



Department
for Education



Data
Science
Laboratory

Make
evidence
based
decisions

Impact of secondary schools on the second wave

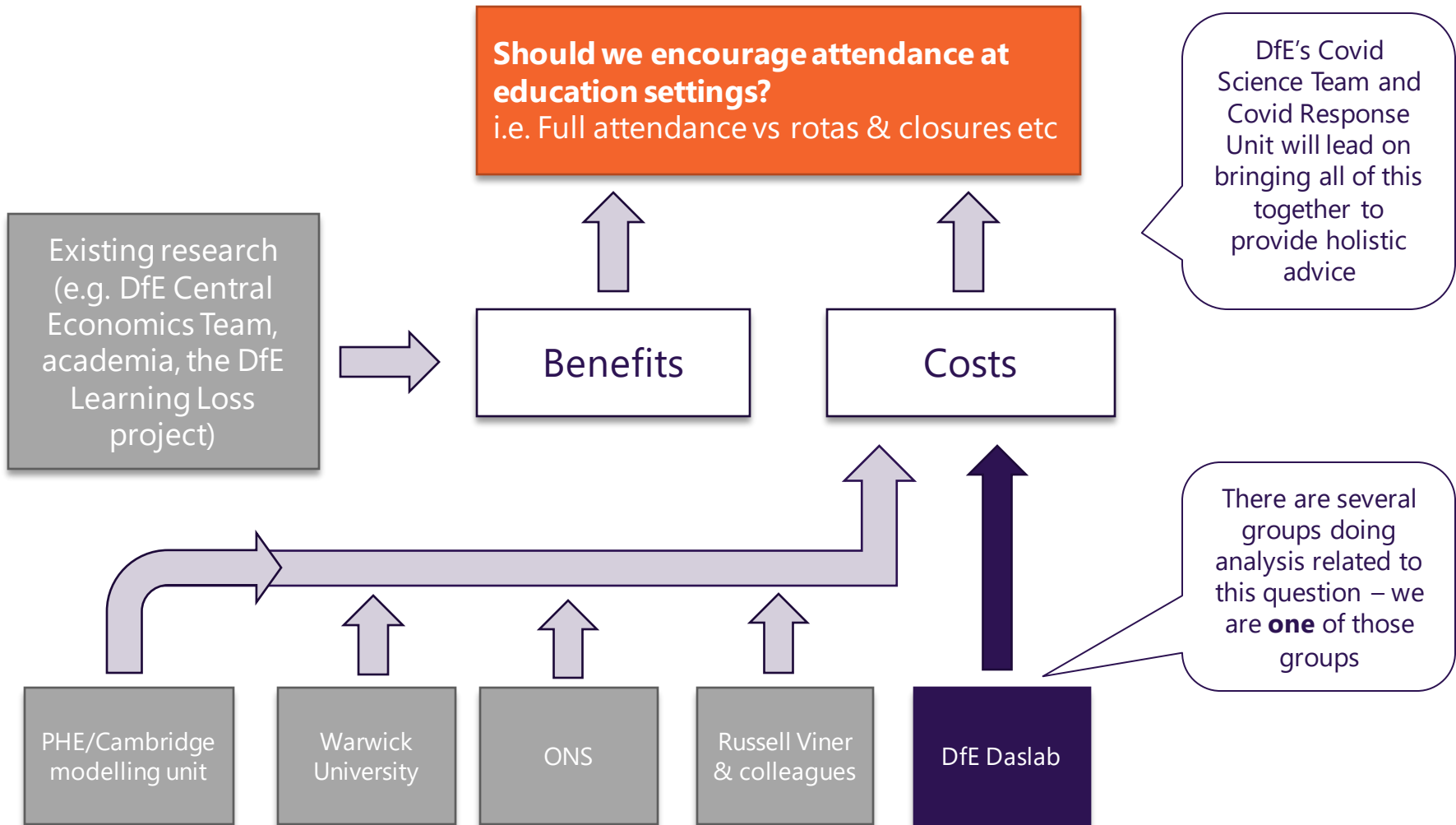
Initial findings & sources of uncertainty

- ▶ The DfE Data Science Lab were commissioned by the ONS-led working group on Covid in schools to investigate whether we can learn anything from the **half term natural experiment** about the impact of the schools system on the spread of the virus
- ▶ After analysing the problem from a variety of angles, using a range of different data sources, and consulting with epidemiologists from SPI-M, we concluded that:
 - ▶ The data are consistent with their being *an* effect of schools on increasing the spread of the virus amongst children
 - ▶ But we cannot tell *how large* this effect is
 - ▶ Nor can we tell what the impact of it is (if any) on the wider community
- ▶ This is due to the combination of:
 - ▶ The short period of time covered by half term
 - ▶ The high degree of uncertainty inherent in most available data sources
 - ▶ Confounding factors occurring at the same time (e.g. wider interventions, behavioural impacts, etc)

This pack sets out what analyses we have investigated, and explains why the degree of uncertainty is so high.

Why have we done
this analysis?

Our aim was to investigate one piece of the puzzle, to contribute to answering the school attendance policy question



How have we done it?

Trends in test result & ONS infection study data

Analysing trends in the various data sources before, during and after half term, to estimate how much slower the virus spread amongst young people while schools were closed

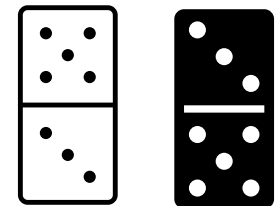


Contact tracing

Deep dive into contact tracing data, to explore how likely secondary school pupils are to report close contact with other age groups, and a demonstration of the limitations of this data

Wider impact

Investigation of the feasibility of using these datasets in combination with published estimates for (e.g.) hospitalisation rates to quantify wider impacts on hospital admissions and deaths



Part 1: Half term trends

Investigation of what the Covid test data and ONS Infection Study can tell us about transmission amongst children during half term

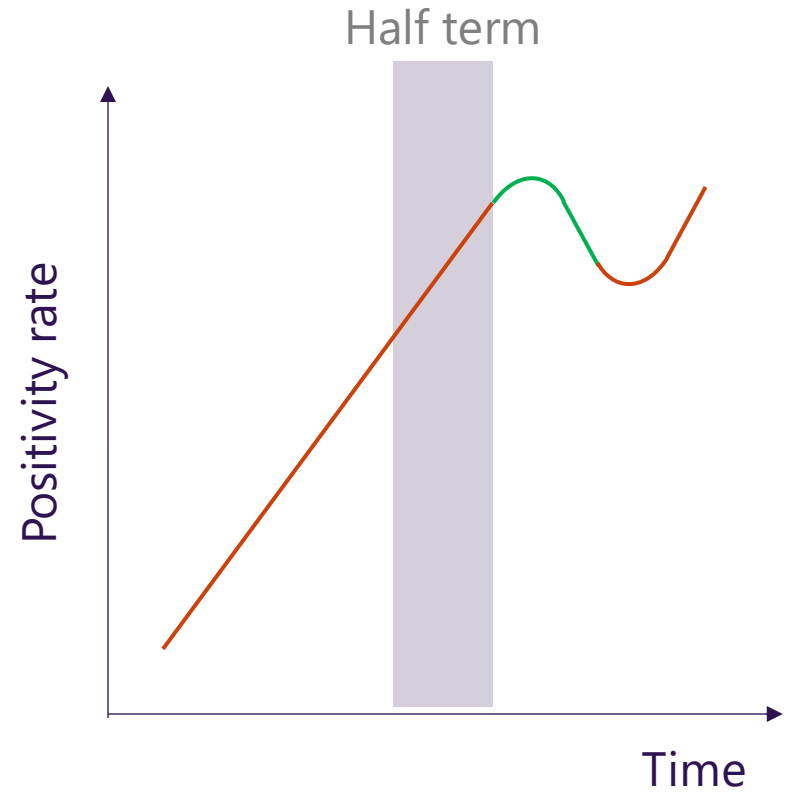
These notes explain which data we used and how we used it.

1. We use non deduplicated SGSS data for this analysis (which is one row per Covid test).
2. We calculate a 7 day rolling average of cases to smooth out the within-week variation.
3. We have not factored in local level lockdown tiers which were implemented around half term and could have had an impact on behaviour and infections.
4. The graphs in this pack were created by using all of the data. In other words, we have not filtered out lateral flow tests or filtered to just symptomatic tests.
5. We did re run the analysis filtering to just include symptomatic cases. We saw the same patterns, which (combined with the timings of half term) tells us mass testing isn't responsible for the trends we see. We have not included this additional analysis in this pack.
6. As we are using non deduplicated SGSS data, patients can appear in the data multiple times, and can count towards multiple positive and negative results.
7. This positivity rate methodology differs from the one used in the weekly Test and Trace publication because PHE don't use the 7 day rolling average, and they use a new de-duplication methodology.
8. This new methodology for creating de-duplicated test data had not been finalised at the time this analysis was conducted. For simplicity, we therefore used the non-deduplicated data as we wanted a picture of historic positivity rates that would not change when people got retested in the future. We would not expect it to substantially impact the headline message presented in this paper

What would we expect to see if half term had an effect?

If schools being closed for half term had an effect on the positivity rate, you would expect to see:

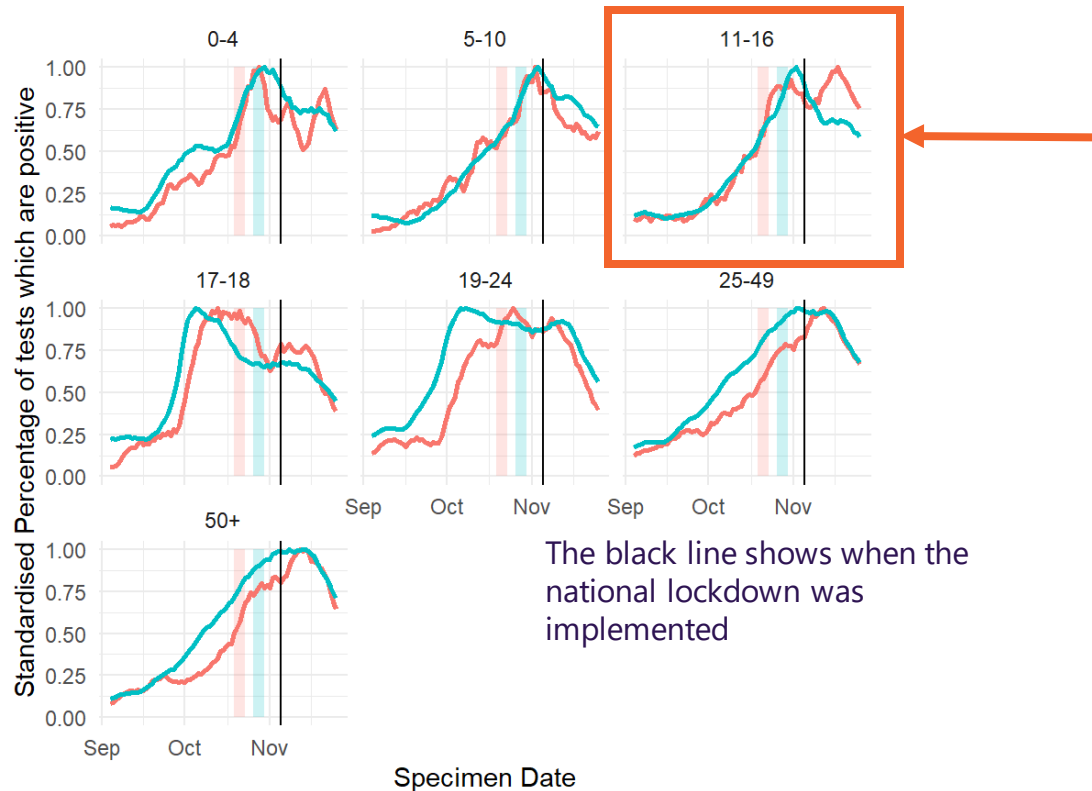
- ▶ Increasing positivity rate until half term
- ▶ Due to the 5-7 day lag (infection to developing symptoms to getting tests) you would expect it to keep increasing through half term
- ▶ After half term, you would expect the effect to start showing, and you would see a drop in positivity rate
- ▶ Then, following schools being back for a week or two, you would expect the rate to start climbing again



Percentage of tests that are positive, by age group

Red line = Leicester and Leicestershire, where half term was a week earlier

Blue line = 137 other LA's, where half term was a week later



The black line shows when the national lockdown was implemented

Date is on the x axis; the y axis shows test positivity standardised so that the maximum point for each line on each mini-chart equals 1. This is to make it easier to compare the **trend** in each line – it doesn't tell you anything about the absolute values.

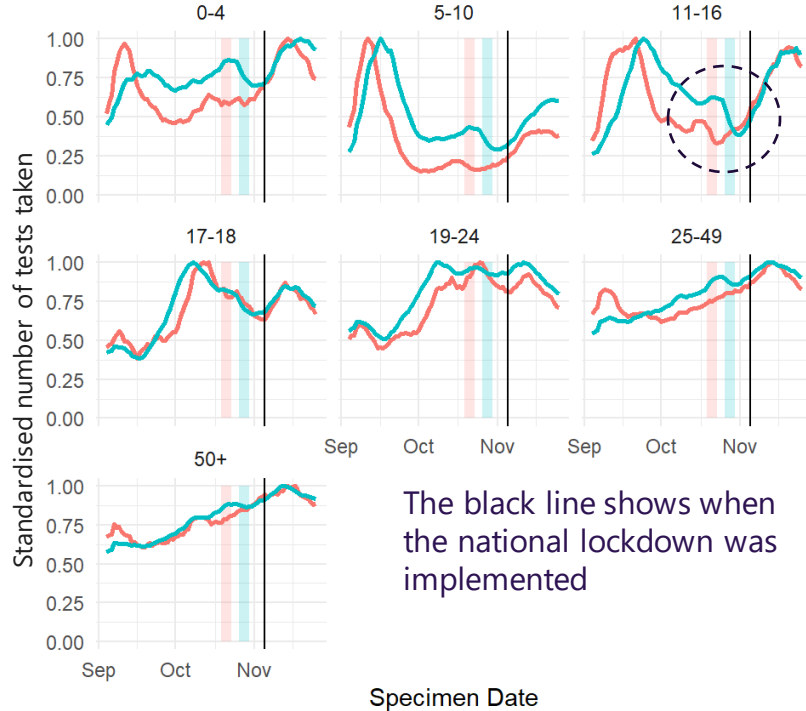
- ▶ This trend in positivity is exactly what we see for both sets of LAs in secondary-aged children – and we see it at different times depending on when half term was.
- ▶ This kind of consistent pattern wasn't observed for adult age groups. It's therefore more likely to be to do with schools closing rather than other interventions
- ▶ Positivity in all age groups has decreased since the national lockdown was introduced

However, what happens when we look at number of tests taken?

Number of tests taken, by age group

Red line = Leicester and Leicestershire, where half term was a week earlier

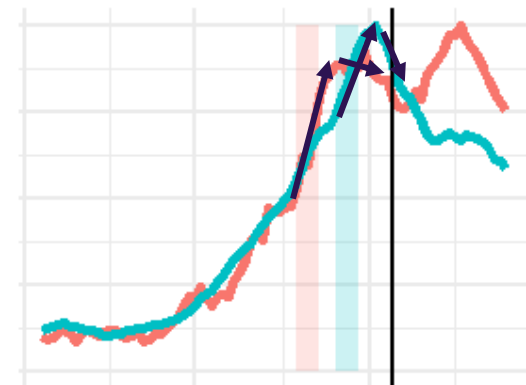
Blue line = 137 other LA's, where half term was a week later



- ▶ This would lead to **artificially inflated positivity during half term**, followed by a **drop the following week**, which is what we see.
- ▶ In fact, the steepness of the increase *during* half term tells us that testing behaviour change is very likely having *an effect*.

- ▶ The number of tests being taken decreased over the half term period.
- ▶ This behaviour change is to be expected. It is less important to test mild symptoms in children when they're not going into school and interacting with others.
- ▶ However, it means that our trend on the previous page could be mostly driven by this behaviour change: if people with **milder symptoms are less likely to get tested** then **positivity will increase**.

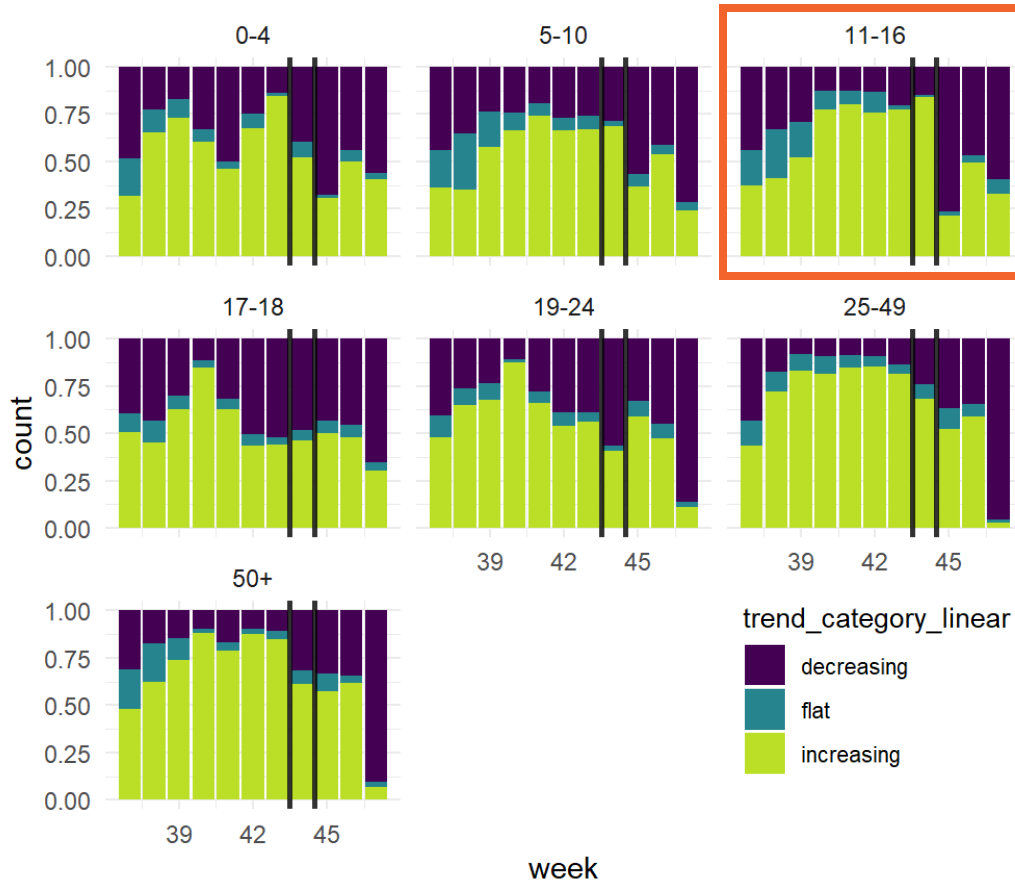
Positivity taken from previous slide
11-16



Does this trend occur at UTLA level?

Proportion of LAs where test positivity is **increasing** vs **decreasing**

Half term week outlined in black.
The national lockdown happened the week after.



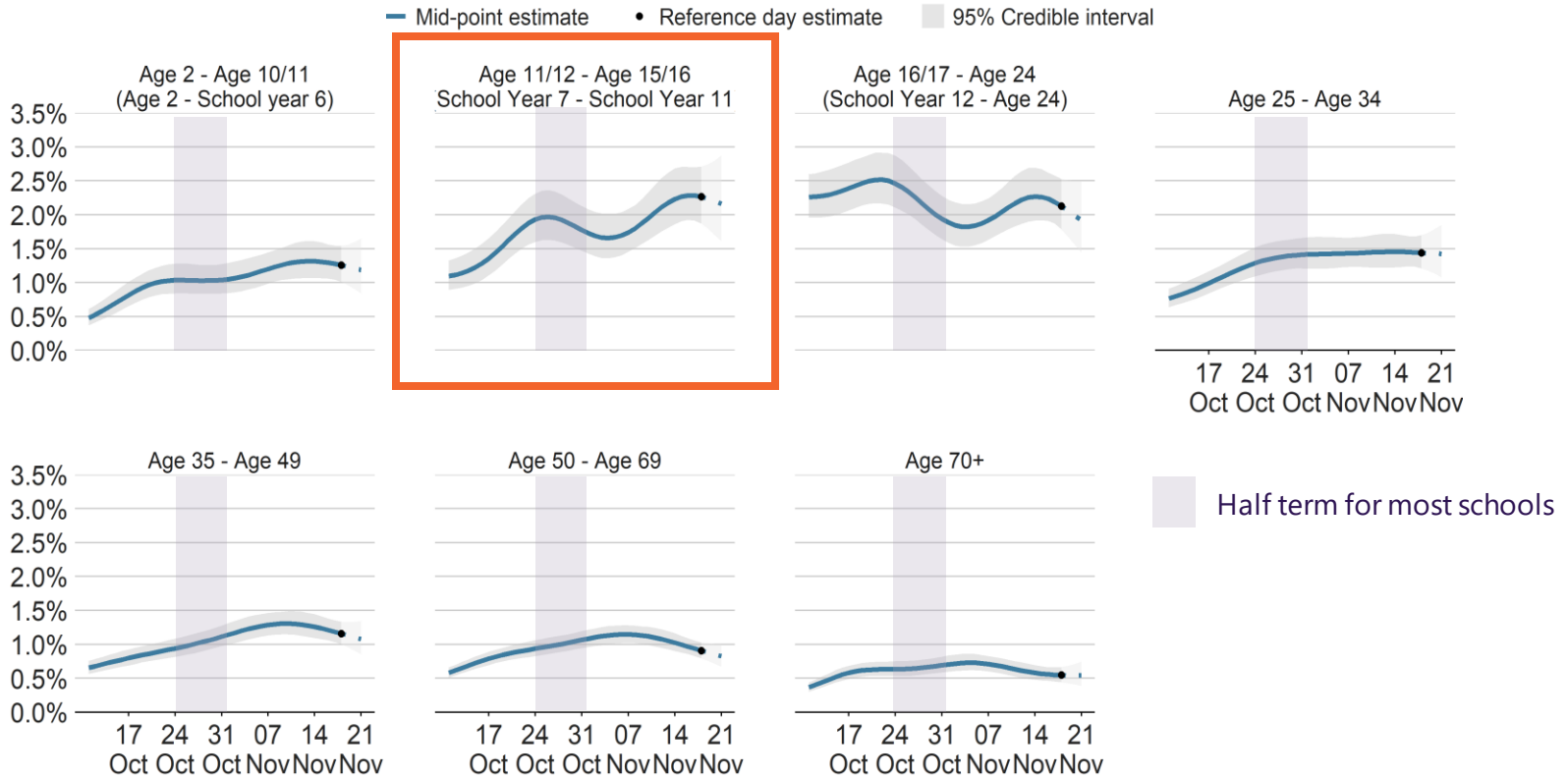
▶ Test positivity was rising amongst 11-16 year olds in almost all LAs before half term – but then started falling almost everywhere immediately after the break. After schools had been open for one week, the proportion with rising trends increased again.

▶ However, we don't know what can be attributed to schools being closed, and what is just due to changes in testing behaviour: more LA's have downwards trends after half term, but they may simply be **returning to normal levels after an artificially inflated peak**

The ONS Infection Study appears to show a dip during and after half term

Percentage of people testing positive for COVID-19 by age over time

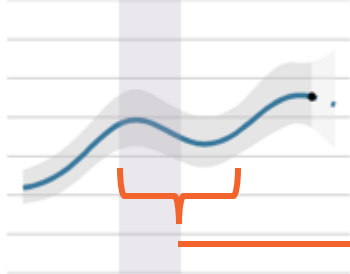
Modelled daily estimates



The area marked with the dashed line and light grey area has a lower level of certainty due to lab results still being processed for this period
Data from 11 October to 21 November 2020, reference region East Midlands.

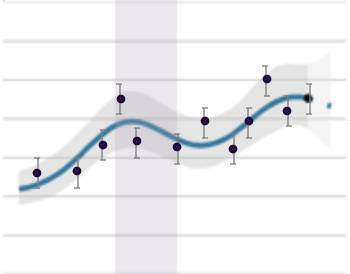
Some effect of half term is likely – but the *size* of the effect could vary substantially

Age 11/12 - Age 15/16
School Year 7 - School Year 11



These charts measure prevalence, and prevalence is roughly equivalent to the sum of *new* infections over the previous fourteen days. So if half term were having an effect, we *would* expect it to be observed during this period

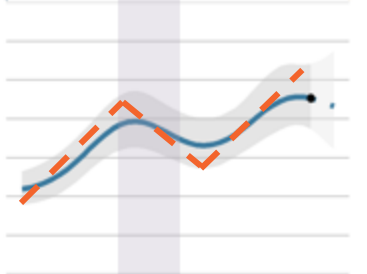
Age 11/12 - Age 15/16
School Year 7 - School Year 11



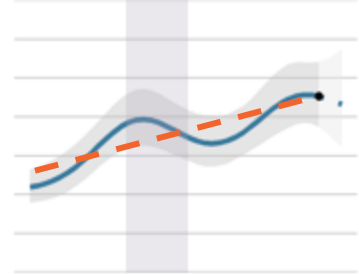
But there's more going on below the surface. These charts are actually created by modelling a line of best fit through a number of points, each representing different samples. And **there are lots of ways of drawing these lines...**

Which means that **both of these trends in orange could plausibly be consistent with this data**. The left hand plot would imply a very large effect of half term; the right hand chart would suggest no effect at all.

Age 11/12 - Age 15/16
School Year 7 - School Year 11



Age 11/12 - Age 15/16
School Year 7 - School Year 11



So although the findings suggest that it is **likely there is an effect** of half term, it is impossible to use this data to **quantify the size of this effect** in any meaningful or helpful way

Summary

We see similar patterns in the positivity and prevalence data that we would expect to see **if schools being closed decreased infection amongst Secondary school aged children.**

However:

- ▶ We also see that during half term, testing amongst that age group **decreased** which **could explain some or all** of the pattern in positivity rates that we see.
- ▶ Even for the ONS prevalence study, there is a lot of uncertainty around the size of the effect that is seen.
- ▶ Drops in infection while school is closed does not mean that these infections were happening *in* school. For example, it could be from travelling into school or due to more mixing between parents.
- ▶ There will be differences across the country, particularly because of the different lockdown tiers, and we haven't explored this variation.

Conclusion

While this *could* be evidence for a “half term” effect on infection amongst school aged pupils, we do not have enough evidence here to prove this conclusively, or to quantify the size of the effect and how it interacts with other factors.

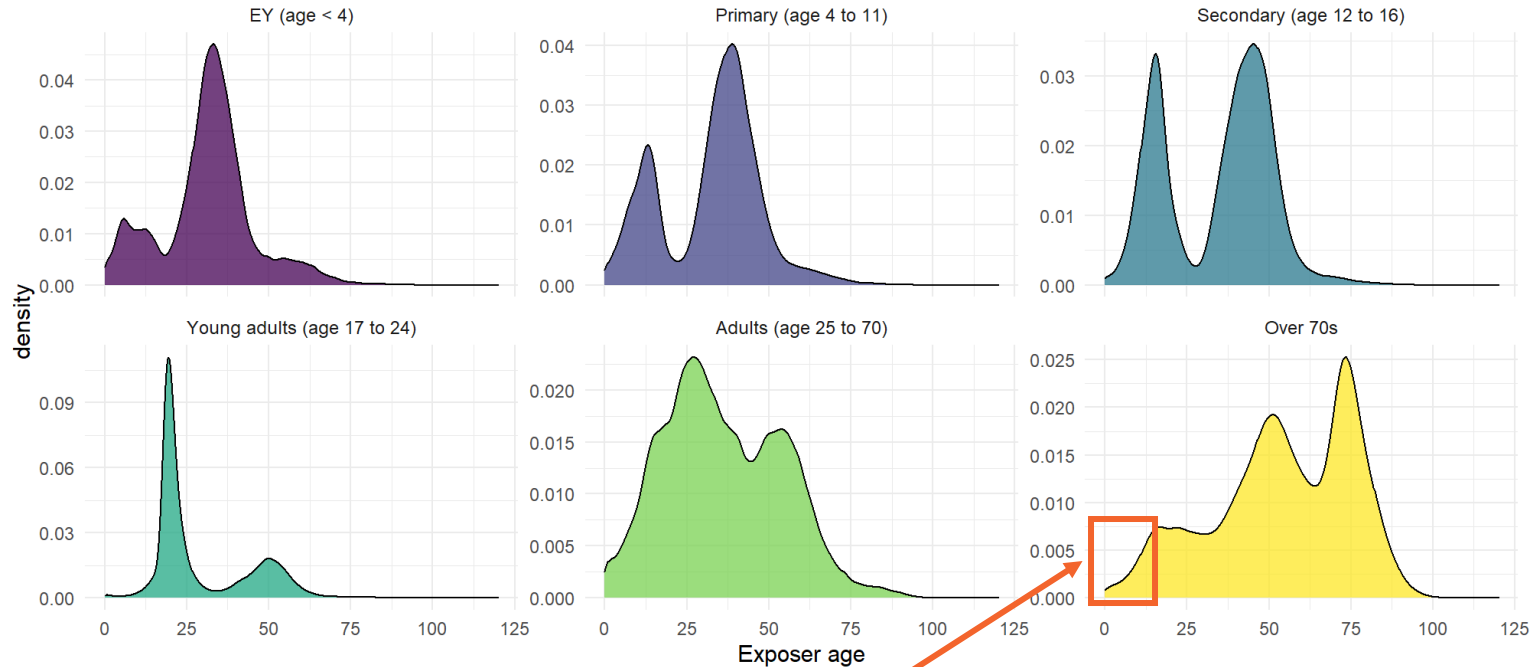
Part 2: Contact between children and older adults

Investigation of the reliability of the contact tracing data from Test & Trace, and whether it can tell us about the level of contact between children and older/vulnerable adults

Available test and trace data shows that older adults are rarely reported as close contacts by infected children

Who exposes who? Age profiles of Covid cases vs that of their contacts

Data on c.1,900,000 exposure events where age data was available. Data up to 2020/12/07



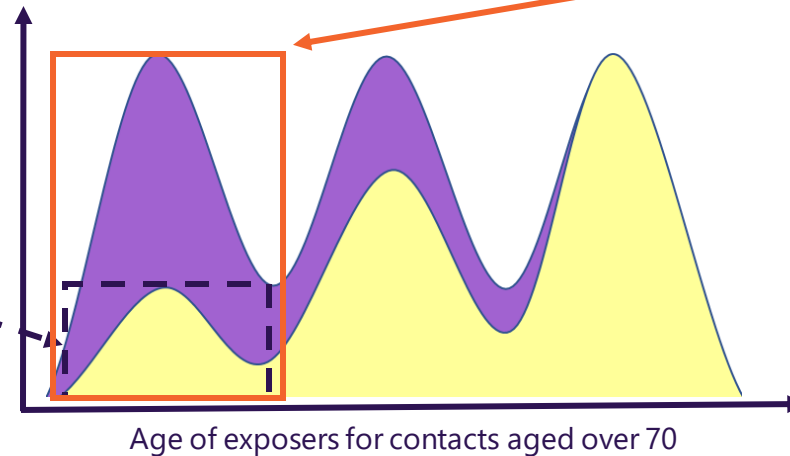
▶ **According to this data source**, a small proportion of over-70s are exposed to the virus by children

▶ The majority of older people listed as contacts **appear** to be exposed to the virus by other adults over the age of 50

However bias and data quality issues make it extremely difficult to infer the true exposure patterns

- **Around 30% of contacts have no age data.** If this information is not missing at random, **the age profile of exposer for contacts over 70 could be very different**, in either direction.
- **Children are more often asymptomatic than adults**, but Test and Trace data **only records symptomatic cases and associated contacts**. As a consequence, **exposure events where over-70s come into contact with infected children may be more common than shown by the data.**

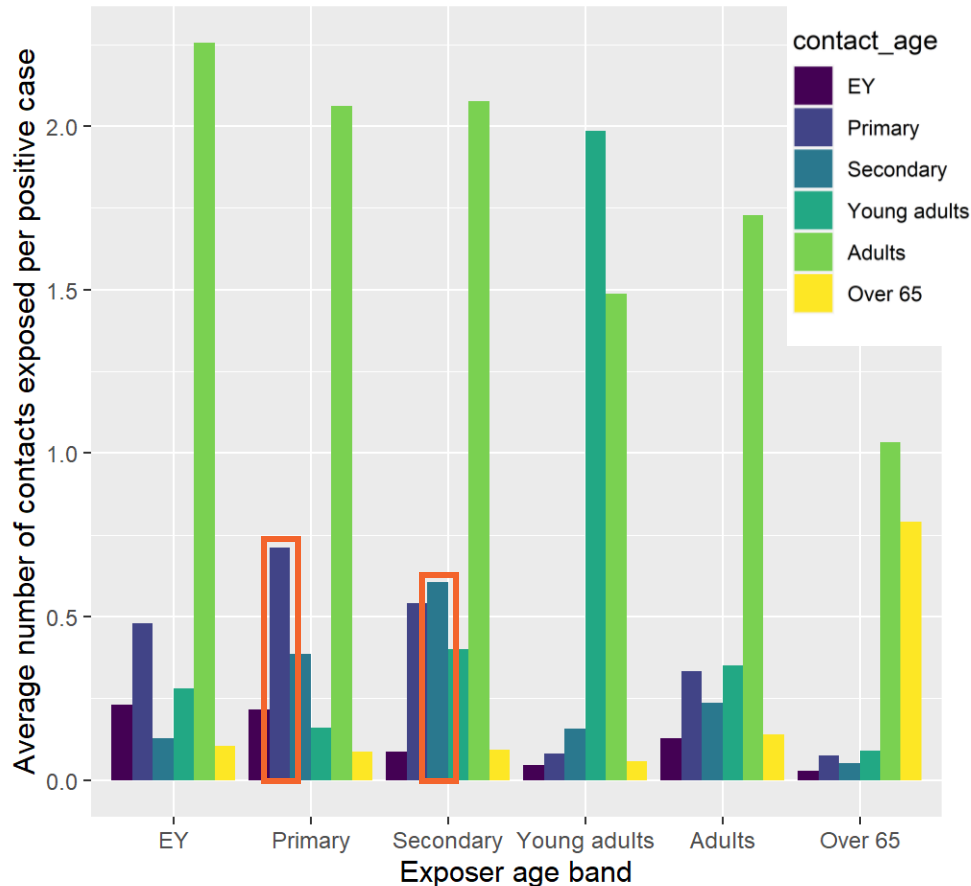
Stylised representation of observed exposer age profile for contacts aged over 70. **Relatively few exposure events involve infected symptomatic children.**



A plausible version of exposer age profile for contacts aged over 70, **if asymptomatic exposures were taken into account.** The true size of this bias is unknown, but it would always underestimate exposure by younger people.

Test and Trace data likely underestimates contact numbers per case

Age profile of contacts exposed by cases

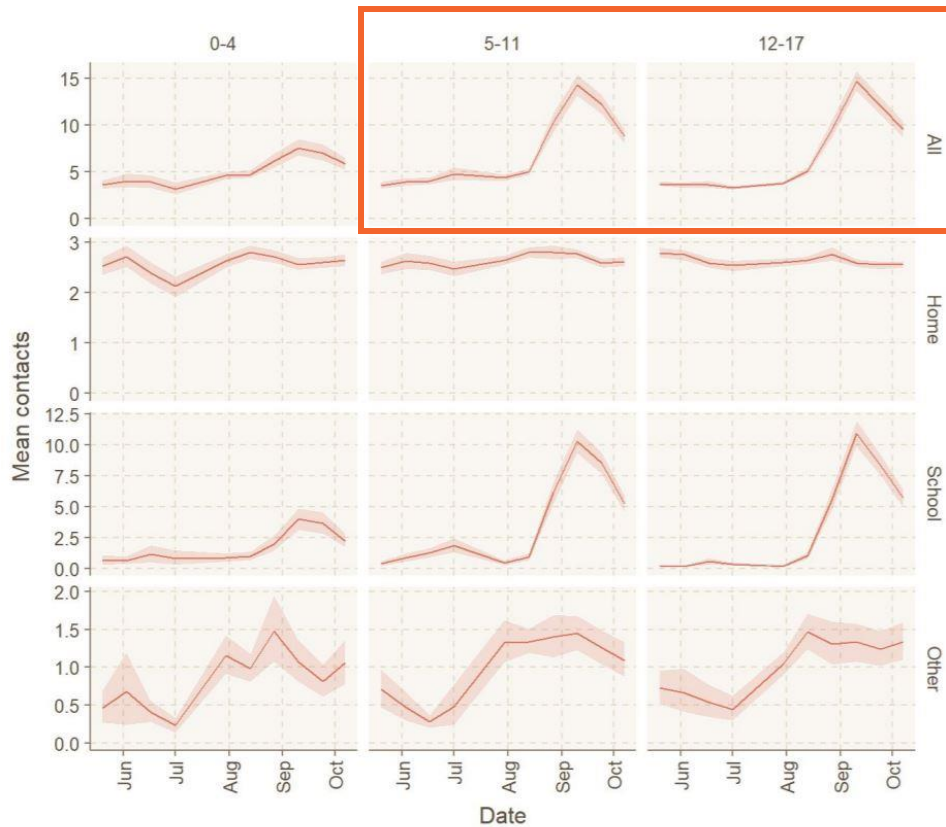


The Test and Trace system records the close contacts **reported** by individuals who tested positive to Covid-19.

Under-reporting means these values are **likely underestimates of true contact numbers**.

The average number of contacts between infected children and their own age groups are unexpectedly low given they almost all attend school. These figures can be compared with other published data for sense checking.

Test and Trace data likely underestimates contact numbers per case



Setting-specific mean contacts by age group for children in the UK over time. As reported in CoMix report for survey week 31.

- ▶ **Other reputable data sources** for contact numbers **report substantially higher figures**. For instance, CoMix survey data¹ used by the Centre for Mathematical Modelling of Infectious Diseases (CMMID) show **between 10 and 15 daily contacts per child** in September and October, for age bands 5-11 and 12-17.
- ▶ The contact tracing data, by contrast, shows an average of **less than 4 reported contacts per child**.
- ▶ We can't use the CoMix data to analyse knock-on impacts for older groups though, as it doesn't tell us the age of those contacts

¹ <https://cmmid.github.io/topics/covid19/reports/comix/CoMix%20Weekly%20Report%2031.pdf>

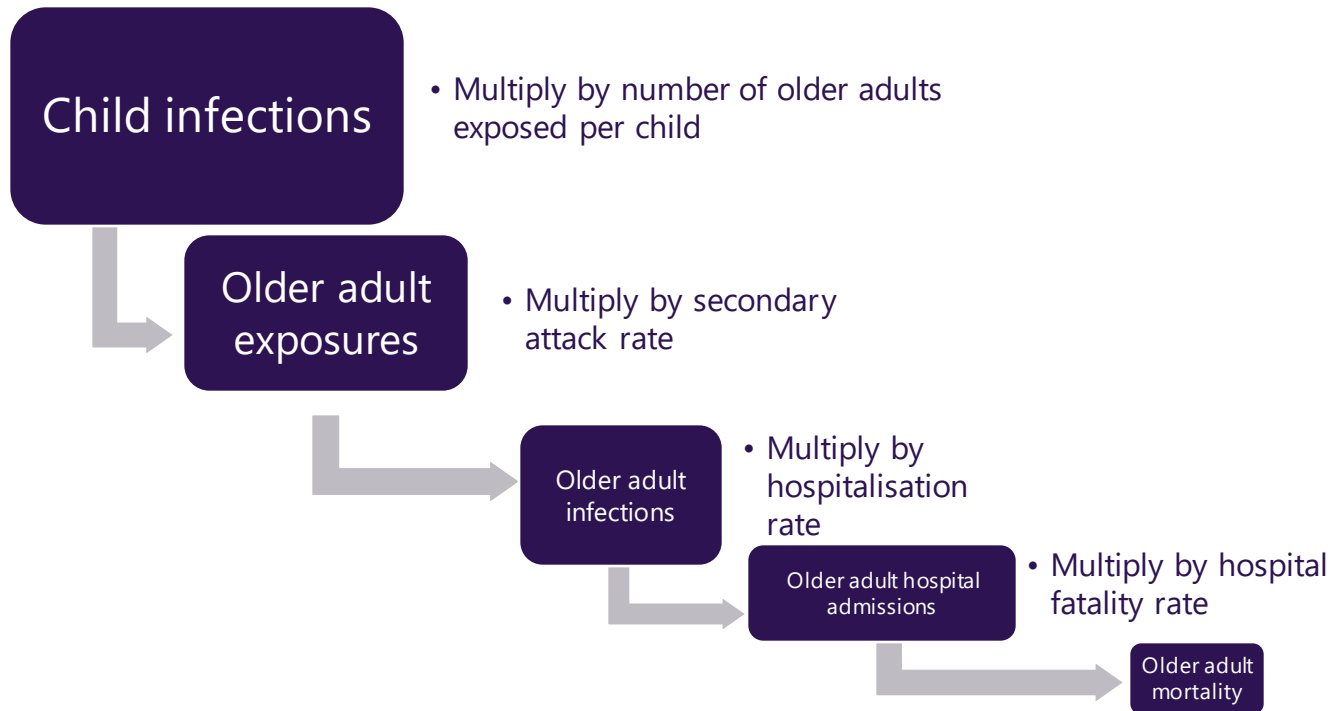
- ▶ There are major sources of uncertainty in the Test and Trace data:
 - ▶ Large amounts of contact records with missing age data
 - ▶ Asymptomatic cases and associated contacts not reported
 - ▶ Under-reporting of contacts for recorded cases
- ▶ Other main data sources for overall contact rates show substantially different, higher estimates
- ▶ Although infected children do come into contact with older adults, the limitations listed above mean that true contact rates cannot be accurately estimated from the Test and Trace data. Consequently, **this data should not be used to quantitatively assess the role of children on transmission to high-risk groups.**

Part 3: Wider impacts

Investigation of whether it is possible to combine the half term analysis with various published estimates to quantify the knock-on impacts of school attendance for hospital admissions and deaths

Quantifying the impact on older/more vulnerable groups is complex and highly uncertain

- ▶ In theory, if you can estimate how many infections amongst young people were prevented by half term, you can then follow this impact through for other age groups



But this would require a number of assumptions to hold

Assumptions:

1. **Reduced infection amongst children during half term was entirely due to schools being closed**
2. **Half term gives a good approximation for how children and families would behave if schools were closed**
3. **Contact between age groups as reported through the Test & Trace programme are accurate**
4. **Asymptomatic children are equally as infectious as symptomatic children**
5. **Elderly contacts of school-aged children are typically members of their household or close family**
 - ▶ A deliberately pessimistic (but reasonable) assumption. To do this analysis, you would need to look at how many contacts children have with elderly groups, and then multiply this by the [estimated probability](#) that a household contact will result in an infection. In reality, some of these contacts may not be household members, so the actual effect might be *smaller* than this
6. **The proportion of infected over-65s who will require hospital admission is between 7% and 34%, as [published in the Lancet](#)**
 - ▶ These estimates vary widely
7. **The proportion of hospitalisations that result in death is around 30%, as published in the [British medical Journal](#)**

And many of these do not stack up

Highlighted assumptions in particular are problematic

- 1. Reduced infection amongst children during half term was entirely due to schools being closed**
 - ▶ This is very hard to be confident about, due to the range of other local factors and interventions in place at the time
- 2. Half term gives a good approximation for how children and families would behave if schools were closed**
 - ▶ This might not be the case. If schools were closed during term-time and children had remote learning during the day, they might have fewer contacts than during half term. Alternatively, children might spend more time with their family during half term than term-time, and so term-time school closure periods might see *more* contact between children than in half term
- 3. Contact between age groups as reported through the Test & Trace programme are accurate**
 - ▶ We know this is not the case (see earlier sections of this report). People under-report the number of contacts they have, and the Comix survey suggests this problem is particularly acute for children. Any estimates of knock-on effects using this data would therefore be *highly uncertain*
- 4. Asymptomatic children are equally as infectious as symptomatic children**
 - ▶ We still don't know whether this is true or not – there is little either way in the scientific literature. This assumption would therefore add another substantial source of uncertainty to any such analysis.
- 5. Elderly contacts of school-aged children are typically members of their household or close family**
 - ▶ To do this analysis, you would need to look at how many contacts children have with elderly groups, and then multiply this by the [estimated probability](#) that a household contact will result in an infection. In reality, some of these contacts may not be household members, so the actual effect might be *smaller* than this. Even if they *were* all household contacts, estimates of the secondary attack rate from children to family members vary substantially between studies
- 6. The proportion of infected over-65s who will require hospital admission is between 7% and 34%, as [published in the Lancet](#)**
 - ▶ These estimates vary widely, adding further uncertainty

Plus, the any estimates for the number of child infections prevented by half term – the first domino in the line – vary extremely widely. After multiplying through by these parameters, all of which include a confidence range, we would end up with a ‘plausible range’ of impacts that would be **far too wide to be useful**.

Conclusions & next steps

Where do we go from here?

Our key findings from this analysis were:

1. A variety of data sources suggest that secondary school-aged children became infected at a slower rate during half term than during the preceding term-time period.
2. There is far too much uncertainty in readily available data sources to be able to:
 - ▶ Quantify this size of this effect
 - ▶ Quantify the extent to which it was driven by schools being closed vs other factors
 - ▶ Attribute it to any specific causes within the school system (e.g. transmission within school buildings; transport to and from school; activities surrounding school; transmission from teachers to children or vice versa, etc)
3. Quantifying the wider knock-on effects for the rest of society would require complex epidemiological modelling and comparisons against other sectors
 - ▶ All we can say is that no substantial 'half-term ripple' showed up for older age groups in the period after half term – so if there *was* an effect, it wasn't big enough to be obvious

Our recommendation is to ask for a commission to SPI-M to undertake this modelling, as the national experts in the field. The aim would be to provide a holistic answer on the relative contributions of education and other settings (hospitality, household visits etc) on transmission as a whole.