

## Coronavirus (COVID-19): Analysis

### Coronavirus (COVID-19): modelling the epidemic in Scotland (Issue No. 66)

#### 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 19th August 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 1.0 and 1.3, with the growth rate between -1% and 6%, based on the period up to 23rd August.

**The number of new cases has continued to increase over the last week. The estimate of R has increased to above 1.**

#### Key Points

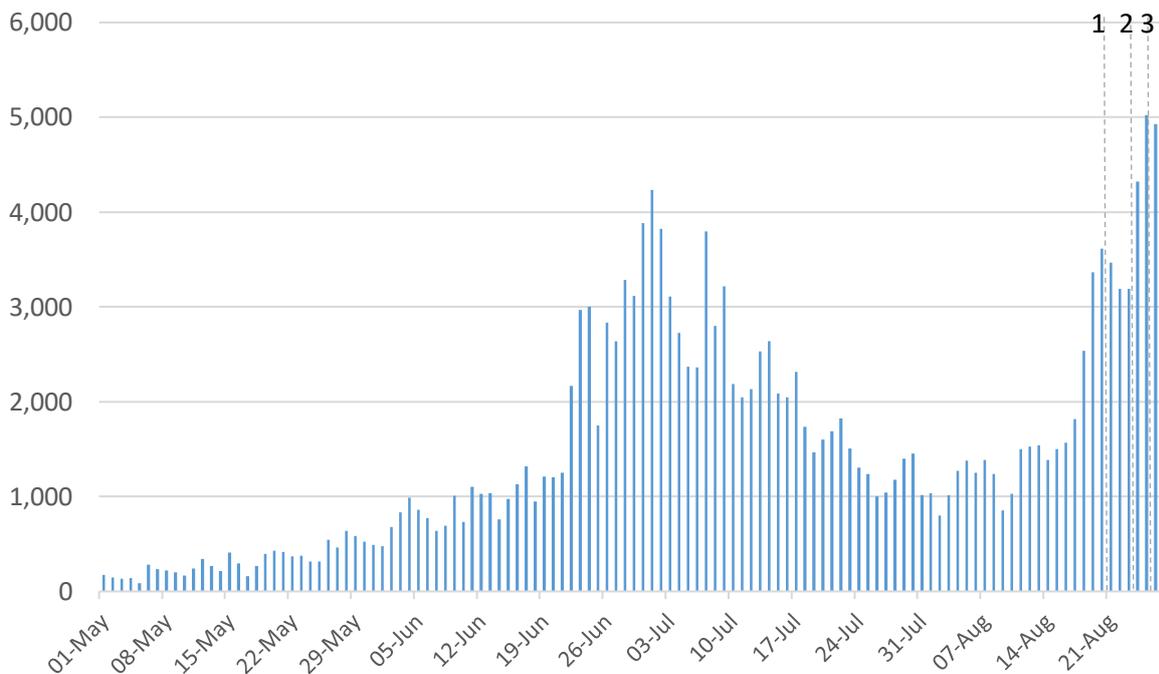
- The reproduction rate R in Scotland is currently estimated as being between 1.0 and 1.3, based on the period up to 23rd August. This is an increase in the lower and upper limits from last week, is now clearly above 1, and is the highest upper limit of R since 12th July 2021.
- The number of new daily infections for Scotland is estimated as being between 45 and 125, per 100,000 people, based on the period up to 23rd August. This is an increase in the lower and upper limits since last week.
- The growth rate for Scotland is currently estimated as between -1% and 6%, based on the period up to 23rd August. This is an increase in the lower and upper limits since last week.

- Average contacts have increased by 15% in the last two weeks (comparing surveys pertaining to 5th August - 11th August and 19th August - 25th August) with a current level of 4.7 daily contacts.
- Contacts within the work have increased by approximately 64% compared to two weeks prior. Contacts within the home and other settings (contacts outside of the home, school and work) have remained at similar levels over the same period.
- All age groups with the exception of those aged 18-29 have had an rise in contacts within the last two week, with those aged 30-39 approximately doubling. Increases across the age groups are largely driven by a rise in contacts within the work setting.
- The biggest increase in interactions is seen between those 30-39 with those under 18.
- Visits to a work place have increased from approximately 14% to 19% with individuals visiting a pub or restaurant increasing from 46% to 49% in the last two weeks.
- Hospitalisations are now rising. Future hospital occupancy and intensive care use are likely to continue rising as infections rise.
- Modelled rates of positive tests per 100K using data to 23rd August indicate that, for the week commencing 5th September 2021, there are 28 local authorities which are expected to exceed 100 cases per 100k with at least 75% probability.
- Of these, twelve local authorities are expected to exceed 300 cases per 100k with at least 75% probability. These are Argyll & Bute, Edinburgh, Dumfries & Galloway, East Dunbartonshire, East Renfrewshire, Glasgow, North Ayrshire, North Lanarkshire, Renfrewshire, South Lanarkshire, West Dunbartonshire and West Lothian.
- Only one local authority, Dumfries & Galloway, is expected to exceed 500 cases per 100k with at least 75% probability.
- Nationwide, the latest levels of wastewater Covid-19 RNA have approximately doubled since the previous week.
- Wastewater Covid-19 RNA concentrations are now approaching the maximum level reached during the peak in July 2021. The rise in wastewater has been greatest in the central belt and the south.
- Modelling of Long Covid gives estimates that on 12th September 2021 between 0.8% and 2.1% of the population are projected to experience symptoms for 12 weeks or more after their first suspected Covid infection in Scotland. This is an increase in the upper limit from last week.

## Recent cases

Figure 1 shows the number of cases reported in Scotland between May and August 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 26th August 2021



This report covers the period up to 20th August for wastewater analysis (indicated by dashed line 1). The estimates of R, incidence, growth rates, the modelled rates of positive tests per 100k, and the long Covid analysis use data to 23rd August (dashed line 2). The medium term projections by the Scottish Government of infections, hospitalisations and ICU beds, and the contact patterns use data to 25th August (dashed line 3).

## 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 UK Health Security Agency (UKHSA) consensus<sup>1</sup> 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 to estimate the proportion of cases that will require hospital, and the length of time people that people will stay there.

### **What the modelling tells us about the epidemic as a whole**

The R value and growth rates are estimated by several independent modelling groups based in universities, Public Health England (PHE) and the Joint Biosecurity Centre. Estimates are considered, discussed and combined at the Epidemiology Modelling Review Group (EMRG), which sits within the UKHSA.

UKHSA's consensus view across these methods as of 25th August, using data to 23rd August, was that the value of R in Scotland was between 1.0 and 1.3 (see Figure 2)<sup>2</sup>.

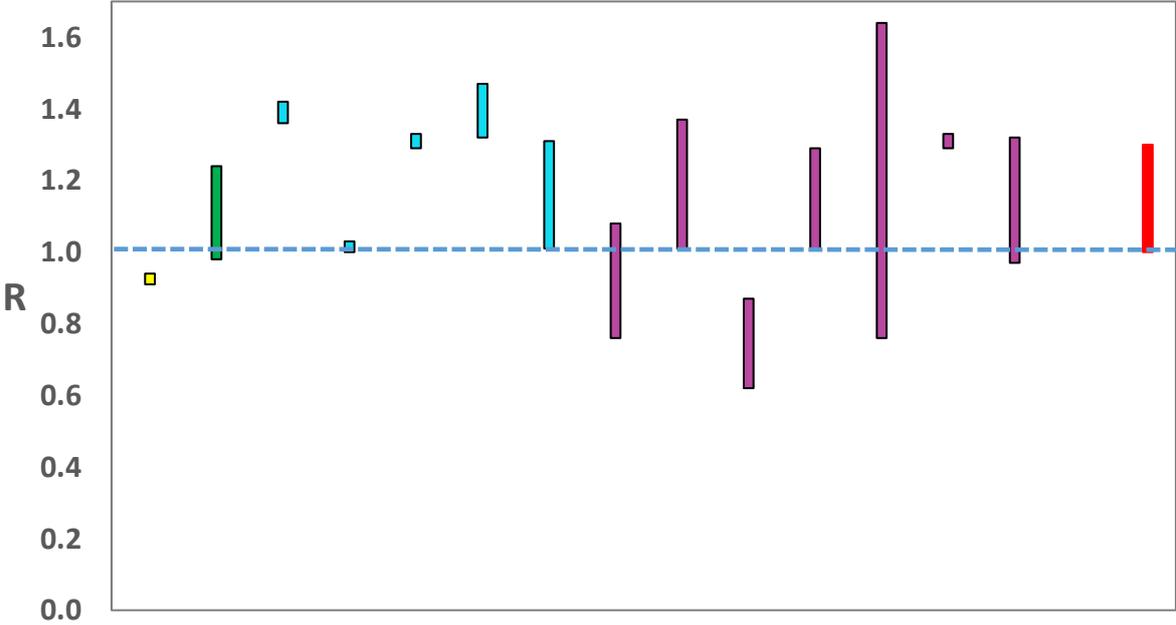
This week the Scottish Government presented two outputs to EMRG. The first uses confirmed cases as published by Public Health Scotland (PHS), and deaths from National Records Scotland (NRS). The second uses instead wastewater data to estimate the number of cases. Both outputs are shown in Figures 2 and 3. Note that as the former model includes deaths, it is returning a lower R value than the latter model where deaths are not included.

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<sup>1</sup> UKHSA has now taken over the role of compiling the consensus from SAGE, based on models which feed into the Epidemiology Modelling Review Group (EMRG).

<sup>2</sup> 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.

Figure 2. Estimates of  $R_t$  for Scotland, as of 25th August, including 90% confidence intervals, produced by EMRG<sup>3</sup>. Data to 23rd August.

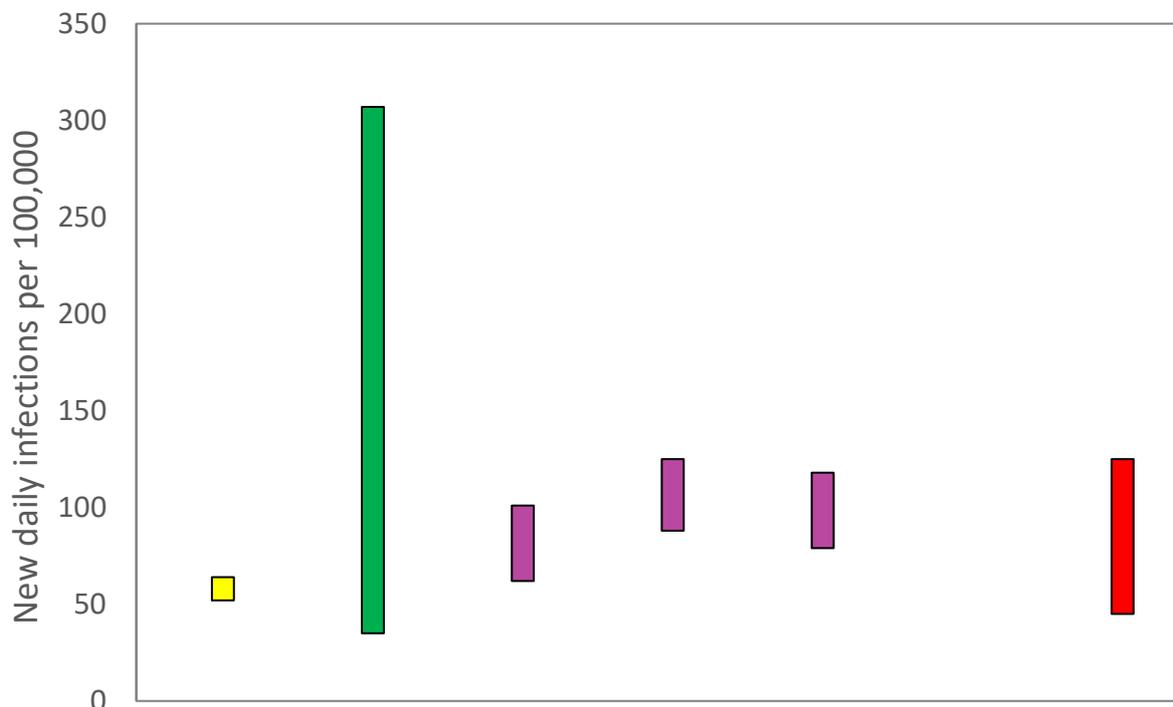


Source: EMRG

The various groups which report to the EMRG use different sources of data in their models to produce estimates of incidence (Figure 3). UKHSA’s consensus view across these methods, using data to 23rd August, was that the incidence of new daily infections in Scotland was between 45 and 125 new infections per 100,000. This equates to between 2,500 and 6,800 people becoming infected each day in Scotland.

<sup>3</sup> 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 and deaths from NRS; green uses wastewater data). The UKHSA consensus range is the right-most (red).

Figure 3. Estimates of incidence for Scotland, as of 25th August, including 90% confidence intervals, produced by EMRG<sup>2</sup>. Data to 23rd August.



Source: EMRG

The consensus from UKHSA for this week is that the growth rate in Scotland is between -1% and 6% per day using data to 23rd August. The lower and upper limits have increased since last week.

### What we know about who is testing positive with Covid

The Early Pandemic Evaluation and Enhanced Surveillance of Covid-19 (EAVE) 2 Study Group<sup>4</sup> has updated the pattern of demographics and clinical risk groups over time for those who tested positive in Scotland (see Technical Annex in issue 34 of the Research Findings).

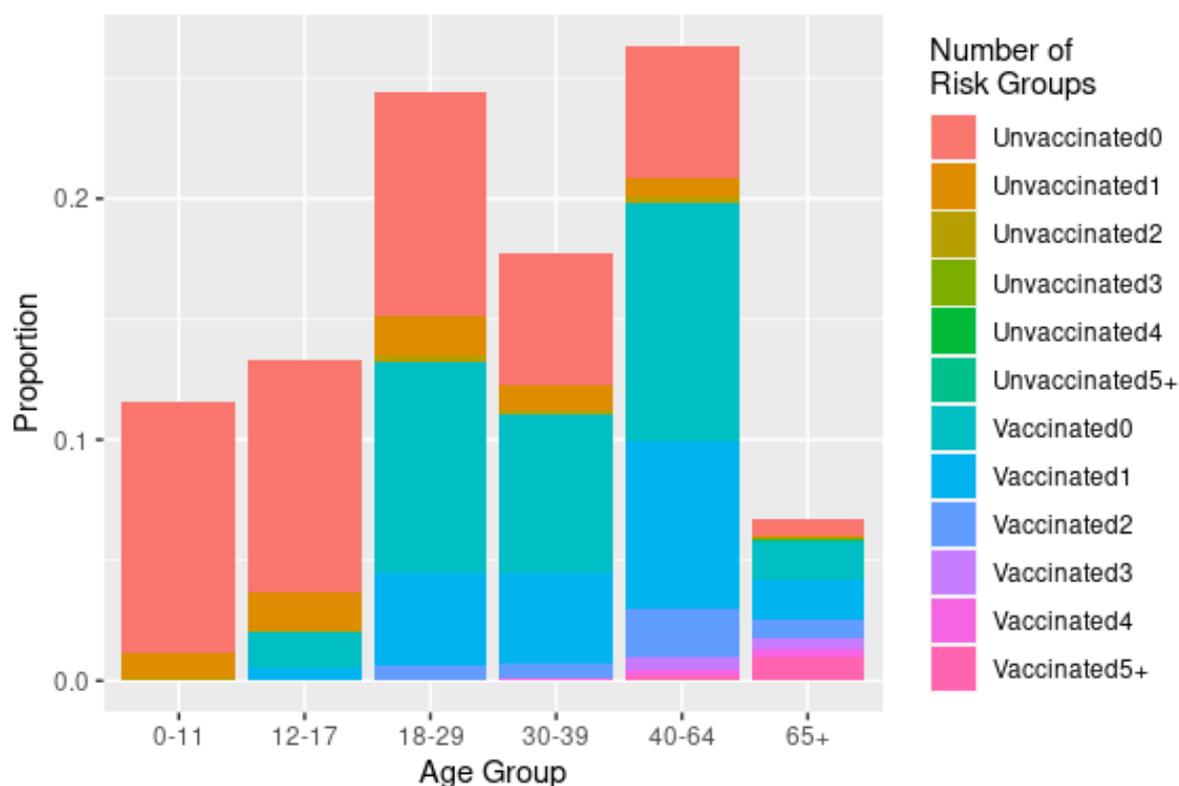
Figure 4 gives the age group, risk group and vaccination status of those first testing positive in the period 7th to 13th August 2021 and linking into the EAVE cohort. Vaccine status is a simple binary classification denoting that the individual had at least one dose of the vaccine before testing positive (vaccinated) or was unvaccinated at the time of testing positive. Risk group status is the number of Q-Covid<sup>5</sup> risk groups to which a person belongs.

<sup>4</sup> Based at Edinburgh University, Strathclyde University Aberdeen University and Public Health Scotland.

<sup>5</sup> [Coronavirus \(COVID-19\) risk assessment - NHS Digital](#)

One quarter of those testing positive are under 18, 50% are aged under 30 and only 6% aged 65+<sup>6</sup>. Among those aged under 18 the vast majority are unvaccinated while among those aged 18-29 just over half of them are vaccinated, most will just have had one dose. Very few individuals testing positive under 40 have multiple co-morbid conditions (0.2% of all cases were under 40 and had 3 or more co morbid conditions). The majority of those aged over 40 are vaccinated when testing positive, and most will have had two doses of vaccine, but a relatively small proportion are in the groups most at risk of a severe outcome. Among those testing positive 1.5% are aged 65+ and have 4 or more co-morbid conditions.

Figure 4. Proportion of positive tests, by age group, clinical risk group and vaccination status for the week beginning 7th August 2021.<sup>7</sup>



## What we know about how people’s contact patterns have changed

Average contacts have increased by 15% in the last two weeks (comparing surveys pertaining to 5th August - 11th August and 19th August - 25th August) with a current level of 4.7 daily contacts as

<sup>6</sup> In January just over 16% of people testing positive were 65 or over, this reduced to just over 5% in mid-April. See issue 48.

<sup>7</sup> Clinical at-risk groups refer to individuals with certain underlying medical conditions who are at-risk of Covid-19 related complications and for whom seasonal influenza vaccination is recommended. See issue 23 for more details.

seen in Figure 5. Contacts within the work have increased by approximately 64% compared to two weeks prior. Contacts within the home and other setting (contacts outside of the home, school and work) have remained at similar levels over the same period.

Figure 5: Mean Adult Contacts (truncated at 100) from SCS.

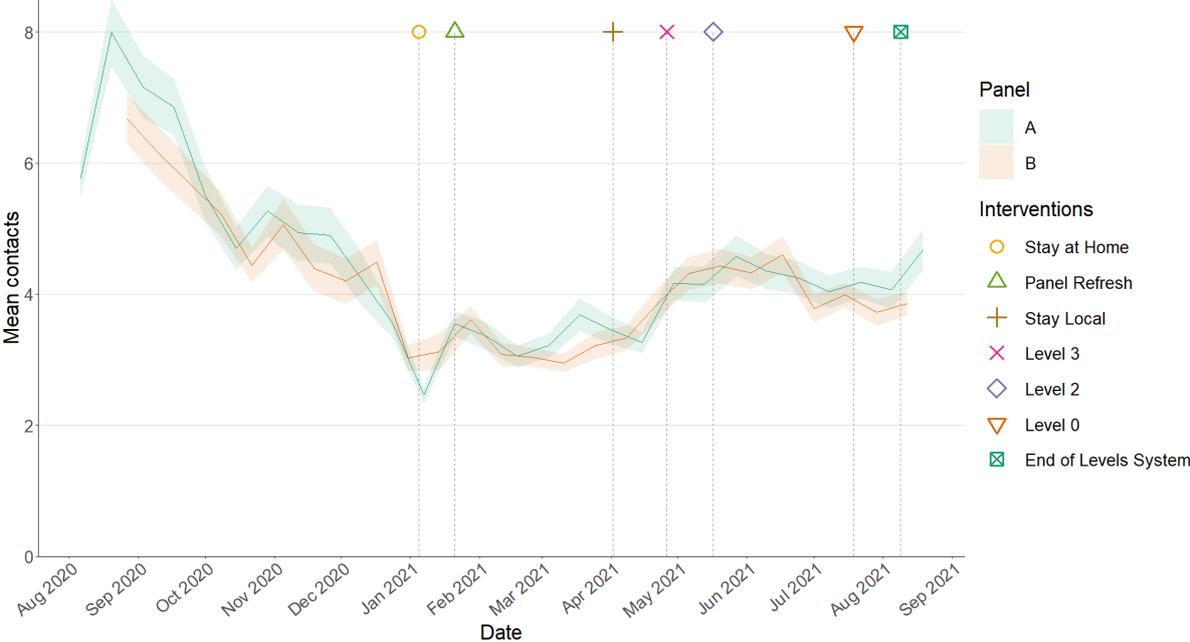
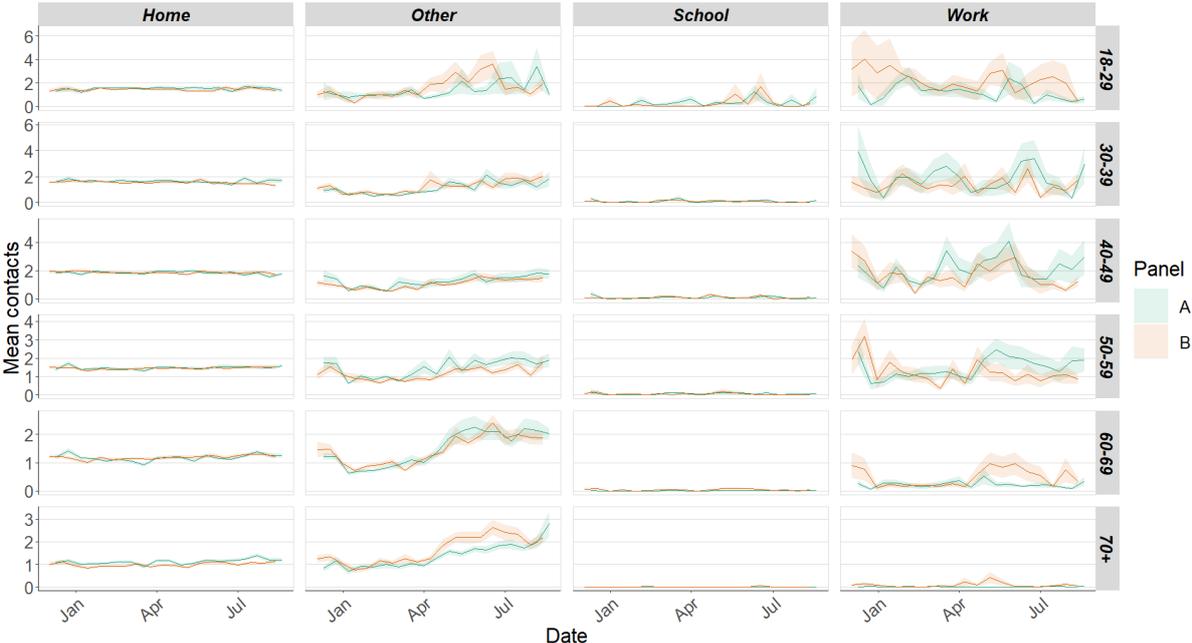


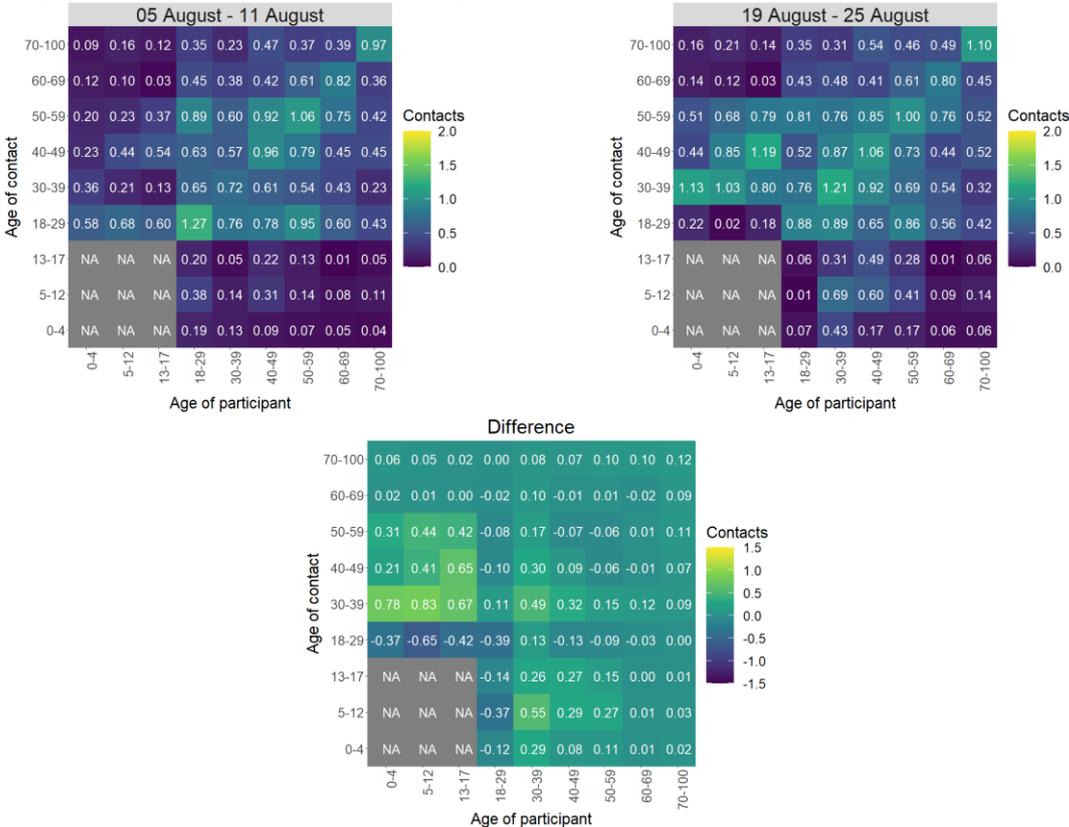
Figure 6 shows how contacts change across age group and setting. All age groups with the exception of those aged 18-29 have had an rise in contacts within the last two week, with those aged 30-39 approximately doubling. Increases across the age groups are largely driven by a rise in contacts within the work setting.

Figure 6: 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 7 show the mean overall contacts between age groups for the weeks relating to 5th August - 11th August and 19th August - 25th August and the difference between these periods. The biggest increase in interactions is seen between those 30-39 with those under 18.

Figure 7: Overall mean contacts by age group before for the weeks relating to 5th August - 11th August and 19th August - 25th August.



As seen in Figure 8, the proportion of participants visiting different locations remains at similar levels across the majority of locations with those visiting a work place and also those visiting a pub or restaurant reporting the biggest increase in attendance. Visits to a work place have increased from approximately 14% to 19% with individuals visiting a pub or restaurant increasing from 46% to 49% in the last two weeks.

Figure 8: Locations visited by participants at least once for panel A and B (from SCS).

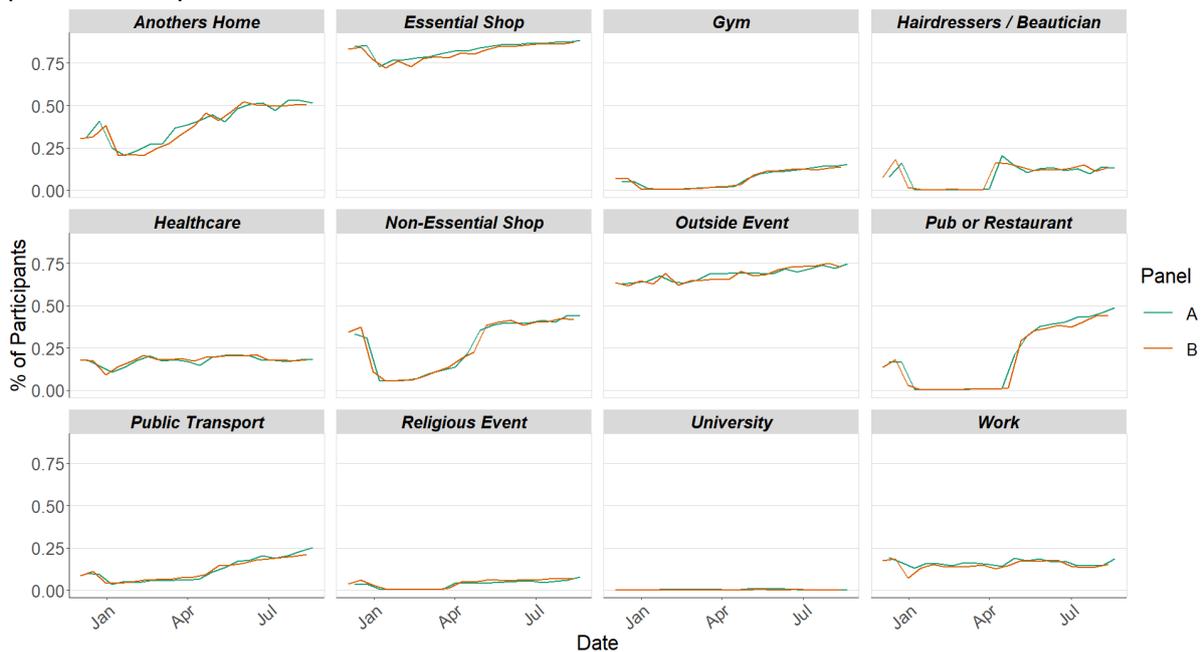


Figure 9 shows the proportion of participants that reported contacts had indoors and outdoors for contacts individually reported for panel A. A contact can be recorded as both indoor and outdoor. The graph also shows contacts reported as outside only and indoor only. The proportion of contacts reported to have been indoors only has increased slightly within the last two weeks, from 55% to 58%.

Figure 9: Proportion of participants reported indoors and outdoors for contacts individually reported for panel A.

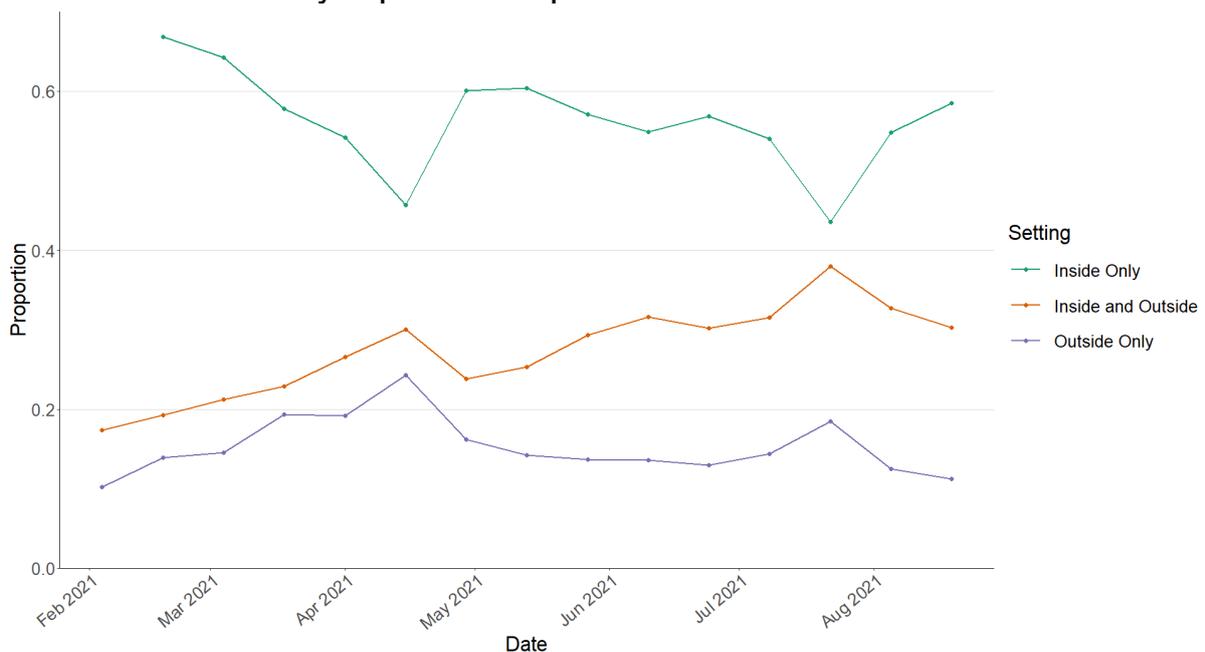
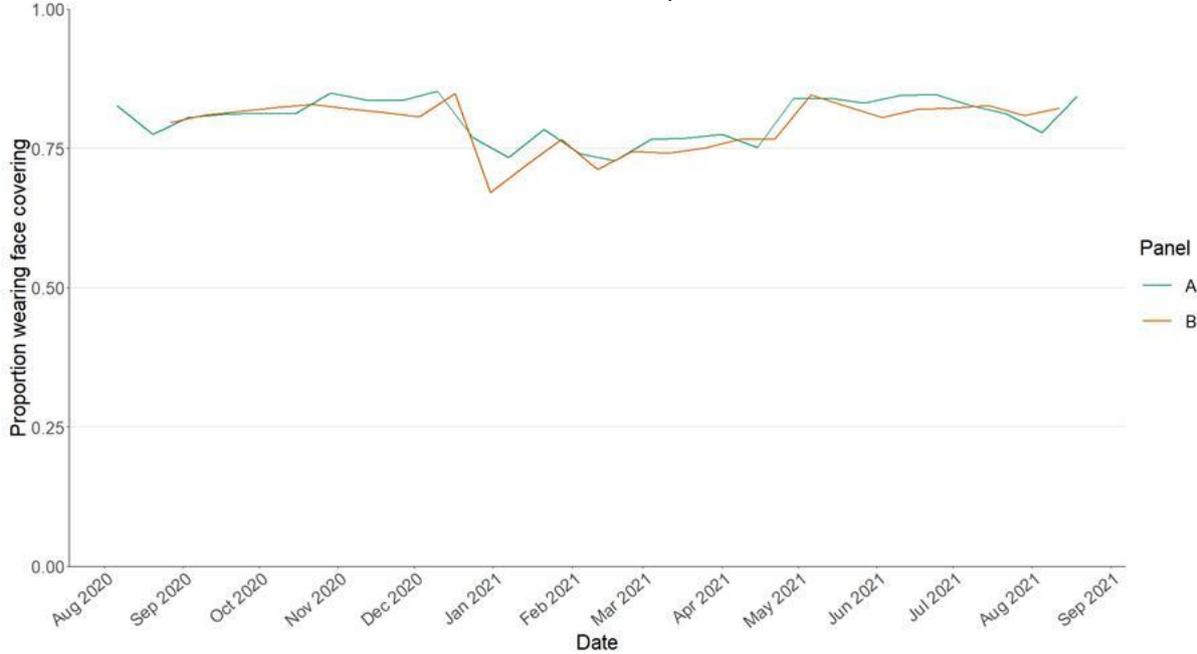


Figure 10 shows the number of people wearing a face covering where they have at least one contact outside of the home. This has increased from 78% to 84% in the last two weeks.

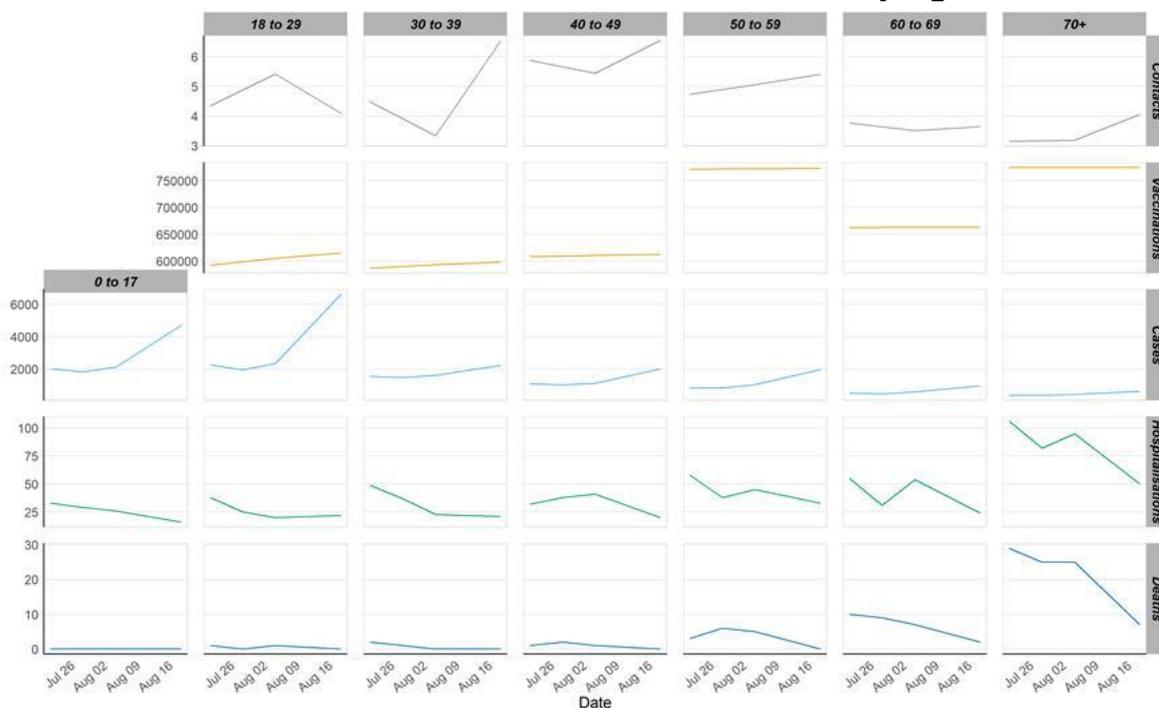
Figure 10: Proportion of adults wearing a face coverings over time (with at least one contact outside of the home).



**Vaccinations and contacts patterns**

From Figure 11, it can be seen that the older age groups have similar levels of contacts but higher vaccinations than the youngest age group, they also have the lowest weekly case number comparatively to the younger age groups, which are currently rising. Despite that they have higher weekly hospitalization levels and deaths to that seen with the younger age groups.

Figure 11: Average contacts for Panel A, weekly cases, covid-19 hospital admissions and deaths<sup>8</sup> and cumulative vaccinations by age band<sup>9</sup>



### 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. Figure 12 shows three projections over the three weeks to 12th September.

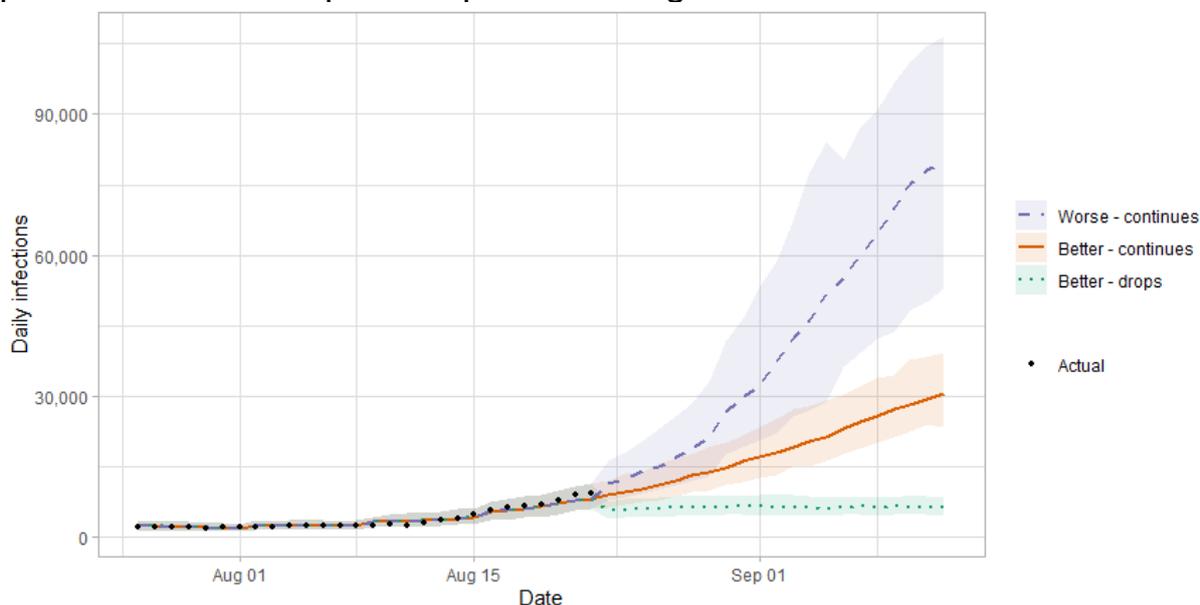
‘Worse - continues’ assumes that transmission increases, and this results in accelerating growth in infections. ‘Better - continues’ assumes transmission remains at the current level. ‘Better - drops’ assumes that the recent increase in transmission is short-lived, and it will return to previous levels<sup>10</sup>.

<sup>8</sup> Deaths, Cases and Hospitalisations from [PHS COVID-19 daily cases in Scotland dashboard](#).

<sup>9</sup> 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.

<sup>10</sup> All scenarios are based on current vaccine roll-out plans and efficacy assumptions.

Figure 12. Medium term projections of modelled total new daily infections, adjusting positive tests<sup>11</sup> to account for asymptomatic and undetected infections, from Scottish Government modelling, based on positive test data reported up to 25th August.



There is uncertainty as to how much infections will increase (or decrease) in coming weeks. This will drive how much hospital beds and intensive care beds will rise.

Figure 13 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.

Hospital and ICU occupancies are rising, and the future increase or decrease in hospital occupancy and intensive care use is highly uncertain, and depends on the number of infections.

<sup>11</sup> The actual positive tests are adjusted to coincide with the estimated day of infection.

Figure 13. Medium term projections of modelled hospital bed demand, from Scottish Government modelling, based on positive test data reported up to 25th August.

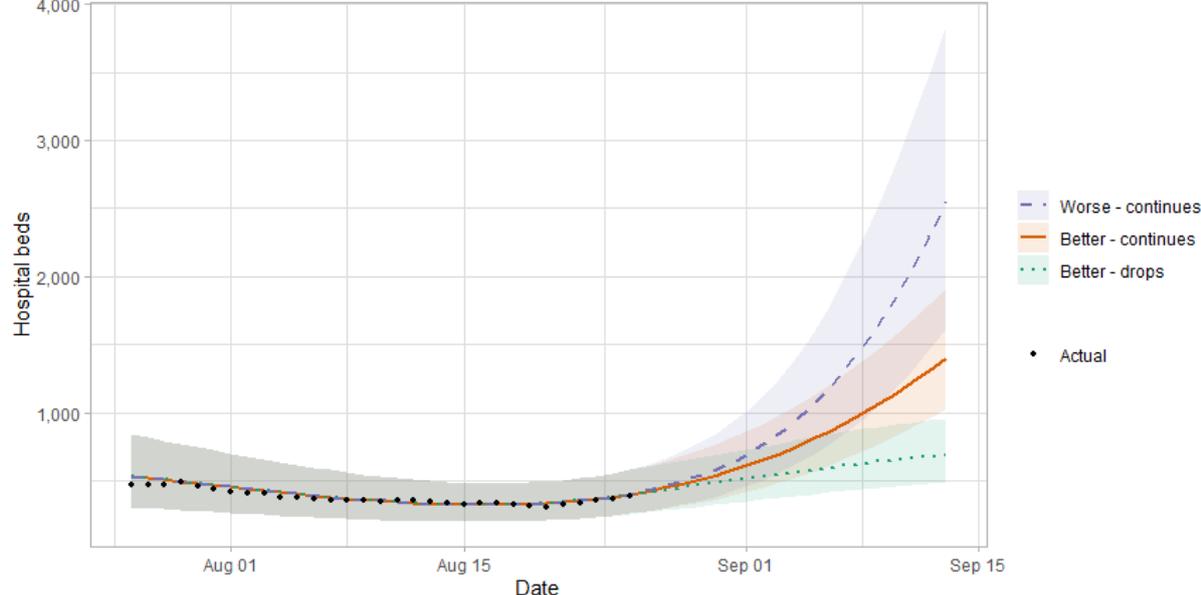
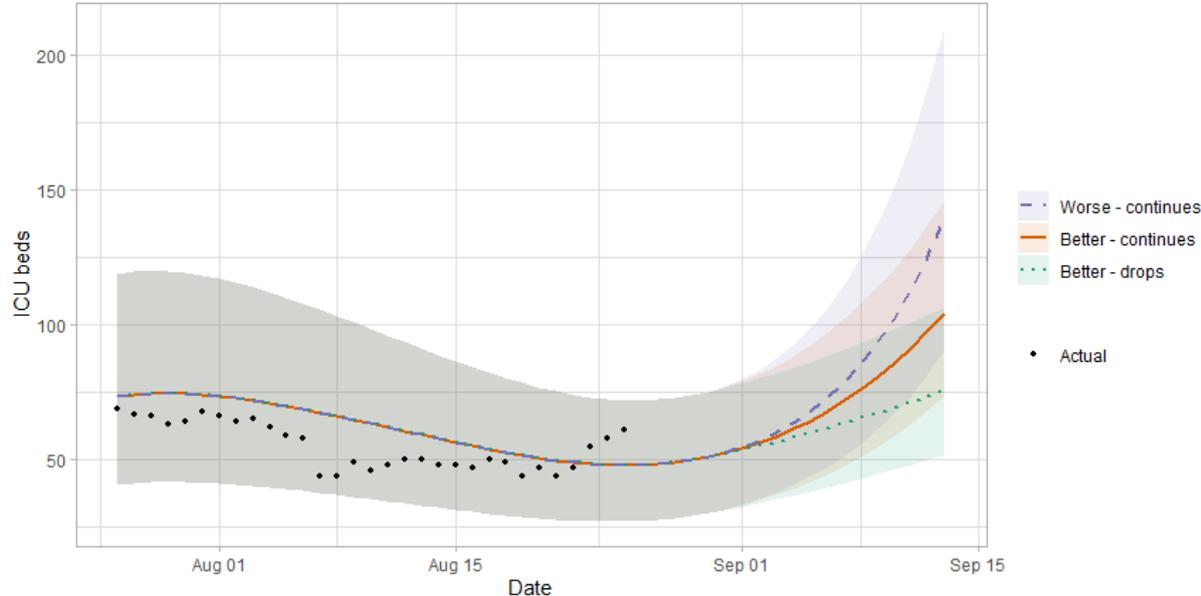


Figure 14 shows the impact of the projection on ICU bed demand.

Figure 14. Medium term projections of modelled ICU bed demand, from Scottish Government modelling<sup>12</sup>, based on positive test data reported up to 25th August.



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

<sup>12</sup> 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

SPI-M produces projections of the epidemic<sup>13</sup> (Figure 15), combining estimates from several independent models (including the Scottish Government's logistics modelling, as shown in Figures 12-14). 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 23rd August and **do not include the effects of any future policy or behavioural changes**.

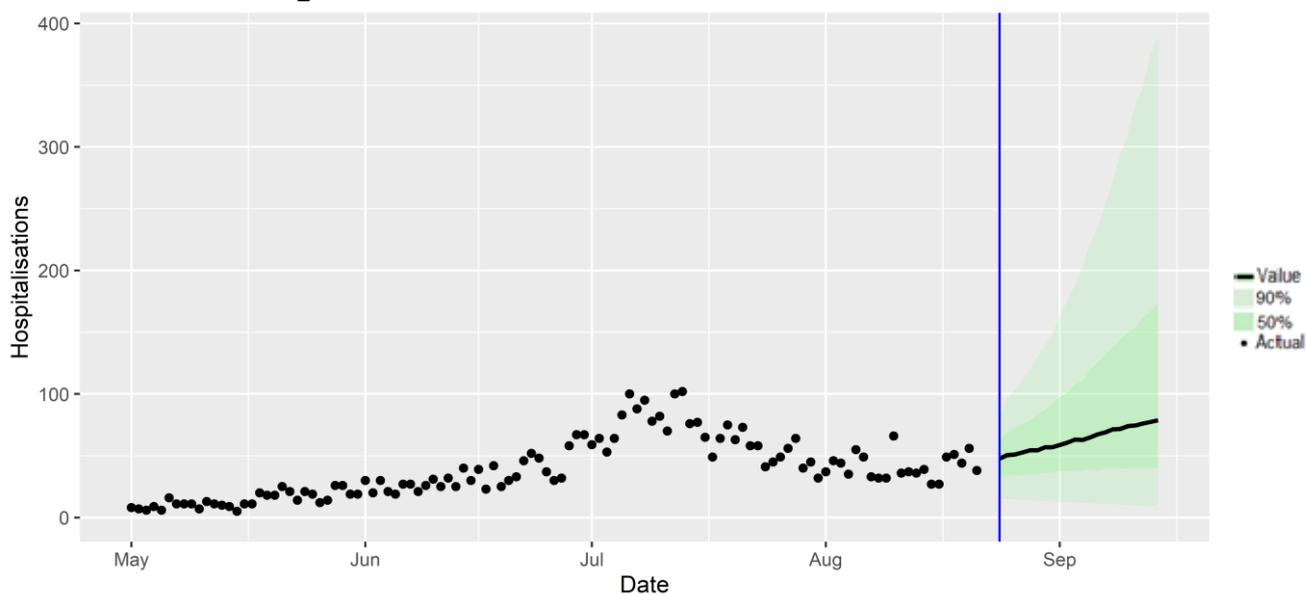
The delay between infection, developing symptoms, the need for hospital care, and death means they cannot fully reflect the impact of behaviour changes in the two to three weeks prior to 23rd August. Projecting forwards is difficult when the numbers of admissions and deaths fall to very low levels, which 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 7th September, 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.

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<sup>13</sup> Four week projections are provided here: [Scientific evidence supporting the government response to coronavirus \(COVID-19\) - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/evidence/scientific-evidence-supporting-the-government-response-to-coronavirus-covid-19)

Figure 15. SPI-M 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 remains at 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 23rd August 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.

Because of the recent increase in cases, infections may be rising rapidly and that the local projections have yet to fully reflect this.

Modelled rates of positive tests per 100K using data to 23rd August (Figure 16) indicate that, for the week commencing 5th September 2021, there are 28 local authorities which are expected to exceed 100 cases per 100k with at least 75% probability<sup>14</sup>.

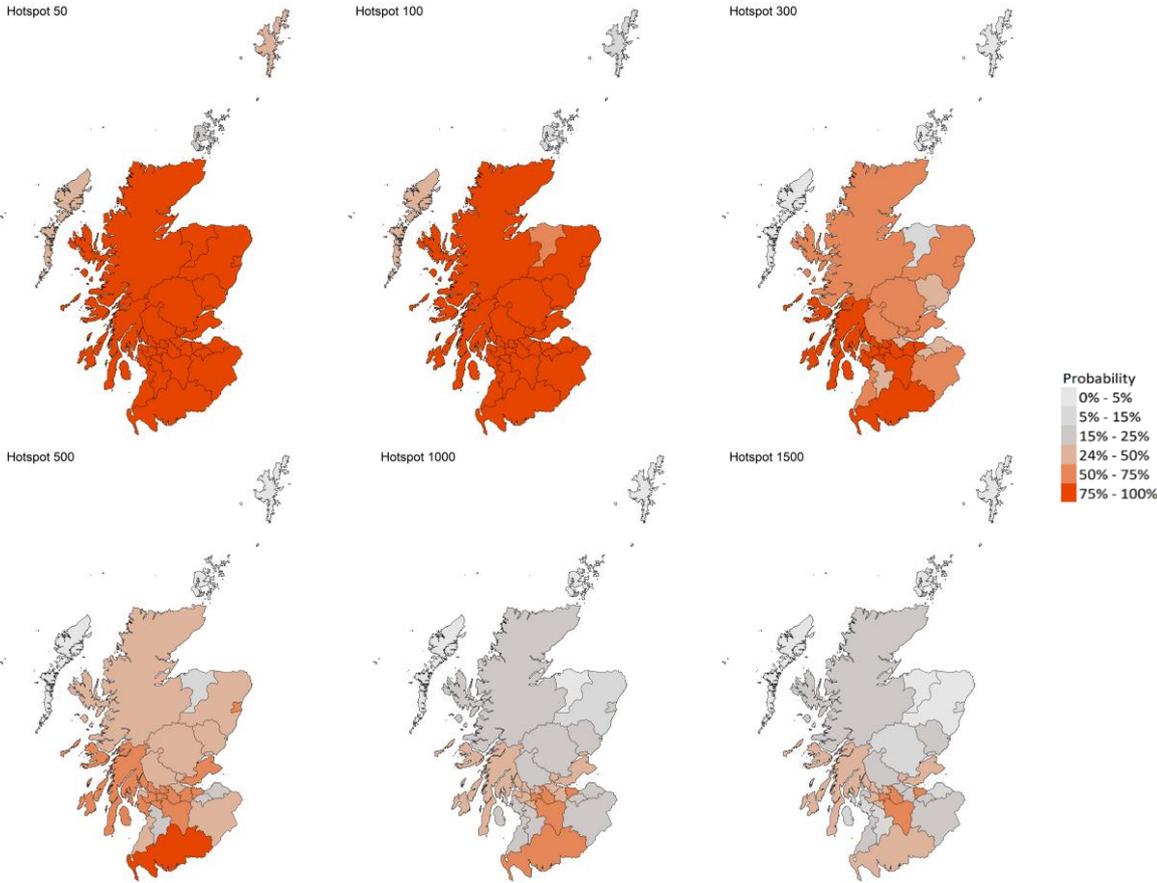
Of these, twelve local authorities are expected to exceed 300 cases per 100k with at least 75% probability. These are Argyll & Bute, Edinburgh, Dumfries & Galloway, East Dunbartonshire, East Renfrewshire, Glasgow,

<sup>14</sup> The exceptions to this are Moray, Na h-Eileanan Siar, Orkney Islands and Shetland Islands.

North Ayrshire, North Lanarkshire, Renfrewshire, South Lanarkshire, West Dunbartonshire and West Lothian.

Only one local authority, Dumfries & Galloway, is expected to exceed 500 cases per 100k with at least 75% probability<sup>15</sup>.

Figure 16. Probability of local authority areas exceeding thresholds of cases per 100K (5th to 11th September 2021), data to 23rd August.



<sup>15</sup> Numbers are included in Table 1 in the Technical Annex.

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

Levels of Covid-19 RNA in wastewater collected at a number of sites around Scotland are adjusted for population and local changes in intake flow rate and compared to 7-day average daily new 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.

Nationwide, the latest levels of wastewater (WW) Covid-19 RNA have approximately doubled since the previous week and averaged around 90 million gene copies per person per day (Mgc/p/d) for the week 14th to 20th August, compared to 42 Mgc/p/d the previous week.

Figure 17 shows the national weekly aggregate for the original 28 sites (sampled from August 2020, in blue) and, from January 2021, the aggregate for the full set of 110 sampled sites (in green), with a small number of unrealistically large outliers excluded. Both WW Covid-19 concentrations and cases are now approaching the maximum level reached during the peak in July 2021.

Figure 17. National average trends in wastewater Covid-19 and daily new case rates (7 day moving average)<sup>16</sup>.

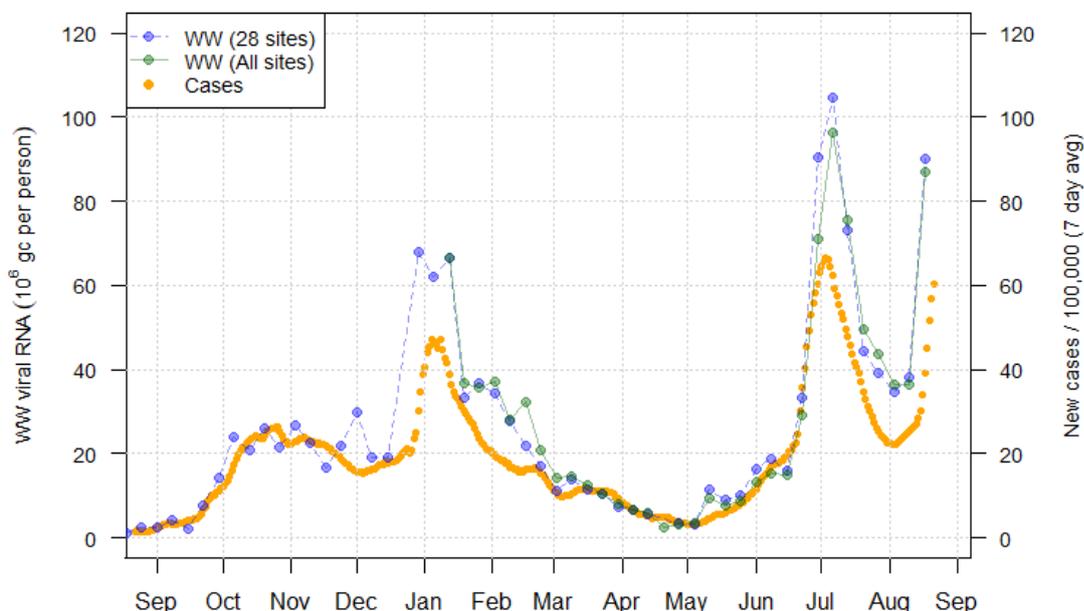
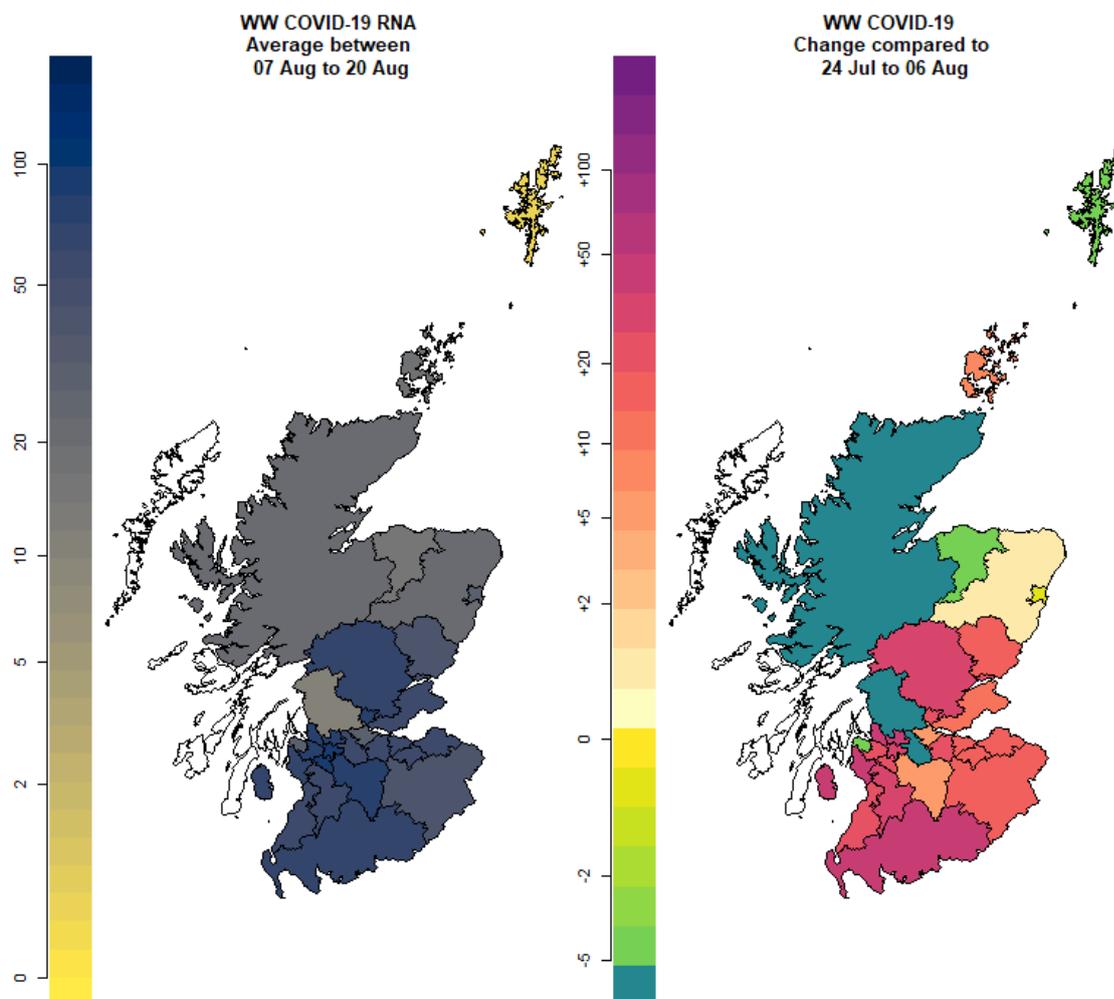


Figure 18 uses colours to map (i) the local authority average WW viral Covid-19 levels (in Mgc/p/d) over the two-week period from 7th August to

<sup>16</sup> 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, were removed.

20th August, and (ii) the change in viral Covid-19 levels compared to the previous two-week period 24th July to 6th August. This shows that the rise has been greatest in the central belt and the south.

Figure 18. Map showing wastewater Covid-19 levels (million gene copies/person/day) for each local authority for 7th August to 20th August and changes relative to 24th July to 6th August. Areas shown in white have insufficient data available for the relevant period<sup>17</sup>.



The increase in both WW Covid-19 concentrations and cases is especially marked in the area covered by the NHS Greater Glasgow and Clyde health board (Figure 19), where the most recent WW measurements at the sites at Dalmuir, Shieldhall, Dalmarnock and

<sup>17</sup> The temporary decrease in the number of samples tested continues this week, which impacts on the frequency of observations and the population covered by sampling. This means there should be particular caution in interpreting the maps in Figure 16 and the local authority results in Table 2 in the Technical Annex. In particular, in Perth and Kinross only one sample has been measured from the main site in Perth in the two week period between 7th and 20th August, making the map output unreliable.

Paisley all show a sharp rise. However, increases are also starting to appear in other parts of Scotland, for example at Nigg in Aberdeen (Figure 20).

Figure 19. Average trends in wastewater Covid-19 and daily case rates (7 day moving average) in NHS Greater Glasgow and Clyde Health Board (pop: 1147 k).

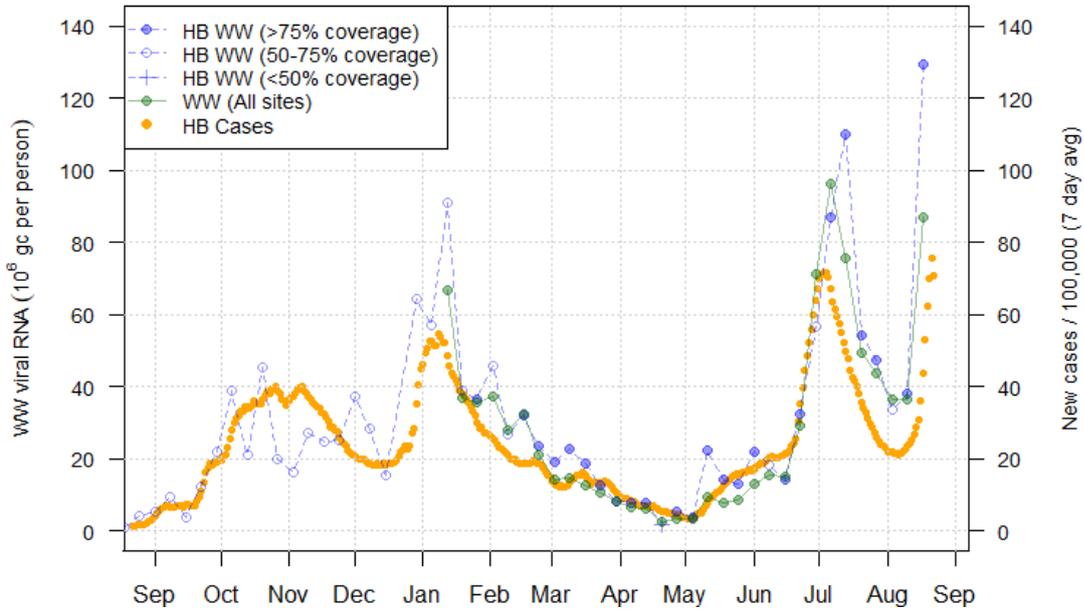
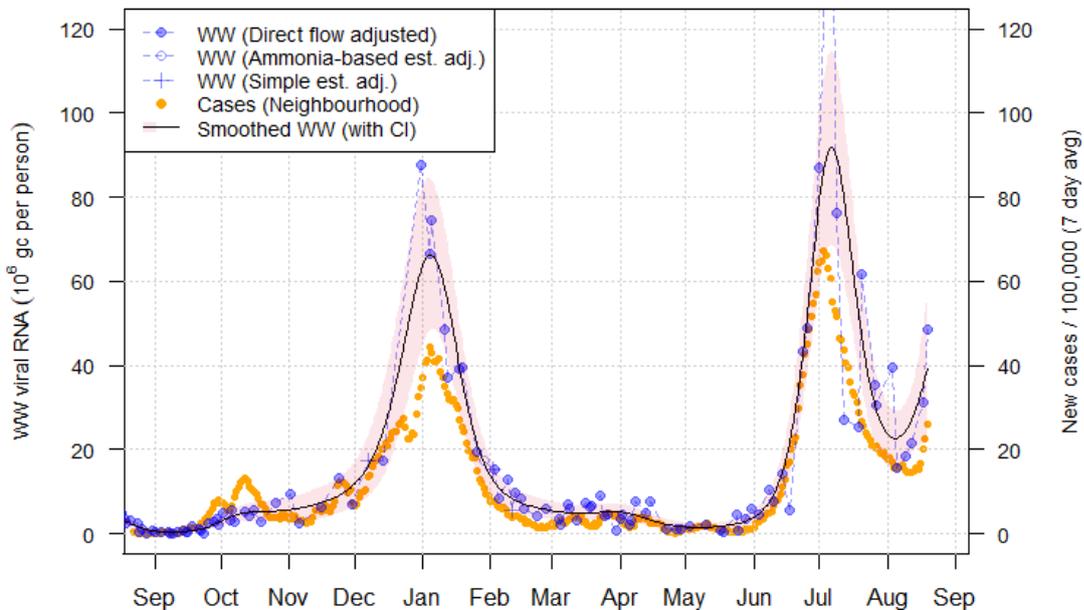


Figure 20. Wastewater Covid-19 and daily case rate (7 day moving average) for Nigg (covered pop: 218k) in Aberdeen<sup>18</sup>.



<sup>18</sup> The black line and red shaded area provide a smoothed curve and confidence interval for WW RNA that is estimated from a generalised additive model based on a Tweedie distribution.

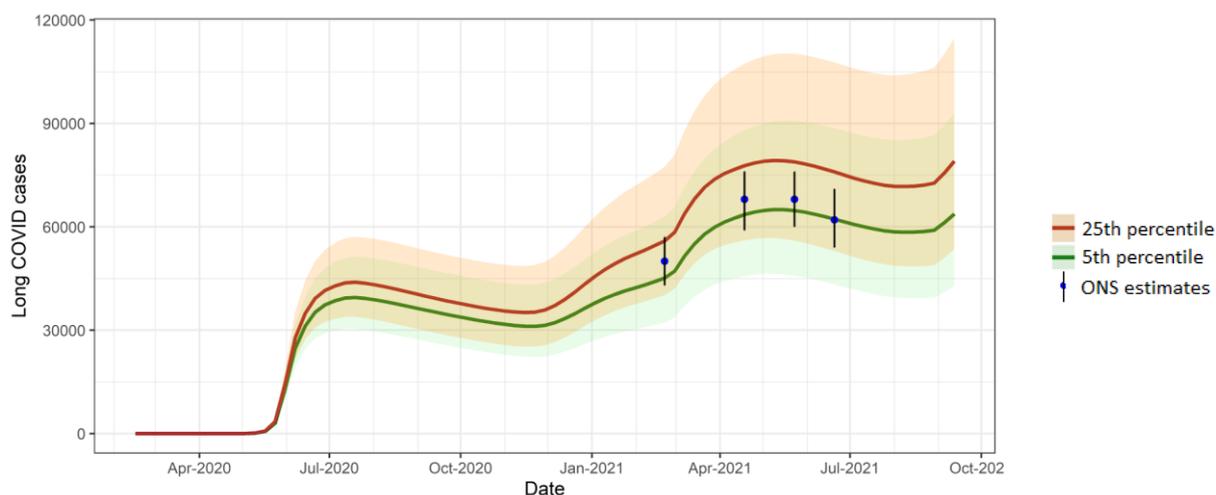
## What estimates do we have of the number of people experiencing long Covid symptoms?

The Scottish Government is modelling the number of people likely to experience long Covid symptoms. This has been projected to estimate long Covid rates in the future, based on Scottish Government medium term projection modelling, as set out in Figure 21.

This modelling estimates that at 12th September 2021 between 43,000 (0.8% of the population) and 115,000 (2.1%) people are projected to experience symptoms for 12 weeks or more after their first suspected Covid infection in Scotland. This is an increase in the upper limit since last week.

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

Figure 21: Estimates of long Covid prevalence at 12 weeks from 16th February 2020 to 12th September 2021 for the 5th and 25th percentile better long Covid 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.

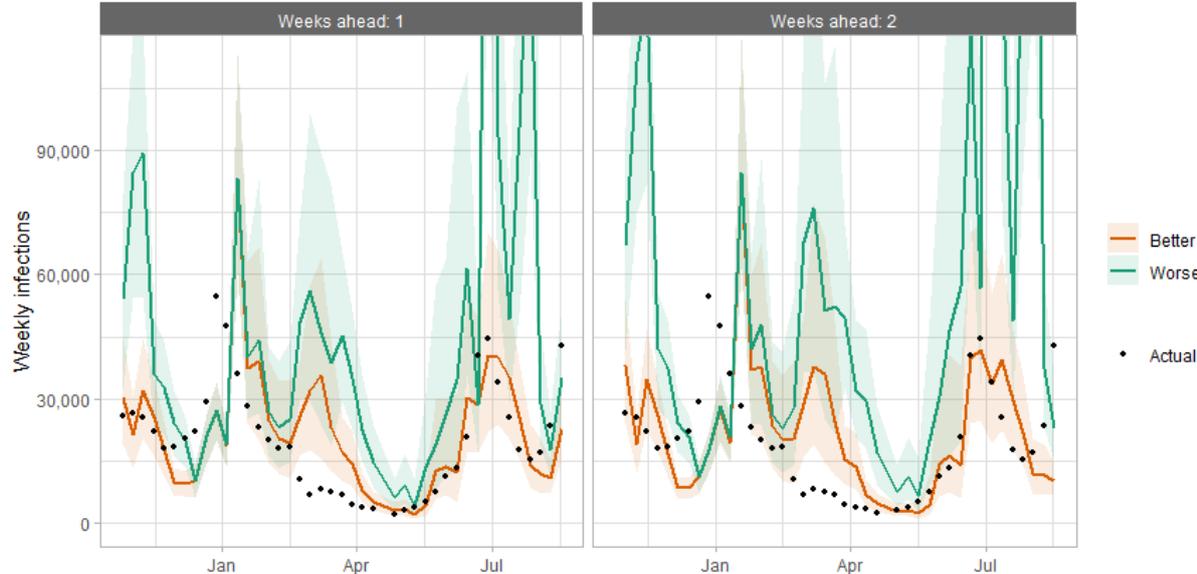
Modelling also allows us to make short-term forecasts of what may happen with a degree of uncertainty. These can be used in health care and other planning. The modelling in this research findings is undertaken using different types of data which going forward aims to both model the progress of the epidemic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

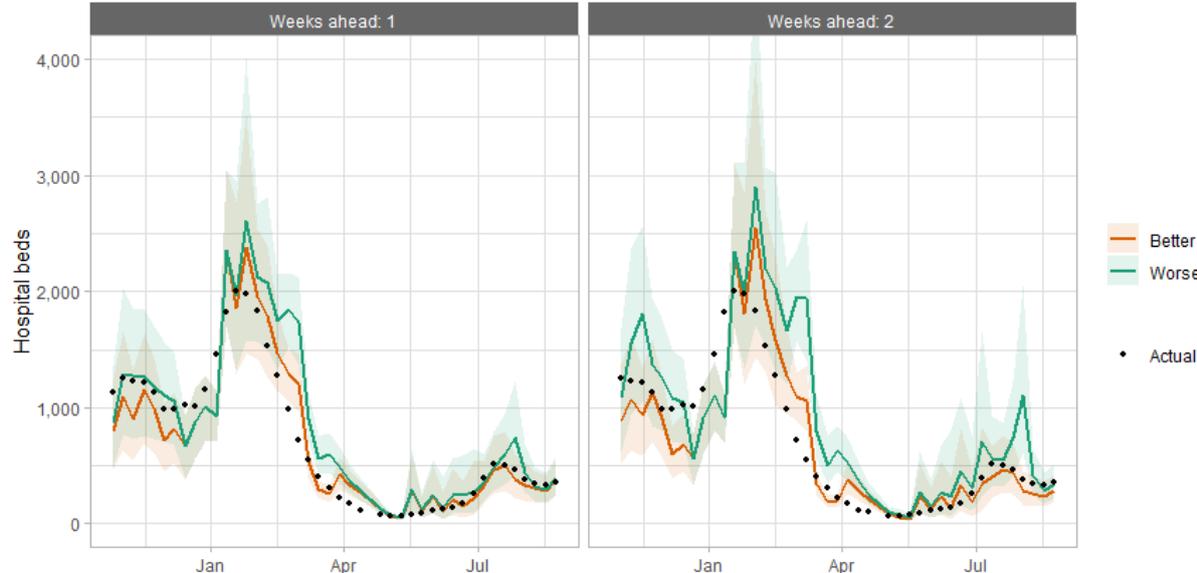
The following charts show the history of our modelling projections in comparison to estimates of the actual data. The infections projections were largely accurate during October to mid-December and from mid-January onward. During mid-December to mid-January, the projections underestimated the number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

Figure 22. 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 23. 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 24. ICU bed projections versus actuals, for historical projections published between one and two weeks before the actual data came in.

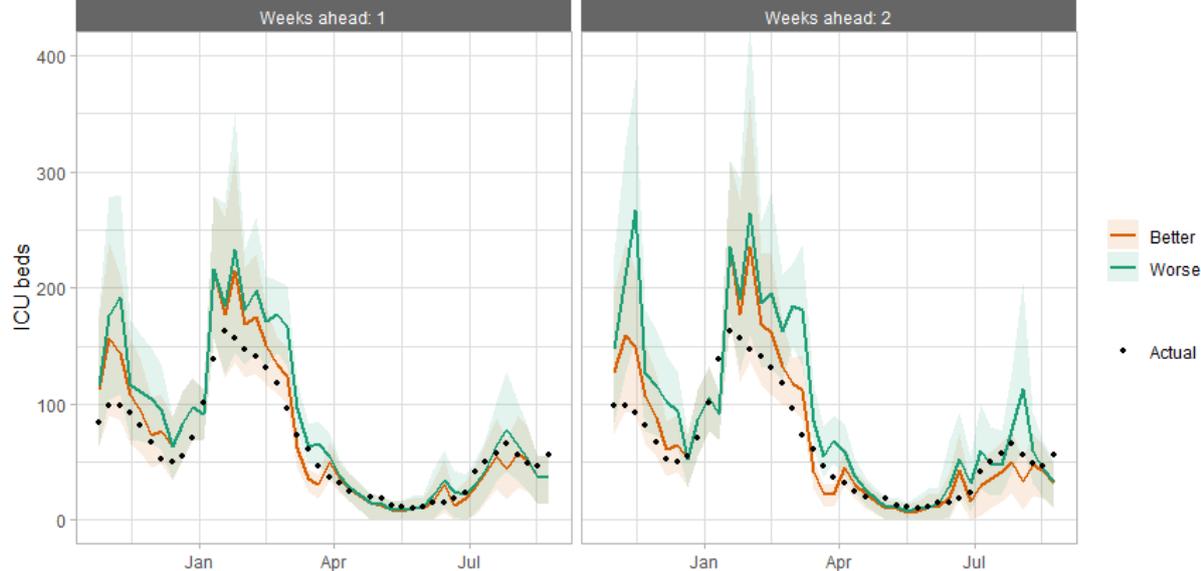


Table 1. Probability of local authority areas exceeding thresholds of cases per 100K (5th to 11th September 2021), data to 23rd August.

Local Authority (LA)	Probability of exceeding (cases per 100k)					
	50	100	300	500	1000	1500
Aberdeen City	75-100%	75-100%	50-75%	50-75%	15-25%	5-15%
Aberdeenshire	75-100%	75-100%	50-75%	25-50%	5-15%	0-5%
Angus	75-100%	75-100%	25-50%	25-50%	15-25%	15-25%
Argyll and Bute	75-100%	75-100%	75-100%	50-75%	25-50%	25-50%
City of Edinburgh	75-100%	75-100%	75-100%	50-75%	50-75%	50-75%
Clackmannanshire	75-100%	75-100%	50-75%	25-50%	25-50%	25-50%
Dumfries & Galloway	75-100%	75-100%	75-100%	75-100%	50-75%	25-50%
Dundee City	75-100%	75-100%	25-50%	25-50%	25-50%	15-25%
East Ayrshire	75-100%	75-100%	25-50%	15-25%	15-25%	5-15%
East Dunbartonshire	75-100%	75-100%	75-100%	50-75%	25-50%	25-50%
East Lothian	75-100%	75-100%	25-50%	15-25%	15-25%	5-15%
East Renfrewshire	75-100%	75-100%	75-100%	50-75%	25-50%	25-50%
Falkirk	75-100%	75-100%	25-50%	25-50%	25-50%	15-25%
Fife	75-100%	75-100%	50-75%	50-75%	25-50%	25-50%
Glasgow City	75-100%	75-100%	75-100%	50-75%	50-75%	50-75%
Highland	75-100%	75-100%	50-75%	25-50%	15-25%	15-25%
Inverclyde	75-100%	75-100%	50-75%	25-50%	25-50%	15-25%
Midlothian	75-100%	75-100%	25-50%	15-25%	15-25%	15-25%
Moray	75-100%	50-75%	5-15%	5-15%	0-5%	0-5%
Na h-Eileanan Siar	25-50%	25-50%	0-5%	0-5%	0-5%	0-5%
North Ayrshire	75-100%	75-100%	75-100%	50-75%	15-25%	5-15%
North Lanarkshire	75-100%	75-100%	75-100%	50-75%	50-75%	50-75%
Orkney Islands	15-25%	5-15%	0-5%	0-5%	0-5%	0-5%
Perth and Kinross	75-100%	75-100%	50-75%	25-50%	15-25%	5-15%
Renfrewshire	75-100%	75-100%	75-100%	50-75%	25-50%	25-50%
Scottish Borders	75-100%	75-100%	50-75%	25-50%	15-25%	15-25%
Shetland Islands	25-50%	5-15%	0-5%	0-5%	0-5%	0-5%
South Ayrshire	75-100%	75-100%	50-75%	25-50%	15-25%	15-25%
South Lanarkshire	75-100%	75-100%	75-100%	50-75%	50-75%	50-75%
Stirling	75-100%	75-100%	50-75%	25-50%	15-25%	15-25%
West Dunbartonshire	75-100%	75-100%	75-100%	50-75%	25-50%	25-50%
West Lothian	75-100%	75-100%	75-100%	50-75%	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 7th and 14th August, 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<sup>19</sup>.

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 <sup>20</sup>
	w/b 7th August	w/b 14th August	w/b 7th August	w/b 14th August	
Aberdeen City	20	40	20	40	41%
Aberdeenshire	17	28	17	28	56%
Angus	37	45	37	45	0%
Argyll and Bute	-	-	-	-	96%
City of Edinburgh	36	79	36	79	70%
Clackmannanshire	54	98	34	98	33%
Dumfries & Galloway	26	109	26	88	100%
Dundee City	47	54	47	54	57%
East Ayrshire	35	89	35	89	99%
East Dunbartonshire	40	128	40	128	56%
East Lothian	36	79	36	79	89%
East Renfrewshire	49	148	49	70	43%
Falkirk	35	27	35	27	26%
Fife	49	59	49	59	98%
Glasgow City	42	138	42	109	29%
Highland	21	27	21	27	92%
Inverclyde	22	45	22	45	73%
Midlothian	36	79	36	79	55%
Moray	12	20	12	20	0%
Na h-Eileanan Siar	-	-	-	-	85%
North Ayrshire	32	102	32	102	83%
North Lanarkshire	47	74	47	74	34%
Orkney Islands	3	35	3	35	44%
Perth and Kinross	-	63	-	63	57%
Renfrewshire	16	132	16	115	44%
Scottish Borders	19	65	16	65	29%
Shetland Islands	1	0	1	0	84%
South Ayrshire	35	81	35	81	58%
South Lanarkshire	60	95	60	75	10%
Stirling	11	0	11	0	48%
West Dunbartonshire	40	128	40	128	60%
West Lothian	21	87	21	87	80%

<sup>19</sup> 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.

<sup>20</sup> Coverage as at the week beginning 14th August 2021.

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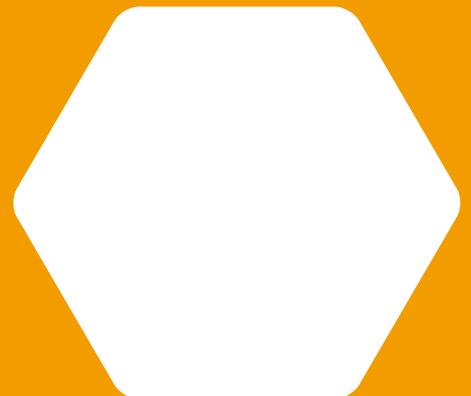
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