# Coronavirus (COVID-19): Analysis

## Coronavirus (COVID-19): modelling the epidemic in Scotland (Issue No. 59)

### 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 1st 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 1.2 and 1.5, with the growth rate between 3% and 7% based on the period up to 5th July. **The R and growth rate indicators lag by two to three weeks, as a result the estimates cannot fully reflect the significant increase in daily cases seen over the past few weeks.**

**Following a recent upsurge, case numbers have started to fall back and there may be a plateau occurring. However there is considerable uncertainty about what this means for future weeks.**

### Key Points

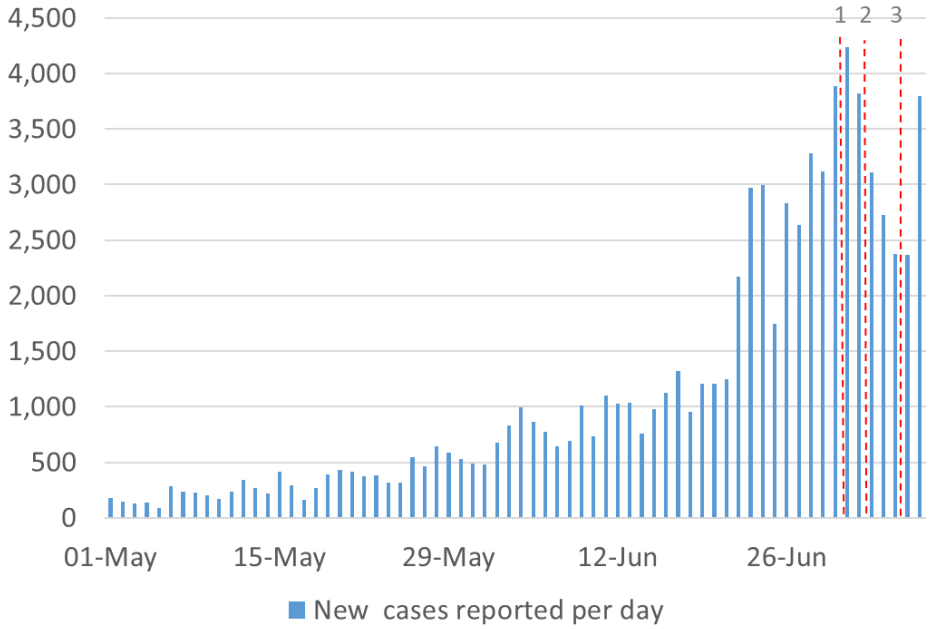
- The reproduction rate R in Scotland is currently estimated as being between 1.2 and 1.5, based on the period up to 5th July. This is unchanged from last week.
- The number of new daily infections for Scotland is estimated as being between 89 and 124, per 100,000 people, based on the period up to 5th June.
- The growth rate for Scotland is currently estimated as being between 3% and 7%, based on the period up to 5th June. This is unchanged from last week.

- Average contacts have remained at a similar level in the last two weeks (comparing surveys pertaining to 10th June - 16th June and 24th June - 30th June) with a current level of 4.2 daily contacts.
- Contacts within the work setting have decreased by 15% compared to two weeks prior and contacts within the other setting (contacts outside of the school, home and work) have increased by 7%. Average contacts within the home setting have remained at similar levels over the same period.
- Mean contacts across all age groups remain around similar level in comparison to two weeks prior with the exception of those aged between 18-29 who have decreased their contacts by 29% which is largely driven by reductions in contacts within the work setting.
- Mean contacts within the other setting is the only setting to show an increase over the same period, with all other settings reporting a decrease in overall mean contacts.
- The biggest increase in interactions is seen with those aged between 30-49 with those aged under 18 whereas the biggest decrease is with those aged between 18-29 with those 5-12.
- The proportion of participants visiting different locations remains at similar levels across all locations with those using public transport reporting the highest increase from 18% to 21% in the last two weeks.
- Based on the recent increase in cases, infections, hospital beds and ICU are projected to rise – for how long this continues is uncertain.
- Modelled rates of positive tests per 100K using data to 5th July indicate that for the week commencing 18th July 2021, there are 26 local authorities with at least a 75% probability of exceeding 150 cases per 100k.
- Of these, 9 local authorities have at least a 75% probability of exceeding 500 cases per 100k (Fife, Dundee, Glasgow, Perth & Kinross, Renfrewshire, East Dunbartonshire, North Lanarkshire, West Lothian and Aberdeen). Fife is the only local authority with at least a 75% probability of exceeding 1000 cases per 100k.
- Overall, wastewater (WW) Covid-19 levels continued to rise rapidly, reaching the highest levels observed. Increases are seen in a broad range of local authorities.
- The highest WW Covid-19 values were seen at the Seafield site, which covers Edinburgh. The reading on 2nd July is almost twice as high as the previous peak in the area. Of the sites that gave WW Covid-19 measurements in the last week, only Stornoway gave negative viral test results.

## Recent increase in cases

Figure 1 shows the number of cases reported in Scotland during May and June 2021, including the recent increase in cases seen in the last week. 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 7th July 2021




This report covers the period up to 30th June for contact patterns (indicated by dashed line 1). Wastewater data is provided to 2nd 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 5th July (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 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.

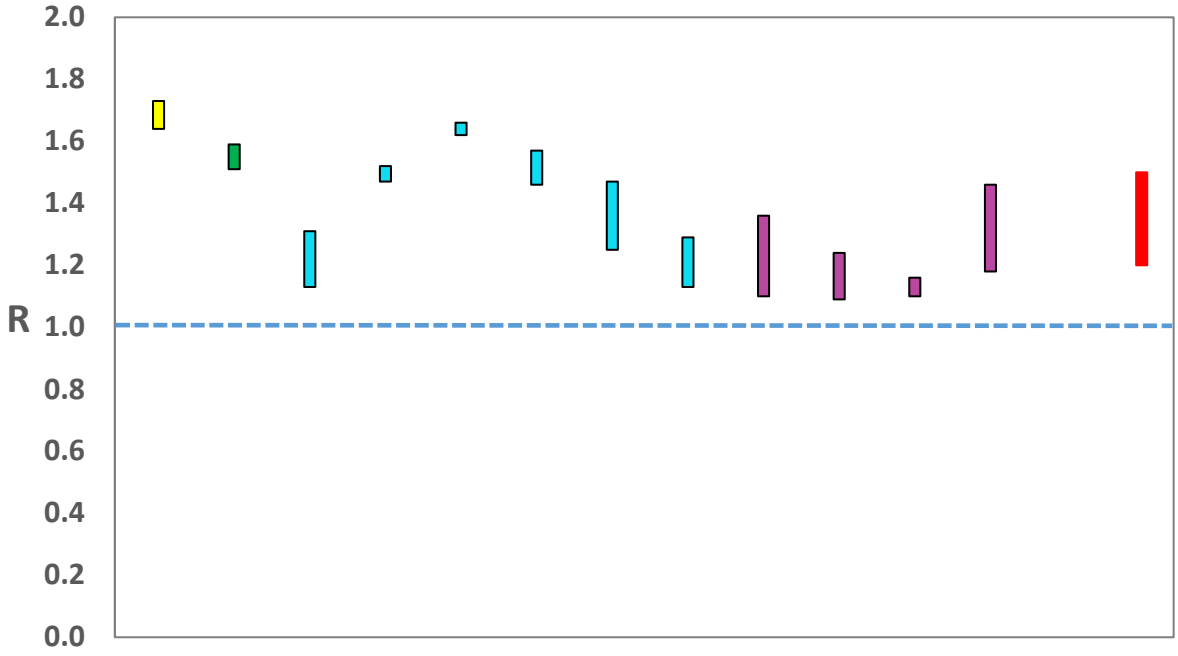
**R is an indicator that lags by two to three weeks and therefore does not reflect any behavioural changes that have happened during this time. In particular, Scotland has seen a significant increase in the number of new daily cases over the past few weeks and the associated R and growth rate estimates will not yet fully reflect this.**

SAGE's consensus view across these methods as of 7th July, using data to 5th July, was that the value of R in Scotland was between 1.2 and 1.5 (see Figure 2)[1].

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.

[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.

Figure 2. Estimates of $R_t$ for Scotland, as of 7th July, including 90% confidence intervals, produced by SAGE[2]. Data to 5th July.

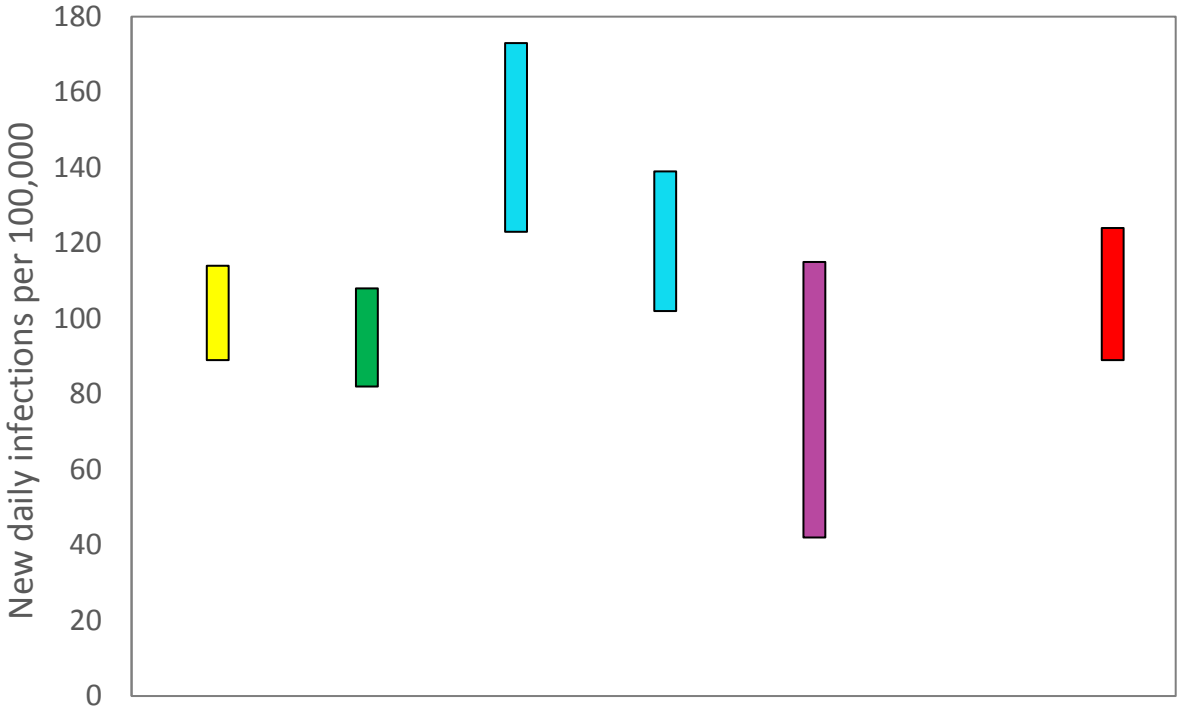



Source: Scientific Advisory Group for Emergencies (SAGE).

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 ). SPI-M's consensus view across these methods, using data to 5th July, was that the incidence of new daily infections in Scotland was between 89 and 124 new infections per 100,000. This equates to between 4,900 and 6,800 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 7th July, including 90% confidence intervals, produced by SPI-M[2]. Data to 5th 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 3% and 7% per day using data to 5th July. This is unchanged from 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 10th June - 16th June and 24th June - 30th June) with a current level of 4.2 daily contacts as seen in Figure 4. Contacts within the work setting have decreased by 15% compared to two weeks prior and contacts within the other setting (contacts outside of the school, home and work) have increased by 7%. Average contacts within the home setting have remained at similar levels over the same period.

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

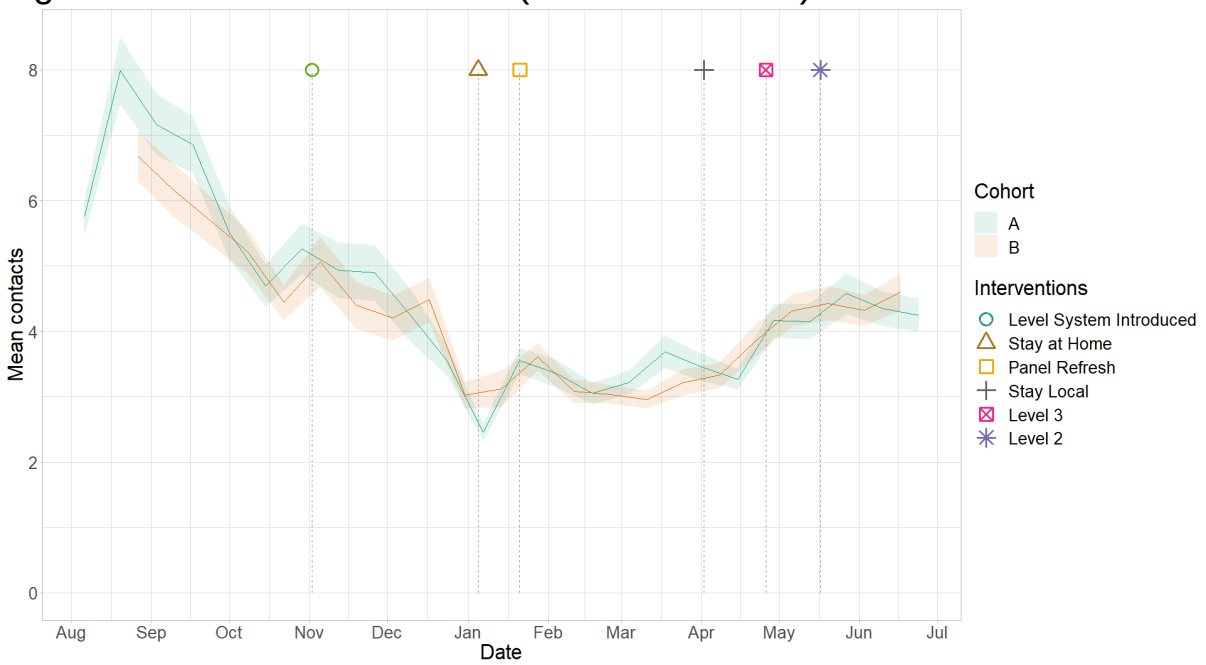
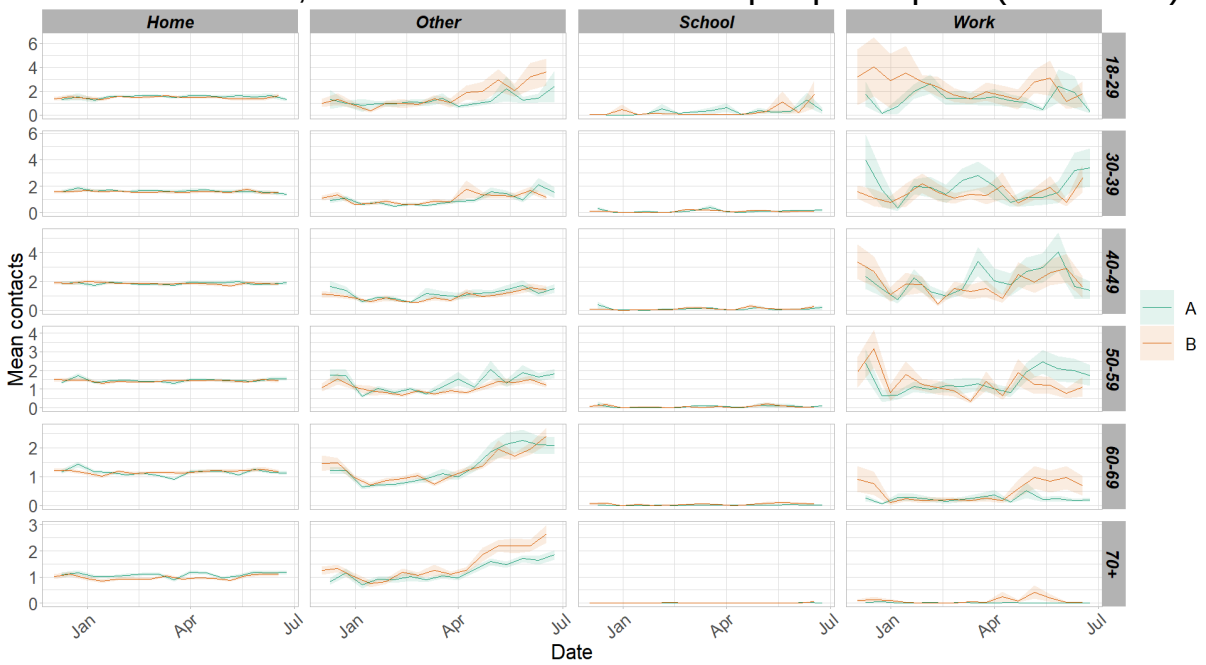


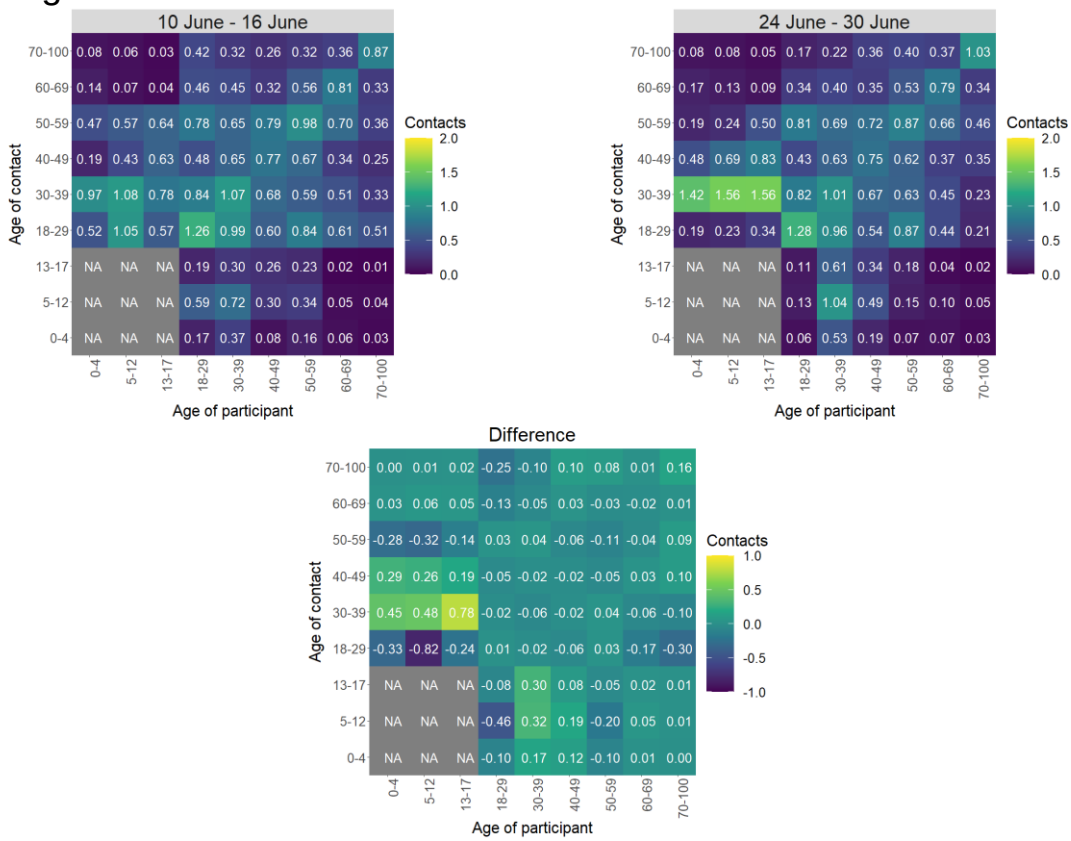

Figure 5 shows how contacts change across age group and setting. Mean contacts across all age groups remain around similar level in comparison to two weeks prior with the exception of those aged between 18-29 who have decreased their contacts by 29% which is largely driven by reductions in contacts within the work setting. Mean contacts within the other setting is the only setting to show an increase over the same period, with all other settings reporting a decrease in overall mean contacts.

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



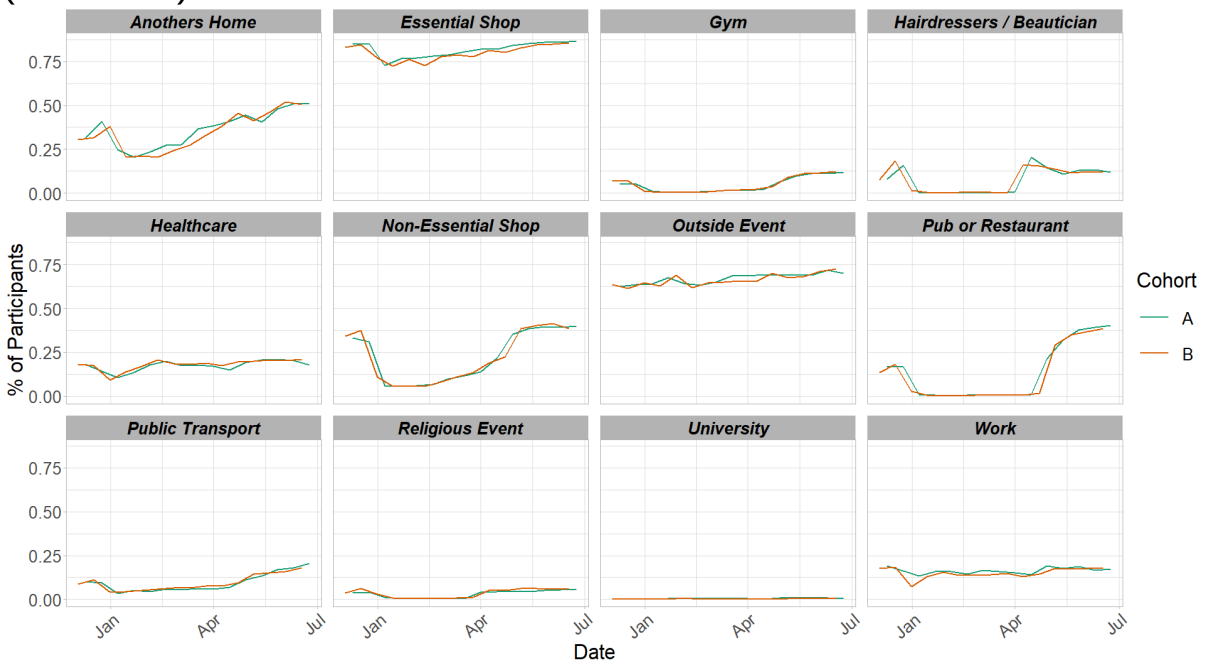
The heatmaps in Figure 6 show the mean overall contacts between age groups for the weeks relating to 10th June - 16th June and 24th June - 30th June and the difference between these periods. The biggest increase in interactions is seen with those aged between 30-49 with those aged under 18 whereas the biggest decrease is with those aged between 18-29 with those 5-12.

Figure 6: Overall mean contacts by age group before for the weeks relating to 10th June - 16th June and 24th June - 30th June.




As seen in Figure 7, the proportion of participants visiting different locations remains at similar levels across all locations with those using public transport reporting the highest increase from 18% to 21% in the last two weeks.

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

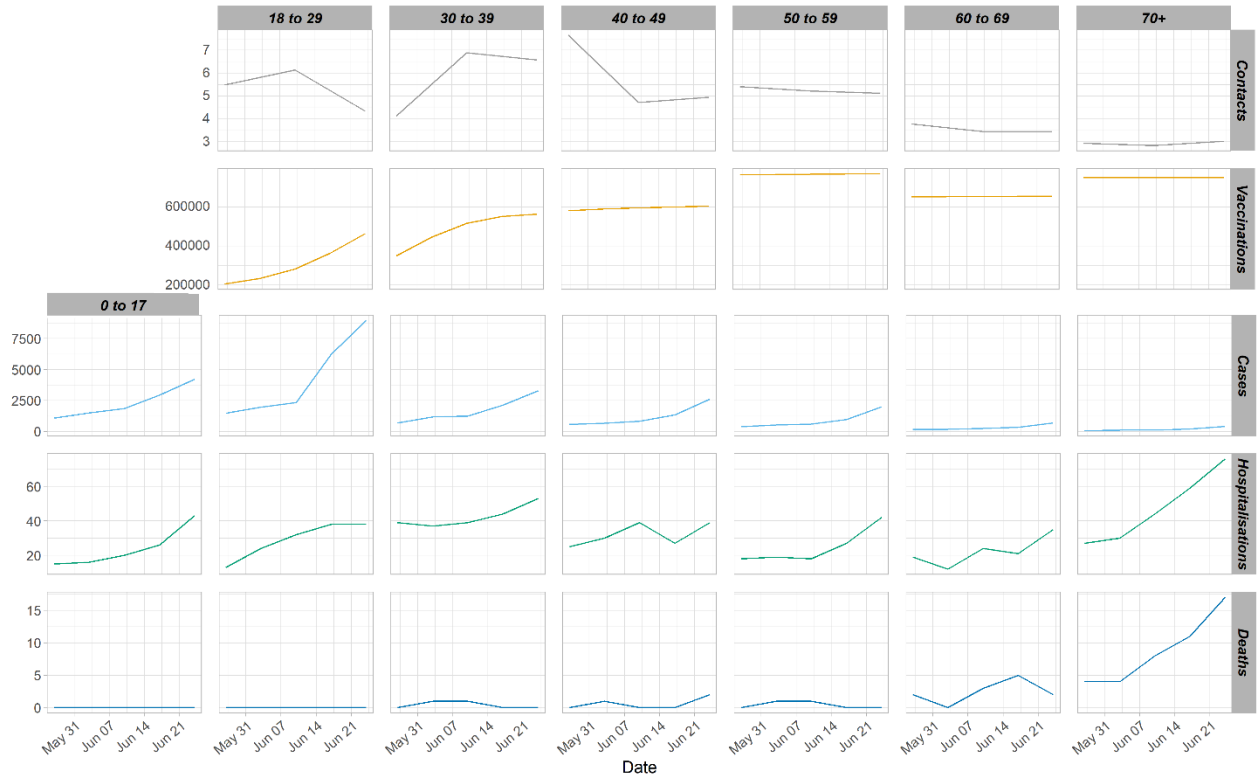



## Vaccinations and contacts patterns

From Figure 8, it can be seen that the older age groups have fewer contacts and more vaccinations than the younger age groups. 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 hospitalization levels 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]



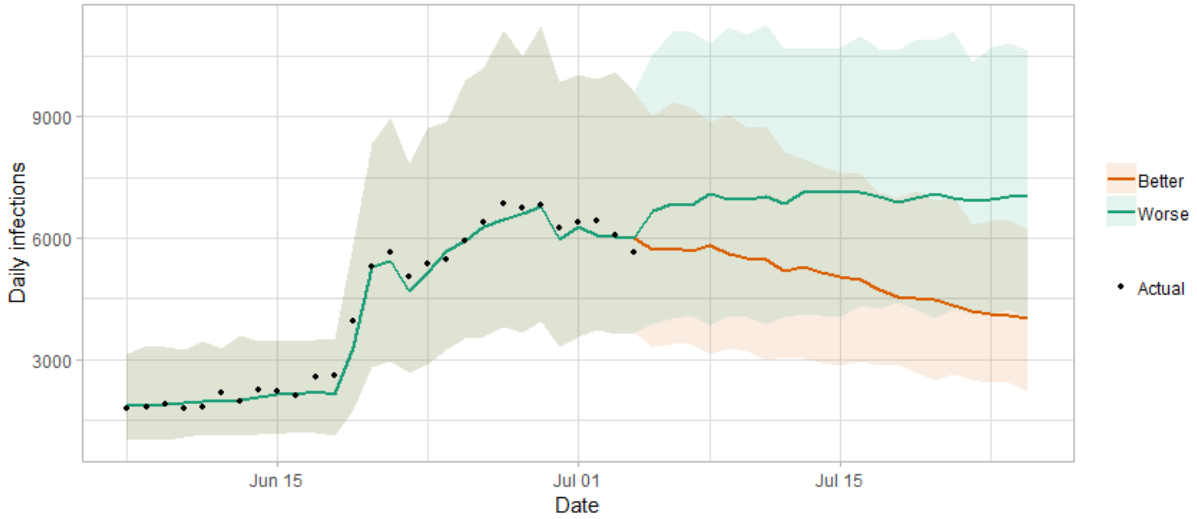

## What the modelling tells us about estimated infections as well as Hospital and ICU bed demand

The Scottish Government assesses the impact of Covid-19 on the NHS in the next few weeks in terms of estimated number of infections. Figure 9 shows two projections. 'Worse' is based on a slightly higher transmission rate than was observed last week. 'Better' is based on a slightly lower transmission rate than was observed last week.[5]

The whole of Scotland will move to Level 0 on 19th July if all necessary vaccination and harm reduction measures are met. As such, we are only providing projections until this date.

[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 5th July.




There is uncertainty as to whether infections will remain level or will reduce 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. Work is ongoing to show the modelled occupancy for stays up to a 28 day limit.

The increase in cases seen in the last weeks is likely to lead to a continuing increase in hospitalisations and intensive care use, with considerable uncertainty as to future weeks.

[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 5th July.

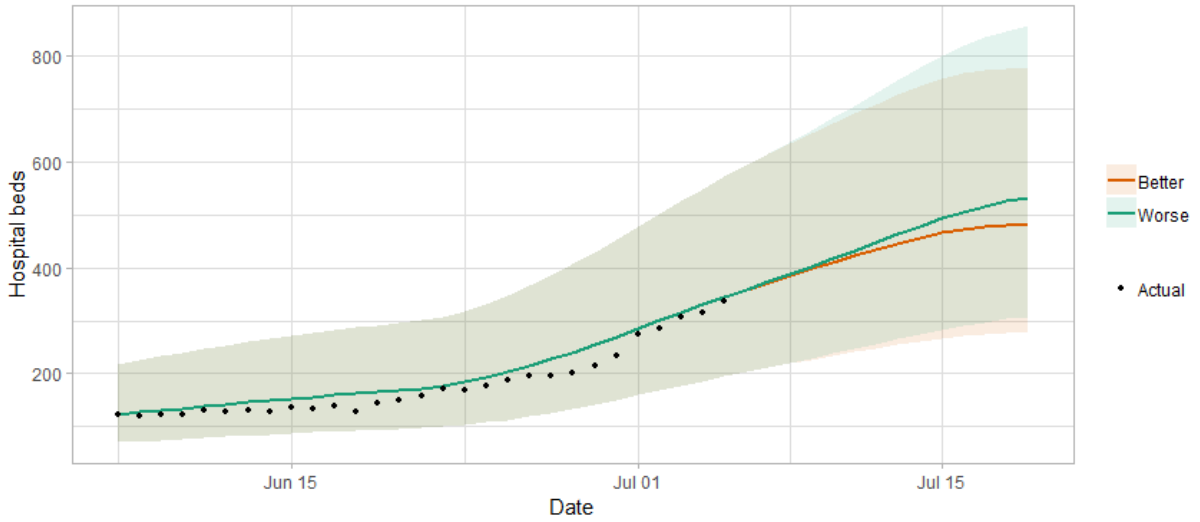
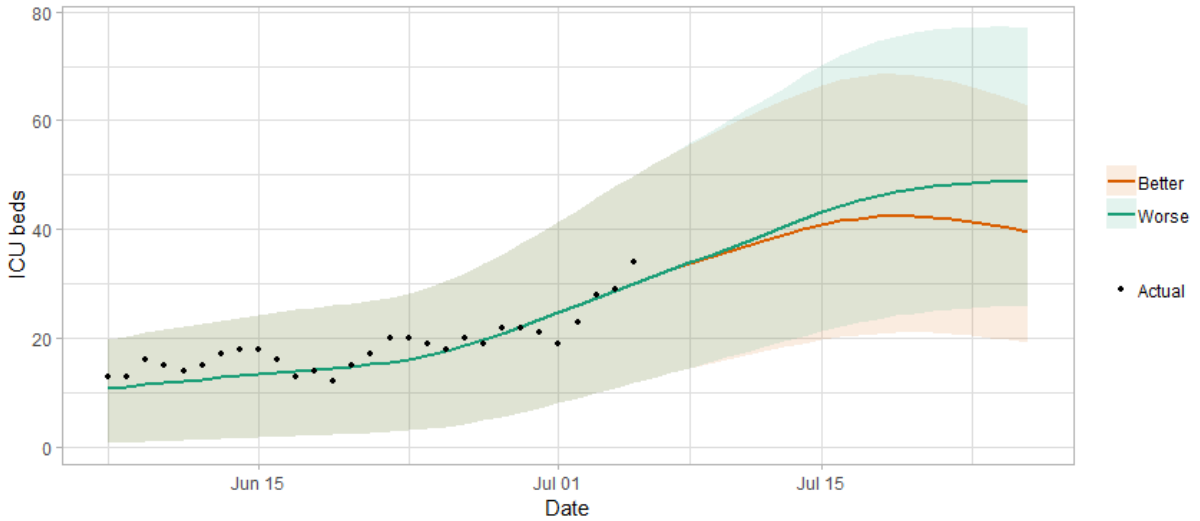



Figure 11 shows the impact of the projection on ICU bed demand.

Figure 11. Medium term projections of modelled ICU bed demand, from Scottish Government modelling[7], based on positive test data reported up to 5th 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

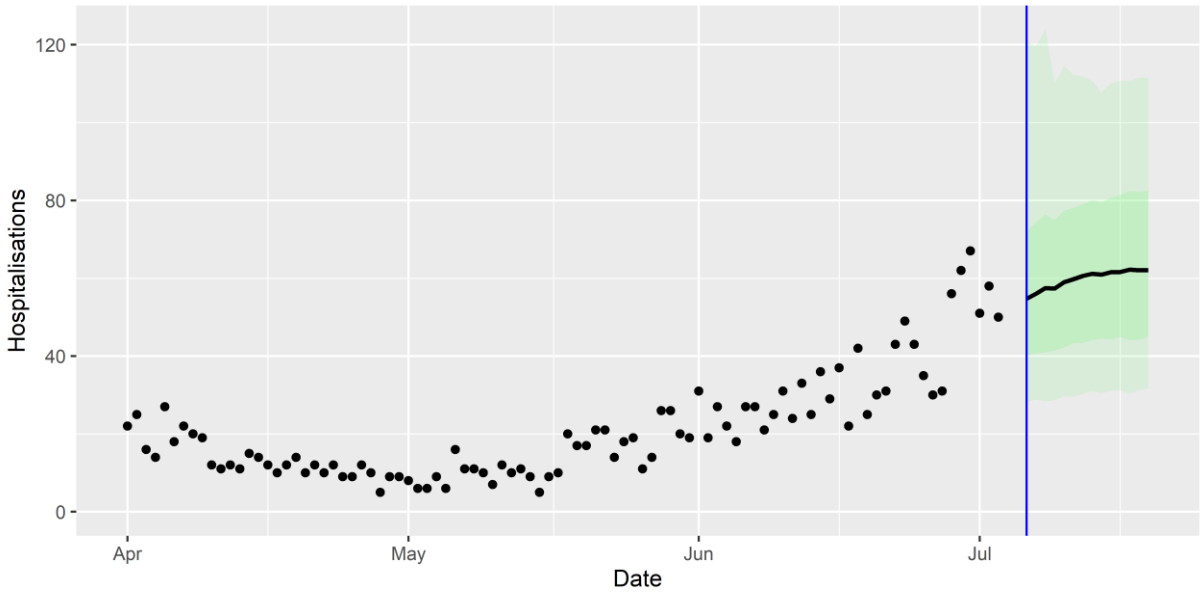
SAGE produces projections of the epidemic[8] (Figure 12), combining estimates from several independent models (including the Scottish Government's logistics modelling, as shown in Figures 9-11). These projections are not forecasts or predictions. They represent a scenario in which the trajectory of the epidemic continues to follow the trends that were seen in the data up to 5th 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 5th July. Projecting forwards is difficult when the numbers of cases, 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 19th July, 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. Projecting forwards is difficult when numbers fall to very low levels, therefore SPI-M-O have decided to pause producing medium term projections for daily deaths in Scotland. SPI-M-O's consensus view is that the number of deaths will remain low over the next few weeks.

## 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 5th 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 5th July (Figure 13) indicate that, for the week commencing 18th July 2021, there are 26 local authorities with at least a 75% probability of exceeding 150 cases per 100k[9].

[9] The exceptions to this are Argyll & Bute, Moray, Na h-Eileanan Siar, the Orkney Islands, Scottish Borders and the Shetland Islands.

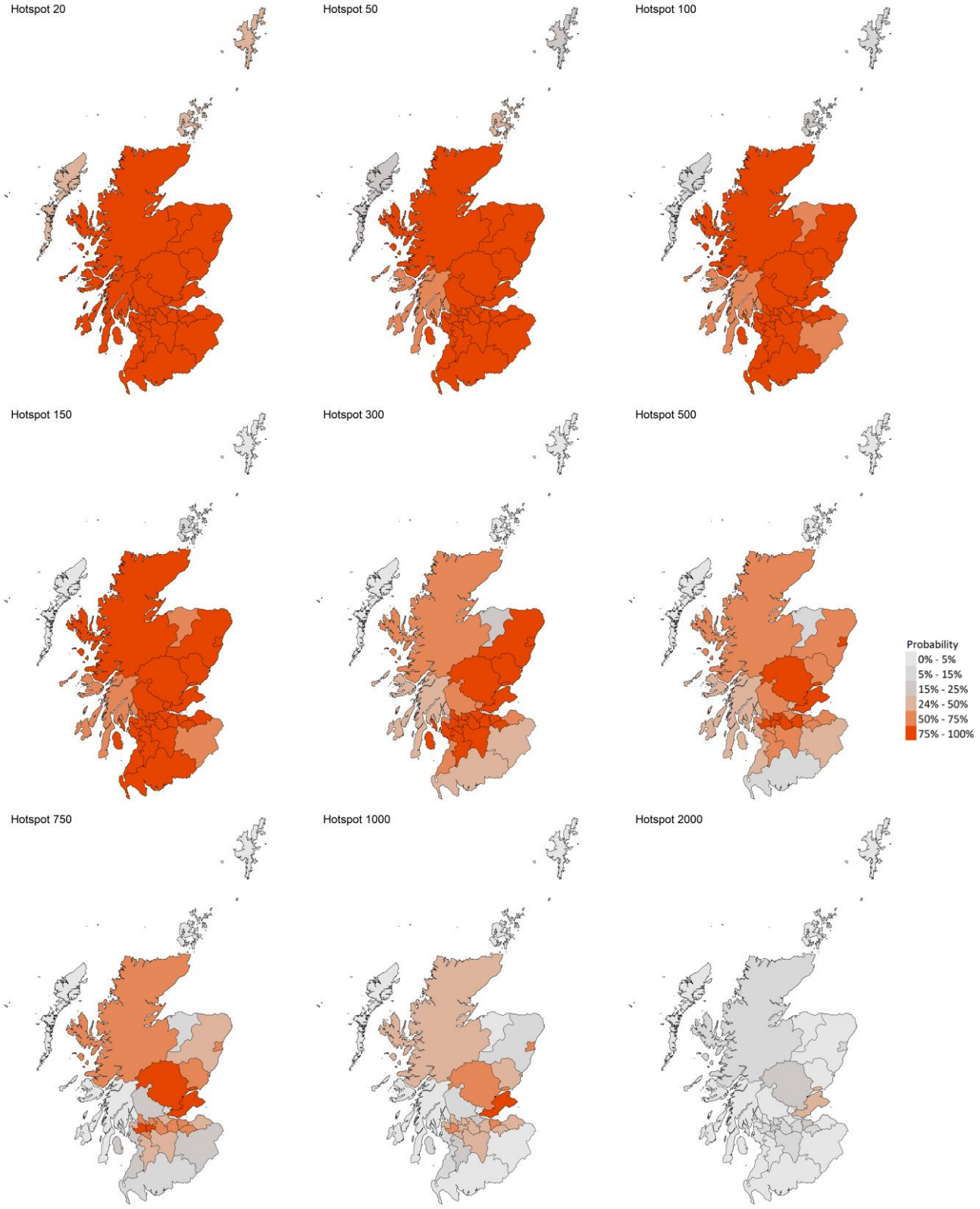
Of these, 9 local authorities have at least a 75% probability of exceeding 500 cases per 100k. These are Fife, Dundee, Glasgow, Perth & Kinross, Renfrewshire, East Dunbartonshire, North Lanarkshire, West Lothian and Aberdeen.

Fife is the only local authority with at least a 75% probability of exceeding 1000 cases per 100k[10].

The local authority level modelling and national level modelling from SPI-M are based on different groups of models and look at different metrics. Furthermore the local level modelling is produced a day later than the national level. As a result, the local authority level and national level modelling do not exactly correspond to each other.

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

Figure 13. Probability of local authority areas exceeding thresholds of cases per 100K (18th to 24th July 2021), data to 5th July



## 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 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.

Nationwide, wastewater (WW) Covid-19 levels continued to rise rapidly, reaching over 65 million gene copies per person per day (Mgc/p/d), equalling the highest levels observed. Increases are seen in a broad range of local authorities.

Figure 14 shows the national aggregate for the original 28 sites (in blue) and, from January 2021, the aggregate for the full set of sampled sites (in green), with a small number of unrealistically large outliers excluded. WW Covid-19 rose at roughly the same rate as case rates, though levels amongst the original 28 sites rose faster still, partly due to a very high measurement at the Seafield wastewater treatment works in Edinburgh (Figure 16).

Of the sites that gave WW Covid-19 measurements in the last week, only Stornoway gave negative viral test results. Over 28% of sites gave levels higher than 50 Mgc/p/d.

Figure 14. National average trends in wastewater Covid-19 and daily case rates (7 day moving average)[11].

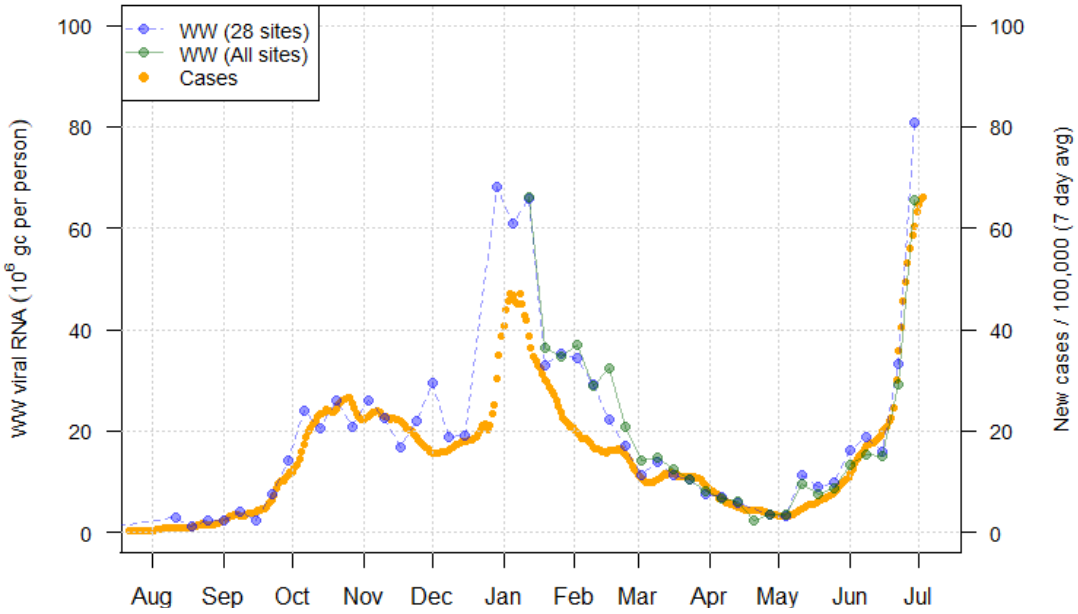
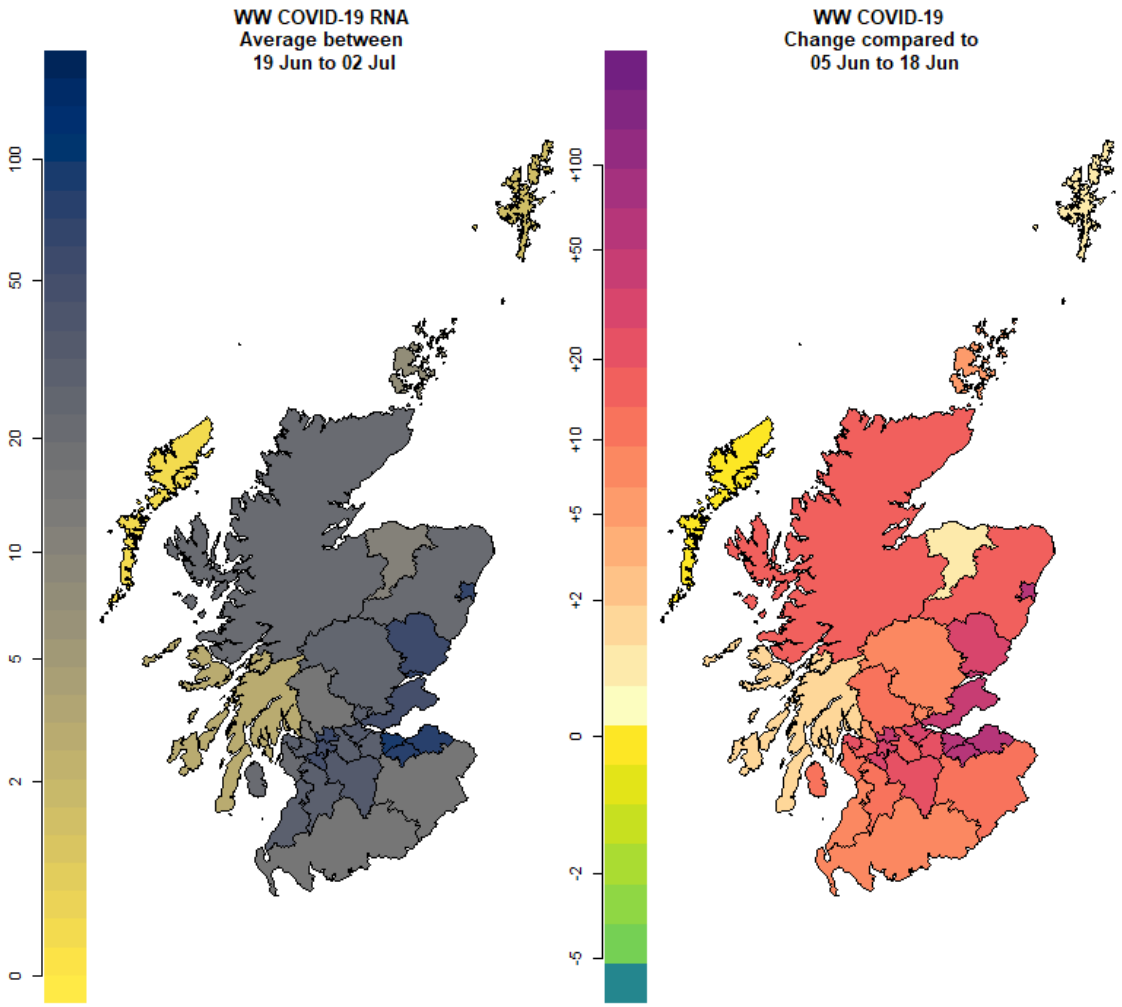



Figure 15 uses colours to map (i) the local authority average viral RNA levels (in Mgc/p/d) over the two-week period from 19th June to 2nd July, and (ii) the change in viral RNA levels compared to the previous two week period 5th June to 18th June. We see a general increase in levels over this period. The highest increases are seen in the major cities of Edinburgh, Aberdeen, and Dundee, as well as Fife.

[11] Anomalously high values, one in Seafield (Edinburgh) in mid-February (See Issue 40) and one in Dunblane in mid-June, are removed.

Figure 15. Map showing wastewater Covid-19 levels (million gene copies/person/day) for each local authority for 19th June to 2nd July and changes relative to 5th June to 18th June.




The highest WW Covid-19 values were seen at the Seafield site, which covers the City of Edinburgh (Figure 16). Here, a reading of 94 Mgc/p/d, roughly in line with case rates, was eclipsed by a reading of 193 Mgc/p/d on 2nd July. This new reading is almost twice as high as the previous peak in the area, but the fact that it falls in line with current trends in WW viral levels and coincides with an increase (albeit lesser in magnitude) of case rates makes it unlikely to be an anomalous result.

In addition to the major cities, we also saw especially large increases in Fife, in particular at Kirkcaldy (Figure 17) and Levenmouth, as well as at Inverclyde.

Please note that the number of cases shown is the daily moving average of cases per 100k. This is used as part of the normalisation process for WW.

Figure 16. Wastewater Covid-19 and daily case rate (7 day moving average) for Seafield (pop: 606k) in Edinburgh[12].

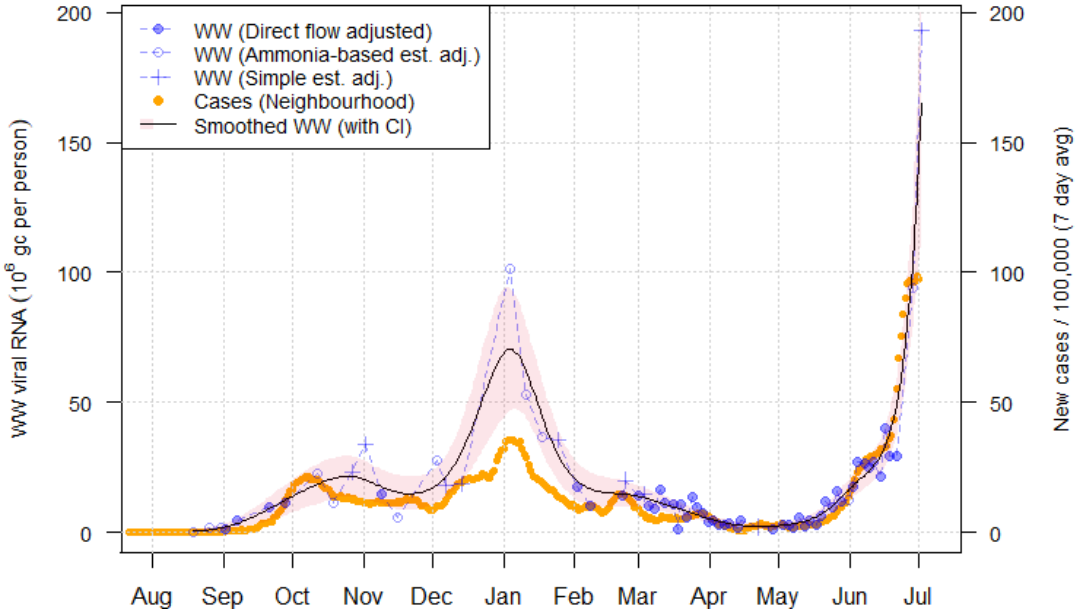
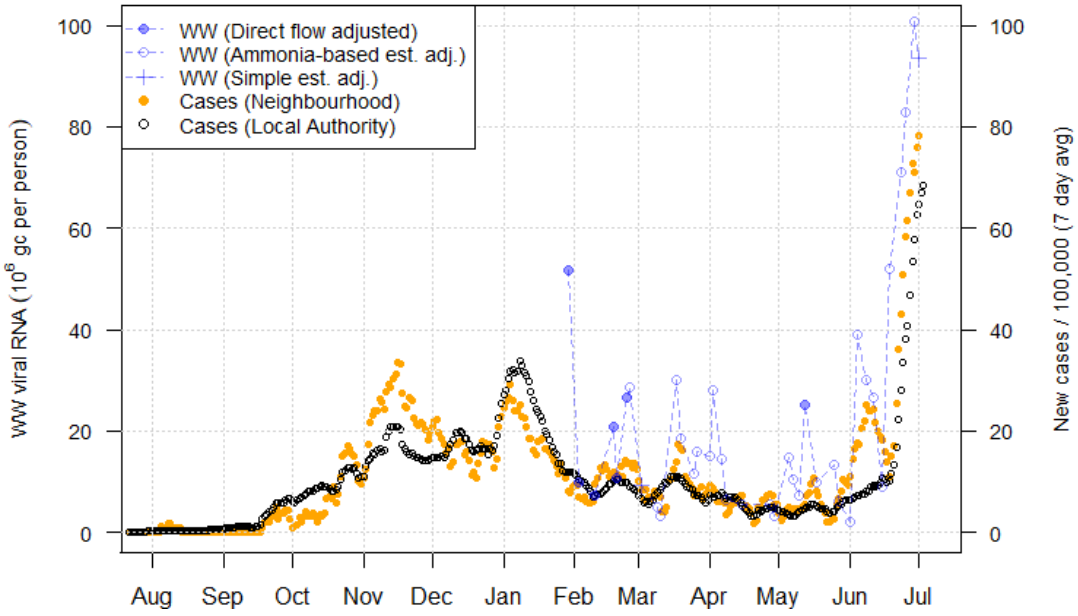



Figure 17. Wastewater Covid-19 and daily case rate (7 day moving average) for Kirkcaldy (pop: 51k) in Fife.




It is notable that in some sites, WW Covid-19 remains low even as cases continue to increase. Persistently low WW Covid-19 levels are found at sites like Ardoch, Fairlie, and Helensburgh. At Helensburgh, WW Covid-19 has remained at or below 5 Mgc/p/d even as cases rose above 30 new cases per day per 100k inhabitants. This is especially surprising

[12] 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.

given that in the past, WW levels at that site were very high in comparison to case numbers. Individual low WW measurements are also found at sites like Galashiels and Dalbeattie. All these sites however do give positive test results.

## 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.

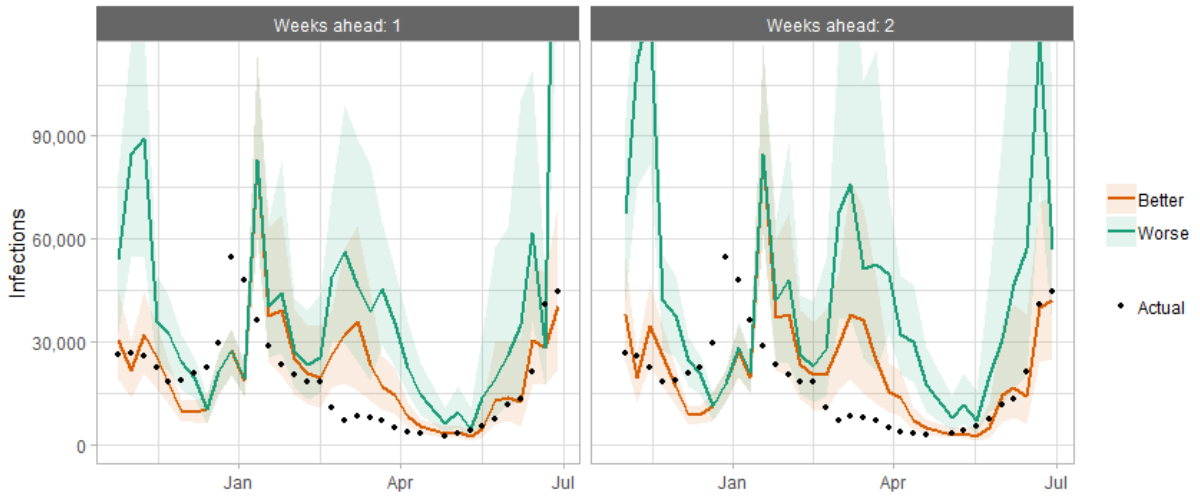
Modelling also allows us to make short-term forecasts of what may happen with a degree of uncertainty. These can be used in health care and other planning. The modelling in this research findings is undertaken using different types of data which going forward aims to both model the progress of the epidemic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

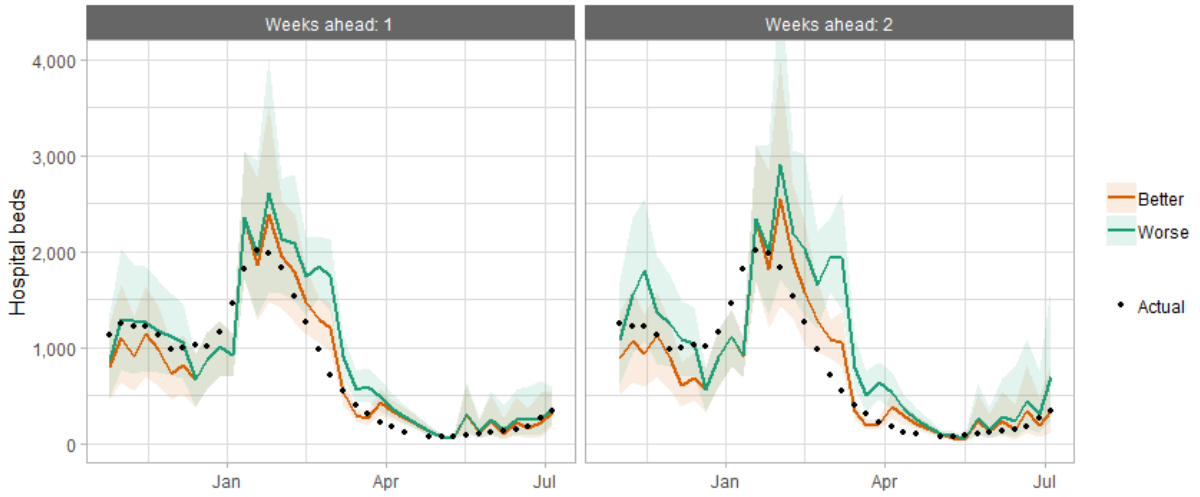
The following charts show the history of our modelling projections in comparison to estimates of the actual data. The infections projections were largely accurate during October to mid-December and from mid-January onward. During mid-December to mid-January, the projections underestimated the number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

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



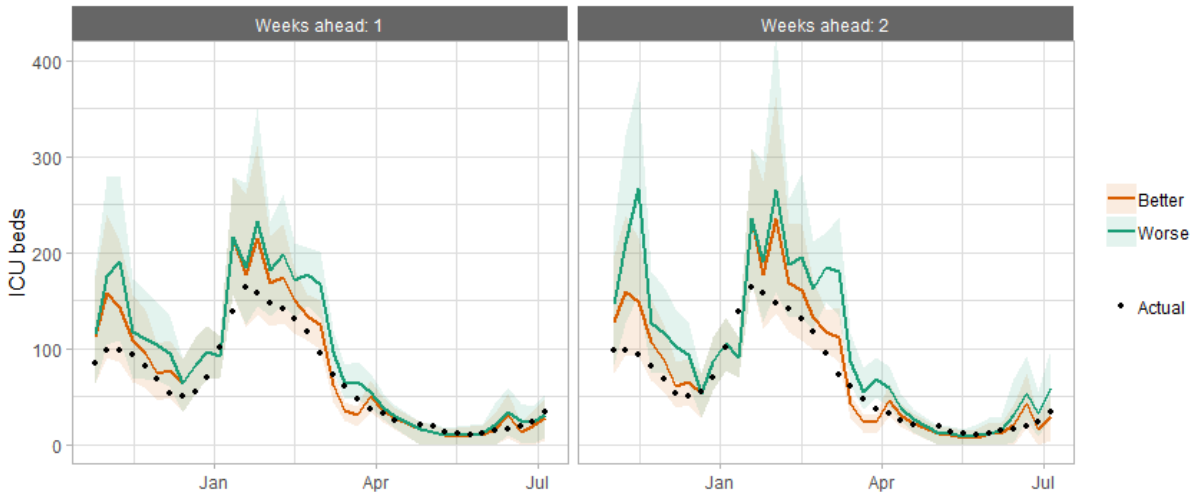

Hospital bed projections have generally been more precise than infections estimates due to being partially based on already known information about numbers of current infections, and number of people already in hospital. The projections are for number of people in hospital due to Covid-19, which is slightly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

Figure 19. 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 20. ICU bed projections versus actuals, for historical projections published between one and two weeks before the actual data came in.




## How is wastewater data used in our modelling?

The Scottish Government has historically used either deaths or cases, as published by Public Health Scotland (PHS), to inform its model to estimate current R values, incidence figures and growth rates.

In recent months, these research findings have explained how an estimate of cases can be made by examining the levels of Covid-19 RNA in wastewater, collected throughout Scotland and adjusted for population and local changes in intake flow rate.

We have developed our modelling such that it is possible to calculate the main nowcast outputs by using this wastewater data, instead of the case data from PHS.

The Scottish WW data is population weighted averages for normalised Wastewater Covid levels. The units are provided in 1 million gene copies per person per day, which roughly matches with cases per 100,000 per day. This is converted into daily cases at a national level. The model makes an allowance for the proportion of infections which are positively identified as cases (using a comparison with the ONS Covid Infection Survey[13]), and then uses a Bayesian method to estimate the key variables throughout the pandemic.

[13] Coronavirus (COVID-19) Infection Survey, UK Statistical bulletins - Office for National Statistics

We are currently only using the wastewater data for Scottish cases, but are working with colleagues in the other UK nations to use their wastewater data in a similar way.

Table 1. Probability of local authority areas exceeding thresholds of cases per 100K (18th to 24th July 2021), data to 5th July.

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

## 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 19th June and 26th June, 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[14].

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[15] |
|---|---|---|---|---|---|
| | w/b 19th June | w/b 26th June | w/b 19th June | w/b 26th June | |
| Aberdeen City | 46.0 | 85.0 | 46.0 | 85.0 | 80% |
| Aberdeenshire | 14.0 | 29.0 | 14.0 | 29.0 | 53% |
| Angus | 49.0 | 59.0 | 49.0 | 59.0 | 56% |
| Argyll and Bute | 0.0 | 3.0 | 0.0 | 3.0 | 18% |
| City of Edinburgh | 30.0 | 144.0 | 30.0 | 144.0 | 97% |
| Clackmannanshire | 32.0 | 32.0 | 32.0 | 32.0 | 92% |
| Dumfries & Galloway | 8.0 | 26.0 | 8.0 | 26.0 | 32% |
| Dundee City | 60.0 | 72.0 | 60.0 | 72.0 | 100% |
| East Ayrshire | 34.0 | 30.0 | 34.0 | 30.0 | 72% |
| East Dunbartonshire | 42.0 | 83.0 | 42.0 | 83.0 | 0% |
| East Lothian | 28.0 | 130.0 | 28.0 | 130.0 | 65% |
| East Renfrewshire | 33.0 | 62.0 | 33.0 | 62.0 | 95% |
| Falkirk | 13.0 | 62.0 | 13.0 | 62.0 | 69% |
| Fife | 31.0 | 74.0 | 31.0 | 74.0 | 80% |
| Glasgow City | 37.0 | 70.0 | 37.0 | 70.0 | 63% |
| Highland | 12.0 | 31.0 | 12.0 | 31.0 | 36% |
| Inverclyde | 18.0 | 46.0 | 18.0 | 46.0 | 93% |
| Midlothian | 31.0 | 138.0 | 31.0 | 138.0 | 88% |
| Moray | 4.0 | 18.0 | 4.0 | 2.0 | 56% |
| Na h-Eileanan Siar | 0.0 | 0.0 | 0.0 | 0.0 | 21% |
| North Ayrshire | 24.0 | 23.0 | 24.0 | 23.0 | 93% |
| North Lanarkshire | 26.0 | 35.0 | 26.0 | 35.0 | 77% |
| Orkney Islands | 11.0 | 4.0 | 11.0 | 4.0 | 34% |
| Perth and Kinross | 20.0 | 29.0 | 20.0 | 29.0 | 45% |
| Renfrewshire | 20.0 | 44.0 | 20.0 | 44.0 | 57% |
| Scottish Borders | 21.0 | 13.0 | 21.0 | 11.0 | 49% |
| Shetland Islands | 0.0 | 0.0 | 0.0 | 0.0 | 29% |
| South Ayrshire | 35.0 | 23.0 | 35.0 | 23.0 | 88% |
| South Lanarkshire | 23.0 | 53.0 | 23.0 | 53.0 | 87% |
| Stirling | 8.0 | 27.0 | 3.0 | 27.0 | 63% |
| West Dunbartonshire | 24.0 | 11.0 | 24.0 | 11.0 | 50% |
| West Lothian | 24.0 | 35.0 | 24.0 | 35.0 | 78% |

[14] 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 the section in the Technical Annex for further details.

[15] Coverage as at the week beginning 23rd June 2021.

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The views expressed in this report are those of the researcher and do not necessarily represent those of the Scottish Government or Scottish Ministers.

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