Department for Education

Explanatory note on SAGE paper: Interdisciplinary Task and Finish Group on the Role of Children in Transmission: Modelling and behavioural science responses to scenarios for relaxing school closures

This note outlines the key modelling findings of SAGE's paper entitled *Interdisciplinary Task and Finish Group on the Role of Children in Transmission: Modelling and behavioural science responses to scenarios for relaxing school closures*.[1] It provides guidance on interpreting the results, the main assumptions made in the analysis and the limitations of the modelling.

1. What is the purpose of the SAGE paper?

The paper assesses the potential impact of more children returning to school on the transmission of SARS-CoV-2 (which causes COVID-19) based on analysis from four separate modelling groups. The paper considered a broad range of specific scenarios requested by DfE, to help understand the relative impact of different approaches on R (the effective reproduction number of the virus). The paper also discusses the behavioural and implementation issues of opening education settings to more pupils. The paper was produced by a subgroup of the Scientific Advisory Group for Emergencies (SAGE), the Children's Task and Finish Working Group.

2. What does the analysis find?

The modelling makes **no assessment of the absolute impact on R, and so does not predict whether R will increase above 1 or not, for any of the scenarios**. Instead, the paper helps to establish an approximate rank ordering of options for opening schools to more children in terms of the **relative impact on transmission of the virus.**[2] Importantly, these findings should be interpreted as indicative: the paper explicitly notes that the results "should not be taken as a definitive answer on whether to pursue specific scenarios for partial re-opening".[3]

Each scenario for relaxing school closures is estimated to increase transmission (as would be expected from any change that increases contacts between people). The modelling also provides several insights for minimising the impact on R of increasing attendance in settings:

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[1] The full paper is available at the following link. See the SAGE website for further updates on COVID-19 response and evidence on the wider impacts of increasing attendance in educational settings.

[2] Any modelling of the estimated absolute impact on transmission depends on the proposed timing of school re-openings (and the background incidence of COVID-19); which other behavioural and social interventions are in place and level of adherence to these; how schools actually implement each scenario (e.g. physical distancing, hygiene etc) and the number of children who actually choose to attend schools under each scenario – among other issues. These questions are beyond the scope of the paper.

[3] See paragraph 14 of the SAGE paper.

- **Limiting the extent and breadth of contacts** between children, households, and schools (e.g. where children from the same household attend different schools) is key to reducing transmission.

- Scenarios where **fewer children are interacting** in school tend to have a lower impact on transmission. This may be by reducing the number of children who return or segmenting attendance (such as with a one week on, one week off arrangement).

- Modelled scenarios in which **younger children are returned** to school tend to have a lower impact on transmission. All models consistently show that resuming early years provision has a smaller impact on R than resuming provision for primary schools, which in turn has a smaller impact than resuming secondary schooling. This is partly due to higher social mixing among secondary school children.

However, there are three important caveats to these insights.

First, the paper provides an initial approximation of the relative, direct impact of different scenarios. The modelling does not include the *indirect* impact on other contacts beyond those in school. Some of these may differ by age of child – for example, increasing attendance of younger children may allow more parents to return to work relative to increasing attendance of older children.

Second, the modelling only focuses on the direct epidemiological impacts of more children returning to educational settings *in isolation*, without accounting for any changes to wider policy, other behavioural responses to opening schools to more children or adherence to social distancing. The paper demonstrates that, although the choice of scenario for reopening settings to more pupils does make a difference to transmission, this is likely to be of secondary importance compared to whether *wider* social distancing practices are adhered to in the community.

Third, the paper also provides a range of insights from behavioural science such as the importance of messaging to teachers, parents and pupils for each scenario and adapting children to new routines. The paper is clear that both how different scenarios are implemented within schools, and how any policy change interacts with wider social distancing measures, is critical to the impact on transmission. It notes that implementing physical distancing and hygiene measures inside school may be more challenging for different ages of children, but the differing effects are not modelled in this analysis.

3. How should the modelling results be interpreted?

These results should be interpreted cautiously. The paper states that “calculations of a numerical relationship between relaxation of different measures and changes in R overstretch the natural and behavioural science available to us now” and that consequently “SPI-M cannot say with consensus, which combination of useful policy changes will result in R remaining below 1”.[4]

Interpreting the main tables

The main results of the four models are presented in Tables 3 and 4 (in the annex to this explanatory note) for each of the nine main scenarios.

The numbers presented are **not** a prediction of R – instead, they estimate how R might **change** under each scenario. For example, a value of 1.05 in Table 3 represents an

[4] SPI-M is the Scientific Pandemic Influenza Group on Modelling

estimated 5% increase in R – it does **not** mean that R would be 1.05 in that scenario. In this hypothetical example, if R was currently estimated to be 0.7, then a 5% increase would mean R would rise to 0.735 (i.e. 0.7 × 1.05). As the results are subject to significant uncertainty, the assessment of overall trends is more important than the precise numbers.

Interpreting the charts (figures 1 and 2)

The headline results are also broken down for different key assumptions used in the modelling, such as infectiousness of children. Each model shows that the impact on transmission is reduced if children are assumed to be less infectious relative to adults. Figure 2 demonstrates this relationship graphically.

The Bristol/Exeter model also estimates the proportional increase in transmission depending on adherence to, and level of, wider social distancing for the eight different scenarios modelled (see figure 1). This shows that deteriorating adherence in the community could have a much larger proportional impact on R than any specific school reopening scenario.

4. How were the scenarios modelled, and what assumptions were made?

The four models take different approaches and use different data, so their results are not identical. The paper presents the range of findings and uses these to form a consensus view about the *relative* risks of transmission of the virus under each of the different scenarios.

Three of the models estimate the impact of opening educational settings to more children by:

a. using 'contacts' data which look at social mixing patterns in everyday life – this considers the number, duration, and type of social contacts made, the setting where these take place; and demographic information of the people involved;[5]

b. using this data to estimate the frequency, type and setting of ‘contacts’ children and school staff *would* have in each scenario for reopening settings to more children; and

c. estimating how these additional ‘contacts’ would affect the transmission of COVID-19, using the best available evidence on the transmissibility of the virus.

In short, the models use our understanding of how people interact in schools to estimate the spread of the virus in settings when reopened to more children, and the impact on R.

The fourth approach is a dynamic model that estimates how people move between states of being susceptible to a virus, to being exposed, infected, and ultimately resistant.

The groups modelled a range of scenarios for educational settings – from remaining open only to vulnerable children and children of critical workers at current levels of attendance (baseline 1), to fully reopening to all children (baseline 2).

What assumptions do the models make?

Many of the modelling assumptions made are conservative, and the paper makes clear that the modelling is likely to provide an ‘upper end estimate’ of the direct impact on R. However, as indirect impacts are not modelled, the full impact on transmission of opening settings to more pupils is likely to be higher.

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[5] These models use contacts data from the BBC Pandemic Study, POLYMOD and the Social Contacts Survey; these consider contacts made pre-COVID-19, but the impact of lockdown is simulated as a baseline

For example, the central assumptions in the model include children being as infectious as adults, that no additional physical distancing measures are in place in school, that adherence to wider social distancing measures is unchanged and that there is full take up of school places. However, accounting for these factors may change the results (e.g. while the evidence on susceptibility and infectivity of children remains inconclusive, the balance of evidence does suggest that both may be lower than in adults, but this is not certain).[6]

The models test these assumptions as sensitivities, such as in figures 1 and 2, and Table 4.

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[6] However, we do know that there is a high degree of scientific confidence that the *severity* of the disease is lower in children than in adults. DfE (2020) – [Overview of scientific advice and information on coronavirus (Covid-19)]

Annex: Tables and Figures

Table 3: Relative assessment of modelled scenarios 1 to 9[7]

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9
		Stay Shut	More vulnerable children and key worker kids	Transition years 5/6/10/12, this side of summer holiday	Early year settings	All primary	All secondary	Half time A (Full class, 2 weeks on/two off – full attendance)	Half time B – Half class in AM/PM each day	Fully reopen
	Some likely sensitivities to assumptions. For most, we have assumed that other contacts beyond school are unchanged (Warwick's is the exception: more household contacts if not in school).	*N/A*	*Models are taking simplification that this 11% is uniform. Heterogeneity in distribution across schools will increase risk of local outbreaks.*	*Models are assuming normal class sizes: could be better than this if classes can be split to make use of partially empty school*	*N/A*	*N/A*	*N/A*	*Assuming half in each staggered group. Result below for pessimistic assumption that total contacts remain the same.*	*Assuming half in each group.*	*N/A*
LSHTM/Cambridge Using BBC all contacts data (Cambridge results for scenario 7)	infectiousness = 1	1	1.007	1.04	1.011	1.083	1.096	1.092	1.1	1.257
	infectiousness = 0.75	1	1.004	1.02	1.007	1.035	1.042	1.073	1.077	1.179
	infectiousness = 0.5	1	1.002	1.009	1.004	1.013	1.016	1.06	1.062	1.132
	infectiousness = 0.25	1	1.001	1.003	1.002	1.004	1.005	1.051	1.052	1.106
	Proportion at school	0.024	0.11	0.251	0.21	0.426	0.412	0.5	0.5	1
PHE Using POLYMOD all contact data (Cambridge results for scenario 7)	infectiousness = 1	1	1.036	1.169	1.041	1.432	1.524	1.214	1.259	1.684
	infectiousness = 0.75	1	1.024	1.094	1.03	1.27	1.32	1.147	1.17	1.468
	infectiousness = 0.5	1	1.013	1.042	1.019	1.121	1.135	1.082	1.089	1.244
	infectiousness = 0.25	1	1.005	1.013	1.008	1.032	1.034	1.03	1.03	1.075
	Proportion at school	0.024	0.11	0.251	0.21	0.426	0.412	0.5	0.5	1

[7] Column headings are taken directly from the SAGE paper – a full description of each modelled option is included in that paper. Please note, scenario 1 (described as 'stay shut') refers to schools **staying open** only to vulnerable children and children of critical workers; scenario 2 refers to an increase in the proportion of these children attending school, or widening the criteria, with no other change.

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9
		Stay Shut	More vulnerable children and key worker kids	Transition years 5/6/10/12, this side of summer holiday	Early year settings	All primary	All secondary	Half time A (Full class, 2 weeks on/two off – full attendance)	Half time B – Half class in AM/PM each day	Fully reopen
Bristol/Exeter Using the Warwick Social Contact Survey. Note currently R relative to adherence 0.9 scenario 1	adherence = 0.8, inf =1	1.000	1.028	1.155	1.040	1.170	1.343		1.172	1.508
	adherence = 0.8, inf =0.75	1.000	1.013	1.085	1.016	1.100	1.213		1.097	1.314
	adherence = 0.8, inf =0.5	1.000	1.010	1.047	1.012	1.047	1.116		1.058	1.158
	adherence = 0.8, inf =0.25	1.000	1.009	1.023	1.011	1.016	1.033		1.017	1.047
	adherence = 0.95, inf =1	1.000	1.031	1.164	1.034	1.186	1.391		1.179	1.583
	ad = 0.8, inf = 1 (relative to ad=0.95)	1.193	1.221	1.361	1.226	1.376	1.586		1.385	1.767
	ad = 0.3, inf = 1 (relative to ad=0.95)	2.130	2.170	2.321	2.169	2.330	2.545		2.339	2.744
	Proportion at school	0.02	0.11	0.27	0.15	0.52	0.48		0.5	1
Warwick Full SEIR model. Broadly comparable to 25% infectivity, see Annex F for details	Relative change in growth rate	1	1.005	1.016	1.012	1.012	1.021	1.016	1.047	1.094
	Relative change in growth rate in children	1	1.026	1.084	1.062	1.066	1.11	1.076	1.131	1.258
	Relative change in cases	1	1.006	1.021	1.011	1.014	1.028	1.019	1.046	1.111
	Proportion at school	0.02	0.13	0.18	0.2	0.42	0.38	0.5	0.5	1

Table 4: Relative assessment of modelling outputs: sensitivity analysis for scenario 7[8]

		Scenario 1	Scenario 7a 2 weeks Optimistic	Scenario 7a 2 weeks Pessimistic	Scenario 7b 1 week Optimistic	Scenario 7b 1 week Pessimistic	Scenario 9
		Stay Shut	Half time A (Half class, 2 weeks on/two off – full attendance)	Half time A (Full class, 2 weeks on/two off – full attendance)	Half time A (Half class, 1 week on/two off – full attendance)	Half time A (Full class, 1 week on/two off – full attendance)	Fully reopen
LSHTM/Cambridge Using BBC all contacts data (Cambridge results for scenario 7)	infectiousness = 1	1	1.043	1.092	1.041	1.085	1.257
	infectiousness = 0.75	1	1.035	1.073	1.034	1.07	1.179
	infectiousness = 0.5	1	1.029	1.06	1.029	1.058	1.132
	infectiousness = 0.25	1	1.025	1.051	1.025	1.05	1.106
	Proportion at school	0.024	0.5	0.5	0.5	0.5	1
PHE Using POLYMOD all contact data (Cambridge results for scenario 7)	infectiousness = 1	1	1.096	1.214	1.089	1.192	1.684
	infectiousness = 0.75	1	1.065	1.147	1.06	1.131	1.468
	infectiousness = 0.5	1	1.036	1.082	1.033	1.073	1.244
	infectiousness = 0.25	1	1.013	1.03	1.012	1.027	1.075
	Proportion at school	0.024	0.5	0.5	0.5	0.5	1
Warwick Full SEIR model. Broadly comparable to 25% infectivity, see Annex F for details	Relative change in growth rate	1	1.009	1.016	1.008	1.016	1.094
	Relative change in growth rate in children	1	1.023	1.076	1.025	1.075	1.258
	Relative change in cases	1	1.008	1.019	1.008	1.019	1.111
	Proportion at school	0.02	0.5	0.5	0.5	0.5	1

[8] Please note that there is an error in the descriptions of the optimistic and pessimistic scenarios in the published paper (as of 22 May 2020). The optimistic scenario relates to half class sizes. A correction is being issued for the main paper, and the column headings have been changed in this explanatory note.

Note on interpreting these charts:

These charts give an indicative insight into the relationship between the proportional increase in R, and the infectiousness of children or adherence to other social distancing measures for different scenarios. **The charts should not be interpreted as absolute estimates or forecasts for R. These charts are illustrative and should only be used to understand the relative impact of different scenarios and assumptions on R.**

See paragraph 28 of the paper: “This is a relative comparison of options for school relaxation, not an absolute assessment of their impact. Any assessment of absolute impacts would be dependent on the proposed timing of interventions (background incidence of COVID-19), other behavioural and social interventions in place and adherence to these measures – among other issues.”

Figure 1: Analysis of the Social Contact Survey: the effective reduction number after re-instating school-aged contacts for scenarios 1-6 and 8-9

This assumes that children are as infectious as adults. Baseline R_0 = 3.1

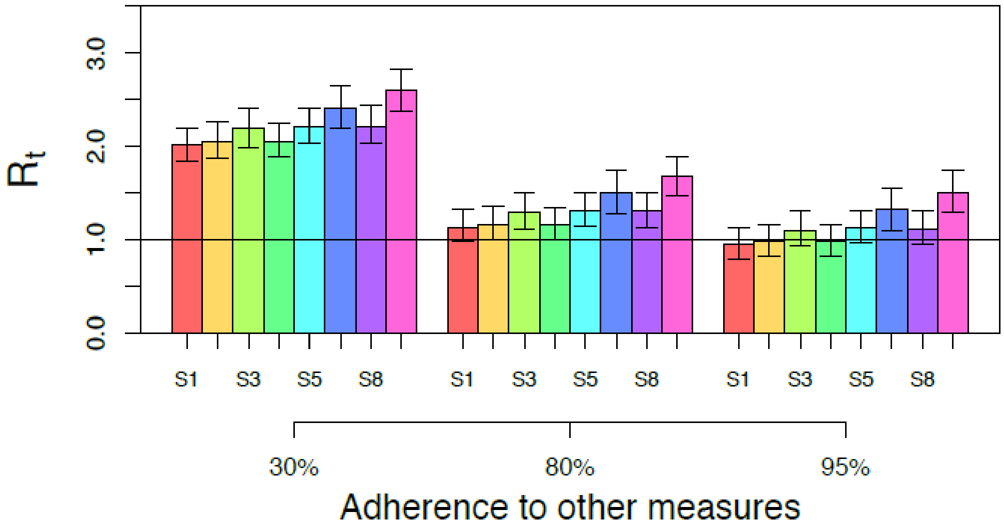

Figure 2: Analysis of the Social Contact Survey: the impact of infectiousness of children on the effective reproduction number when primary or secondary schools are open (scenarios 5 and 6)

This assumes a 90% reduction in all other contacts outside the home. Baseline R_0 = 3.1