Coronavirus (COVID-19): modelling the epidemic in Scotland (Issue No. 61)

Background

This is a report on the Scottish Government modelling of the spread and level of Covid-19. This updates the previous publication on modelling of Covid-19 in Scotland published on 15th July 2021. The estimates in this document help the Scottish Government, the health service and the wider public sector plan and put into place what is needed to keep us safe and treat people who have the virus.

This edition of the research findings focuses on the epidemic as a whole, looking at estimates of R, growth rate and incidence as well as local measures of change in the epidemic.

In Scotland, the modelled estimate for R is between 0.9 and 1.2, with the growth rate between 1% and 4% based on the period up to 19th July.

There is uncertainty around the status of the epidemic in Scotland, which may suggest it is at a turning point. Cases have been decreasing over the past two weeks. This uncertainty is reflected in the growth rate being positive and the R estimate crossing 1. The intervals of the R and growth rate estimates do not exactly correspond to each other due to the submission of different independent estimates and rounding in presentation.

Key Points

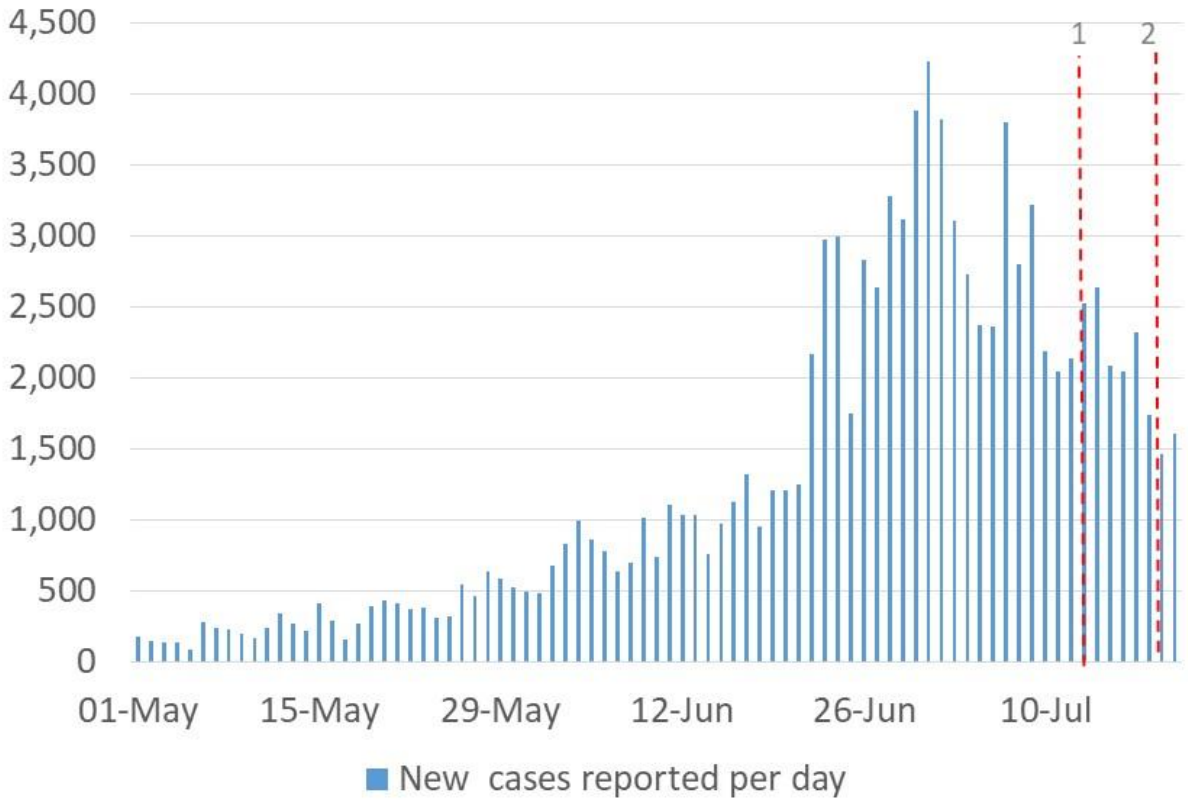
- The reproduction rate R in Scotland is currently estimated as being between 0.9 and 1.2, based on the period up to 19th July. The lower and upper limits have decreased since last week.
- The number of new daily infections for Scotland is estimated as being between 119 and 227, per 100,000 people, based on the period up to 19th July.
- The growth rate for Scotland is currently estimated as being between 1% and 4%, based on the period up to 19th July. The lower and upper limits have decreased since last week.

- Average contacts have remained at a similar level in the last two weeks (comparing surveys pertaining to 24th June - 30th June and 8th July - 14th July) with a current level of 4.0 daily contacts.
- Contacts within work have decreased compared to two weeks prior by 19% whereas there has been a slight rise in contacts had within the home setting, increasing by 6%. Average contacts within the other setting (contacts had outside of the work, school and home) have remained at similar levels over the same period.
- Mean contacts across all age groups have either remained stable or shown a reduction in comparison to two weeks prior with the exception of those aged between 18-29 reporting an increase of 17%.
- The highest number of interactions are reported between those aged 18-29 with each other. The biggest decrease in the total number of contacts between age groups in the last two weeks is seen amongst those aged 30-49 with those under 18, decreasing by at least 43%.
- The proportion of participants visiting different locations remains at similar levels across the majority of locations with those visiting a pub or restaurant reporting the highest increase from 40% to 43% in the last two weeks.
- Hospitalisations from the increase in cases during the last few weeks have likely plateaued, and the future increase or decrease in hospital occupancy and intensive care use is highly uncertain, and depends on both current infection levels and the impact of the recent move to level 0 nationally.
- Modelled rates of positive tests per 100K using data to 19th July indicate that, for the week commencing 1st August 2021, there are 26 local authorities with at least a 75% probability of exceeding 100 cases per 100K.
- Of these, 20 local authorities are expected to exceed 150 cases per 100K with at least a 75% probability. Only one local authority (Renfrewshire) is expected to exceed 300 cases per 100K with this probability.
- Overall, relative to the peak reported in the previous report, wastewater Covid-19 levels declined nationally. This general trend is not followed at all sites (as of 20th July), with some showing more static levels. This will be monitored closely over the next few weeks.
- The Scottish Government has started to model the number of people likely to experience long Covid symptoms. This modelling estimates that on 8 August 2021 between 0.7% and 1.9% of the population are projected to experience symptoms for 12 weeks or more after their first suspected Covid infection in Scotland.

Recent cases

Figure 1 shows the number of cases reported in Scotland between May and July 2021. The vertical dashed lines indicate the cut off points for each of the modelling inputs; after these dates, the number of cases is not incorporated into the outputs.

Figure 1: Cases reported in Scotland to 21st July 2021.



This report covers the period up to 14th July for contact patterns (indicated by dashed line 1). Wastewater data is provided to 19th July (dashed line 2). The estimates of R, incidence, growth rates, the modelled rates of positive tests per 100k, and the medium term projections by the Scottish Government of infections, hospitalisations and ICU beds use data to 19th July (dashed line 2).

Overview of Scottish Government Modelling

Modelling outputs are provided here on the current epidemic in Scotland as a whole, based on a range of methods. Because it takes a little over three weeks on average for a person who catches Covid-19 to show symptoms, become sick, and either die or recover, there is a time lag in

what our model can tell us about any re-emergence of the epidemic and where in Scotland this might occur.

However modelling of Covid-19 deaths is an important measure of where Scotland lies in its epidemic as a whole. In addition, the modelling groups that feed into the SAGE consensus use a range of other data along with deaths in their estimates of R and the growth rate. These outputs are provided in this research findings. The type of data used in each model to estimate R is highlighted in Figure 2.

We use the Scottish Contact Survey (SCS) to inform a modelling technique based on the number of contacts between people. Over time, a greater proportion of the population will be vaccinated. This is likely to impact contact patterns and will become a greater part of the analysis going forwards.

The logistical model utilises results from the epidemiological modelling, principally the number of new infections. The results are split down by age group, and the model is used to give a projection of the number of people that will go to hospital, and potentially to ICU. This will continue to be based on both what we know about how different age groups are affected by the disease and the vaccination rate for those groups.

What the modelling tells us about the epidemic as a whole

The various groups which report to the Scientific Pandemic Influenza Group on Modelling (SPI-M) use different sources of data in their models (i.e. deaths, hospital admissions, cases) so their estimates of R are also based on these different methods.

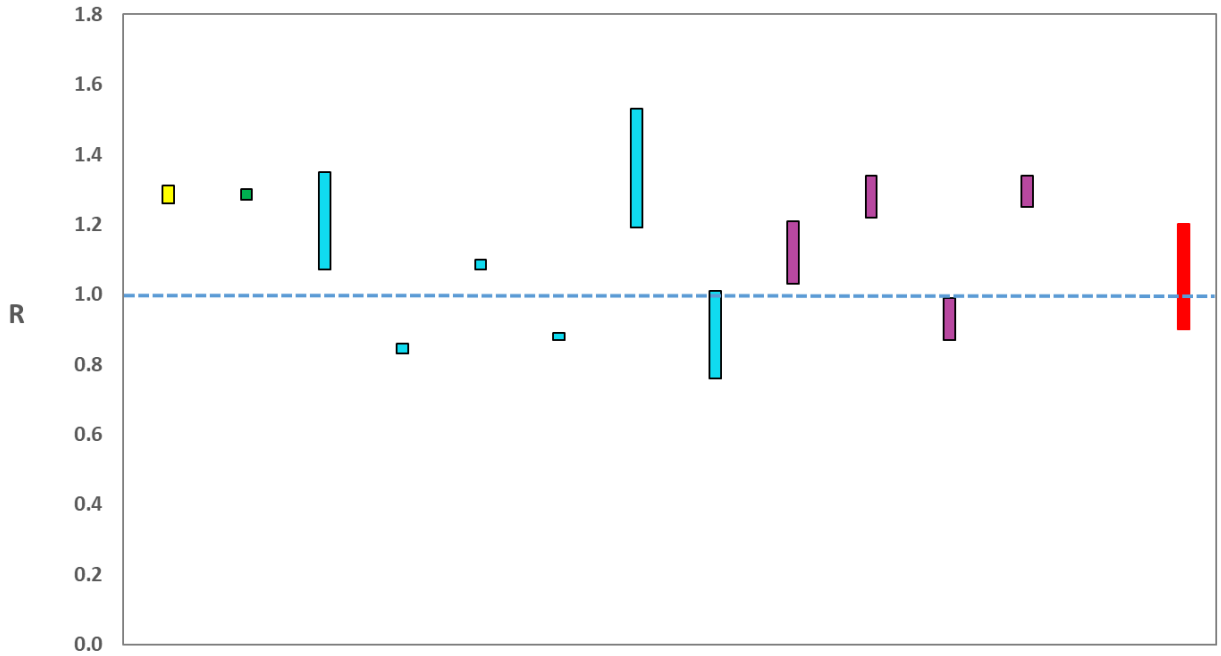
R is an indicator that lags by two to three weeks and therefore does not reflect any behavioural changes that have happened during this time. In particular, the recent decline in the number of new daily cases in Scotland may not yet be fully reflected in the R and growth rate estimates. The decline in new cases suggests it is possible that the current value of R in Scotland could be below 1.

SAGE's consensus view across these methods as of 21st July, using data to 19th July, was that the value of R in Scotland was between 0.9 and 1.2 (see Figure 2)[1].

[1] Particular care should be taken when interpreting this estimate as it is based on low numbers of cases, hospitalisations, or deaths and / or dominated by clustered outbreaks. It should not be treated as robust enough to inform policy decisions alone.

This week the Scottish Government presented two outputs to SPI-M. The first uses confirmed cases as published by Public Health Scotland (PHS). The second uses instead wastewater data to estimate the number of cases. Both outputs are shown in Figures 2 and 3.

Figure 2. Estimates of R_t for Scotland, as of 21st July, including 90% confidence intervals, produced by SAGE[2]. Data to 19th July.

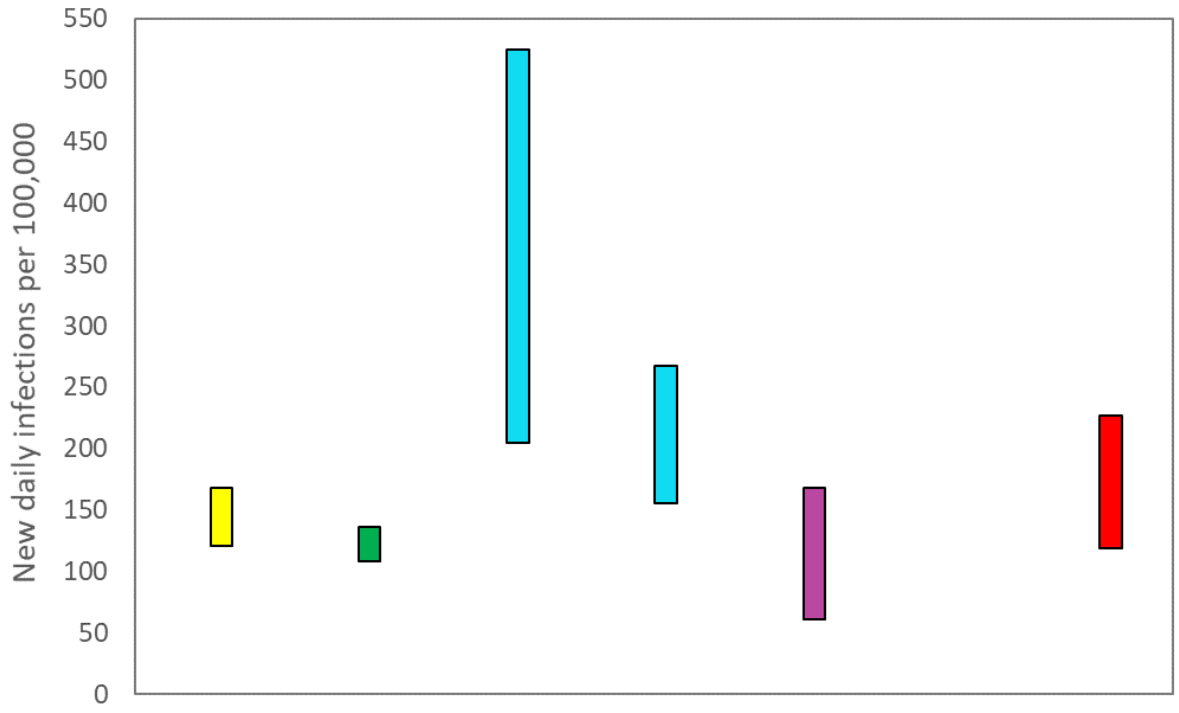


Source: Scientific Advisory Group for Emergencies (SAGE).

The various groups which report to the Scientific Pandemic Influenza Group on Modelling (SPI-M) use different sources of data in their models to produce estimates of incidence (Figure 3). SPI-M's consensus view across these methods, using data to 19th July, was that the incidence of new daily infections in Scotland was between 119 and 227 new infections per 100,000. This equates to between 6,500 and 12,400 people becoming infected each day in Scotland.

[2] The cyan bars use Covid-19 test data and purple bars use multiple sources of data. The estimates produced by the Scottish Government are the two on the left. (Yellow uses confirmed cases from PHS; green uses wastewater data).The SAGE consensus range is the right-most (red).

Figure 3. Estimates of incidence for Scotland, as of 21st July, including 90% confidence intervals, produced by SPI-M[2]. Data to 19th July.



Source: Scientific Pandemic Influenza Group on Modelling (SPI-M).

The consensus from SAGE for this week is that the growth rate in Scotland is between 1% and 4% per day using data to 19th July. The lower and upper limits have decreased since last week.

What we know about how people's contact patterns have changed

Average contacts have remained at a similar level in the last two weeks (comparing surveys pertaining to 24th June - 30th June and 8th July - 14th July) with a current level of 4.0 daily contacts as seen in Figure 4. Contacts within the work have decreased compared to two weeks prior by 19% whereas there has been a slight rise in contacts had within the home setting, increasing by 6%. Average contacts within the other setting (contacts had outside of the work, school and home) have remained at similar levels over the same period.

Figure 4: Mean Adult Contacts (truncated at 100) from SCS.

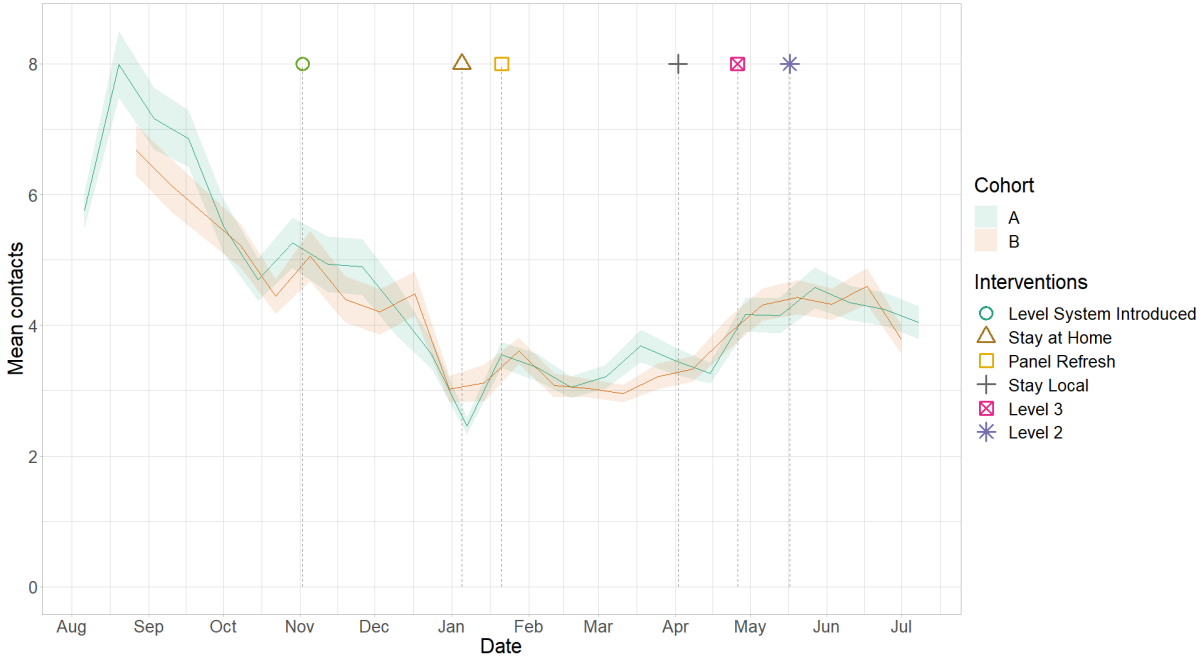
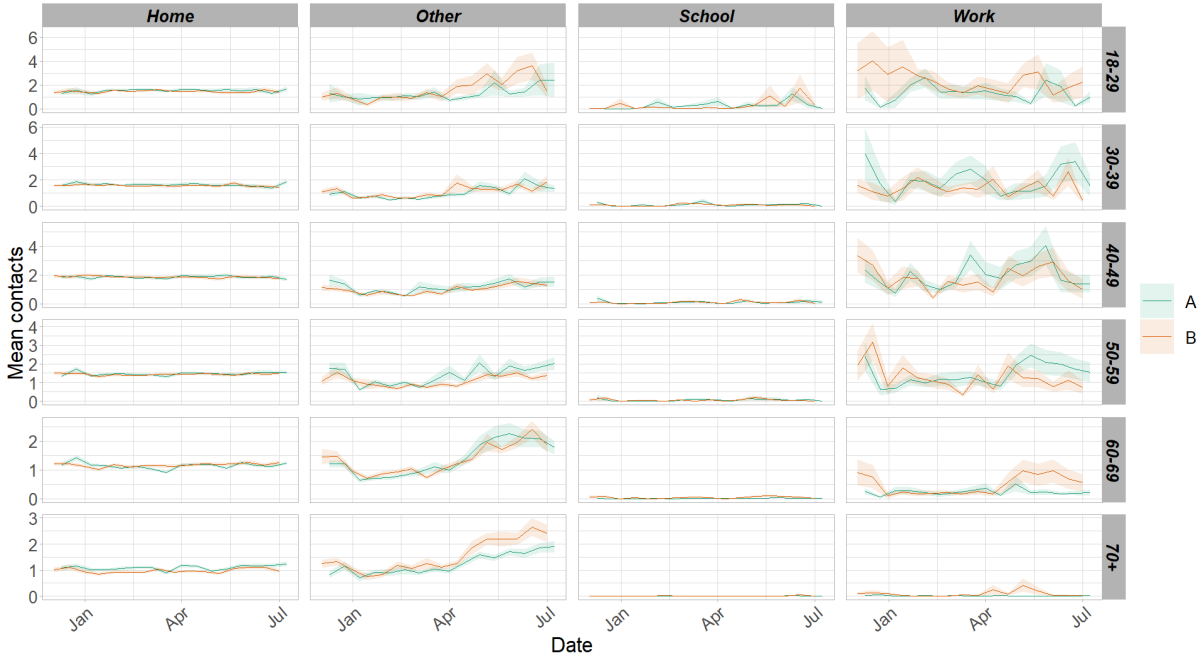


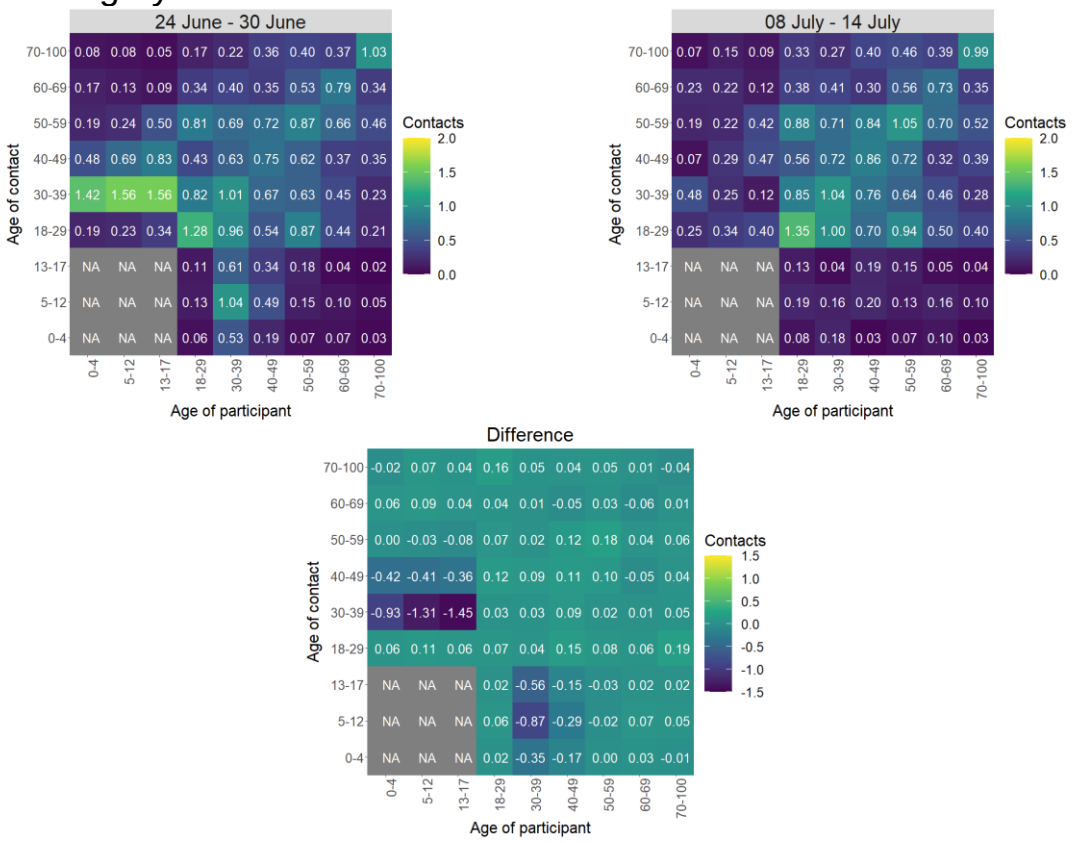
Figure 5 shows how contacts change across age group and setting. Mean contacts across all age groups have either remained stable or shown a reduction in comparison to two weeks prior with the exception of those aged between 18-29 reporting an increase of 17%. The increase in this age group is largely driven a rise in contacts within the work setting for those aged between 18-29.

Figure 5: Average (mean) contacts for each panel per day by setting for adults in Scotland, truncated to 100 contacts per participant (from SCS).



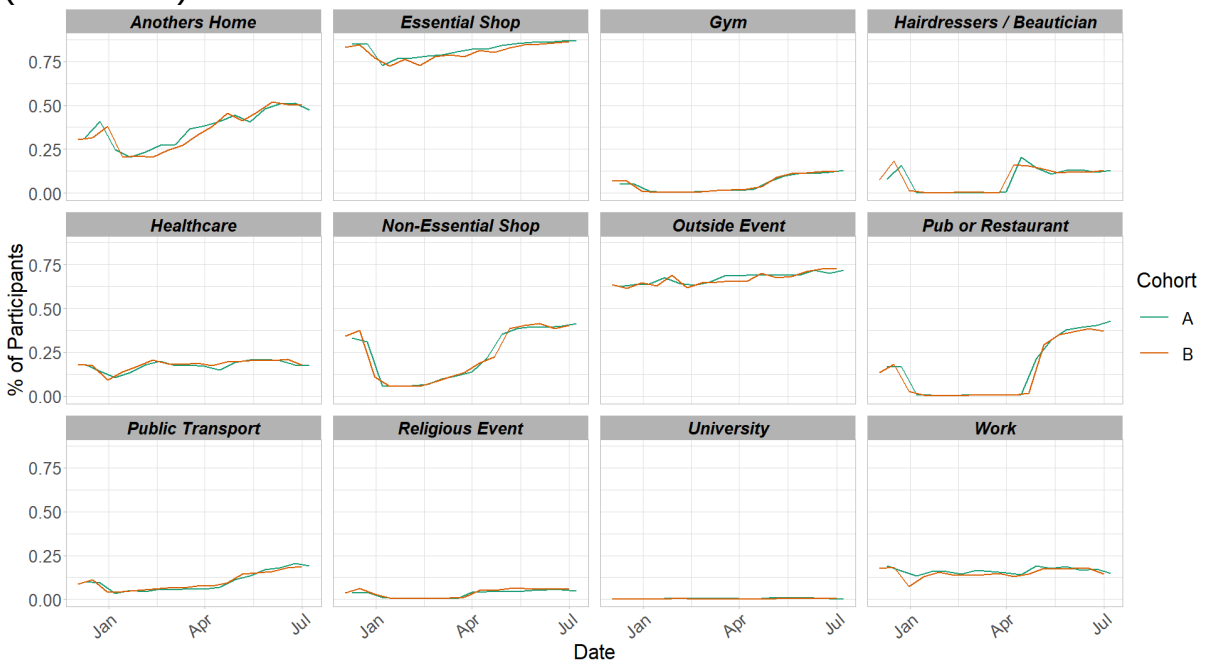
The heatmaps in Figure 6 show the mean overall contacts between age groups for the weeks relating to 24th June - 30th June and 8th July - 14th July and the difference between these periods.

Figure 6: Overall mean contacts by age group before for the weeks relating to 24th June - 30th June and 8th July - 14th July. The highest number of interactions are reported between those aged 18-29 with each other. The biggest decrease in the total number of contacts between age groups is seen amongst those aged 30-49 with those under 18, decreasing by at least 43%.



As seen in Figure 7, the proportion of participants visiting different locations remains at similar levels across the majority of locations **with** those visiting a pub or restaurant reporting the highest increase from 40% to 43% in the last two weeks

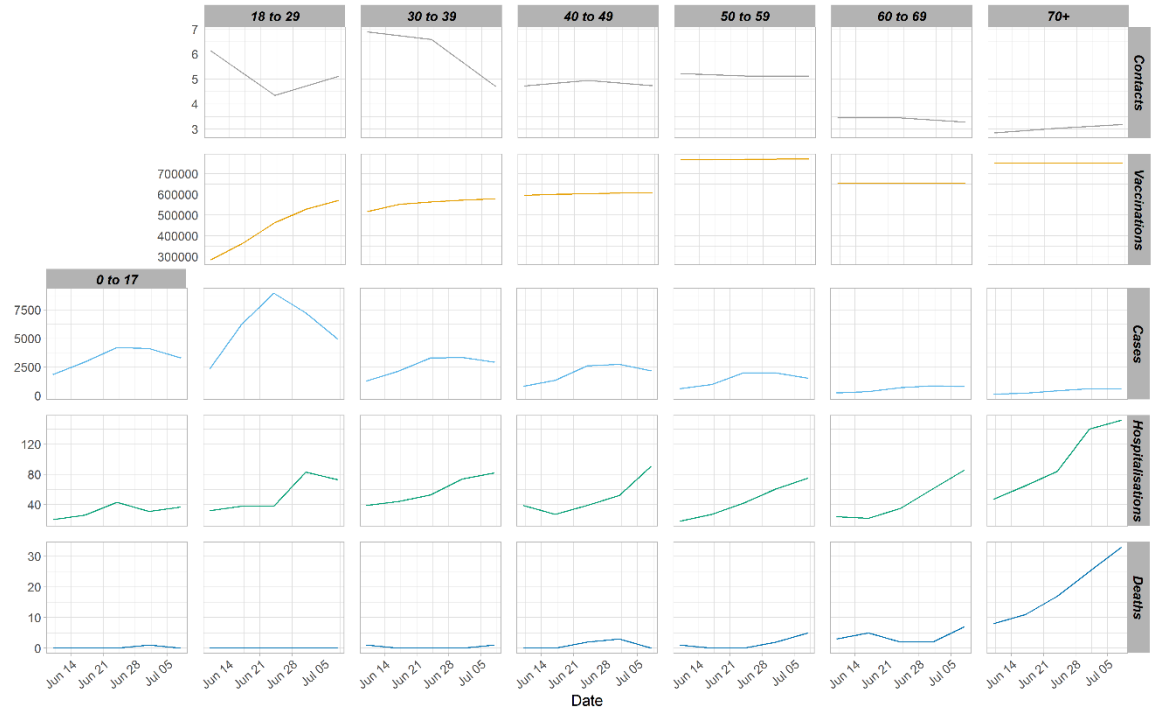
Figure 7: Locations visited by participants at least once for panel A and B (from SCS).



Vaccinations and contacts patterns

From Figure 8, it can be seen that the older age groups have fewer contacts and more vaccinations than the youngest age group. They also have the lowest weekly case number comparatively to the younger age groups. Despite that, they have similar, or higher for the oldest age group, weekly hospitalisation levels and deaths to that seen with the younger age groups.

Figure 8: Average contacts for Panel A, weekly cases, Covid-19 hospital admissions and deaths[3] and cumulative vaccinations by age band[4]

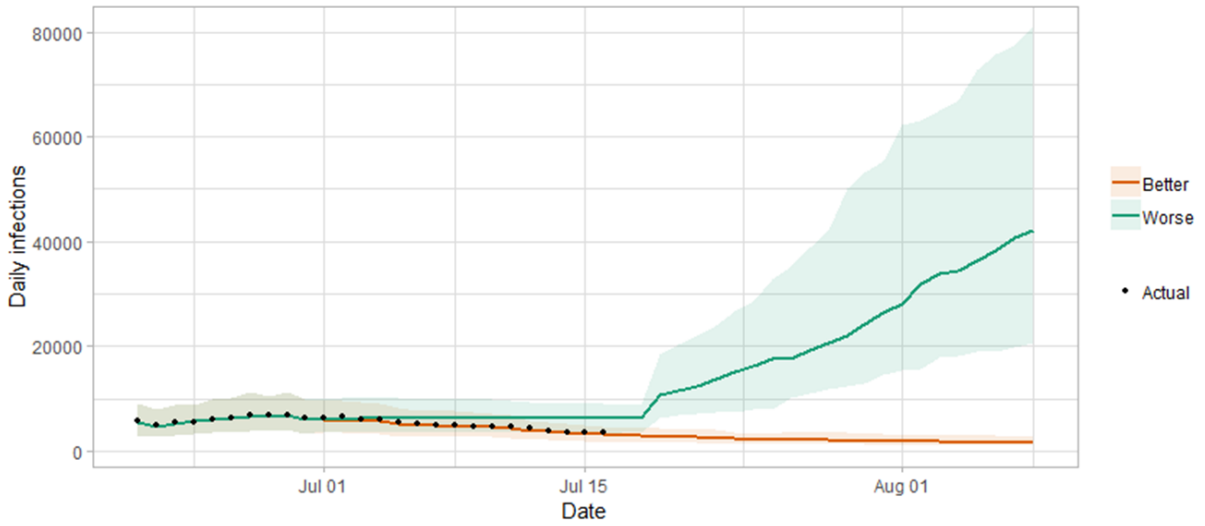


What the modelling tells us about estimated infections as well as Hospital and ICU bed demand

The Scottish Government assesses the impact of Covid-19 on the NHS in the next few weeks in terms of estimated number of infections. There is also uncertainty in the current level of infections, with confirmed cases having fallen, but other measures such as waste water and test positivity rate remaining high. Figure 9 shows two projections. 'Worse' assumes that infections have remained at a plateau for the last few weeks, and that behaviour changed instantaneously after the whole of Scotland moved to Level 0 on 19th July. 'Better' assumes that infections have fallen at the same rate as confirmed cases and that behaviour changes gradually over a period of months.[5]

[3] Deaths, Cases and Hospitalisations from PHS COVID-19 daily cases in Scotland dashboard.
[4] Vaccination and contact data for the 0-17 age cohort is not presented due to the vast majority of this age group not being offered vaccinations and the SCS excluding contacts between children.
[5] Both scenarios are based on current vaccine roll-out plans and efficacy assumptions.

Figure 9. Medium term projections of modelled total new daily infections, adjusting positive tests[6] to account for asymptomatic and undetected infections, from Scottish Government modelling, based on positive test data reported up to 19th July.



There is uncertainty as to whether infections will increase or decrease in coming weeks. This will drive whether hospital beds and intensive care beds also continue to rise.

Figure 10 shows the impact of the projections on the number of people in hospital. The modelling includes all hospital stays, whereas the actuals only include stays up to 28 days duration that are linked to Covid-19.

Hospitalisations from the recent increase in cases have likely plateaued, and the future increase or decrease in hospital occupancy and intensive care use is highly uncertain, and depends on both current infection levels and the impact of the move to level 0 nationally.

[6] The actual positive tests are adjusted to coincide with the estimated day of infection.

Figure 10. Medium term projections of modelled hospital bed demand, from Scottish Government modelling, based on positive test data reported up to 19th July.

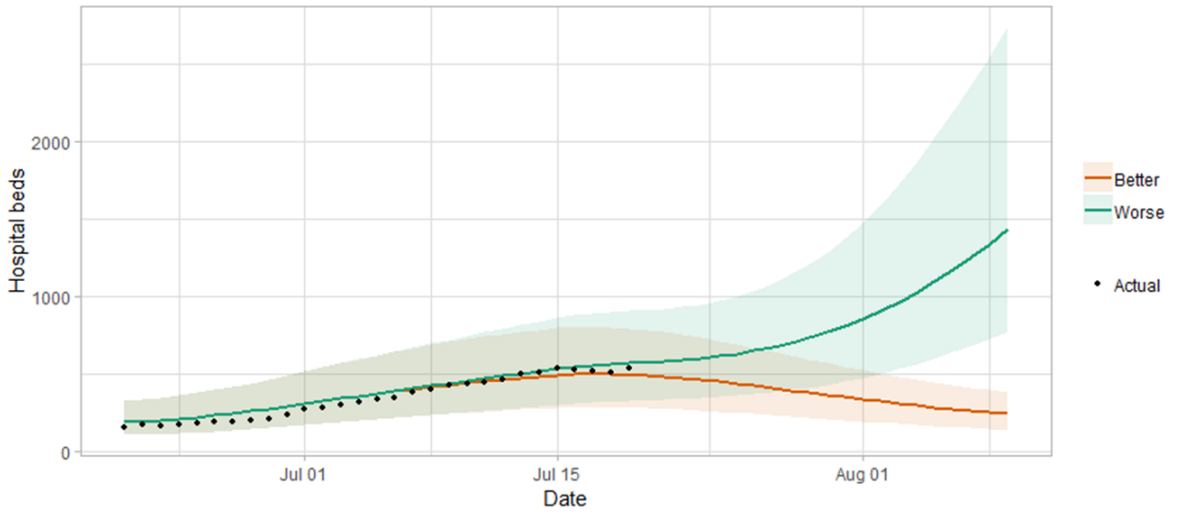
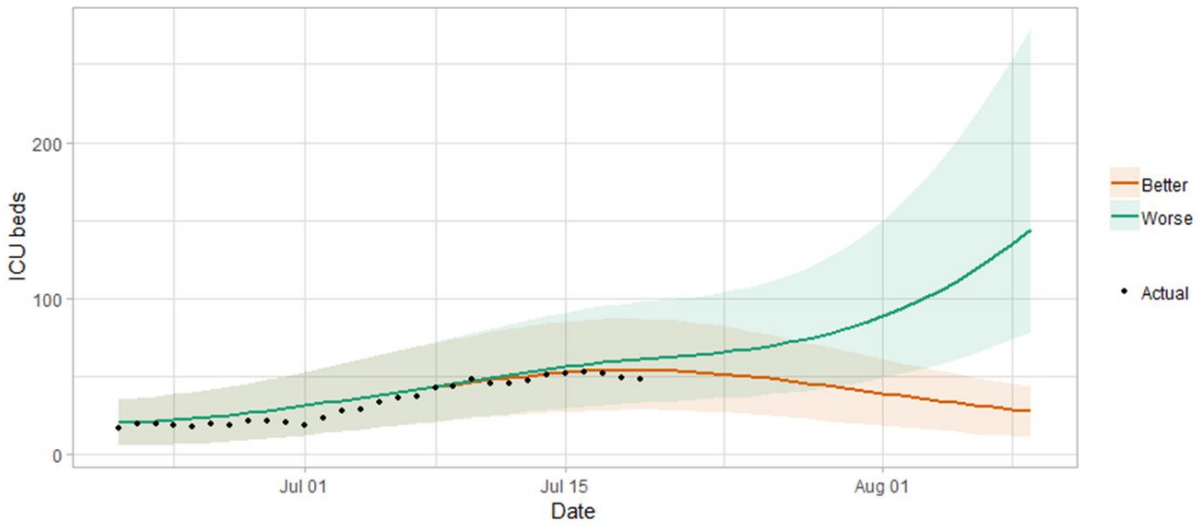


Figure 11 shows the impact of the projection on ICU bed demand.

Figure 11. Medium term projections of modelled ICU bed demand, from Scottish Government modelling[7], based on positive test data reported up to 19th July.



A comparison of the actual data against historical projections is included in the Technical Annex.

[7] Actual data does not include full numbers of CPAP. ICU bed actuals include all ICU patients being treated for Covid-19 including those over 28 days.

What the modelling tells us about projections of hospitalisations and deaths in the medium term

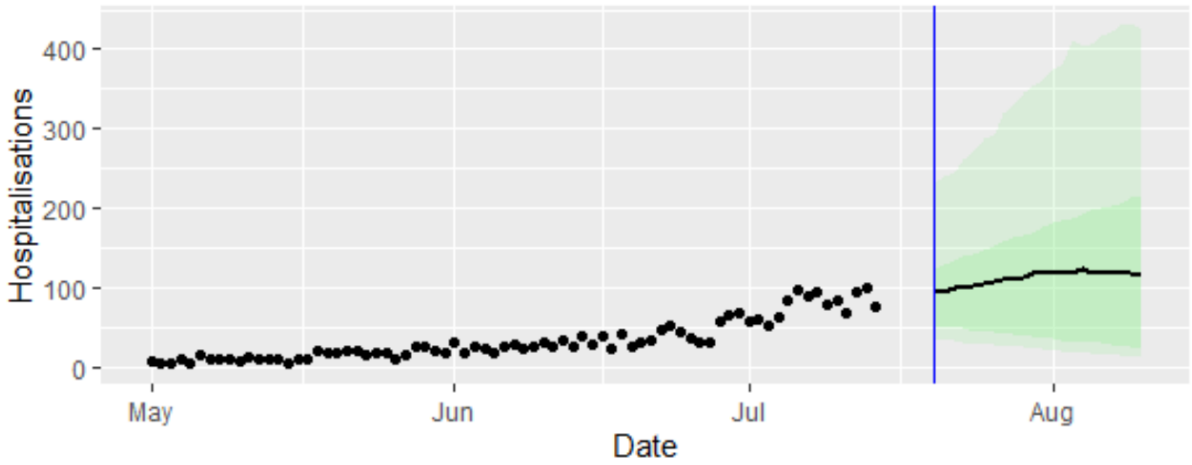
SAGE produces projections of the epidemic[8] (Figure 12), combining estimates from several independent models (including the Scottish Government's logistics modelling, as shown in Figures 9-11). These projections are not forecasts or predictions. They represent a scenario in which the trajectory of the epidemic continues to follow the trends that were seen in the data up to 19th July and do not include the effects of any future policy or behavioural changes.

The delay between infection, developing symptoms, the need for hospital care, and death means they will not fully reflect the impact of behaviour changes in the two to three weeks prior to 19th July. Projecting forwards is difficult when the numbers of admissions and deaths fall to very low levels, which can result in wider credible intervals reflecting greater uncertainty. The interquartile range can be used, with judgement, as the projection from which estimates may be derived until the 10th August, albeit at lower confidence than the 90% credible interval.

These projections include the potential impact of vaccinations over the next few weeks. Modelling groups have used their expert judgement and evidence from Public Health England, Scottish Universities & Public Health Scotland, and other published efficacy studies when making assumptions about vaccine effectiveness.

[8] Four week projections are provided here: Scientific evidence supporting the government response to coronavirus (COVID-19) - GOV.UK (www.gov.uk)

Figure 12. SAGE medium-term projection of daily hospitalisations in Scotland, including 50% and 90% credible intervals.



We are not projecting the numbers of people expected to die with Covid-19 this week. The number of daily deaths has fallen to very low levels.

What we know about which local authorities are likely to experience high levels of Covid-19 in two weeks' time

We continue to use modelling based on Covid-19 cases and deaths using data to 19th July from several academic groups to give us an indication of whether a local authority is likely to experience high levels of Covid-19 in the future. This has been compiled via SPI-M into a consensus. In this an area is defined as a hotspot if the two week prediction of cases (positive tests) per 100K population is predicted to exceed a threshold, e.g. 500 cases.

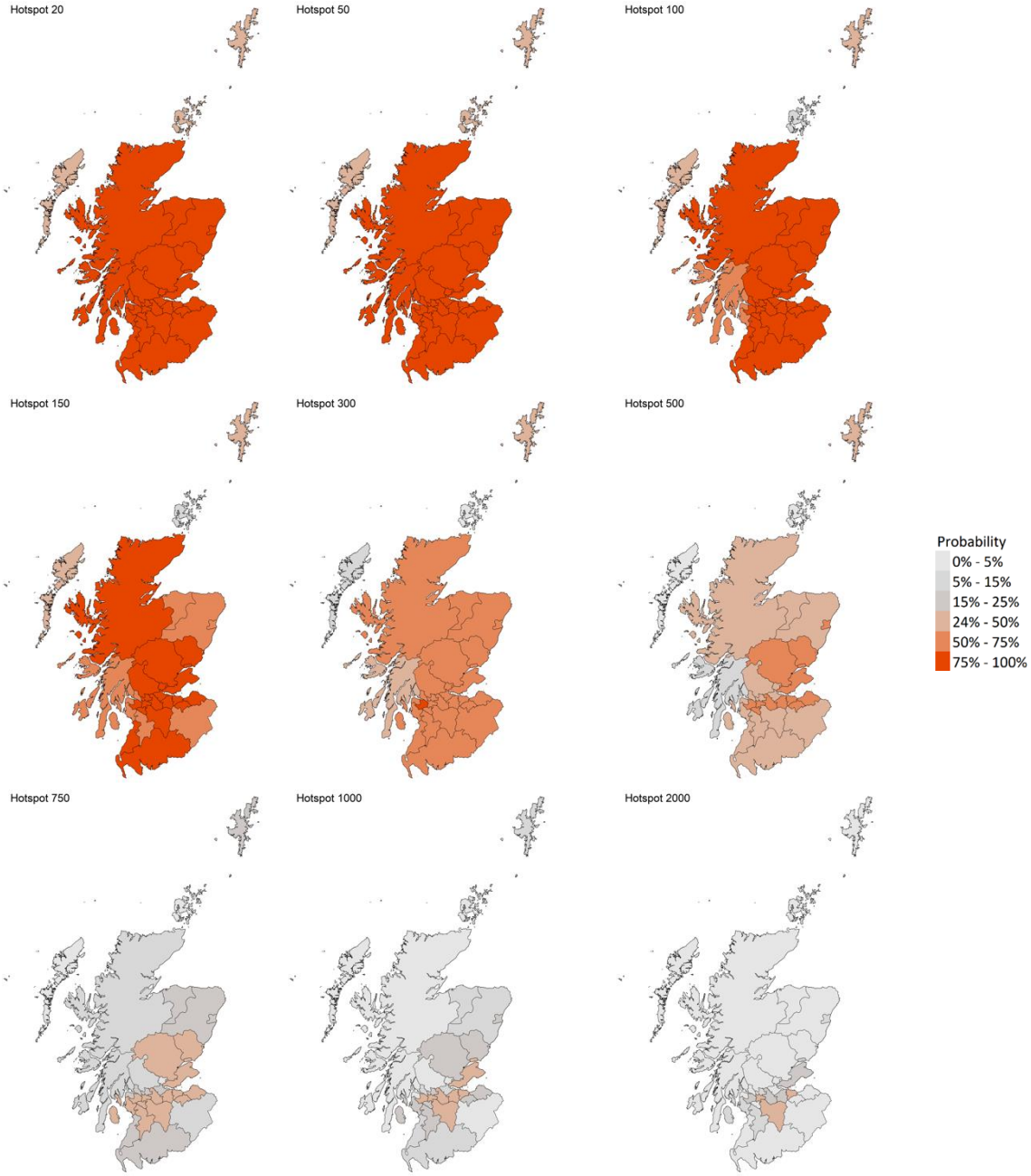
Modelled rates of positive tests per 100K using data to 19th July (Figure 13) indicate that, for the week commencing 1st August 2021, there are 26 local authorities with at least a 75% probability of exceeding 100 cases per 100K[9].

Of these, 20 local authorities are expected to exceed 150 cases per 100K with at least a 75% probability. Only one local authority (Renfrewshire) is expected to exceed 300 cases per 100K with this probability[10].

[9] The exceptions to this are Argyll & Bute, Inverclyde, Na h-Eileanan Siar, North Ayrshire, Orkney and Shetland

[10] Numbers are included in Table 1 in the Technical Annex.

Figure 13: Probability of local authority areas exceeding thresholds of cases per 100K (1st to 7th August 2021), data to 19th July.



What can analysis of wastewater samples tell us about local outbreaks of Covid-19 infection?

Levels of Covid-19 in wastewater collected at a number of sites around Scotland are adjusted for population and local changes in intake flow rate and compared to daily 7-day average positive case rates derived from Local Authority and Neighbourhood (Intermediate Zone) level aggregate data. See Technical Annex in Issue 34 of these Research Findings for the methodology.

Relative to the peak reported in the previous report, wastewater (WW) COVID-19 levels declined nationally to approximately 55 million gene copies per person per day (Mgc/p/d). This general trend is not followed at all sites (as of 20th July), with some showing more static levels. This will be monitored closely over the next few weeks[11].

In Figure 14, the blue line corresponding to the original 28 sites and green line representing the aggregate for the full set of sampled sites converge in the most recent week. This is because the original 28 sites, which are generally larger, were better sampled in the last week. In the recent dry weather, availability of flow or ammonia data is critical for normalisation for the wastewater data, otherwise results can be overstated. Fortunately, this data is available for many of the recent results. The results for Seafield, covering Edinburgh and parts of the Lothians, are show in Figure 15.

[11] Up to date data is not available from a significant number of mostly smaller sites this week for technical reasons.

Figure 14. National average trends in wastewater Covid-19 and daily case rates (7 day moving average)12.

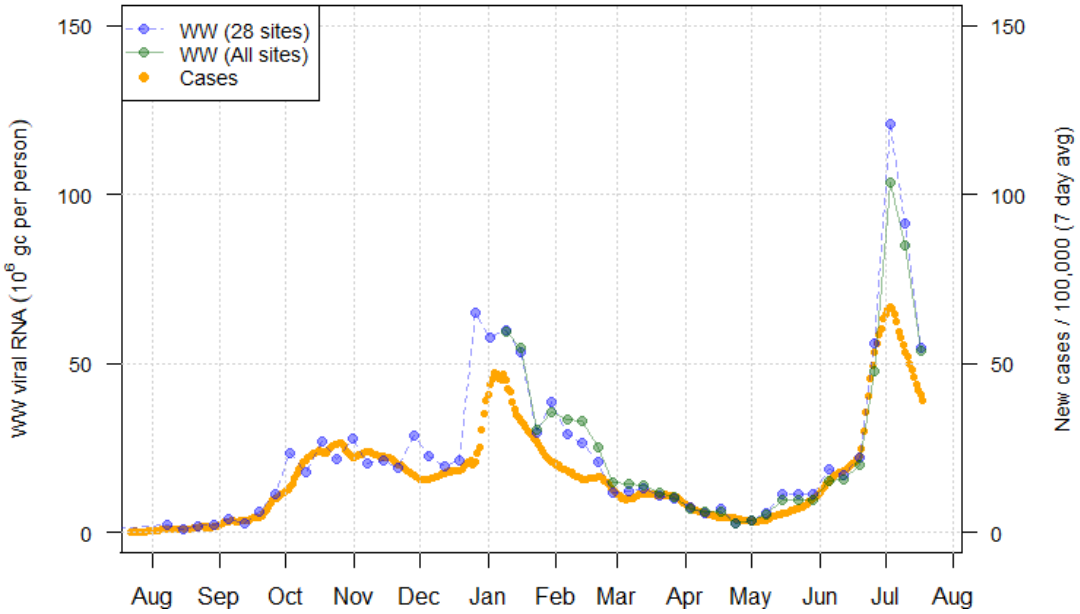
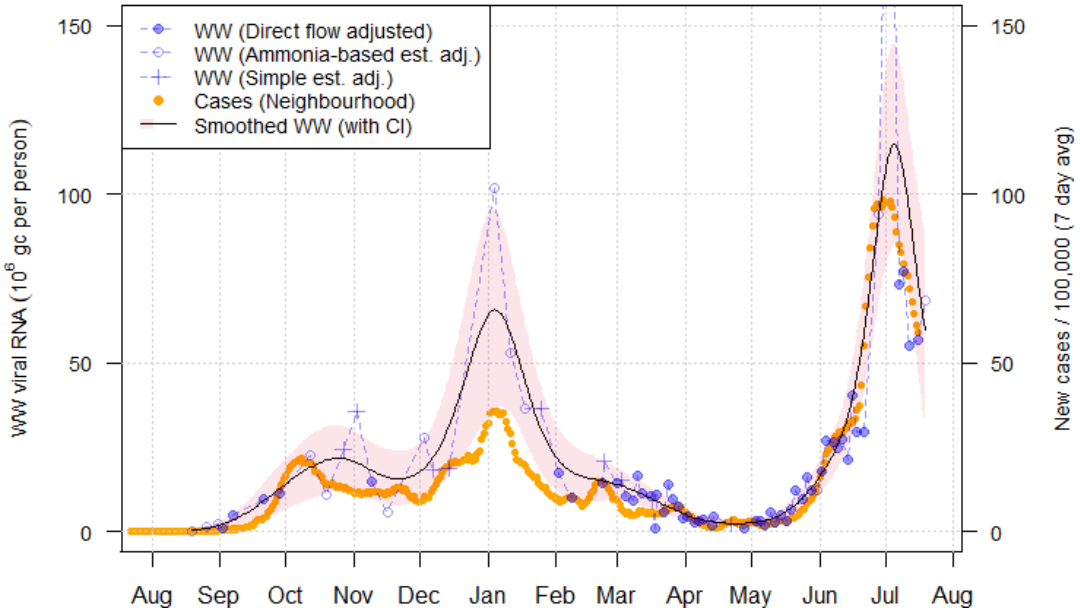


Figure 15. Wastewater Covid-19 and daily case rate (7 day moving average) for Seafield (covered pop: 606k) in Edinburgh[13].



[12] Anomalously high values, one in Seafield (Edinburgh) in mid-February (See Issue 40), one in Dunblane in mid-June, and two in Daldowie in January, are removed.
[13] The black line and red shaded area provide a smoothed curve and confidence interval estimated from a generalised additive model based on a Tweedie distribution.

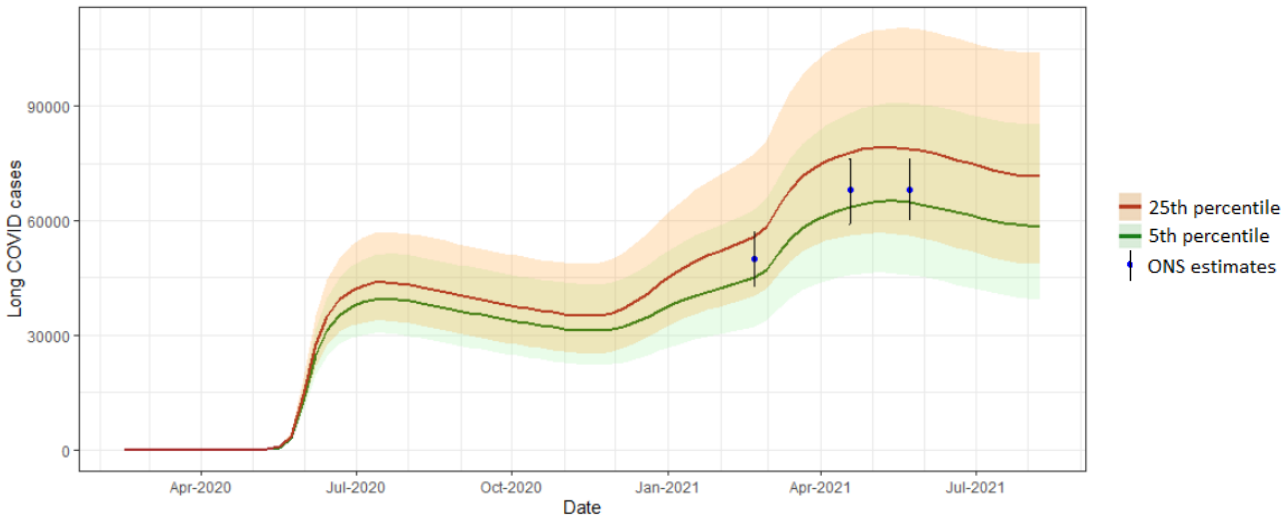
What estimates do we have of the number of people experiencing long Covid symptoms?

The Scottish Government has recently been modelling the number of people likely to experience long Covid symptoms. This has then been projected forward to estimate long Covid rates in the future based on Scottish Government medium term projection modelling.

This modelling estimates that at 23rd May 2021 between 46,000 (0.7% of the population) and 110,000 (1.9%) people were projected to experience symptoms for 12 weeks or more after their first suspected Covid infection in Scotland. When compared with the estimates of long Covid from the ONS Covid-19 Infection Survey (see blue bars on Figure 14), the ONS estimate that in the same period there were 68,000 people in Scotland who first had (or suspected they had) Covid-19 at least 12 weeks previously (95% confidence interval: 60,000 and 76,000). This is in-line with the modelled estimates at the 5th percentile of the better infection scenario (see Figure 9 for more details) in Scottish Government modelling, as shown in Figure 16. It should be noted that the Scottish Government estimates account for the whole population whereas the ONS estimates relate to self-reported long Covid for people living in private households only.

These are preliminary results, further data on rates of long Covid and associated syndromes as research emerges are required.

Figure 16. Estimates of long Covid prevalence at 12 weeks from 16th February 2020 to 8th August 2021 for the 5th and 25th percentile better scenario infection rates (showing 95% confidence intervals). ONS estimates with range also shown.



What next?

The modelled estimates of the numbers of new cases and infectious people will continue to be provided as measures of the epidemic as a whole, along with measures of the current point in the epidemic such as R_t and the growth rate. Further information can be found at https://www.gov.scot/coronavirus-covid-19.

We may report on exceedance in future weeks when the background levels of Covid-19 reduces so that it can be useful in identifying outbreaks.

Technical Annex

Epidemiology is the study of how diseases spread within populations. One way we do this is using our best understanding of the way the infection is passed on and how it affects people who catch it to create mathematical simulations. Because people who catch Covid-19 have a relatively long period in which they can pass it on to others before they begin to have symptoms, and the majority of people infected with the virus will experience mild symptoms, this “epidemiological modelling” provides insights into the epidemic that cannot easily be measured through testing e.g. of those with symptoms, as it estimates the total number of new daily infections and infectious people, including those who are asymptomatic or have mild symptoms.

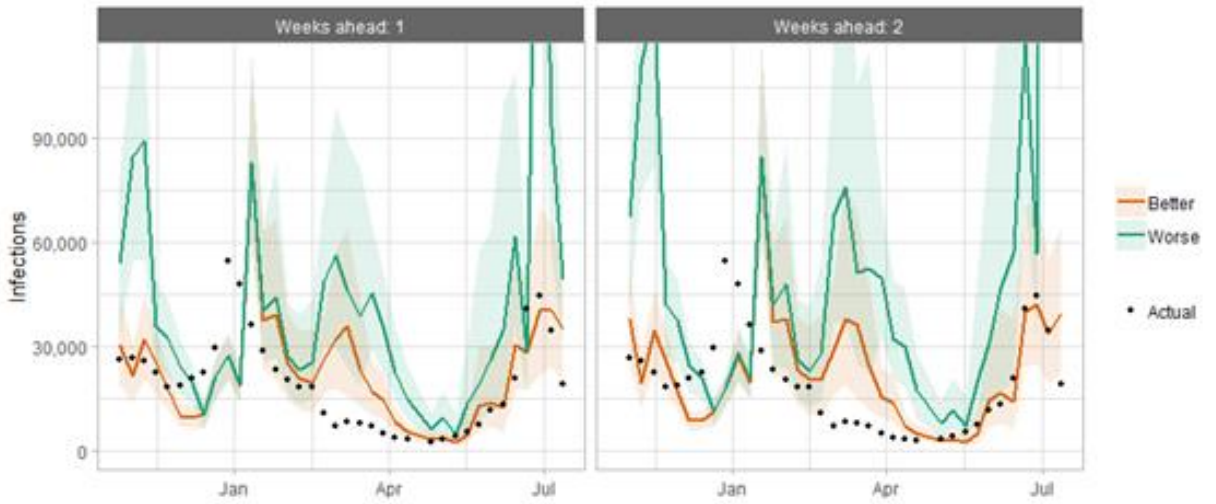
Modelling also allows us to make short-term forecasts of what may happen with a degree of uncertainty. These can be used in health care and other planning. The modelling in this research findings is undertaken using different types of data which going forward aims to both model the progress of the epidemic in Scotland and provide early indications of where any changes are taking place.

The delivery of the vaccination programme will offer protection against severe disease and death. The modelling includes assumptions about compliance with restrictions and vaccine take-up. Work is still ongoing to understand how many vaccinated people might still spread the virus if infected. As Covid-19 is a new disease there remain uncertainties associated with vaccine effectiveness. Furthermore, there is a risk that new variants emerge for which immunisation is less effective.

How the modelling compares to the real data as it emerges

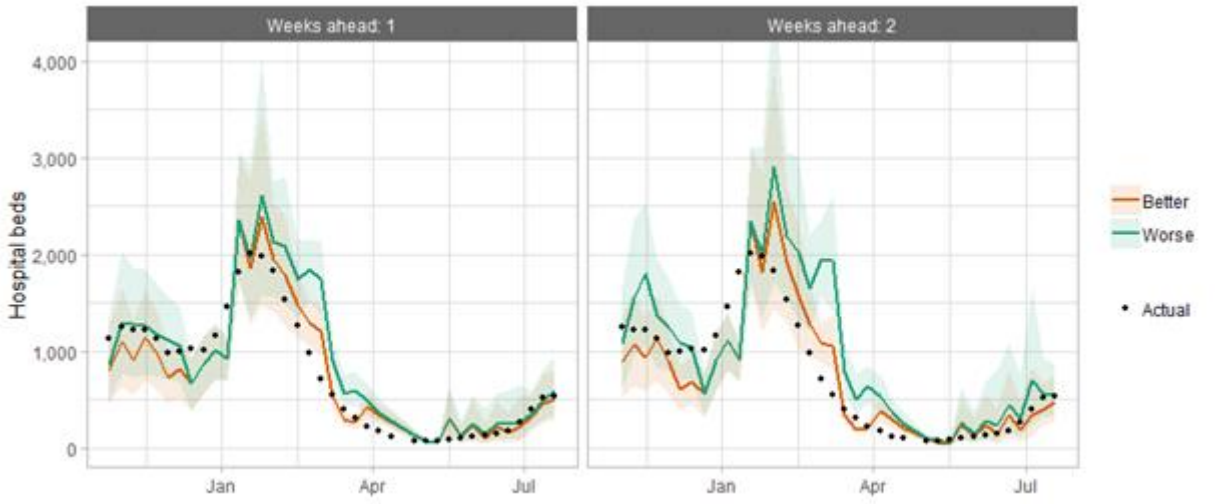
The following charts show the history of our modelling projections in comparison to estimates of the actual data. The infections projections were largely accurate during October to mid-December and from mid-January onward. During mid-December to mid-January, the projections underestimated the number of infections, due to the unforeseen effects of the new variant.

Figure 17. Infections projections versus actuals, for historical projections published between one and two weeks before the actual data came in.



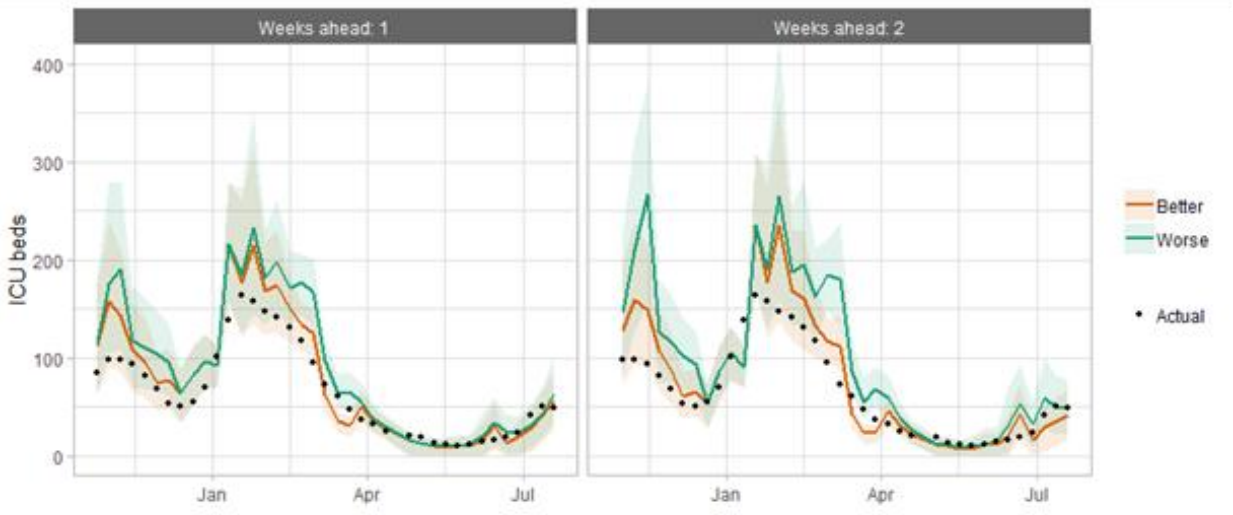
Hospital bed projections have generally been more precise than infections estimates due to being partially based on already known information about numbers of current infections, and number of people already in hospital. The projections are for number of people in hospital due to Covid-19, which is slightly different to the actuals, which are number of people in hospital within 28 days of a positive Covid-19 test.

Figure 18. Hospital bed projections versus actuals, for historical projections published between one and two weeks before the actual data came in.



As with hospital beds, ICU bed projections have generally been more precise than infections. The projections are for number of people in ICU due to Covid-19. The actuals are number of people in ICU within 28 days of a positive Covid-19 test up to 20 January, after which they include people in ICU over the 28 day limit.

Figure 19. ICU bed projections versus actuals, for historical projections published between one and two weeks before the actual data came in.



Long COVID

Long Covid is a complex condition, with an emerging, but limited, evidence base. It is characterised by the existence of symptoms for several weeks or months after acute Covid-19. As the available evidence accrues techniques need to be developed to assess the prevalence of long Covid at national and sub-national level in Scotland to inform health board planning.

Emerging evidence shows that a significant proportion of people who have contracted Covid-19 go on to have long term rehabilitation support needs. This is not limited just to intensive care survivors and those who received acute hospital care, for whom needs can be complex and varied.

The condition usually presents with clusters of symptoms, often overlapping, which may change over time and can affect many systems within the body. Common symptoms can include, but are not limited to: fatigue, persisting high temperature, breathlessness, cognitive impairment, generalised pain, and mental health problems.

The term long Covid is commonly used to describe signs and symptoms that continue or develop after acute Covid-19 and are not explained by an alternative diagnosis. It includes both ongoing symptomatic Covid-19 (from 4 to 12 weeks) and post-Covid-19 syndrome (12 weeks or more).

The ONS has provided estimates publically of the number of people in the community population in Scotland with self-reported long Covid[14].

A significant proportion of people that experienced milder symptoms during their initial illness struggle with a range of longer lasting symptoms.

[14] Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK - Office for National Statistics (ons.gov.uk)

Table 1. Probability of local authority areas exceeding thresholds of cases per 100K (1st to 8th August 2021), data to 19th July.

	Probability of exceeding (cases per 100k)								
Local Authority (LA)	20	50	100	150	300	500	750	1000	2000
Aberdeen City	75-100%	75-100%	75-100%	50-75%	50-75%	50-75%	15-25%	15-25%	5-15%
Aberdeenshire	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	15-25%	5-15%	0-5%
Angus	75-100%	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	15-25%	0-5%
Argyll and Bute	75-100%	75-100%	50-75%	50-75%	25-50%	5-15%	5-15%	0-5%	0-5%
City of Edinburgh	75-100%	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	25-50%	25-50%
Clackmannanshire	75-100%	75-100%	75-100%	75-100%	50-75%	25-50%	0-5%	0-5%	0-5%
Dumfries & Galloway	75-100%	75-100%	75-100%	75-100%	50-75%	25-50%	15-25%	5-15%	0-5%
Dundee City	75-100%	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	25-50%	15-25%
East Ayrshire	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	25-50%	15-25%	5-15%
East Dunbartonshire	75-100%	75-100%	75-100%	75-100%	50-75%	25-50%	15-25%	15-25%	5-15%
East Lothian	75-100%	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	15-25%	0-5%
East Renfrewshire	75-100%	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	15-25%	0-5%
Falkirk	75-100%	75-100%	75-100%	75-100%	50-75%	25-50%	15-25%	5-15%	0-5%
Fife	75-100%	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	25-50%	15-25%
Glasgow City	75-100%	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	25-50%	25-50%
Highland	75-100%	75-100%	75-100%	75-100%	50-75%	25-50%	5-15%	0-5%	0-5%
Inverclyde	75-100%	75-100%	50-75%	50-75%	50-75%	25-50%	15-25%	0-5%	0-5%
Midlothian	75-100%	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	15-25%	0-5%
Moray	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	15-25%	5-15%	0-5%
Na h-Eileanan Siar	25-50%	25-50%	25-50%	25-50%	5-15%	0-5%	0-5%	0-5%	0-5%
North Ayrshire	75-100%	75-100%	50-75%	50-75%	50-75%	25-50%	25-50%	15-25%	5-15%
North Lanarkshire	75-100%	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	25-50%	15-25%
Orkney Islands	25-50%	25-50%	5-15%	5-15%	0-5%	0-5%	0-5%	0-5%	0-5%
Perth and Kinross	75-100%	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	15-25%	0-5%
Renfrewshire	75-100%	75-100%	75-100%	75-100%	75-100%	50-75%	25-50%	25-50%	15-25%
Scottish Borders	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	5-15%	0-5%	0-5%
Shetland Islands	25-50%	25-50%	25-50%	25-50%	25-50%	25-50%	15-25%	5-15%	0-5%
South Ayrshire	75-100%	75-100%	75-100%	75-100%	50-75%	25-50%	15-25%	5-15%	0-5%
South Lanarkshire	75-100%	75-100%	75-100%	75-100%	50-75%	25-50%	25-50%	25-50%	25-50%
Stirling	75-100%	75-100%	75-100%	75-100%	50-75%	25-50%	5-15%	0-5%	0-5%
West Dunbartonshire	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	15-25%	5-15%	0-5%
West Lothian	75-100%	75-100%	75-100%	75-100%	50-75%	50-75%	25-50%	25-50%	15-25%

What levels of Covid-19 are indicated by wastewater (WW) data?

Table 2 provides population weighted daily averages for normalised WW Covid-19 levels in the weeks beginning the 7th and 14th July, with no estimate for error. This is given in Million gene copies per person, which approximately corresponds to new cases per 100,000 per day. Coverage is given as percentage of LA inhabitants covered by a wastewater Covid-19 sampling site delivering data during this period[15].

Table 2. Average daily cases per 100k as given by WW data

Local authority (LA)	Average daily WW case estimate, with outliers included		Average daily WW case estimate, with outliers removed		Coverage[16]
	w/b 7th July	w/b 14th July	w/b 7th July	w/b 14th July	
Aberdeen City	52.0	46.0	52.0	46.0	80%
Aberdeenshire	49.0	28.0	35.0	28.0	53%
Angus	156.0	81.0	156.0	81.0	56%
Argyll and Bute	5.0	-	5.0	-	0%
City of Edinburgh	68.0	63.0	68.0	63.0	97%
Clackmannanshire	68.0	204.0	68.0	123.0	11%
Dumfries & Galloway	22.0	21.0	20.0	20.0	35%
Dundee City	179.0	90.0	179.0	90.0	100%
East Ayrshire	28.0	32.0	28.0	32.0	72%
East Dunbartonshire	138.0	85.0	138.0	85.0	0%
East Lothian	90.0	59.0	90.0	59.0	65%
East Renfrewshire	80.0	52.0	80.0	52.0	95%
Falkirk	64.0	48.0	64.0	48.0	69%
Fife	86.0	48.0	86.0	48.0	83%
Glasgow City	112.0	67.0	112.0	67.0	59%
Highland	53.0	30.0	43.0	30.0	36%
Inverclyde	31.0	25.0	31.0	25.0	93%
Midlothian	97.0	63.0	97.0	63.0	73%
Moray	30.0	33.0	25.0	33.0	56%
Na h-Eileanan Siar	0.0	12.0	0.0	12.0	21%
North Ayrshire	30.0	22.0	30.0	22.0	92%
North Lanarkshire	116.0	76.0	116.0	76.0	24%
Orkney Islands	18.0	6.0	18.0	6.0	34%
Perth and Kinross	51.0	37.0	51.0	37.0	45%
Renfrewshire	81.0	86.0	81.0	86.0	57%
Scottish Borders	20.0	75.0	20.0	26.0	5%
Shetland Islands	3.0	11.0	3.0	11.0	29%
South Ayrshire	25.0	33.0	25.0	33.0	88%
South Lanarkshire	73.0	59.0	65.0	59.0	67%
Stirling	45.0	22.0	45.0	22.0	10%
West Dunbartonshire	77.0	-	77.0	-	0%
West Lothian	79.0	44.0	79.0	44.0	85%

[15] Advancements in detection and interpretation practices allow us to identify when outlying results are anomalous rather than indicators of spikes in Covid-19 levels. Table 2 provides population weighted daily averages for normalised WW Covid-19 levels both with and without the outliers removed. See Technical Annex in Issue 60 of these Research Findings for further details.

[16] Coverage as at the week beginning 14th July 2021.

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