on the 16th March.

To this package of measures, school closure is added, either immediately (17th March) or after the Easter holidays. School closure is assumed to continue until September.

5) In the base case, school closure is assumed to reduce "School" contacts to zero with no compensating changes in mixing. Note that "School" contacts as measured in POLYMOD also include college and university contacts.
6) As a sensitivity analysis, we look at a number of compensating strategies where children increase their contact with the elderly as a result of school closure. We assume that either 10, 20, or 50% of school-age children make one contact with one additional elderly person per weekday. These are labelled E10 / E20 / E50 respectively.

Results

The package of measures announced on March 16th is expected to reduce the peak height and size of the epidemic (see figure and table). However, substantial numbers of cases and deaths remain, and peak demand is likely to far exceed the capacity of the health service. Adding school closure is expected to reduce this peak demand further (figure) and the total number of cases. Under base-case assumptions adding school closure to the package of interventions reduces deaths by a further 24,000 over the course of the epidemic (an additional reduction in deaths of about 9%). Closing schools now or after Easter makes little difference to the total size of the epidemic.

Increasing contact between children and the elderly as a result of school closure can reduce the impact of the policy on preventing additional deaths and hospitalised cases. However, the compensatory behaviour has to be very large for this to mitigate the effect of school closure entirely. For instance, even if 50% of children have an additional daily contact with an elderly individual, then the overall impact of school closure is still positive – reducing the median estimate of deaths from around 290,000 without school closure to 282,000 with school closure (table).

Even with school closure, the UK is likely to experience a large epidemic which will result in overwhelming demand for health services.

Scenario	Cases, thousands Median (IQR)
Base	24100 (21900-25500)
Intervention	19900 (16100-22000)
Measures (17 Mar sch. cl.)	18000 (16400-20000)
Measures (Easter sch. cl.)	17800 (16200-19900)
Measures (17 Mar) / E10	17900 (16300-20000)
Measures (17 Mar) / E20	17900 (16300-20100)
Measures (17 Mar) / E50	18100 (16500-20300)

	Deaths, thousands Median (IQR)
Base	447 (383-496)
Intervention	290 (217-344)
Measures (17 Mar sch. cl.)	266 (222-317)
Measures (Easter sch. cl.)	264 (220-317)
Measures (17 Mar) / E10	268 (224-320)
Measures (17 Mar) / E20	271 (228-324)
Measures (17 Mar) / E50	282 (239-334)

	Non-ICU beds occupied, thousands Median (IQR)
Base	26100 (22700-28700)
Intervention	18100 (13900-21200)
Measures (17 Mar sch. cl.)	16700 (14100-19600)
Measures (Easter sch. cl.)	16600 (14000-19600)
Measures (17 Mar) / E10	16700 (14200-19700)
Measures (17 Mar) / E20	16900 (14400-19900)
Measures (17 Mar) / E50	17400 (14900-20400)

	ICU beds occupied, thousands Median (IQR)
Base	3520 (3020-3910)
Intervention	2290 (1710-2710)
Measures (17 Mar sch. cl.)	2090 (1750-2500)
Measures (Easter sch. cl.)	2080 (1730-2500)
Measures (17 Mar) / E10	2110 (1760-2520)
Measures (17 Mar) / E20	2140 (1790-2550)
Measures (17 Mar) / E50	2220 (1880-2630)

Table: Estimated number of cases, deaths and ICU/non-ICU hospital beds over the course of the epidemic under different mitigation strategies.
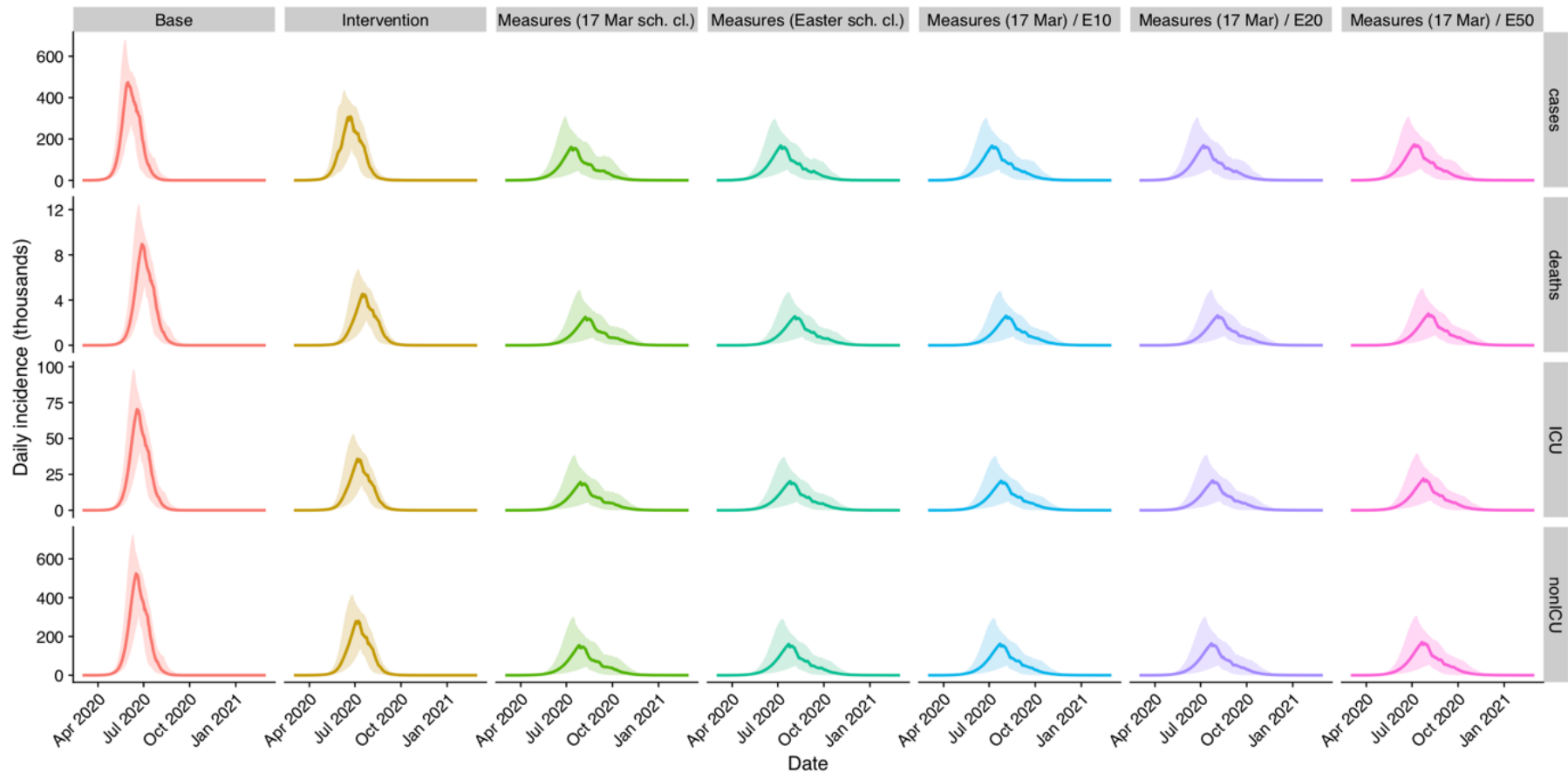
Figure: Estimated national epidemic curves for no intervention (Base) the currently announced set of interventions (not including HH quarantine, "Intervention") and school closure (the right hand 5 columns). Columns three and four are for immediate school closure, or school closure after Easter, respectively. The right hand three columns are for immediate school closure with compensating behaviour in which increasing proportions of children have an additional weekday contact with an elderly individual.