BRIEFING:

Impact Analysis for Covid-19 Decision-making: School Opening

February 2021

EXECUTIVE SUMMARY

The human consequences of the Covid-19 pandemic on individuals, families and communities right across the UK is clear to see. The virus has fundamentally affected all of us; through our health, our relationships and our livelihoods. We must also remember that the impacts go beyond the here and now; with significant long-term health impacts predicted and the impact of lost schooling having the potential to impact livelihoods, productivity and life chances well into the future. This short report considers these impacts in the context of the difficult decision facing policymakers with regards to the reopening of school as restrictions of the third national lockdown are loosened. As a baseline, it uses the framework for understanding the range of costs associated with the pandemic and Government responses that was developed by a Legatum Institute report in December 2020.[i]

The starting point is that there are significant costs associated with the closure of schools and that, since 5th January 2021, schooling has taken place remotely in families' homes for the vast majority of children. Along with pupils themselves, teachers and parents have worked hard to make this possible. However, fully remote learning cannot replace the quality of in-person schooling, has a negative impact on children's wellbeing and negatively affects parents' ability to work.

As the impact of the third national lockdown and vaccine rollout starts to be seen in infections and mortality, the Government now faces the decision on when to reopen primary and secondary schools. This involves an incredibly difficult balancing act between the immediate and long-term impacts of lost schooling on children, their families and the country, and the health, economic and social impacts that a potential rise in infections that reopening schools could result in.

This short briefing considers this issue for schools in England. In common with our earlier proof-of-concept evaluation tool, we use the concept of Quality-Adjusted Life Years (QALYs) to allow us to assess health, social and economic costs on a consistent basis. A key challenge with implementing this approach practically is to develop an assumption of society's willingness to pay for an additional QALY. This raises a range of ethical questions over how something as fundamental as additional years of individual lives can be valued. In this respect, it is clear that the intrinsic value of life is immeasurable. However, beneath this, there is a more pragmatic question of how societal resources can best be deployed to maximise wellbeing, including by extending and improving peoples' lives.

Our framework allows us to analyse scenarios that compare:

- **The value of the benefits of school opening**: Using a range of sources we estimate that each day of primary and secondary schools being open delivers benefits worth between 5,250 and 12,750 QALYs.
- **The value of the health consequences of school opening:** We use the outputs from a Susceptible-Infectious-Recovered (SIR) model to estimate the increase in infections, hospitalisations and deaths that schools reopening could trigger. We then estimate the QALYs lost both directly from these and indirectly through knock-on consequences to the health system.

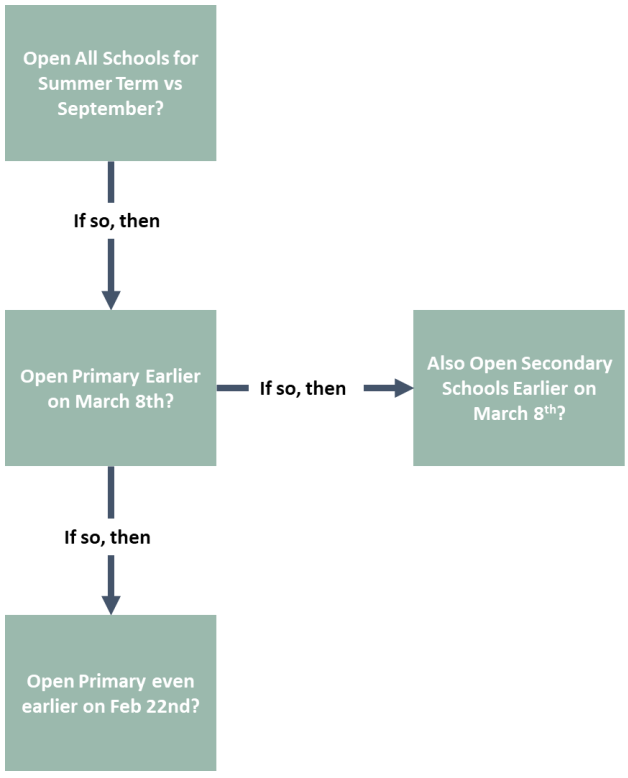
As with the original proof of concept, a vital consideration is the baseline against which these impacts are assessed. We do not compare the reopening of schools against a notional baseline of an indefinite continuation of the closure. Doing so would provide a false comparison (as we know that schools will return) and would lead to virtually all dates of schools re-opening providing net benefits.

Instead, our analysis compares the various costs and benefits of reopening on a specific date against other potential dates for reopening. It also considers different reopening dates for primary and secondary schools.

For the decision currently being taken, we create a staged approach to operationalise this concept (see figure 1). We first consider whether there would be net benefits from opening schools in England for the 2020/21 Summer term (April 19th), as opposed to re-opening for the start of the 2021/22 school year (in September 2021).

We find this, unsurprisingly, has very substantial net benefits. We then analyse the benefits and costs of earlier dates of opening for primaries and secondaries (or both). We take each step in turn to identify the

Figure 1: Decision-making framework for choices of school re-opening



marginal costs and benefits of each earlier opening. This provides evidence over whether each earlier date of re-opening would lead to a net social welfare gain (i.e. QALYs gained from opening exceed QALYs lost).

Our analysis suggests that:

- Primary schools returning on March 8th would create a net benefit to society unless a value of a QALY of two to three times the standard HM Treasury valuation is used;
- Secondary schools returning March 8th alongside primary schools would also give a net benefit to society unless vaccinations are not as effective as expected in bringing the transmission risk down;
- It would only have been a net benefit to bring back primary schools in England on February 22nd if the impact of opening schools on the R rate is towards the low end of estimated ranges.

Unsurprisingly, this shows that the potential choices over reopening schools are heavily dependent on the overall, underlying (with no policy change) infection rate in society, as well as the impact that we think reopening schools will have on the R-rate.

What this paper shows is that, under reasonable assumptions for each of these, a model can be developed that supports decision makers with robust evidence. Where there are disagreements over key assumptions, these figures can be inserted into the model and sensitivities provided (as we have below). There are a range of other considerations that might also affect the decision, including the distributional pattern of health and educational impacts and the risk that allowing a higher rate of infection could increase the risk of harmful mutations of the virus. Again, it is feasible to include these within a model such as this.

1) FRAMING THE ISSUE

The health, personal, social and economic impacts of the Covid-19 crisis have been profound and widespread. These have come as a consequence of the pandemic itself, for instance through morbidity and mortality directly associated with the virus. They have also come indirectly, through changes in behaviour (either self-enforced or directed by Government) that have led to significantly reduced economic and leisure activity and social interaction.

One of the most widely discussed of this latter category has been the impact on children's education and development from the closure of schools. Here, a wide range of evidence already points to substantial educational, social and economic costs of closing schools.[ii] With this in mind, it is no surprise that doing so was one of the last measures the Government put in place when the pandemic took hold in 2020 and that, since then, they have sought to avoid doing so throughout the 2020/21 academic year.

However, despite the significant costs of doing so and the lower transmissibility of the virus amongst school-aged children[iii], the emergence of the new "Variant of Concern" in the UK during the later months of 2020 led to a situation where the Government determined it had become necessary.

This has meant that, apart from a few exceptions (including the children of some key workers), since 5th January 2021 schooling has taken place remotely in families' homes. Of course, along with pupils themselves, teachers and parents have worked hard to make this work. However, fully remote learning cannot replace the quality of in-person schooling,[iv] and negatively affects parents and guardians' ability to work.

As the impact of the third English national lockdown and vaccine rollout starts to be seen in infections and mortality, the Government now faces the decision on when to reopen English primary and secondary schools. This involves an incredibly difficult balancing act between the immediate and long-term impacts of lost schooling on children, their families and the country, and the health, economic and social impacts of a potential rise in infections caused by re-opening schools.

This short briefing considers this issue for schools in England. As a foundation it uses the broad framework and approach outlined in an earlier Legatum Institute report, which outlined a proof of concept for an evaluation tool for Covid-19 policy choices.[v]

2) METHODOLOGICAL APPROACH

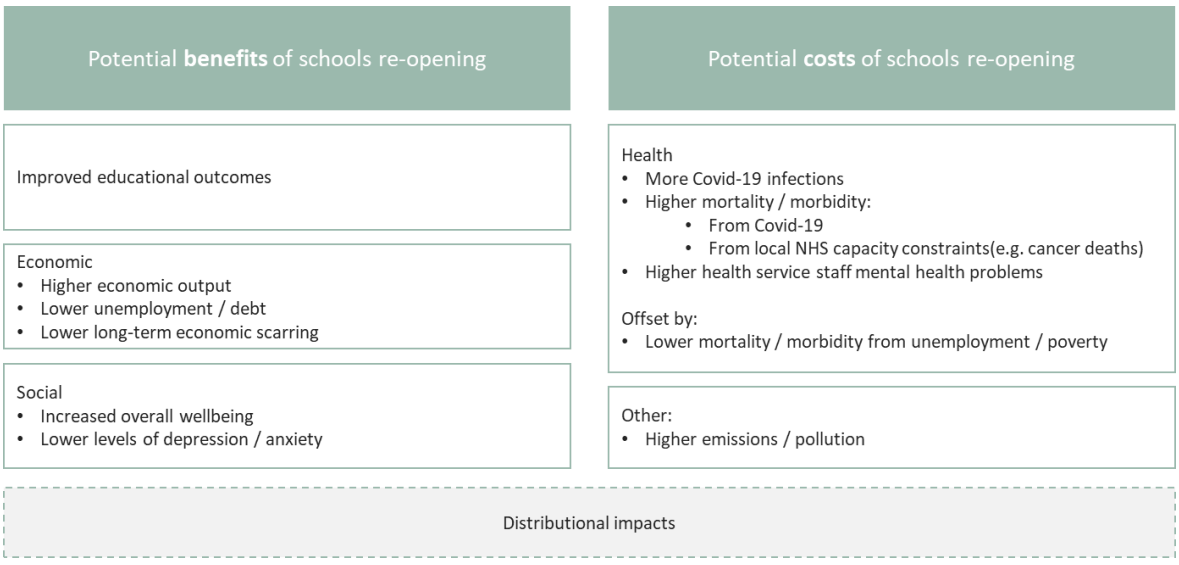
Applied to this question, the framework developed in the earlier Legatum Institute briefing allows for a consideration of the most important benefits and costs of school opening. This can then be used to conduct an analysis of whether it is likely to be socially beneficial to open schools on particular dates in the future.

Before turning to outline the approach placing a value on the various costs and benefits associated with these decisions, this section provides an outline of the range of costs and benefits considered. It also outlines how projections of infection rates are created and the broad modelling approach through which these aspects are brought together.

Identifying the range of potential costs and benefits

The starting point of this is to outline the various potential benefits and costs of schools re-opening. This is shown in figure 2, that demonstrates a range of educational, economic, social and health impacts. It also shows that, across each of the potential benefits and costs, there are likely to be differential impacts on different segments of society. These will be important when understanding the consequences and respective values associated with these benefits and costs (see below).

Figure 2: Overall of costs and benefits flowing from school re-opening



Identifying the potential impacts on infection rates

A key element in understanding the potential costs of re-opening schools is the impact that doing so would have on infection rates (as these drive the health impacts outlined).

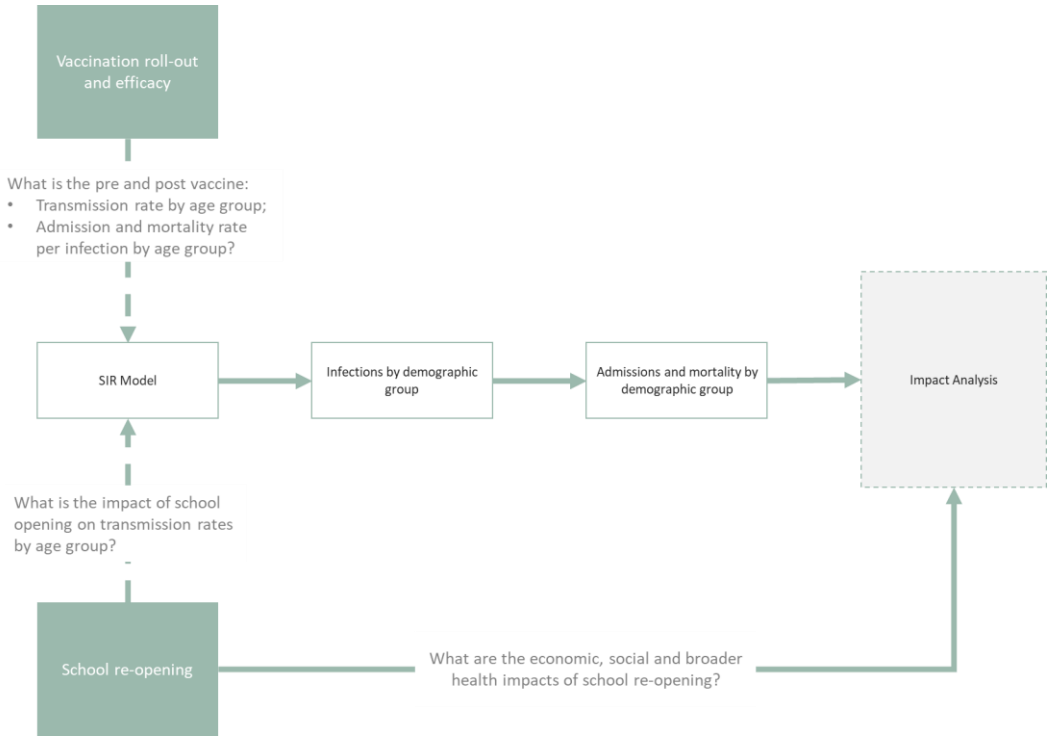
To do this, we have extended the original proof of concept to incorporate outputs from Susceptible-Infectious-Recovered (SIR) models. These models create estimates of who is susceptible to infection, is actually infected or has recovered from infection at any point in time, under different assumptions (for example, on transmission and mortality rates).[vi]

The evaluation tool can be used with any SIR model.[vii]

Broad methodological approach

The diagram below sets out how we have used the SIR model and incorporated a view on vaccination roll-out and effectiveness to augment the impact analysis.

Figure 3: Stylised methodology to understanding costs and benefits of school re-opening



Measuring impacts against a realistic baseline

As with the original proof of concept, a vital consideration is the baseline against which the impacts of schools re-opening are assessed. The important thing to note is that we do not compare the re-opening of schools against a notional baseline of an indefinite continuation of the closure. Doing so would provide a false comparison (as we know that schools will return) and would lead to virtually all dates of schools re-opening providing net benefits.

Instead, our analysis compares the various costs and benefits of re-opening on a specific date against other potential dates for re-opening. It also considers different re-opening dates for primary and secondary schools.

In practical terms this means that, as a starting point, we assume that all schools will re-open for the start of the 2021/2022 school year (in September 2021). This allows us to understand the total educational, economic and wellbeing impacts of schools remaining closed until then. We can then calculate the potential benefits of re-opening sooner against the potential costs, and assess whether the benefits outweigh the costs.

For example, this allows us to understand, compared to re-opening in September 2021, whether there would be net benefits from opening for the summer term of the 2020/21 school year. We can then analyse whether a further incremental change (such as opening on March 8th) provides further net social benefits or costs. This approach, and its implications for decision making, is considered further below.

3) PLACING A VALUE ON POTENTIAL COSTS AND BENEFITS

The previous section outlined the range of costs and benefits that we have considered and the broad framework in which these costs and benefits would be analysed. In order to populate this framework and carry out the impact analysis we need evidence on the values associated with each of these costs and benefits. For example, we need to understand:

- The value of the benefits of school opening
- The value of the health consequences of school opening

In common with our proof-of-concept evaluation tool, we use the concept of Quality-Adjusted Life Years (QALYs) to allow us to assess health, social and economic costs on a consistent basis.

A key challenge with implementing this approach practically is to develop an assumption for society's willingness to pay for an additional QALY. This raises a range of ethical questions over how something as fundamental as individual lives can be valued. In this respect, it is clear that the intrinsic value of life is immeasurable. However, beneath this, there is a more pragmatic question of how societal resources can best be deployed to maximise wellbeing, including by extending and improving peoples' lives. Examples include how much to spend on preventing fatalities on the road system and, in day-to-day allocation decisions within the NHS. Given the complexity and sensitivity of this issue, it is no surprise that this has been the subject of significant debate, and a range of different approaches exist.[viii]

For the purposes of this proof of concept, we rely on precedent of existing analysis within Government. This is typically based on HM Treasury appraisal guidance, that puts the current monetary willingness to pay value for 1 QALY as being equal to £60,000. As we note in our earlier report, the choice of the value of a QALY has a significant impact on results. A discussion of this can be found in the annex of the original repot.

The following sections provide an overview of the evidence from which we have drawn estimates of the values of various costs and benefits associated with school re-opening.

Valuing the benefits of an extra day of school opening

Here, we consider the benefit to be the avoidance of the losses associated with an additional day of schools in England being closed. The potential losses associated with school closures can be categorised in three main groups:

- The educational loss from reduced in-person schooling, leading to long-term economic losses for both individuals and society;
- Greater need for childcare by parents leading to short-term economic losses; and
- The loss in wellbeing for children.

We have constructed estimates of the benefits of reopening schools based on reducing the impacts coming from these three categories. Our headline findings are given below, and more detailed explanations are provided in the annex of this report.

Table 1 provides headline estimates of the educational, economic and wellbeing impacts of each day of school closures. They are drawn from a range of evidence, which is summarised at annex 1. Each area of costs is presented in QALYs to allow for comparison. The table shows that the total cost of each day that both primary and secondary schools stay closed in England amounts to between 5,250 and 12,750 QALYs.

Table 1: Educational, economic and wellbeing impacts of English school closures

Type of impact		QALY Estimate
Educational impact of school closure (measured by long-term economic losses from learning loss)		
Daily QALY impact		3,000 – 9,000 per day
Short-term economic impact of school closure (parental economic opportunity cost from increased childcare)		
Daily QALY impact		1,500 – 3,000 per day
Wellbeing impact of school closure		
Life satisfaction drop in January for UK population (where main difference was school closure)	-0.3	
Number of English school pupils this might impact	6.9m pupils	
Wellbeing Year impact	5,721 WELLBYs	
Daily QALY impact (where 1 WELLBY = ~7.5 QALYs)		750 per day
Combined education, economic and wellbeing impacts		**5,250 – 12,750 QALYs per day**

Source: Various – see annex 1.

Table 2 provides estimates of the additional health costs of increased Covid-19 infections leading to increased hospitalisations and deaths (whether these arise from opening schools or other sources). These are based on evidence in our previous evaluation tool, updated with the recent analysis from DHSC et al (December 2020).[ix] We use the estimate of direct and indirect health impacts from this report, and convert these to rates per Covid-19 hospitalisation / infection on the basis of out-turn data from 2020.

Table 2: Direct and indirect health impacts from increased Covid-19 infections

Impact Type	QALY Quantification
Covid-19 Mortality	7.6 QALYs per Covid-19 death
Morbidity from Covid-19 (long-Covid + other)	13 QALYs per 100 Covid-19 hospitalisations 8 QALYs per 1,000 Covid-19 infections
Changes to health system (Morbidity + Mortality)	
• Emergency care	51 QALYs per 100 Covid-19 hospitalisations
• Adult social care	18 QALYs per 100 Covid-19 hospitalisations
• Elective care	152 QALYs per 100 Covid-19 hospitalisations
• Cancer Care	0.6 QALYs per 100 Covid-19 hospitalisations
Health impacts of exceeding hospital capacity	*Assume below critical peak*
Health service staff burn-out and mental health problems	12 QALYs per 100 Covid-19 hospitalisations

Source: Various – see Legatum Institute (2020)[x]

We also incorporate an estimate of the long-term health impacts of recession. School closures lead to economic impacts in the short and long-term, and these in turn lead to health impacts. Based on analysis in DHSC et al (December 2020)[xi] we calculate that 1 QALY is lost for each £1.6m in lost economic output.

What does this mean in practice?

To understand what this means in practice we can assess, for a given assumed day of school re-opening, how many QALYs the associated benefits would deliver (by calculating how many additional days of schooling this would provide). To understand whether it would increase social welfare to go ahead with this, we then need to know the consequent QALY costs of the increased infections. Where total QALYs gained exceed total QALYs lost, this could be judged as the right decision to take at the margin.

Table 3 presents this analysis for various assumptions on school reopening (for both primary and secondary schools). We use the estimates of the QALY costs of

Covid-19 hospital admissions and mortality shown in table 2 above to assess by how much hospitalisation and mortality would need to increase to exceed the gains generated by the reopening of schools.

The table uses the example of all schools re-opening on April 19th as the base case against which marginal costs and benefits of different re-opening dates are assessed.

For example, it shows that if primary schools were to open on March 8th (whilst secondary schools remained closed), this would be associated with a gain of around 63,000 QALYs compared to reopening on April 19th. This means that re-opening on this date would provide net social welfare gains unless additional infections resulted in more than 20,000 additional hospitalisations and 5,000 deaths. If hospitalisations and deaths caused by school opening were above this level then there would be a net *loss* of QALYs overall, whereas if they were below then there would be a net gain.

Table 3: QALYs gained from school opening and the health impacts that would offset these benefits (compared to base case of schools opening on April 19th)

	School Days Gained		QALYs gained	Health Impacts that would offset the QALYs gained		QALYs lost
	Primary	Secondary		Deaths	Hospitalisations	
All Schools Return April 19th (Base Case)	-	-	-	-	-	-
Primary Schools Return March 8th	+18	0	*+63,000*	+5,000	+20,000	*-63,000*
All Schools Return March 8th	+18	+18	*+97,000*	+7,500	+30,000	*-97,000*
Primary Schools Return Feb 22nd *(Secondary April 19th)*	+28	+0	*+98,000*	+7,750	+31,000	*-98,000*
All Schools Return Feb 22nd	+28	+28	*+151,000*	+11,500	+45,000	*-151,000*

Notes: England only

4) ESTIMATING THE COSTS AND BENEFITS OF SCHOOLS RE-OPENING AT DIFFERENT DATES

The previous sections have outlined our broad approach to measuring and valuing the various costs and benefits of reopening schools. This section provides and overview of the scenarios that have been assessed, alongside key evidence that underpins these results.

As highlighted above, the starting point is to choose a baseline against which the marginal costs and benefits of different re-opening dates can be assessed. Given the Government's commitment to re-opening schools as one of the first steps in loosening restrictions, the baseline is that all schools re-open on 19th April (the start of the 2020/21 summer term). Given the downward trend seen in data on infections and hospitalisations, at the time of writing, this a pragmatic starting point for decision analysis.

Against this baseline, we can then assess the marginal educational, economic and wellbeing benefits and the marginal health costs of re-opening schools at various earlier points in time. To provide evidence to support the current debate, we also differentiate between primary and secondary schools.

Alongside the baseline, we have therefore assessed three different scenarios, shown in table 4.

Table 4: Baseline and scenarios for school re-opening

Scenarios
BASELINE. All Schools Return April 19th
Scenario 1. Primary Schools Return March 8th *(Secondary April 19th)*
Scenario 2: Primary Schools Return Feb 22nd *(Secondary April 19th)*
Scenario 3: All Schools Return March 8th

An important consideration across all of these is what happens to transmission of the virus. In the context of school reopening, two things matter: the underlying R-

rate and how this is affected by the roll-out of vaccines, and how school reopening affects the R-rate. Table 5 provides an outline of the assumptions used for the analysis in this briefing.

It shows two cases for the progression of the R-rate. The TBIfGC model we are using incorporates a downward trending R due to the impact of vaccinations on the progression of the virus. In the latest version of the model, R reduces at a rate of around 10% each month in the absence of further policy changes. The other, more pessimistic case assumes that vaccinations do not push the observed R down in the way we hope. For this case we have assumed that the underlying R-rate is constant (in the absence of policy changes). Infections still fall in this scenario if the policy mix keeps R below 1.

Alongside the impact of the vaccine roll-out on the R-rate we also need to assess how much opening schools would increase R by, and hence infections, hospitalisations and deaths on different dates. A range of estimates of this factor have been made:

- In September 2020, the Scientific Advisory Group for Emergencies (SAGE) estimated a decrease in R of between 0.2 and 0.5 from closing all schools,[xii]
- Researchers at the London School of Hygiene and Tropical Medicine have recently estimated an increase of between 0.3-0.7 from opening all schools from a baseline R of 0.8,[xiii]
- Recent studies from Norway and the United States point to a low risk of Covid-19 infection and spread in schools, including limited in-school Covid-19 transmission.[xiv]

Given the uncertainty, we test a range of increases to the R-rate of between 10-50% above the prevailing rate at the time of school reopening for both primary and secondary schools reopening together. Taking the impact of just opening primary schools and just opening secondary schools separately, we use a similar impact on R for each cohort on the basis of recent work by the CoMix social contact survey.[xv] Given that the impact of opening both primary schools and secondary schools together is likely to increase R by a range of 10-50%, we assume that opening either cohort independently would result in a 4.9-22.5% increase in R.

Table 5: Assumptions on vaccination roll-out and R-rate

Vaccination roll-out and impact assumptions		
Roll-out	300,000 people (in England) per day (based on seven day average)	
Impact	Rising to 50% effective over 3 weeks	
Underlying change in R-rate in absence of policy changes		
	Expected	**Cautious**
Base trajectory of R-rate	-10% per month	Constant
Impact of schools re-opening on R-rate	**Low**	**High**
Impact of schools re-opening	+10%	+50%

Figures 4 and 5 demonstrate what these assumptions mean for the number of daily cases for some of the scenarios highlighted above, for both a falling and constant underlying (no policy change) R.

Figure 4: Projection of daily cases under various scenarios of school reopening, with underlying R-rate falling (log-scale)

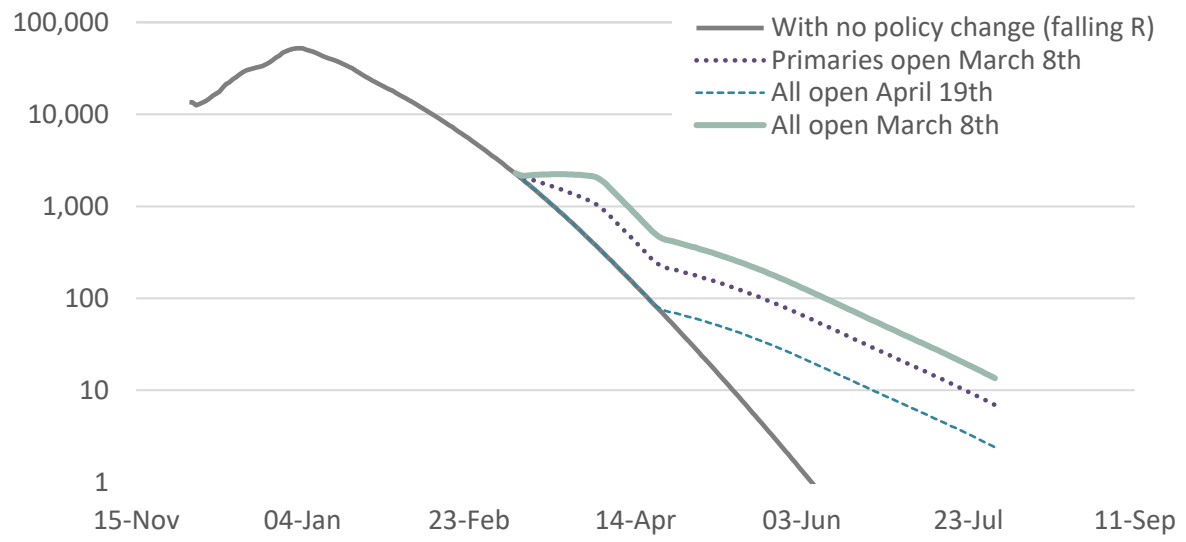
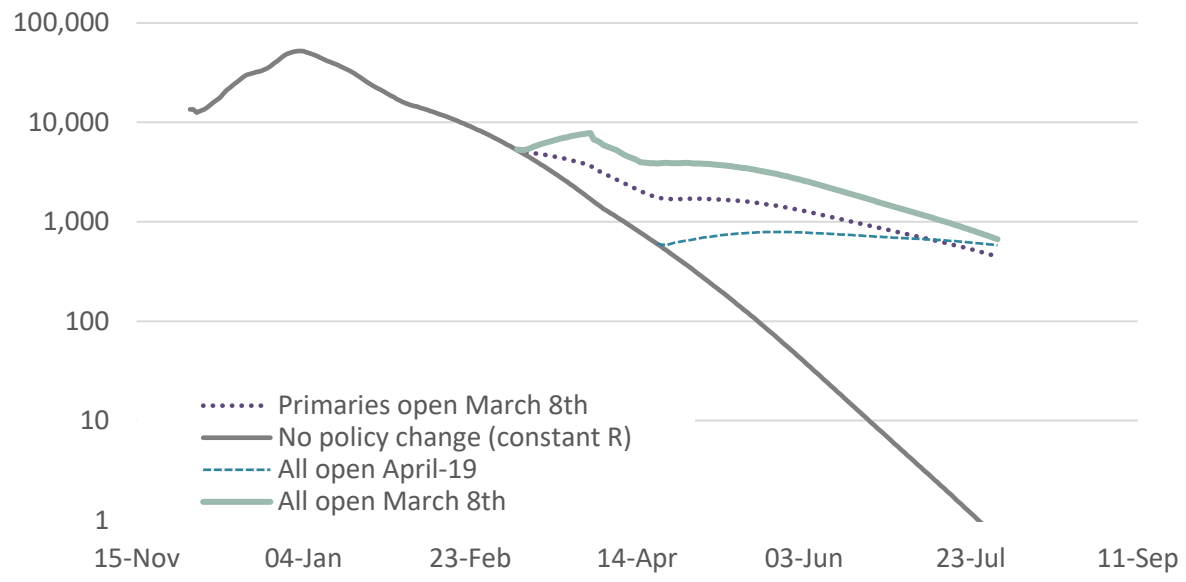


Figure 5: Projection of daily cases under various scenarios of school reopening, with underlying R-rate constant (log-scale)



Figures 6 and 7 demonstrate what these assumptions mean for daily mortalities for some of the scenarios highlighted above, for both a falling and constant underlying (no policy change) R.

Figure 6: Projection of daily mortality under various scenarios of school reopening, with underlying R-rate falling (log scale)

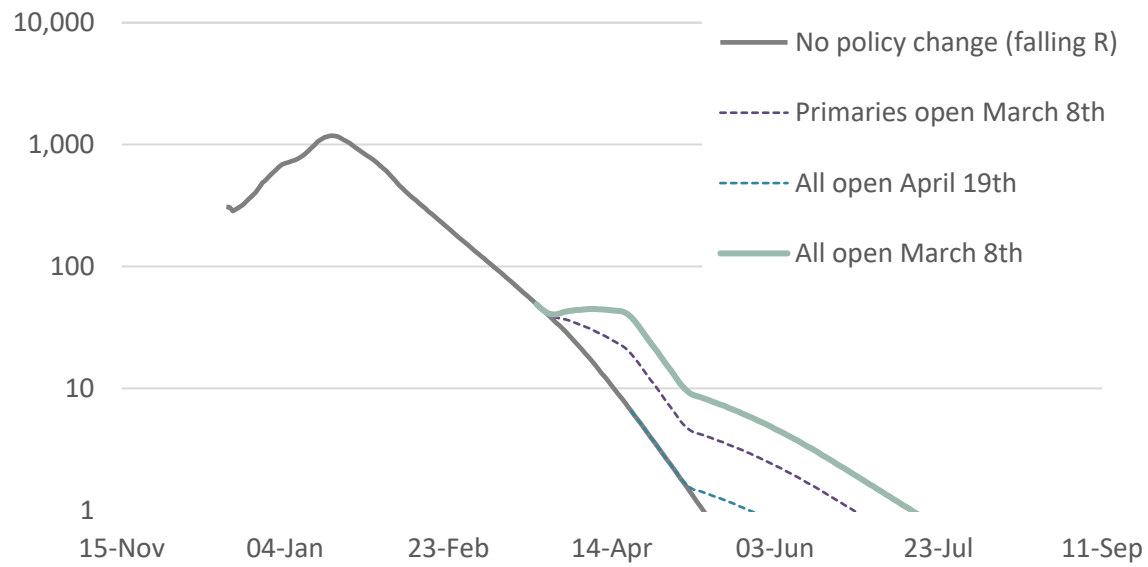


Figure 7: Projection of daily mortality under various scenarios of school re-opening, with underlying R-rate constant (log scale)

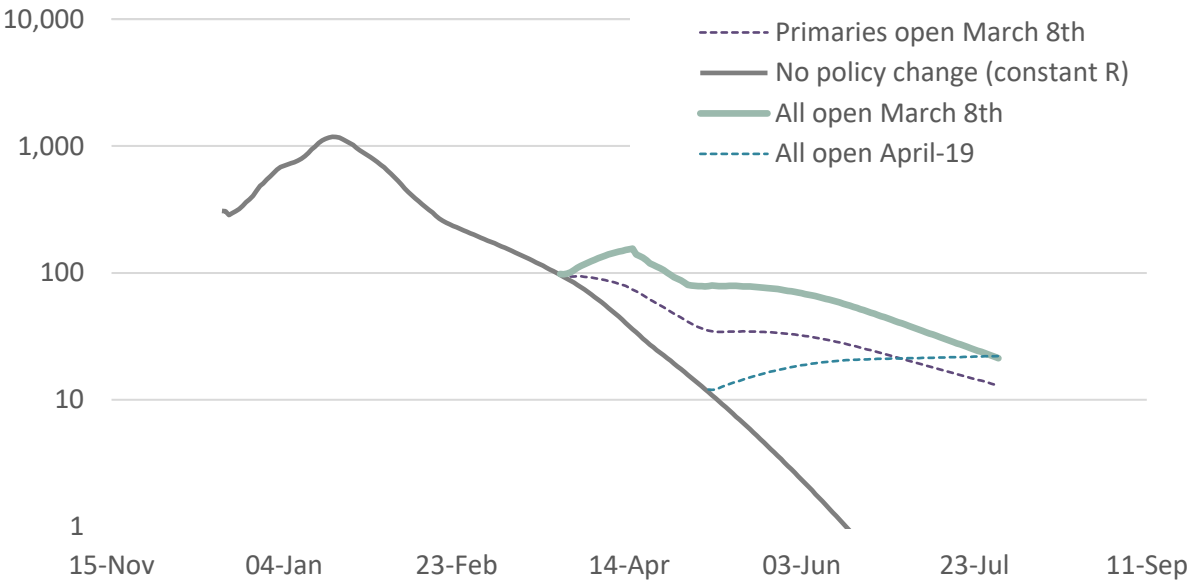


Table 6 brings this together to show what these assumptions mean for the headline health impacts of the school-re-opening scenarios. This table shows the estimated cumulative difference in deaths and admissions for the scenarios shown.

Table 6: Cumulative health impacts of the school re-opening scenarios under different assumptions

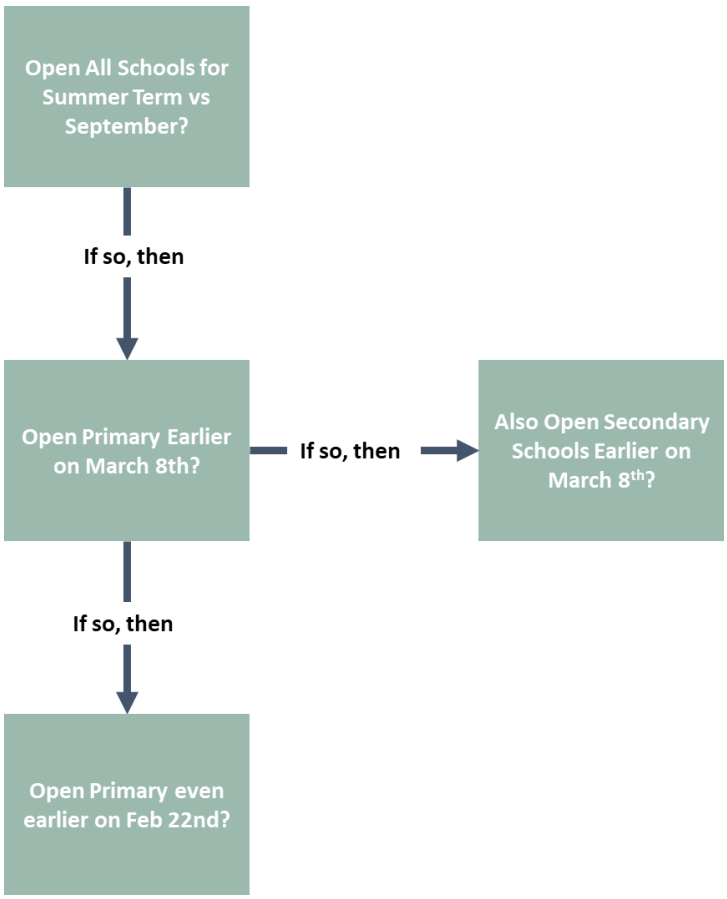
	Underlying (no policy change) R-rate falling		**Underlying R-rate constant**
Scenarios	**Increase in R rate due to schools re-opening = 1.1**	**Increase in R rate due to schools re-opening = 1.5**	**Increase in R rate due to schools re-opening = 1.5**
1. All Schools Return April 19th (Base Case)	-	-	-
2. Primary Schools Only Return March 8th	+ 74 Deaths + 297 Admissions	+ 694 Deaths + 2,799 Admissions	+ 2,241 Deaths + 8,771 Admissions
3 All Schools Return March 8th	+ 195 Deaths + 789 Admissions	+ 1,226 Deaths + 4,948 Admissions	+ 6,028 Deaths + 24,085 Admissions
4. Primary Schools Return Feb 22nd *(Secondary April 19th)*	+ 248 Deaths + 1,013 Admissions	+3,304 Deaths +13,393 Admissions	
5. All Schools Return Feb 22nd	+ 627 Deaths + 2,559 Admissions	+ 5,148 Deaths + 20,899 Admissions	

5) DECISION MAKING UNDER THIS FRAMEWORK

The section above provided a range of estimates for the health impacts of reopening schools for different scenarios, under a range of assumptions relating to the underlying (no policy change) R-rate and the potential impact of opening on R. These can then be combined with estimates of the potential benefits of reopening to assess whether the different scenarios of reopening dates would provide net social welfare benefits.

Figure 8 shows how we have approached this question. We first consider whether there would be net benefits from opening schools in England for the 2020/21 Summer term (April 19th), as opposed to re-opening for the start of the 2021/22 school year (in September 2021). If this is found to have net benefits, earlier dates of opening for primaries and secondaries (or both) can then be considered against the option of re-opening on April 19th.

Figure 8: Decision-making framework for choices of school re-opening



We have used our current model to test each of these decisions in turn, with a range of assumptions to test how sensitive the decisions are. Throughout the following analysis we have used our low estimate of the value of schooling to be conservative and commented where using a higher value of schooling would change the net benefit case from negative to positive.

Opening all schools for the summer term versus September

Opening all schools on April 19th for the summer term would deliver 65 extra in-person schooling days. Table 7 shows that we find that it is socially beneficial to open all schools for the summer term even under our worst-case assumptions – and hence it would be even more beneficial under all other assumptions.

Table 7: **Estimated consequences of opening primary and secondary schools on 19th April vs September**

Base trajectory of R-rate	**Constant**	
Increase in R rate due to schools re-opening	**50% for all (high range)**	
Additional days of in-person schooling (primary & secondary)	+65 primary	+65 secondary
Additional deaths	+ 2,865	
Additional hospitalisations	+ 11,556	
Socio-economic value of school opening *(low range)*	+349,000 QALYs	
Health-related cost of opening	-51,000 QALYs	
Net gain from opening	**+298,000 QALYs**	

Opening primary schools on 8th March versus all schools on 19th April

Next, we assess the marginal costs and benefits of opening primary schools on 8th March. This would deliver an additional 18 days of in-person primary schooling. Table 8 shows that it is more socially beneficial to open primary schools on March 8th compared to April 19th under all assumptions. Even under the more conservative assumptions opening primary schools earlier is worthwhile if the value of a QALY is under £100,000.

Table 8: **Estimated consequences of opening primary schools on 8th March versus all schools on 19th April**

Base trajectory of R-rate	**-10% per month**	**-10% per month**	**Constant**
Increase in R rate due to schools reopening	**10% for all, c.5% for just primary schools**	**50% for all, c.20% for just primary schools**	**50% for all, c.20% for just primary schools**
Additional days of in-person schooling (primary & secondary)	+18 primary +0 secondary		
Additional deaths	**+74**	**+694**	+2,241
Additional hospitalisations	+297	+2,799	+8,771
Socio-economic value of school opening *(low range)*	+62,000 QALYs	+62,000 QALYs	+62,000 QALYs
Health+ cost of opening	-1,000 QALYs	-12,000 QALYs	-40,000 QALYs
Net gain from opening	**+61,000 QALYs**	**+50,000 QALYs**	**+22,000 QALYs**

Opening primary schools on 22nd February versus primary schools on 8th March (with secondary schools opening on 19th April)

Next, we test whether it would be socially beneficial to open primary schools at an even earlier date – 22nd February. The decision has already been made not to do this, but it is worthwhile to explore whether our model suggests this was the correct decision. Table 9 shows that our model suggests it would have only been socially beneficial to open primary schools on February 22nd under better case assumptions (expected lower underlying caseload, and *also* lower impact on R from opening).

Table 9: **Estimated consequences of opening primary schools on 22nd February versus primary schools on 8th March (with secondary schools opening on 19th April)**

Base trajectory of R-rate	**-10% per month**	**-10% per month**	**Constant**
Increase in R rate due to schools reopening	**10% for all, c.5% for just primary schools**	**50% for all, c.20% for just primary schools**	**50% for all, c.20% for just primary schools**
Additional days of in-person schooling (primary & secondary)	+10 primary +0 secondary		
Additional deaths	+175	+2,610	Not yet assessed – would be a higher net loss from opening
Additional hospitalisations	+715	+10,594	
Socio-economic value of school opening *(low range)*	+35,000 QALYs	+35,000 QALYs	
Health+ cost of opening	-3,000 QALYs	-47,000 QALYs	
Net gain from opening	**+32,000 QALYs**	**-12,000 QALYs**	

Opening secondary as well as primary schools on 8th March versus secondary schools on 19th April

Finally, we test whether our model suggests it would be socially beneficial to open secondary as well as primary schools on 8th March versus secondary schools on 19th April. This would give an additional 18 days of in-person secondary schooling. Table 10 shows that this decision is finely balanced. Under more conservative assumptions opening secondary schools earlier is not worthwhile at the lower range of educational value. However, it could be beneficial to open secondary schools on March 8th if:

- There is a lower underlying caseload (potentially due to the impact of vaccinations on transmission); or
- The value of education is double that of our lower range. Our higher range is three times the value of our lower range, so this is reasonable.

Table 10: **Estimated consequences of opening secondary as well as primary schools on 8th March versus secondary schools on 19th April**

Base trajectory of R-rate	**-10% per month**	**-10% per month**	**Constant**
Increase in R rate due to schools reopening	**10% for all**	**50% for all**	**50% for all**
Additional days of in-person schooling (primary & secondary)		+0 primary +18 secondary	
Additional deaths	+122	+532	+3,790
Additional hospitalisations	+492	+2,149	+15,290
Socio-economic value of school opening *(low range)*	+34,000 QALYs	+34,000 QALYs	+34,000 QALYs
Health+ cost of opening	-2,000 QALYs	-10,000 QALYs	-68,000 QALYs
Net gain from opening	**+32,000 QALYs**	**+24,000 QALYs**	**-34,000 QALYs**

Summary of findings

Table 11 summarises our findings.

Table 11: Baseline and scenarios for school re-opening

Scenarios	Pre-requisite assumptions for opening
BASELINE. All Schools Return April 19th	**Worthwhile: even under very conservative assumptions**
Scenario 1. Primary Schools Return March 8th	**Worthwhile if:** • **QALY value is up to £100,000 under conservative assumptions,** ***Or*** • **QALY value is up to £200,000 under lower assumed caseloads**
Scenario 2: Secondary Schools Return March 8th *(Primary March 8th)*	**Worthwhile if:** • **Caseload assumption is low** ***Or*** • **Socio-economic value of opening schools is in mid-upper range**
Scenario 3: Primary Schools Return Feb 22nd *(Secondary April 19th)*	**Worthwhile if:** • **Caseload assumption is low, and impact of opening schools on transmission is low**

In any modelling of this type there are a large range of uncertainties and considerations. We have tested many of the most important variables, but some important considerations remain.

For example, with regard to transmission:

- It is possible that the underlying impact of vaccines could be more favourable, as well as the lower impact we have tested.
- A higher infection rate in the middle of 2021 could increase the risk of problematic virus mutations being present in the UK, leading to substantial health, economic and social costs. Everything else equal this would favour reopening schools later to reduce the overall infection numbers further.

With regard to valuations there are a number of material considerations:

- The indirect health impacts could be lower than the ratios we have used as the capacity pressure on the NHS reduces.
- The economic impacts of school closures could be greater than we have assumed – we have been conservative in our interpretation of the returns to schooling and shown results assuming the low end of our range. Higher returns to schooling would favour reopening schools at any point other than those where pressure on the NHS makes it difficult.

A final important consideration is that both health and education costs fall more heavily on those with lower incomes:

- Health impacts of Covid-19 are around twice as bad for the most deprived communities versus the least deprived,[xvi]
- Education losses for lower income groups:
    - Are likely to be proportionately higher: Dutch evidence suggests that education losses may be up to 55% larger for those from less-educated homes compared to their more advantaged peers.[xvii]
    - Will have a higher welfare impact: Education losses result in income losses, and the marginal utility of income is also higher for those with lower incomes. Welfare weights used by DWP suggest that the net economic benefit per individual in the bottom income quintile should be multiplied by a weight of up to 2.5.[xviii]

Combining these greater education losses for disadvantaged children and higher welfare weights suggest that the value of the total education gains from reopening in our scenarios could be 50% higher than we have estimated. As the same groups are likely to suffer the negative health consequences of opening, we have not quantified and incorporated this net uplift at this stage.

A1) ANNEX 1: ECONOMIC, SOCIAL AND WELLBEING IMPACTS OF SCHOOL CLOSURE

Economic benefits from learning benefits of in-person schooling

There is a range of evidence on the economic impacts of learning losses, including an analysis of much of the recent literature for the OECD.[xix] This paper finds that existing research suggests that the students affected by the closures might expect some 3% lower income over their entire lifetimes. For nations, this could mean that average annual GDP growth is 1.5ppt lower for the remainder of the century. These figures are based on extensive research regarding the links between education, income and economic growth. However, these valuations do not appear to be suitable to make the decision on reopening schools because they reflect the average return to schooling, and imply very large returns for each individual day's schooling. When considering the decision on whether to open schools now or in a few weeks' time, we need to estimate the marginal value of each days' education. We have not been able to find a study which does this so have constructed reasonable estimates using two approaches.

The first approach follows Layard et al (2020)[xx] and estimates the marginal value of education as two times the daily cost of education.

Cost of schooling for today's pupils	
England expenditure per pupil[xxi]	£5,700 p.a.
School-day spending (190 days)	£30 / day
Benefit Cost Ratio = 2	£60 / day
QALYs per 1,000 school days	***1***

Our second approach takes as a starting point the assumption that a significant proportion of today's GDP is attributable to the schooling that today's adults have received. We have made a number of assumptions to calculate a reasonable estimate of the economic impact that could be attributable to a marginal day's schooling. This suggests a value three times as high as our first approach, implying a benefit-cost ratio of 6 at the margin.

Value of schooling for today's adults	
England GDP[xxii]	£1.8tr
England working-age population (economically active)[xxiii]	29m
Schooling: 11 years * 190 days	2,090 days
2020 GDP per day of school	£30
Lifetime value per day of school (assuming a discount rate of 3% over 40 years of working life)	£700 / day
Assume greater than half of this value is due to non-school effects *(e.g. tertiary education, home)*	£300 / day
Assume declining marginal value (two thirds at the margin)	£200 / day
QALYs per 1,000 school days	***~3***

To assess the total benefits of opening schools in England per day, we need to incorporate the total number of primary and secondary school pupils, how many are home schooling (given that children of key workers and vulnerable children can still attend school) and an assumption about the value of home schooling relative to in-person schooling. The table below shows our data and assumptions.

	Primary schools	Secondary schools
All pupils in England	4.71m	3.41m
Home schooling rate	77%	95%
Pupils home schooling	3.63m	3.24m
Assumed home schooling quality	50%	65%
School day equivalents lost	1.81m/ day	1.13m/ day
QALYs lost per school day (low)	1,813	1,134
QALYs lost per school day (high)	5,561	3,401

Source: Gov.uk Explore Education Statistics. Currently covers state-funded schools only, as no breakdown of primary/secondary schools is available for independent schools. There were a total of 0.58m children in independent schools in 2019/20

We therefore find that the education value of a day of school opening across England is 3,000-9,000 QALYs. The higher numbers of pupils and our assumption of lower home-schooling quality mean that we estimate the education value of primary opening per day is 60% greater than secondary.

Short-term economic benefits of a day of school opening

- School closures mean increased childcare demands on working parents.
- We use a 2008 study of the economic impacts of school closures in an influenza pandemic to estimate the scale of these effects.[xxiv]

Parental economic opportunity cost of school closure	
Workforce with dependent children	38%
Workforce without non-working parent	16%
Workforce without any alternative care (*assume 55% have access to informal care or have kids in school*)	7%
Effective workforce loss (assuming 20% cover at work)	6%
Effective workforce loss (*assuming 30% can work from home while 'home schooling'*)	4%
Workforce opportunity cost (*assuming half could return to work if schools reopened*)	2%
GDP opportunity cost (*England daily GDP = £9.2bn*)	£183m / day
QALYs per school day opened in England – assuming average wages	*3,000*
QALYs per school day opened in England – assuming lower average wage of marginal working parent	*1,500*

Source: Legatum Institute esimtates based on Sadique et al. (2008) "Estimating the costs of school closure for mitigating an influenza pandemic"

Wellbeing benefits of school opening

- Children are suffering a range of impacts on their mental health and wellbeing from both the pandemic, and directly from school closures.
- Data is not readily available to quantify these impacts.

- However, the ONS have been tracking a range of wellbeing indicators through their Opinions and Lifestyle survey and weekly data on "Coronavirus and the social impacts on Great Britain". We have previously used the data on life satisfaction to estimate the wellbeing impact of the pandemic control measures. This measure showed a marked decline of 0.3 points on a 10-point scale at the beginning of January. Although not all of this can be attributed to the closure of schools, this was the key new policy change that occurred.
- This data is only for those aged 16 and above. However, it is reasonable to assume that the impact at the beginning of January was worse than average for children as substantial impacts on younger people are being found. For example, in a survey by the mental health charity YoungMinds, which included 2,111 participants up to age 25 years with a mental illness history in the UK, 83% said the pandemic had made their conditions worse.[xxv]
- Taken together an average decline in wellbeing of 0.3 point on a 10 point scale for each day of school closure appears a reasonable estimate. Applying this to the English school population gives the following estimate of the daily QALY cost of a day of school closure (using the concept of a wellbeing year, which is equal to 7.5 QALYs).

Wellbeing Impact of school closure	
Average life satisfaction drop in January for the UK (main difference from previous months was school closure)	-0.3
Assume impact on all English school pupils	6.9m
Wellbeing-year impact (0.3 *6.9m/365)	5,721
Daily QALY impact (where 1 WELLBY = ~7.5 QALYs)	**750 / day**

ENDNOTES

[i] Legatum Institute, (2020), *Policymaking during a global pandemic: developing a proof of concept for an evaluation tool for Covid-19 policy choices.*

[ii] Examples include:

- "The crisis in lost learning calls for a massive national policy response". Institute for Fiscal Studies. February 1, 2021
- Engzell, P., Frey, A., Verhagen, M., (2021), *Learning Loss Due to School Closures During the COVID-19 Pandemic.*
- "Mental health effects of school closures during COVID-19" Joyce Lee (2020) *The Lancet*

[iii] Based on lower secondary attack rates found by Public Health England (see *"Investigation of novel SARS-CoV-2 variant: Variant of Concern 202012/01 Technical briefing 3"* January 8, 2021

[iv] Engzell, P., Frey, A., Verhagen, M., (2021), *Learning Loss Due to School Closures During the COVID-19 Pandemic.* SocArXiv

[v] Legatum Institute, (2020), *Policymaking during a global pandemic: developing a proof of concept for an evaluation tool for Covid-19 policy choices.*

[vi] Tolles and Luong (2020) Modeling Epidemics With Compartmental Models. JAMA. 2020;323(24):2515–2516.

[vii] The results in this briefing are based on the open-source model developed by the Tony Blair Institute for Global Change (TBIfGC). Mulheirn (October 18, 2020) An interactive Total Covid Cost model. Available here: https://medium.com/@ian.mulheirn/an-interactive-total-covid-cost-model-7ee5c965386e Accessed 14/02/2021.

[viii] See for example:

- Bobinac et al. (2010) Willingness to Pay for a Quality-Adjusted Life-Year: The Individual Perspective. Department of Health Policy and Management and Institute for Medical Technology Assessment, Erasmus University Rotterdam, Rotterdam, The Netherlands
- HSE (2020) A scoping study on the valuation of risks to life and health: the monetary value of a life year (VOLY)
- Mason et al (2010) Modelling the monetary value of A QALY: A new approach based on UK data.

[ix] "DHSC, ONS, GAD and Home Office (2020). Direct and Indirect Impacts of COVID-19 on Excess Deaths and Morbidity - December 2020 update, 17 December 2020"

[x] Legatum Institute, (2020), *Policymaking during a global pandemic: developing a proof of concept for an evaluation tool for Covid-19 policy choices.*.

[xi] "DHSC, ONS, GAD and Home Office (2020). Direct and Indirect Impacts of COVID-19 on Excess Deaths and Morbidity - December 2020 update, 17 December 2020"

[xii] SAGE: NPIs table (pivot) - 21 September 2020

[xiii] James D Munday et al. (pre-print, 2021). Estimating the impact of reopening schools on the reproduction number of SARS-CoV-2 in England, using weekly contact survey data.

[xiv] University of Minnesota (January 8, 2021) Three studies highlight low COVID risk of in-person school

[xv] Report for SPI-M-O and SAGE, January 27, 2021. The effect of school opening or closure on social contacts in England from the CoMix social contact survey Report for survey week 43b - Updated

[xvi] The Independent Scientific Advisory Group for Emergencies (2020) The Independent SAGE Report 21. COVID-19 and Health Inequality

[xvii] Per Engzell, Arun Frey, Mark Verhagen. (November 9, 2020) The collateral damage to children's education during lockdown

[xviii] DWP (2010) The Department for Work and Pensions Social Cost-Benefit Analysis framework. Methodologies for estimating and incorporating the wider social and economic impacts of work in Cost-Benefit Analysis of employment programmes

[xix] OECD (2020) The Economic Impacts of Learning Losses

[xx] Layard et al. (2020), When to Release the Lockdown? A wellbeing Framework for Analysing Costs and Benefits.

[xxi] IFS (2020) 2020 Annual Report on Education Spending in England: Schools

[xxii] ONS (2019): Regional economic activity by gross domestic product, UK: 1998 to 2018

[xxiii] ONS Labour Force Survey

[xxiv] Sadique, M.Z., Adams, E.J. & Edmunds, W.J. (2008) Estimating the costs of school closure for mitigating an influenza pandemic. BMC Public Health 8, 135

[xxv] "Mental health effects of school closures during COVID-19" Joyce Lee (2020) *The Lancet*