BRIEFING:

Analysis for Covid-19 Decision-making: 29th March 2021 Update

EXECUTIVE SUMMARY

The human consequences of the Covid-19 pandemic on individuals, families, and communities right across the UK has been clear to see. The virus has fundamentally affected all of us; through our health, our relationships, and our livelihoods. Significant long-term health impacts have been predicted and the impact of lost schooling has impacted livelihoods, productivity, and life chances well into the future.

Our earlier report in February considered these impacts in the context of the then upcoming decision whether to reopen school on 8th March, as the first step of loosening restrictions of the third national lockdown. As a baseline, the report used the framework for understanding the range of costs associated with the pandemic and Government responses that was developed by an earlier Legatum Institute report in December 2020.[i]

Our analysis at the time suggested that:

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

Unsurprisingly, the analysis showed that the potential choices over reopening schools (and subsequent phased reopening) were heavily dependent on the overall, underlying (with no policy change) infection rate in society, as well as the impact reopening schools (and other activities) will have on the R-rate.

Our February report outlined that a model can be developed that supports decision makers, underpinned by a combination of robust evidence and reasonable assumptions for each of the unknown factors. Where there were different views over key assumptions, these could be accommodated in the model and sensitivities considered (as we demonstrated). 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.

Three weeks on from the reopening of schools in England, it is possible to review the accuracy of the assumptions used to model the scenarios, both in terms of the underlying patterns of infection, admission and mortality rates; the efficacy of vaccination; and also the impact of opening schools on the transmission of the virus. Such a retrospective analysis will help refine forward-looking assumptions that underpin decisions about future phases of opening up.

The key lessons from this analysis are as follows:

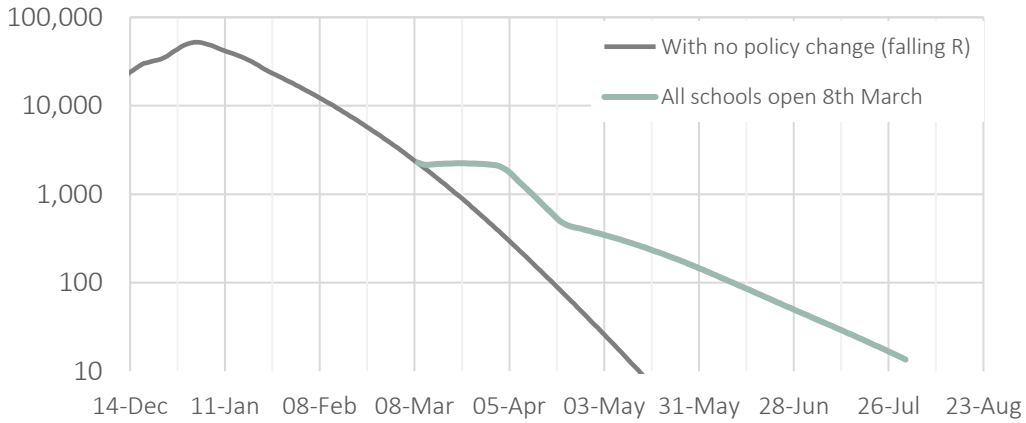
- The extensive ramp-up in lateral flow testing, especially in schools, is masking the underlying rate of decline in infections in the adult population.
- The decline in infections among older age groups occurred earlier and to a greater extent than among younger adults – showing the vaccines are working (the impact of the second jab for the 80+ group is already observable).
- The cold spell in February appears to have slowed the rate of infection decline among all age groups, suggesting that temperature affects transmission.
- The plateauing of case numbers associated with school opening occurred as expected, albeit somewhat earlier (although the ramp-up of lateral flow testing in the week before schools opened is a contributory factor).
- The impact of opening schools on infection rates is no more than had been expected, albeit on a higher base because of the cold spell.
- Hospital admissions are not declining as fast as infections, suggesting that NHS is admitting more marginal cases as capacity constraints ease.
- The reduced rate of decline in PCR positive tests among the adult population in March is likely to be a result of a greater proportion of asymptomatic / mild cases, as it is not translating into a change in patterns of hospital admissions.
- Hospital admissions for under 20s have not risen in recent weeks – there is no sign yet of any meaningful impact on young people.
- The decrease in mortality, led by the older age groups, is slightly more hopeful than the assumptions made when evaluating school opening – notwithstanding the higher rates of infection and hospital admissions.
- If anything, the vaccine programme is protecting the more vulnerable to a greater degree than had been anticipated (by our model in February). However, given that the impact of school opening will take another week or so to be seen in the mortality data, some circumspection is still appropriate.
- This analysis indicates that the decision to open schools was well grounded, and bodes well for further waves of relaxation of lockdown measures.

1) INFECTIONS

The starting point for the modelling assumptions made in our February report was the expected progression of the R-rate in England, accounting for the roll-out of the vaccination programme. The model we used implied a downward trending R, due to the impact of vaccinations[1] on the progression of the virus, which was expected to reduce at a rate of around 10% each month in the absence of further policy changes.

Alongside the impact of the vaccine roll-out on the R-rate we also assessed how much opening schools would increase R by, and hence infections, hospital admissions and deaths on different dates. Given the uncertainty[ii,iii,iv] on the impact of opening schools, we considered a range of increases to the R-rate of between 10-50% above the prevailing rate at the time of school reopening.

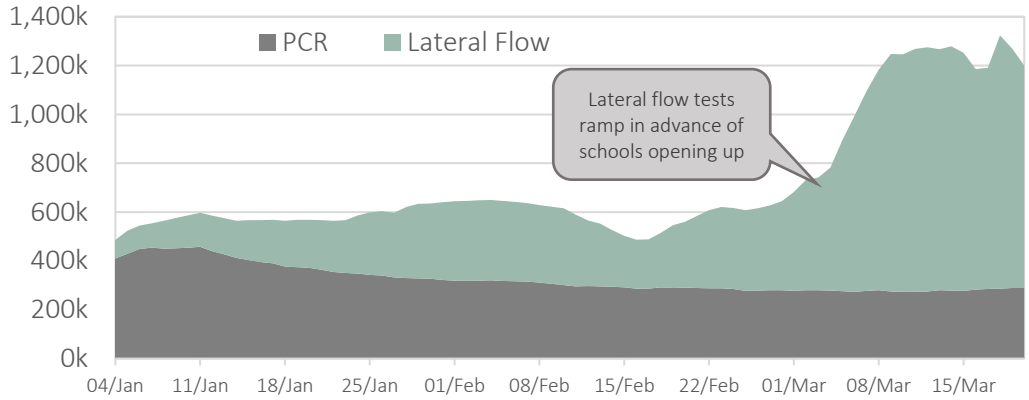
Figure 1: February projection of daily cases (positive tests) under various scenarios of school reopening, with underlying R-rate falling (log-scale)



[1] Assumed to be 300,000 per day in England (which has been surpassed), rising to 50% effective over three weeks

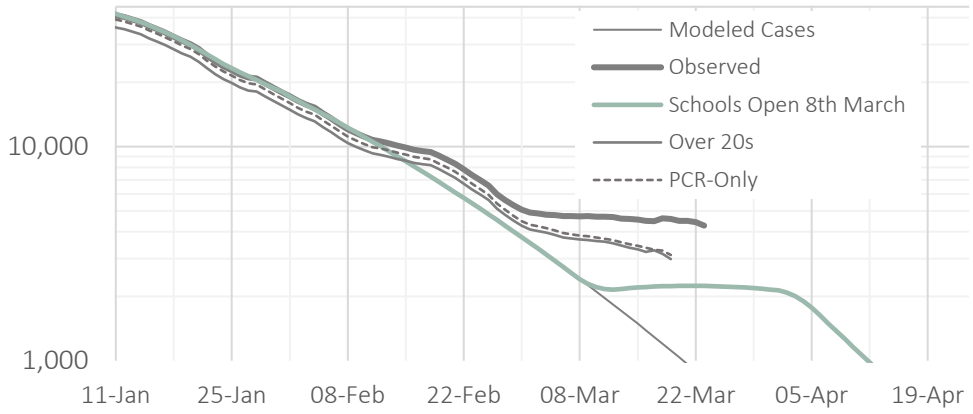
Since publishing in February, the testing regime has evolved, with much more extensive lateral flow testing (especially in schools), albeit with a relatively constant number of PCR tests.

Figure 2: Daily test numbers for England, by type of test



The evolution of cases over the months of February and March has progressed relatively closely to the assumptions used in the model, with a number of exceptions. Firstly, there appears to have been an impact from the cold spell in early February. Furthermore, the slowdown in the reduction in cases that was expected as a result of school opening appears to have been anticipated by one week.

Figure 3: Observed daily cases (log-scale)

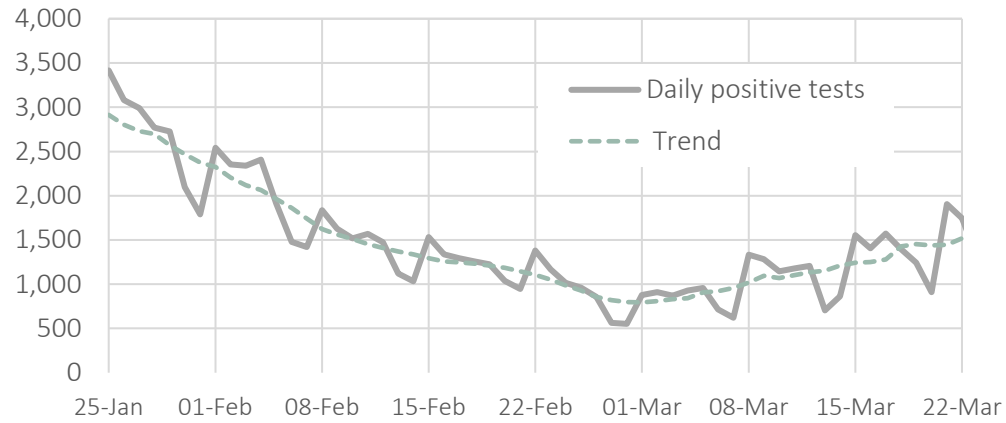


In the week commencing 8th February, the rate of decline in positive tests slowed. This was also the week in which temperatures dropped, and potentially the virus was more transmissible. Google data does not show much notable difference in mobility for that week – suggesting it is not predominantly behaviourally driven. Subsequently, the rate of decline in cases resumes its downward trend until early March.

From the beginning of March, in the week prior to school opening, there is a second more noticeable change in trend, as the lateral flow testing regime ramped up. As a result, the total number of positive tests begins to exhibit only a low rate of decline. The underlying rate of decline for PCR tests and for those over 20 (all tests) also flattens, but not to the same extent. Figure 3 illustrates the widening gap between the PCR test results and the overall test results – predominantly as a result of positive test results in the under 20s (i.e. school-age) population.

In assessing the impact of school opening, we had assumed a plateauing of cases starting from 8th March as a result of the increased mingling of school-age children. However, it seems as if the transmission pattern shifted a week before schools opened.

Figure 4: Positive test results among the under 20s.



As can be seen in Figure 4, the daily trend in positive tests for the week of 1st March was upward for under 20s, which does coincide with the increased level of testing. However, R-rates for over 20s also rose during that week (see Figure 5).

Figure 5: Observed R-rates (7-day ratio of positive test results)

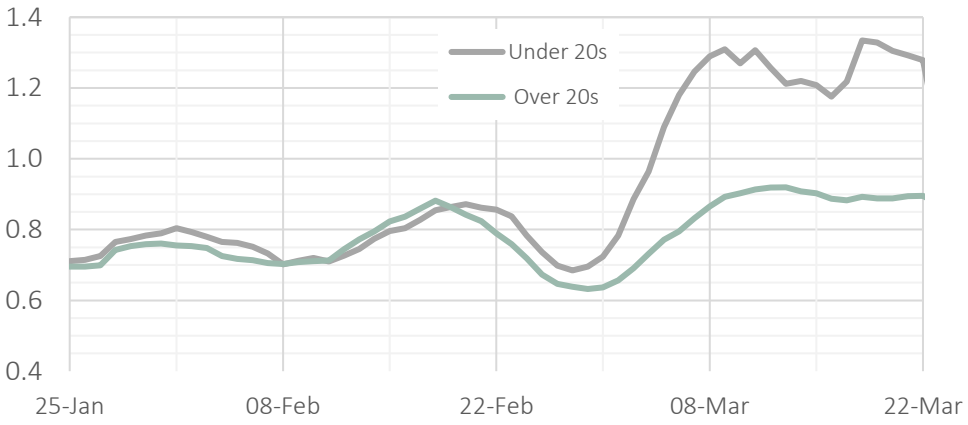
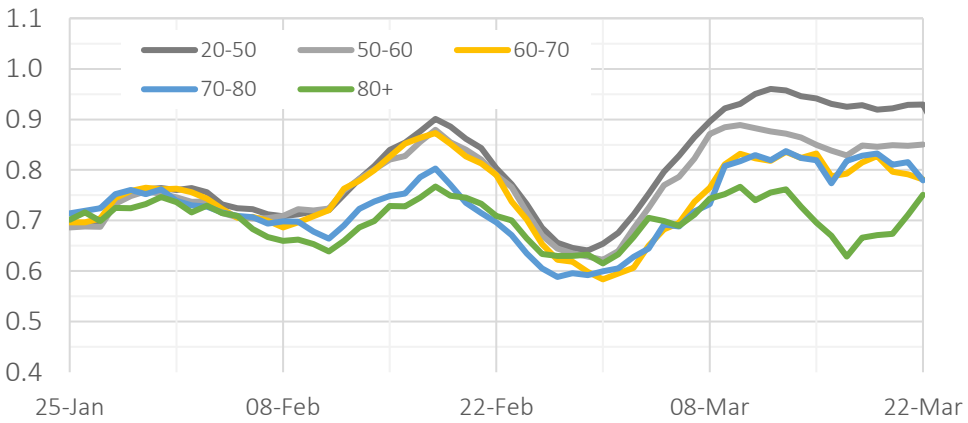


Figure 5 also illustrates that there was a rise in the R-rate for all age groups around the time of the cold spell (7th – 14th Feb), which subsequently declined. In the week of 1st March the transmission rate among under 20s increased, and infections began to rise among this group. Among the over 20s, the R-rate has settled at around 0.9 post school opening. Given the relatively constant rate of PCR testing and pattern of positive PCR-only results, it cannot be fully attributed to changes in test patterns, and could well be evidence of increased transmission as a result of school opening.

While this broad pattern can be seen across all adult age groups, there is positive evidence of the impact of earlier vaccination of older age groups (see Figure 6).

Figure 6: Observed R-rates (7-day ratio of positive test results) for over 20s



The R-rates for the 70+ groups have been lower than those for younger adults since early February. Given these groups were in the first wave of vaccination, this is unsurprising. Subsequently the R-rate for 60-70 year-olds also shifted downwards, and most recently since 8th March a similar pattern can be seen for 50-60 year-olds. For the 80+ cohort, who are now receiving their second dose, there is some indication that this is boosting immunity. Although with cases for the over 80s currently at around 100 per day, this observed R-rate will be quite volatile.

So, what can be learned from the patterns of test results over the months of February and March?

- The decline in cases among older age groups occurred earlier and to a greater extent than predicted – a sign of the vaccines working.
- The cold spell in February slowed the rate of decline among all age groups, suggesting that there is a seasonal/temperature effect in transmission
- The plateauing of case numbers associated with school opening occurred as expected, albeit somewhat earlier (although the ramp-up of lateral flow testing in schools is a contributory factor).
- Despite the increased testing the impact of opening schools is no more than had been expected, albeit on a higher base because of the cold spell.

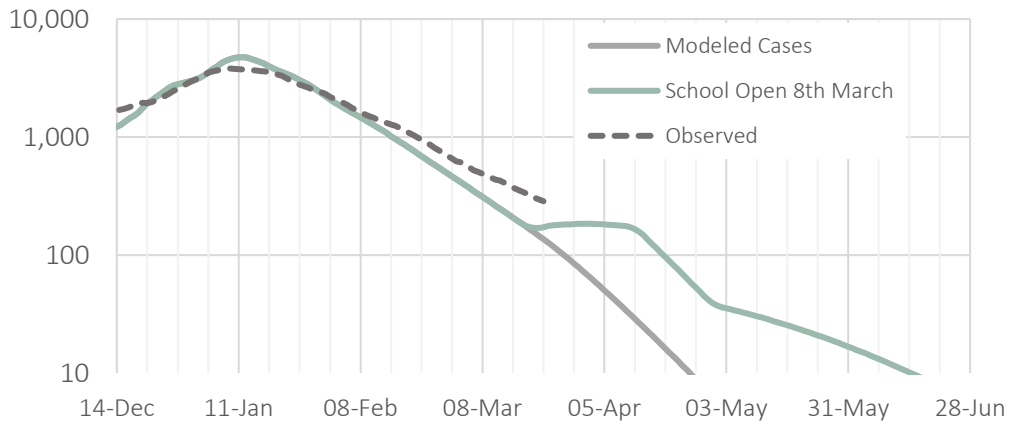
However, to fully assess whether the assumptions underlying the assessment of when to open schools were sound, it is also necessary to consider the impact on hospital admissions and mortality.

2) HOSPITAL ADMISSSIONS

Another manifestation of the severity of the pandemic is the rate of hospital admissions. Assuming uniform criteria for admission, then changes in admission rates also reflect the underlying nature of the pandemic and its impacts in terms of morbidity and also mortality. When assessing changes to the current lockdown, there were two considerations relating to admissions: firstly, if opening schools (or other relaxation) were to cause an increase in hospitalisation, would the NHS have capacity to accommodate it? Second, we also considered the social and health costs of the additional morbidity (as measured by hospitalisations) and the knock-on consequences on the NHS in terms of delayed treatment. Hence, to judge the impact of opening schools, we need to assess the impact on the NHS and on morbidity.

As part of our February assessment, we projected that hospital admissions would decline over time following the reduction in cases, and that as cases plateaued when schools opened, there would be a slowdown in the rate of decrease of hospital admissions (see Figure 7).

Figure 7: February projection of daily hospital admissions under scenario of school reopening, with underlying R-rate falling (log-scale)

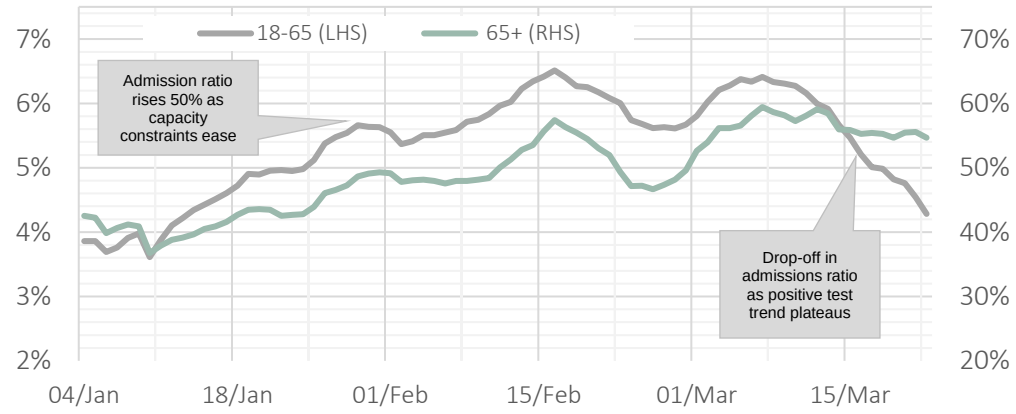


Given that hospital admission rates for Covid are higher for older age groups, the underlying patterns of declining admissions would be less affected by school opening than cases – because older people are more likely to be admitted to

hospital when infected. The shift in pattern would also likely manifest itself a week to 10 days after infection.

Two notable patterns can be observed in Figure 7. The first is that the decline in daily hospital admissions is slower than the decline in infections. Positive tests roughly matched the expected rate until mid-February, whereas admissions did not. This can be seen more clearly by looking at Covid hospital admissions as a proportion of cases. From January to mid-February the probability of being admitted to hospital conditional on a positive test rose by approximately 50% - and comparably so for both under and over 65-year-olds. (See Figure 8 – *note the 10x difference in hospitalisation rates conditional on a positive test for the two age-groups.*) As hospital capacity eased, proportionately more were admitted. Was this coincidental on the severity of the Kent strain, or relaxation of admission criteria? The patterns of mortality suggest that the increased severity of the Kent strain is not the major contributor (see later).

Figure 8: Covid hospital admissions as a proportion of positive tests (nine days prior)

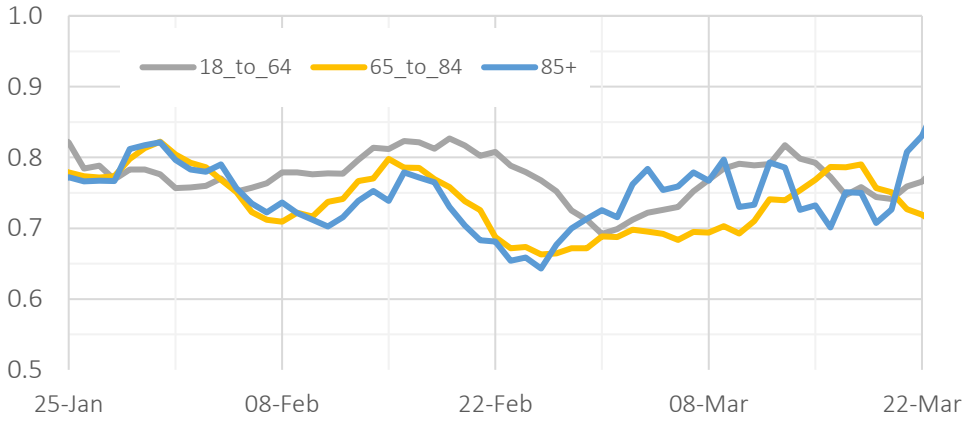


The temporary reduction in the ratio of admissions to positive tests in the aftermath of the cold spell in February (week following 15th Feb in Figure 8) indicates that hospital admissions did not respond. More notably, the slowing decline in cases since the beginning of March is not being matched in hospital admissions, which have continued to decline steadily. As a result, for under 65s the probability of hospital admission, conditional on a positive test has dropped 30%. Given the short-term shift this more likely to be a consequence of increased

asymptomatic testing rather than a shift in clinical thresholds for admission – in contrast with the steady shift in January - February.

A further suggestion that admission rates are following a different pattern to infections can be seen in the 'R-rates' for admission – whereby the older vaccinated groups are not seeing a faster drop in admissions, despite seeing a faster drop in infections.

Figure 9: Observed admission R-rates (7-day ratio of admissions)



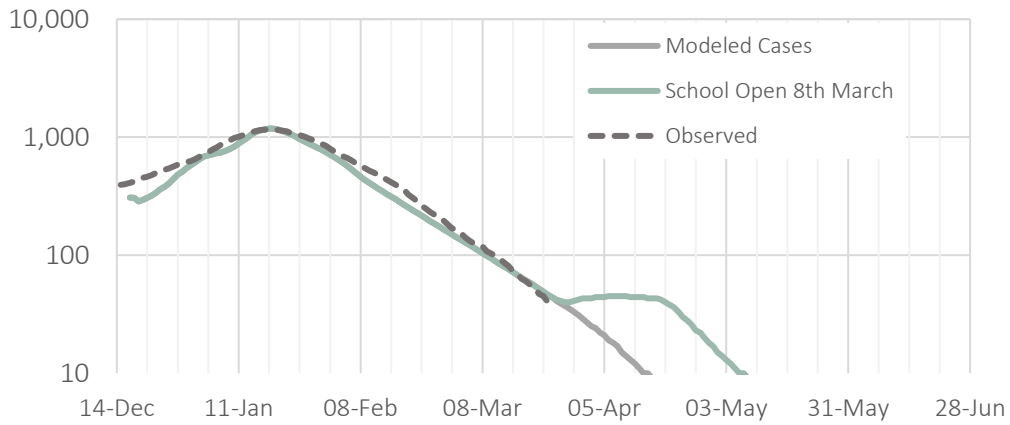
In conclusion, over the medium term it is likely that clinical thresholds for hospital admission have gradually relaxed, as pressure on capacity has been reduced. However, in the last few weeks, the reduced rate of decline in PCR positive tests among the adult population is likely to be a consequence of picking up a greater proportion of mild/asymptomatic cases, as it is not translating into a change in patterns of hospital admissions.

3) MORTALITY

The projection that has had the greatest impact on decision-making with respect to timing of school opening (and other relaxations) has been the impact on mortality. The cost in terms of life-years lost as a result of Covid deaths is the biggest single factor in the trade-offs being made. Hence, when reviewing the robustness of the assumptions, the mortality impact is the one that needs to be most carefully scrutinised. Conditional on the projections for the infection rate and morbidity, the major assumption is with respect to the mortality rate for those of different age groups. Would it remain constant or would the vaccination roll-out reduce it? Would the impact of the Kent strain increase it?

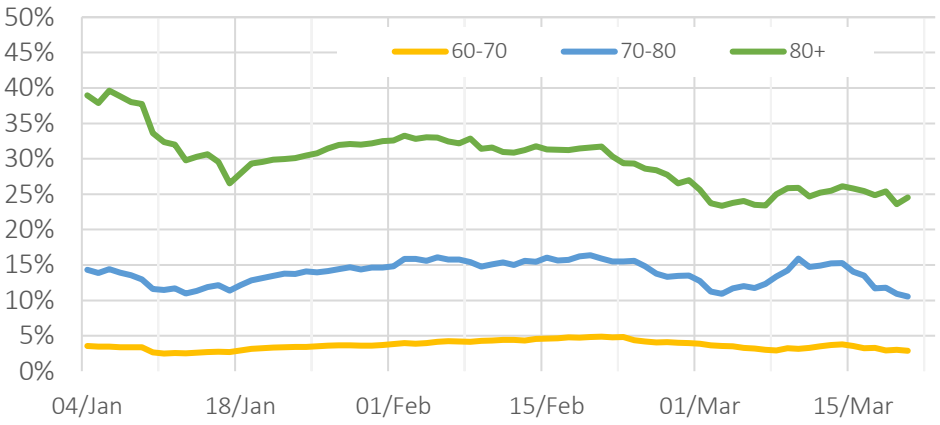
Figure 10 displays the projected mortality for the school opening scenario (vs. staying shut), and so far the mortality rate is tracking with (and recently slightly below) the projections. Although, given the delay from infection to mortality, there would not be much of a change yet expected in the trajectory from school opening.

Figure 10: February projection of daily mortality under scenario of school reopening, with underlying R-rate falling (log-scale)



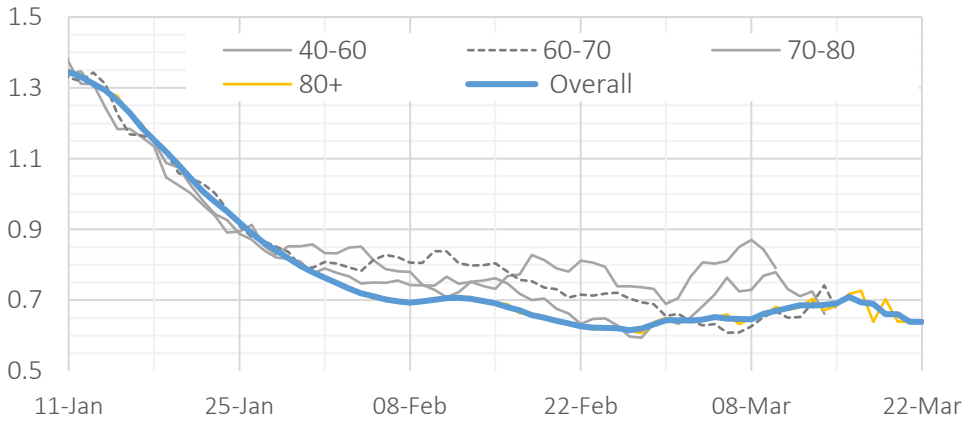
However, what is notable from this graph is that the impact of the cold spell in February has not been seen in increased mortality (vs. trend) in March. Nor does this declining trend in mortality match the slower decline in hospital admissions. In fact, the mortality to infection (or positive test) ratio has been declining (see Figure 11), suggesting tests are picking up milder cases across the board. This lower mortality rate also suggests that the vaccination programme has had more downward impact on the hazard rate than had been anticipated.

Figure 11: Covid mortality as a proportion of positive tests (16 days prior)



The positive impact of the vaccination programme on older age cohorts can be seen in the mortality 'R-rates', whereby the 80+ cohort has had the lowest mortality R-rate since they diverged in late January (following their initial vaccination). The lower morality R-rates for older age cohorts shown in Figure 12 are comparable to the lower infection R-rates for these older groups, but not replicated in hospital admission patterns.

Figure 12: Observed mortality R-rates (7-day ratio of Covid deaths)



The pattern of decreasing mortality, led by the older age groups (which have dominated the overall mortality figures) suggests the vaccine programme is protecting the more vulnerable to a greater degree than the assumptions made when evaluating school opening, despite hospital admissions not declining so fast. However, given that the impact of school opening will take another week or so to be seen in the mortality data, some circumspection is still appropriate.

4) CONCLUSION

When considering options for releasing restrictions, the impact on (excess) mortality is one of the most important considerations, and often the clearest measure to check after the fact. The decline in mortality rates to date supports the decision to open schools. However, it is a backward-looking metric and it far from captures the full picture.

Understanding the level of hospital admissions and their knock-on impacts are indicative of overall net morbidity. However, as has been observed, they can be subject to drift in admission thresholds. These thresholds need to be carefully considered, especially while other activities are not being undertaken. As the criteria are relaxed for Covid admissions, it is worth asking whether these marginal admissions are crowding out other activity that could be more critical.

While infection rates are the primary near real-time measure, positive cases are certainly drifting towards lower severity on average, and increasingly among the under 20s, who are subject to significant lateral flow testing regimes. The rapid drop in hospitalisation to infection rates for the 20-65 year-olds in recent weeks suggests a shift in severity of cases captured by tests. In the coming months, it will be necessary to ensure that decisions are not overly driven by the numbers of asymptomatic and mild cases.

Overall, the combined pattern of declines in infections, hospital admissions and mortality indicates that the decision to open schools was well grounded, and bodes well for further waves of relaxation of lockdown measures.

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] SAGE: NPIs table (pivot) - 21 September 2020
[iii] 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.
[iv] University of Minnesota (January 8, 2021) Three studies highlight low COVID risk of in-person school