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Coronavirus (COVID-19): Analysis

Coronavirus (COVID-19): modelling the epidemic in Scotland (Issue No. 64)

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 5th 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 0.7 and 0.9, with the growth rate between -4% and -1%, based on the period up to 9th August.

The number of new cases in Scotland has been declining since the recent peak in early July (when there were over 400 per hundred thousand people). The estimate of R remains below 1. Hospital admissions have been declining slowly since mid-July, with ICU admissions also continuing to decline.

R is an indicator that lags by two to three weeks and therefore should not be expected to reflect recent fluctuations, such as the small increase in reported cases that has been seen in the last week.

Key Points

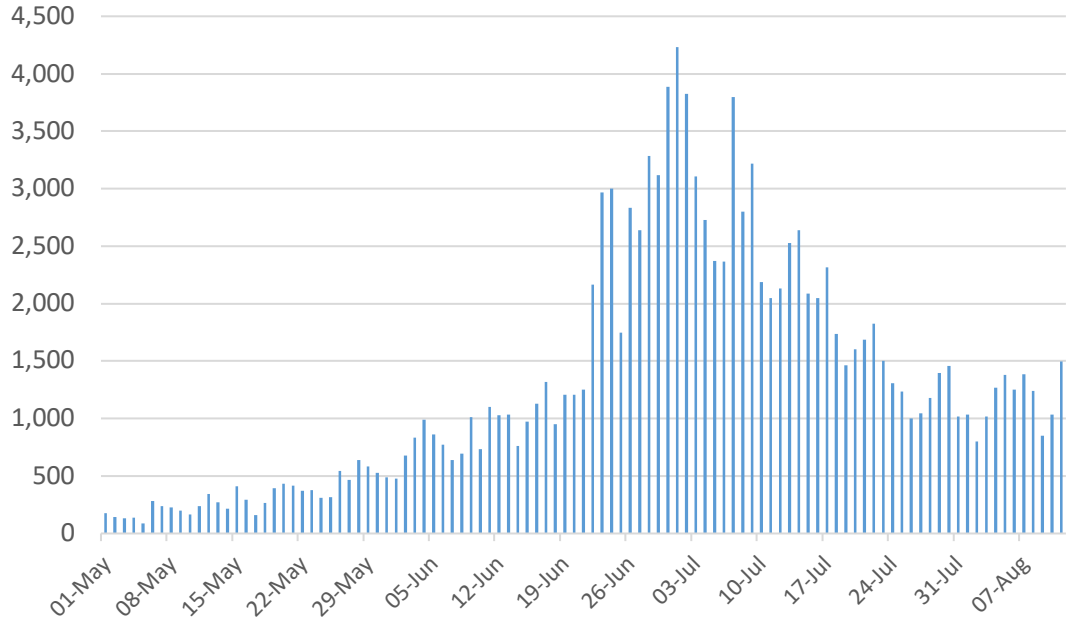
- The reproduction rate R in Scotland is currently estimated as being between 0.7 and 0.9, based on the period up to 9th August. This is unchanged since last week.
- The number of new daily infections for Scotland is estimated as being between 49 and 85, per 100,000 people, based on the period up to 9th August.

- The growth rate for Scotland is currently estimated as between -4% and -1%, based on the period up to 9th August.
- Average contacts have decreased by approximately 7% in the last two weeks (comparing surveys pertaining to 15th July - 21st July and 29th July - 4th August) with a current level of 3.7 daily contacts.
- Contacts within the work setting have increased by approximately 11% whereas contacts within the other setting (contacts outside of the work, school and home) have decreased by 16% compared to two weeks prior.
- Mean contacts across all age groups have shown a decrease in comparison to two weeks prior with the exception of those aged between 60-69 who have reported an increase of 12%.
- The proportion of contacts reported to have been indoors only has decreased within the last two weeks, whereas the proportion of contacts occurring outside only has shown an increase over the same period.
- Hospitalisations have been declining from a peak in mid-July. Potential future changes in hospital occupancy and intensive care use depend on both current infection levels and the impact of the recent relaxations of measures which will take a few weeks to become apparent.
- Modelled rates of positive tests per 100K using data to 9th August indicate that, for the week commencing 22nd August 2021, there are 27 local authorities which are expected to exceed 50 cases per 100k with at least 75% probability.
- Of these, eight local authorities are expected to exceed 100 cases per 100k with at least 75% probability. These are Dumfries & Galloway, Fife, Glasgow, Midlothian, North Ayrshire, North Lanarkshire, South Lanarkshire and West Lothian.
- There are no local authorities expected to exceed 300 cases per 100k with at least 75% probability.
- Nationwide, wastewater Covid-19 concentrations have fallen by around 20% from last week. However regional variations exist.
- In both North and South Lanarkshire, wastewater Covid-19 levels remain higher than would be expected given the number of cases.
- The Scottish Government is modelling the number of people likely to experience long Covid symptoms. This modelling estimates that on 29th 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 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 11th August 2021.



This report covers the period up to 4th August for contact patterns (indicated by dashed line 1). Wastewater data is provided to 6th August (dashed line 2). The estimates of R, incidence, growth rates, the modelled rates of positive tests per 100k, the medium term projections by the Scottish Government of infections, hospitalisations and ICU beds, and the long Covid analysis use data to 9th 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[1] 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 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.

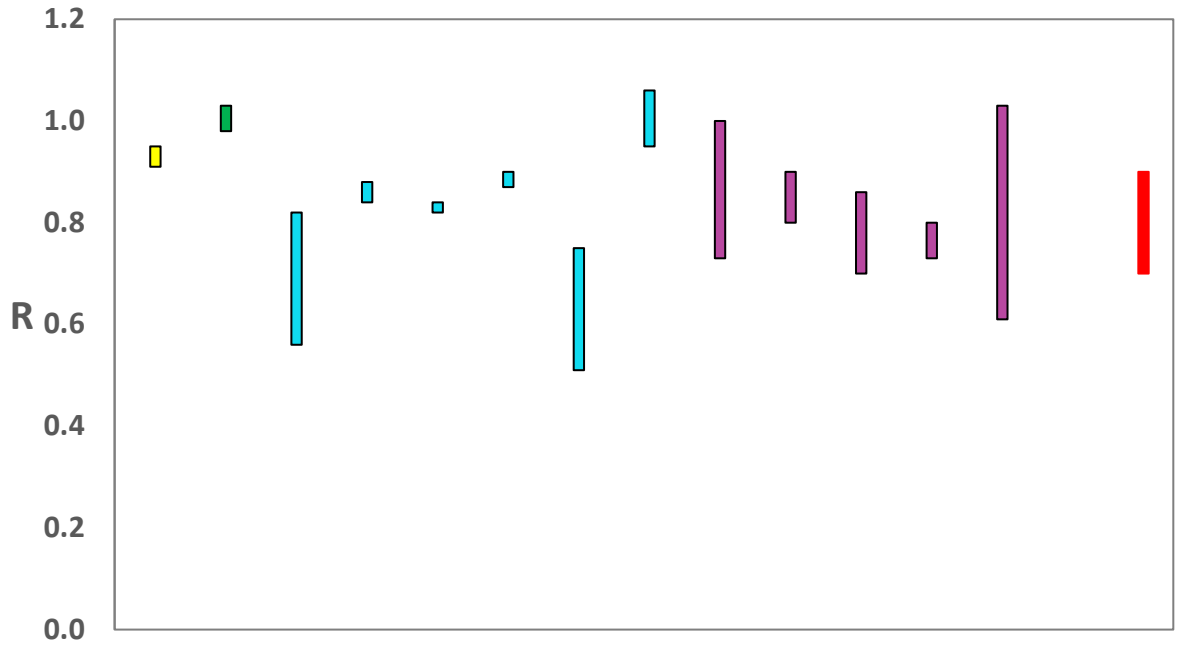
R is an indicator that lags by two to three weeks[2] and therefore should not be expected to reflect recent fluctuations, such as the small increase in reported cases that has been seen in the last week.

UKHSA's consensus view across these methods as of 11th August, using data to 9th August, was that the value of R in Scotland was between 0.7 and 0.9 (see Figure 2)[3].

[1] 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).
[2] Different data-streams and different models are expected to be lagged in their estimates by different amounts when compared with the true underlying epidemiological situation. This is due to multiple lags such as reporting and delays in the infection processes. However, the consensus combination generally reflects a 2-week lag.
[3] 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 EMRG. 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 11th August, including 90% confidence intervals, produced by EMRG[4]. Data to 9th August.

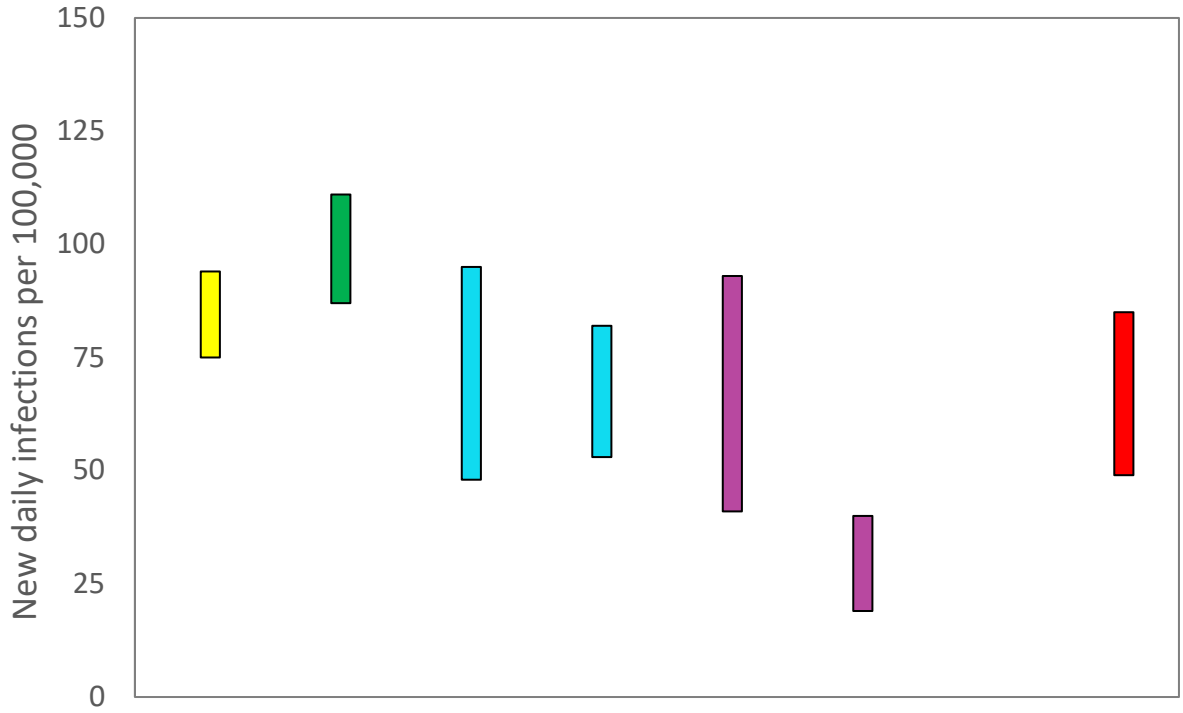


Source: EMRG

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 9th August, was that the incidence of new daily infections in Scotland was between 49 and 85 new infections per 100,000. This equates to between 2,700 and 4,600 people becoming infected each day in Scotland.

[4] 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 UKHSA consensus range is the right-most (red).

Figure 3. Estimates of incidence for Scotland, as of 11th August, including 90% confidence intervals, produced by EMRG[2]. Data to 9th August.



Source: EMRG

The consensus from UKHSA for this week is that the growth rate in Scotland is between -4% and -1% per day using data to 9th August. The lower and upper limits have decreased since last week.

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

Average contacts have decreased by approximately 7% in the last two weeks (comparing surveys pertaining to 15th July - 21st July and 29th July - 4th August) with a current level of 3.7 daily contacts as seen in Figure 4. Contacts within the work setting have increased by approximately 11% whereas contacts within the other setting (contacts outside of the work, school and home) have decreased by 16% compared to two weeks prior.

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

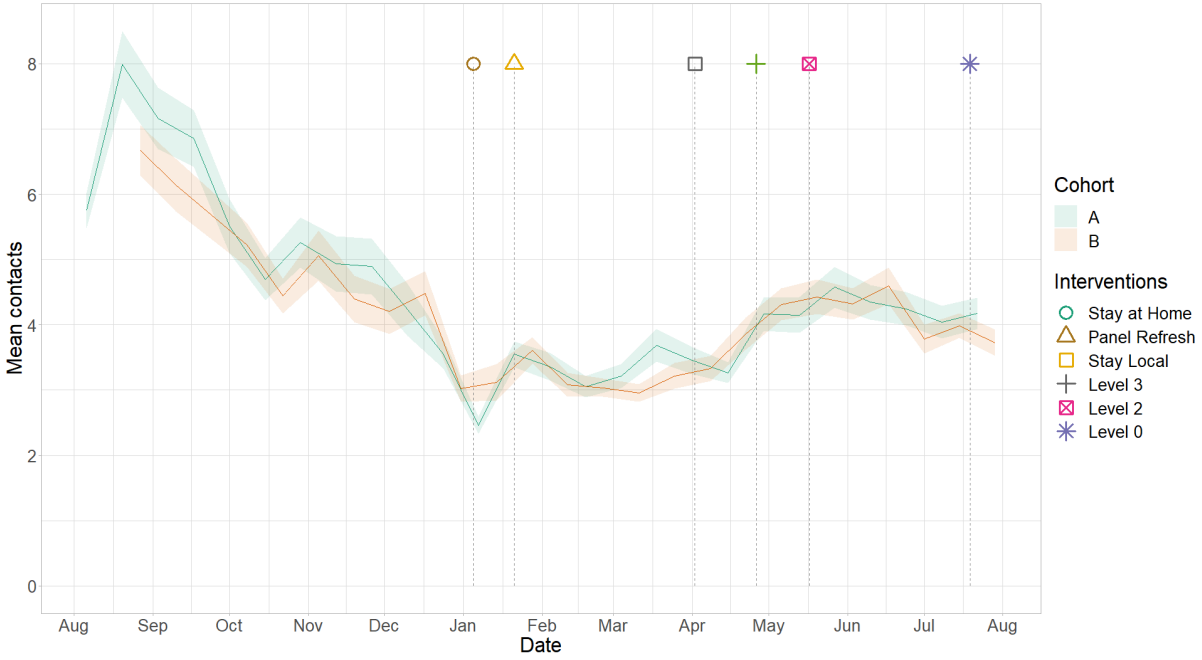


Figure 5 shows how contacts change across age group and setting. Mean contacts across all age groups have shown a decrease in comparison to two weeks prior with the exception of those aged between 60-69 who have reported an increase of 12%. Those aged 18-29 have shown the biggest decrease, by 22%, which is largely driven by a reduction in contacts within the other setting.

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

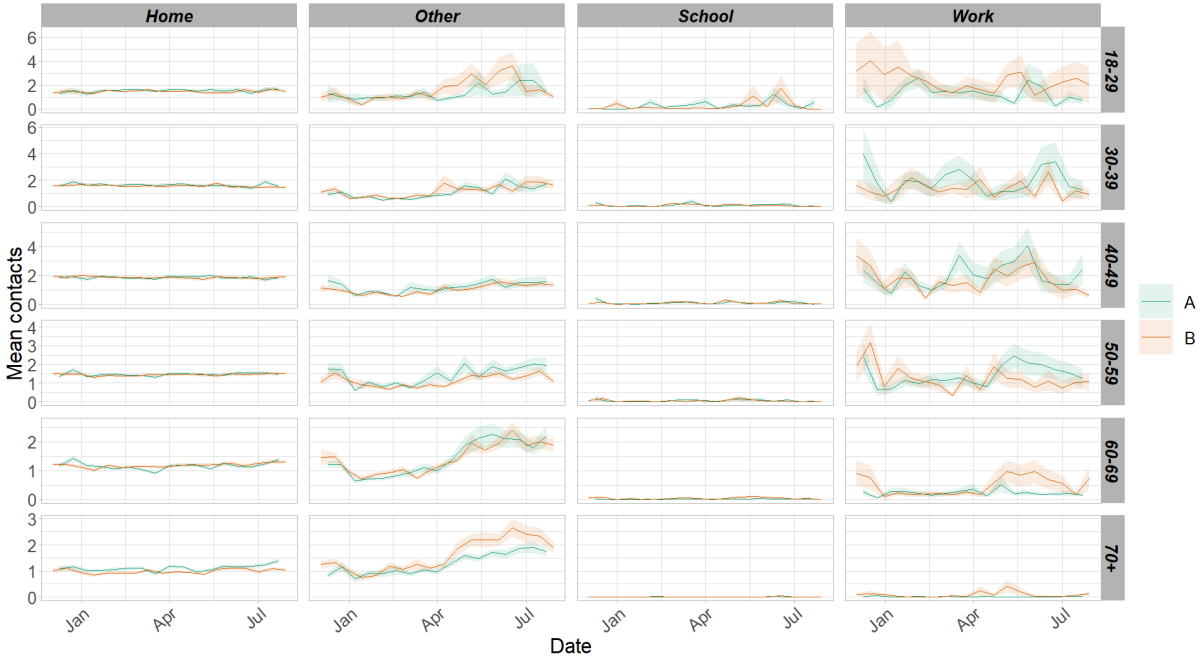
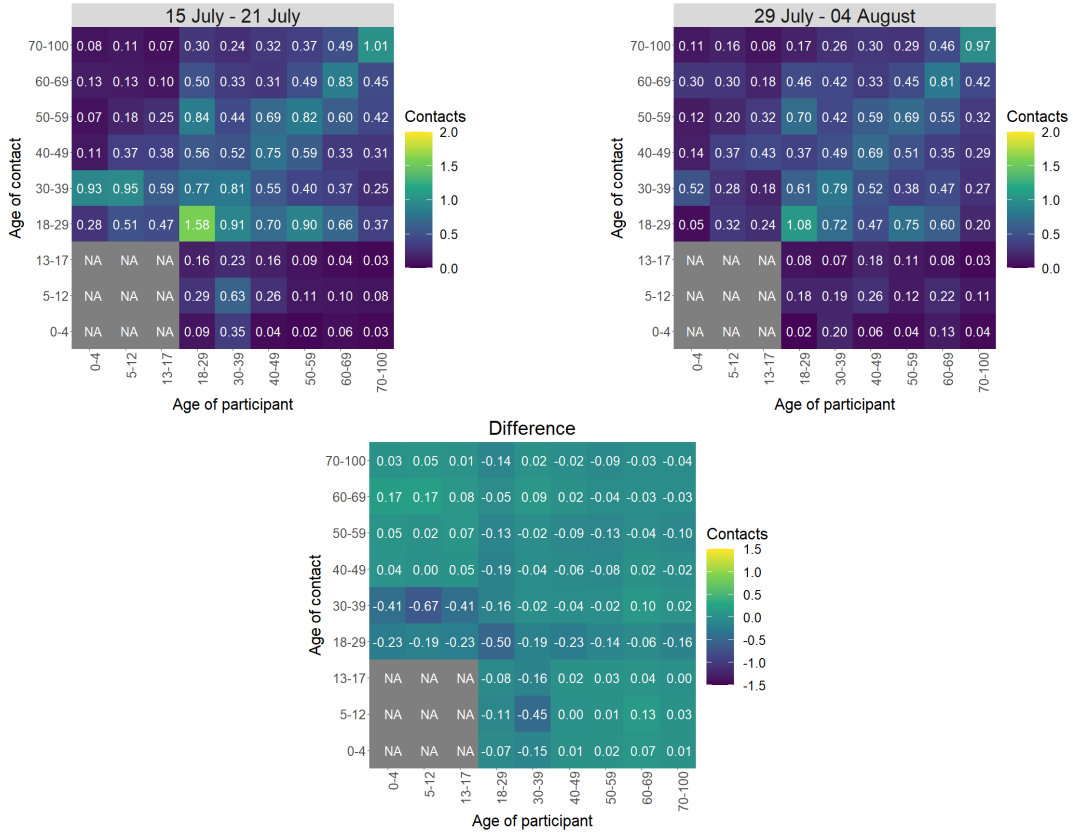


Figure 6 shows the difference in contacts between those who work from home compared to those who have a workplace outside of the home. This shows that those who do not work from home have higher and more variable contacts than those who work from home. This also shows that contacts had within the work place make up the majority of overall contacts for those who do not work at home, therefore changes in work contacts has proportionate impact on overall contacts.

Figure 6: Mean overall and work contacts by work location (home or away from home) for each panel 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 15th July - 21st July and 29th July - 4th August and the difference between these periods. The biggest decrease in interactions in the last two weeks is seen between those aged 30-39 with individuals under 18 and also between those aged 18-29 with each other.

Figure 7: Overall mean contacts by age group for the weeks relating to 15th July - 21st July and 29th July - 4th 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 pub or restaurant reporting the highest increase from 41% to 44% in the last two weeks.

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

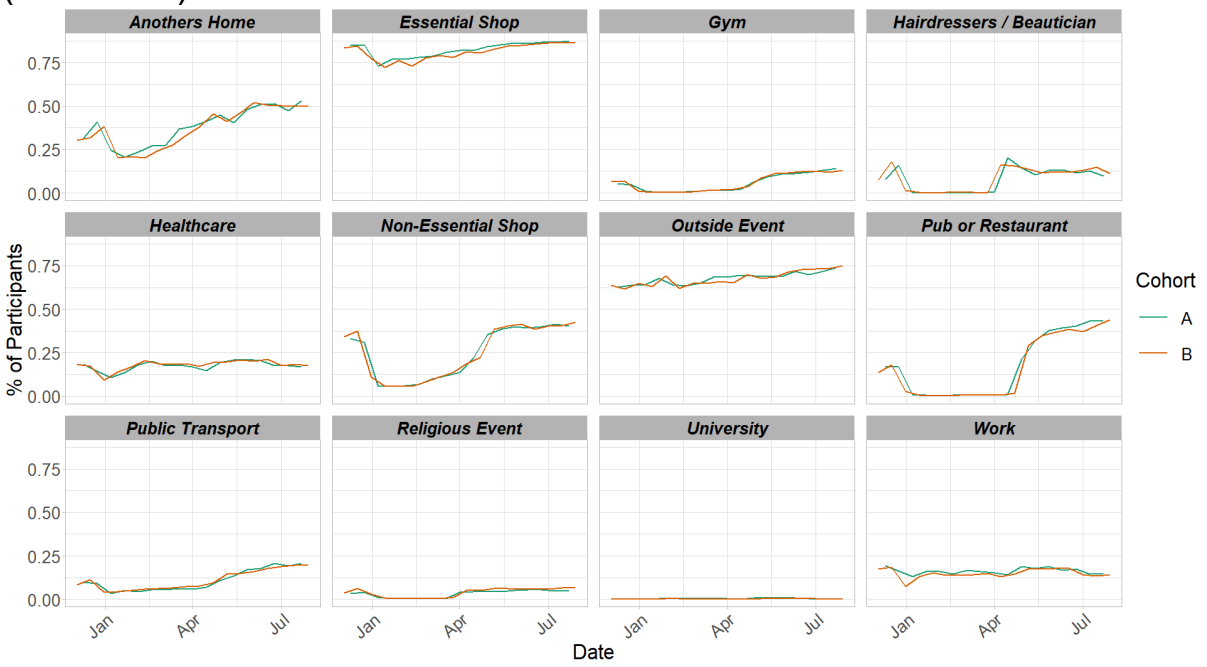
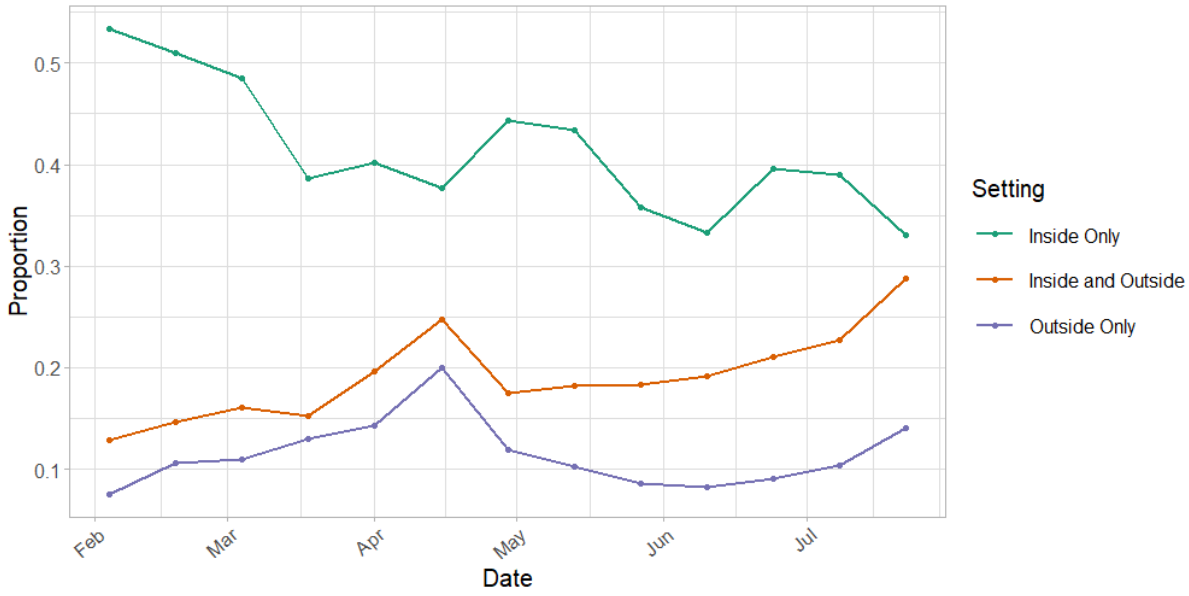


Figure 9 shows the proportion of participants that reported contacts had indoors and outdoors for contacts individually reported for panel B. A contact can be recorded as both indoor and outdoor. The graph also shows contacts reported as outside only and indoor only. The proportion of contacts reported to have been indoors only has decreased within the last two weeks whereas the proportion of contacts occurring outside only has shown an increase over the same period.

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



Vaccinations and contacts patterns

From Figure 10, 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 hospitalization levels and deaths to that seen with the younger age groups.

Figure 10: Average contacts for Panel A, weekly cases, covid-19 hospital admissions and deaths[5] and cumulative vaccinations by age band[6]

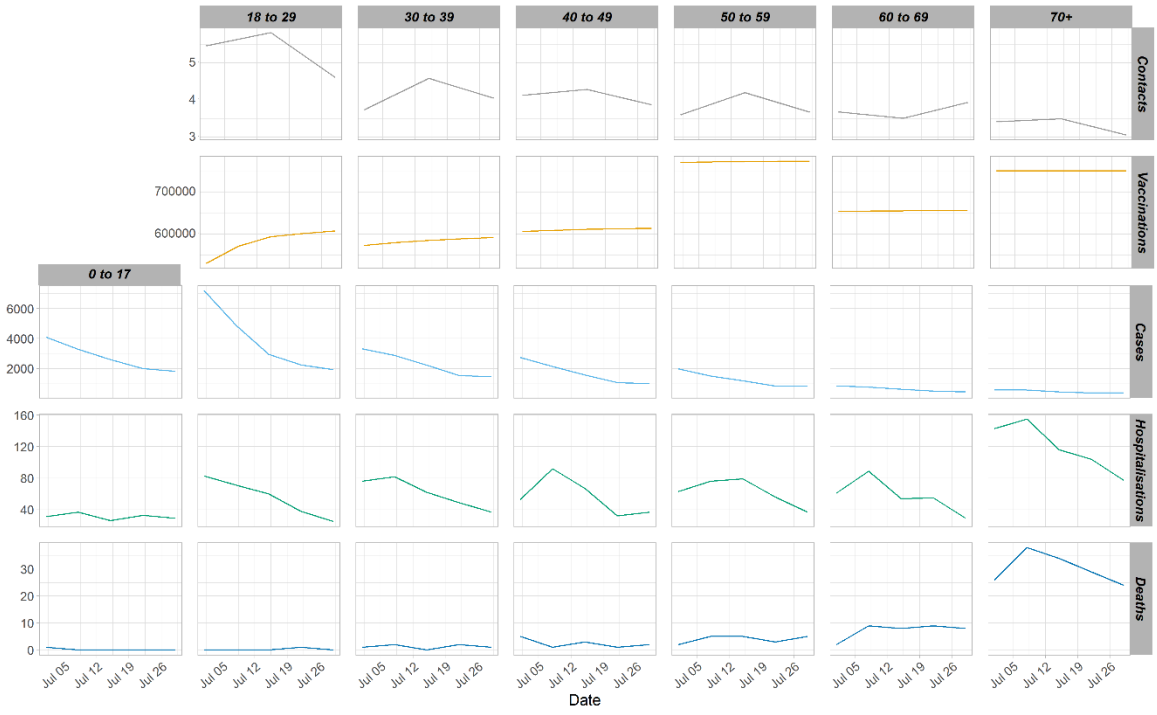
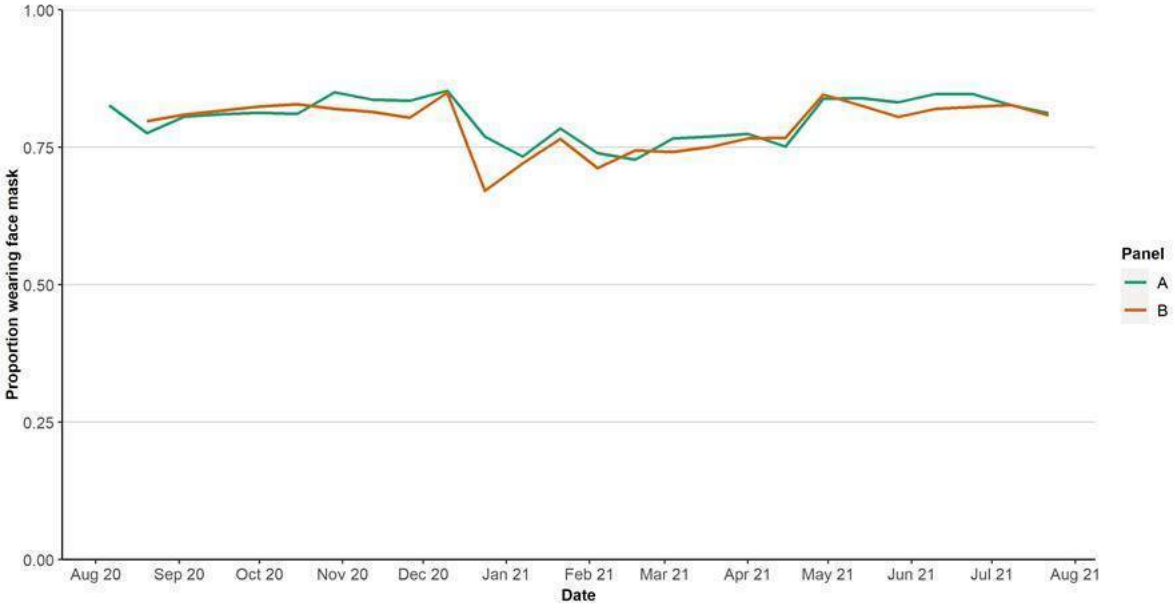


Figure 11 shows the estimated proportion of people wearing a face covering where they have had at least one contact outside of the home. Levels remained consistent up until the Christmas period when there was a decrease from approximately 85% to 67% in the proportion wearing a face covering. Following this, the proportion of people wearing face coverings increased to 84% by the end of April and has remained relatively consistent since.

[5] Deaths, Cases and Hospitalisations from PHS COVID-19 daily cases in Scotland dashboard.
[6] 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.

Figure 11: Proportion of adults wearing a face coverings over time (with at least one contact outside of the home).



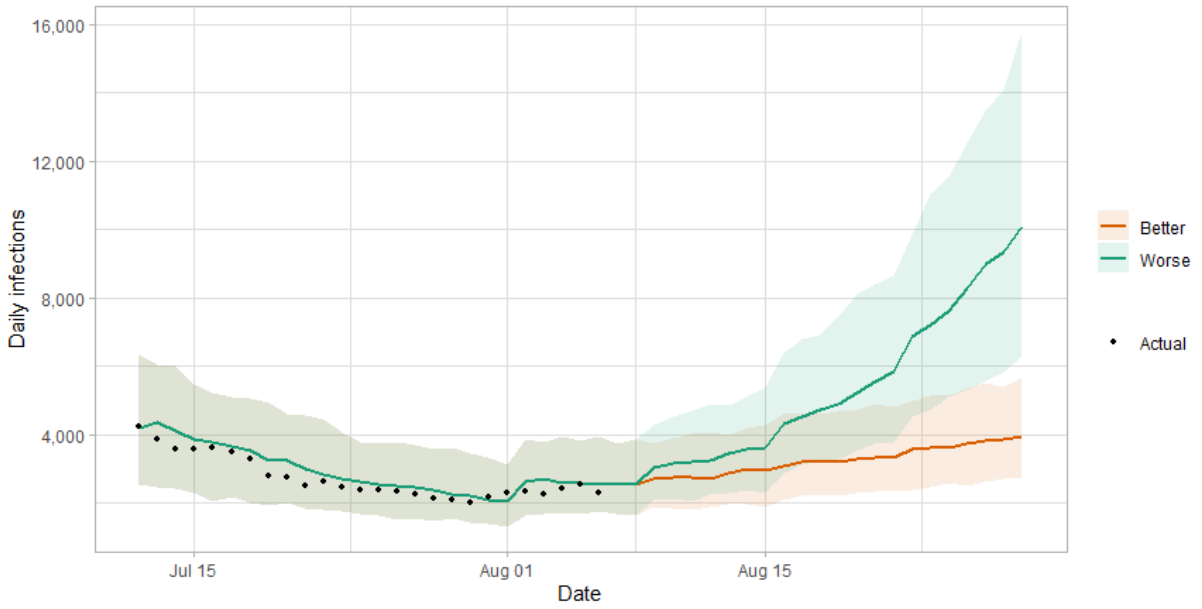
What the modelling tells us about estimated infections as well as Hospital and ICU bed demand

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 two projections over the three weeks to 29th August.

'Worse' assumes a behaviour change over a two month period following the changes in restrictions on the 9th of August. 'Better' assumes this behavioural change happens more gradually over a five to six month period leading to lower transmission[7].

[7] Both 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[8] to account for asymptomatic and undetected infections, from Scottish Government modelling, based on positive test data reported up to 9th August.



There is uncertainty as to whether infections will increase in coming weeks, and if so by how much. This will drive whether hospital beds and intensive care beds also continue to 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 occupancy from the June increase in cases are falling, 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 relaxation of restrictions.

[8] 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 9th August.

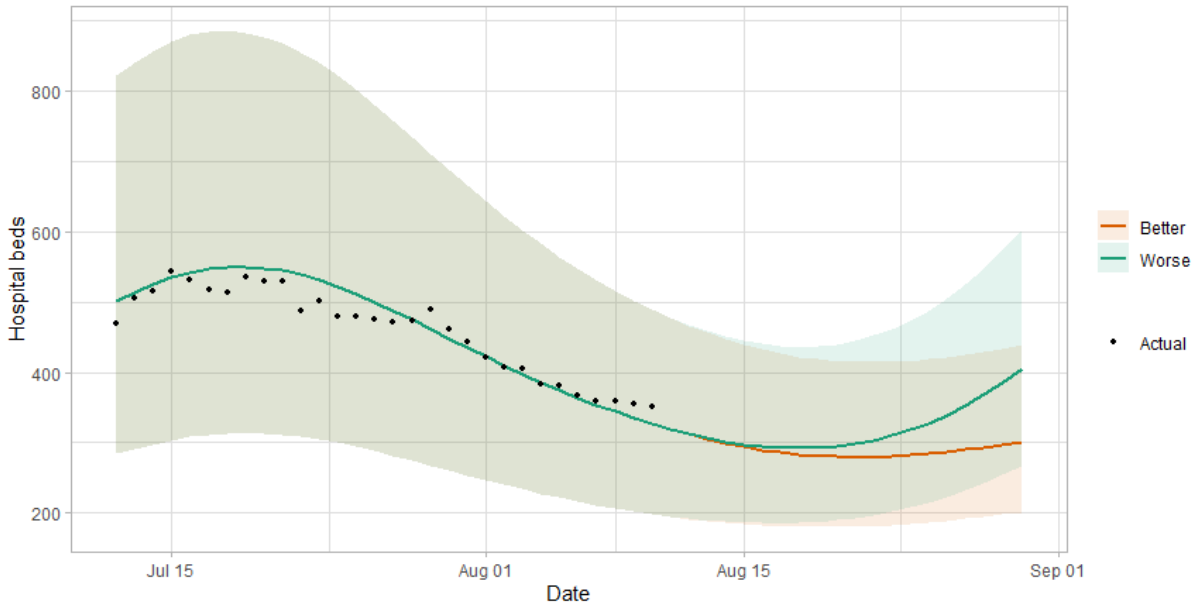
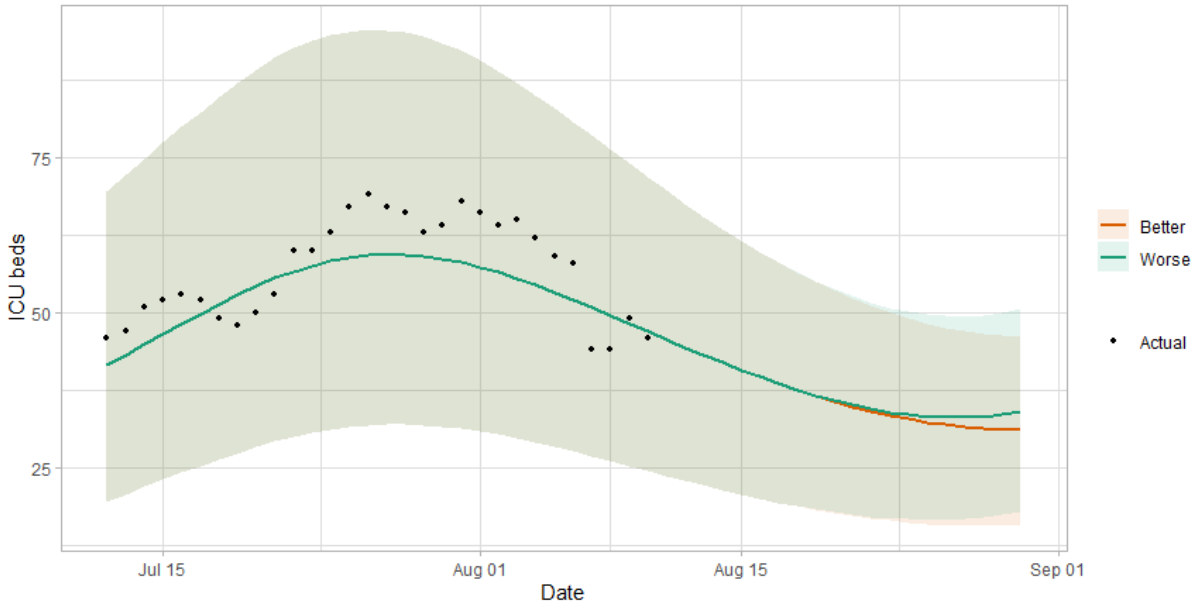


Figure 14 shows the impact of the projection on ICU bed demand.

Figure 14. Medium term projections of modelled ICU bed demand, from Scottish Government modelling[9], based on positive test data reported up to 9th August.



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

[9] 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

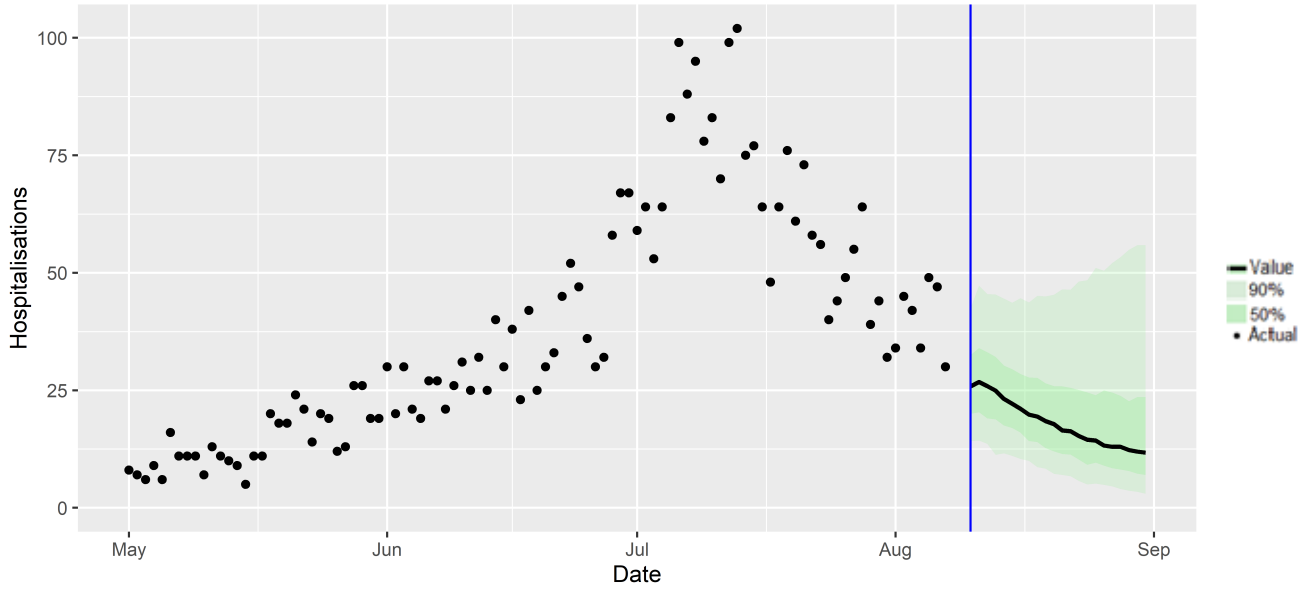
SPI-M produces projections of the epidemic[10] (Figure 15), combining estimates from several independent models (including the Scottish Government's logistics modelling, as shown in Figures 12-14). These projections are not forecasts or predictions. They represent a scenario in which the trajectory of the epidemic continues to follow the trends that were seen in the data up to 9th 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 9th 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 29th 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.

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

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 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.

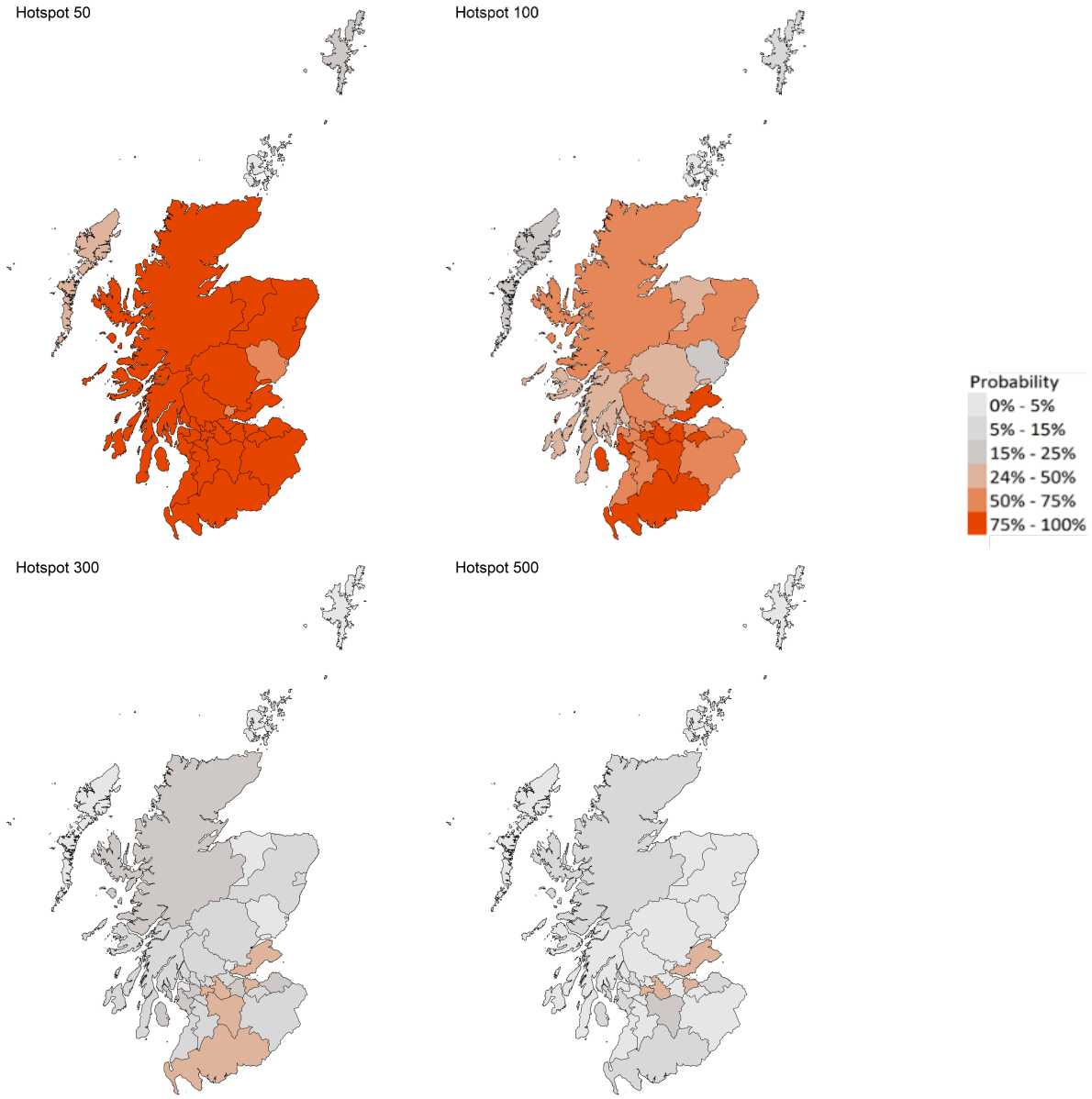
Modelled rates of positive tests per 100K using data to 9th August (Figure 16) indicate that, for the week commencing 22nd August 2021, there are 27 local authorities which are expected to exceed 50 cases per 100k with at least 75% probability[11].

Of these, eight local authorities are expected to exceed 100 cases per 100k with at least 75% probability. These are Dumfries & Galloway, Fife, Glasgow, Midlothian, North Ayrshire, North Lanarkshire, South Lanarkshire and West Lothian.

[11] The exceptions to this are Angus, Clackmannanshire, Na h-Eileanan Siar, Orkney Islands and Shetland Islands.

There are no local authorities expected to exceed 300 cases per 100k with at least 75% probability[12].

Figure 16. Probability of local authority areas exceeding thresholds of cases per 100K (22nd to 28th August 2021), data to 9th August.



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

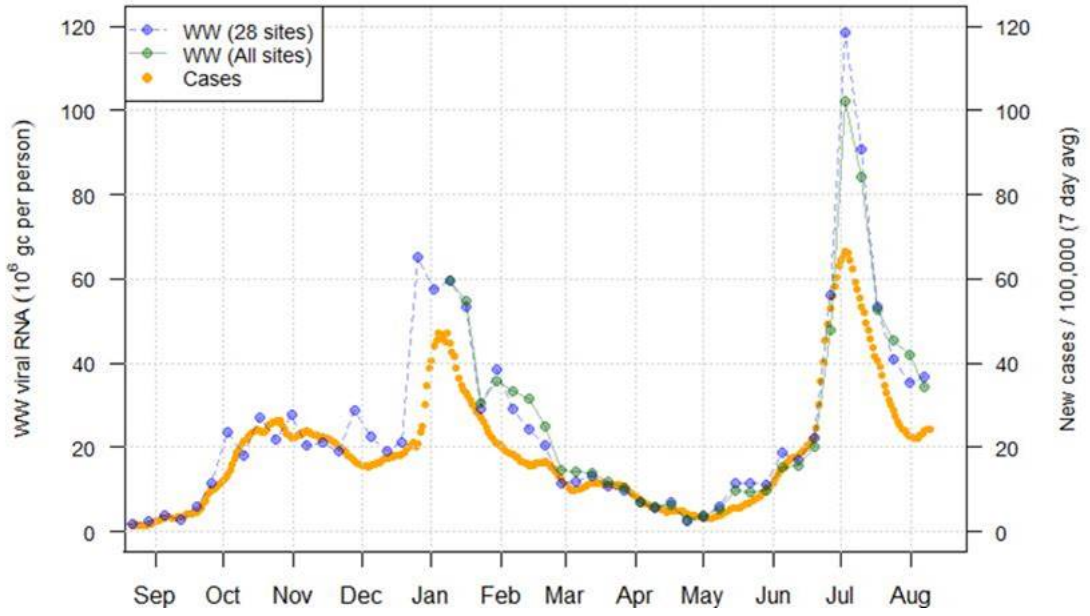
[12] Numbers are included in Table 1 in the Technical Annex.

aggregate data. See Technical Annex in Issue 34 of these Research Findings for the methodology.

Nationwide, the latest levels of wastewater (WW) Covid-19 to 10th August averaged around 34 million gene copies per person per day (Mgc/p/d), with some suggestions that the decline has slowed and may be reaching a plateau. Levels in Lanarkshire remain high.

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. Nationally WW Covid-19 concentrations have continued to decline slowly from the levels reported last week. Compared to levels seen previously during the pandemic, the current values remain in a similar range to that seen in late January/early February. WW viral levels are also high relative to case rates compared to the usual relationship of 1 Mgc/p/d equalling approximately 1 new case per 100k inhabitants per day.

Figure 17. National average trends in wastewater Covid-19 and daily new case rates (7 day moving average)[13].



The larger sites all show a decline in WW Covid-19 from the peak in early July, but whereas at Hatton (Figure 18) and Seafield the timing of the peak largely coincided with that for cases, at Shieldhall (Figure 19), Nigg and Dalmuir the decline in WW Covid-19 has lagged behind the decline in cases. A recent high measurement was registered at Hatton, though

[13] 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.

further measurements are required to identify whether this shows a change in the trend.

Figure 18. Wastewater Covid-19 and daily case rate (7 day moving average) for Hatton (covered pop: 194k) in Dundee[14].

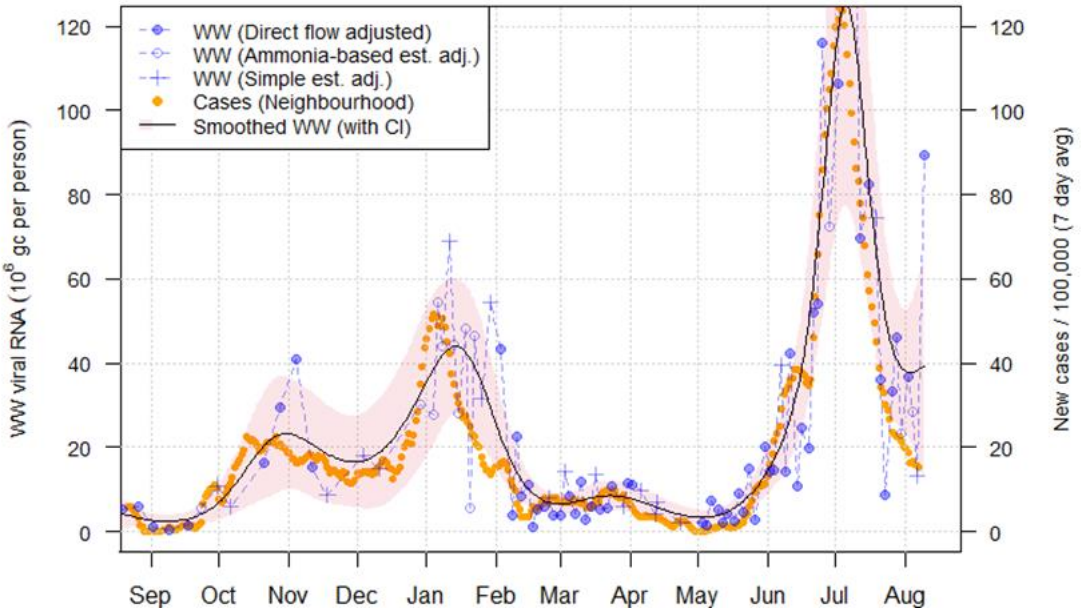
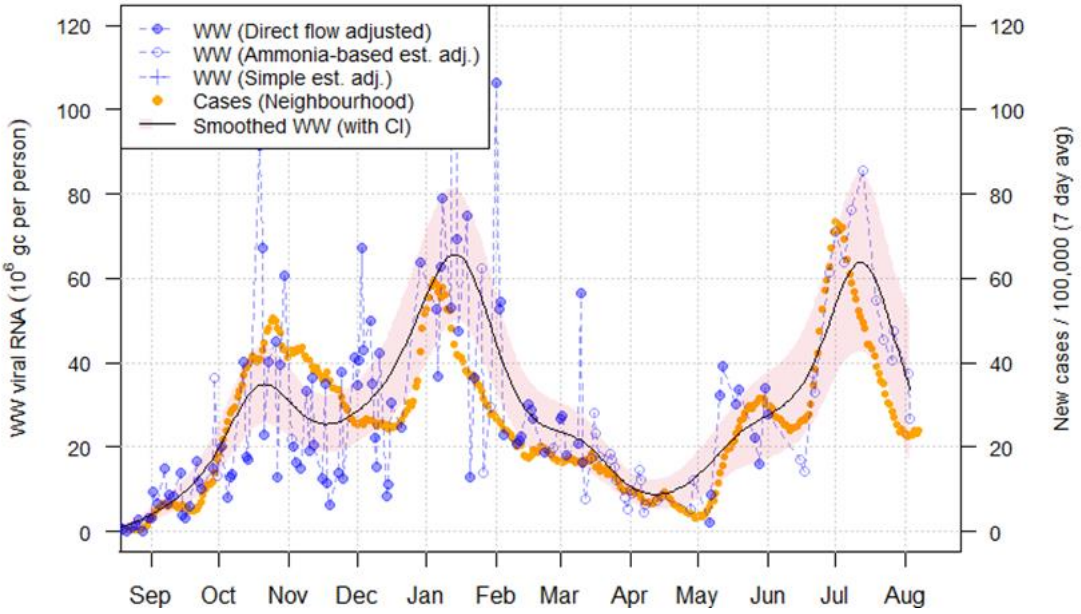


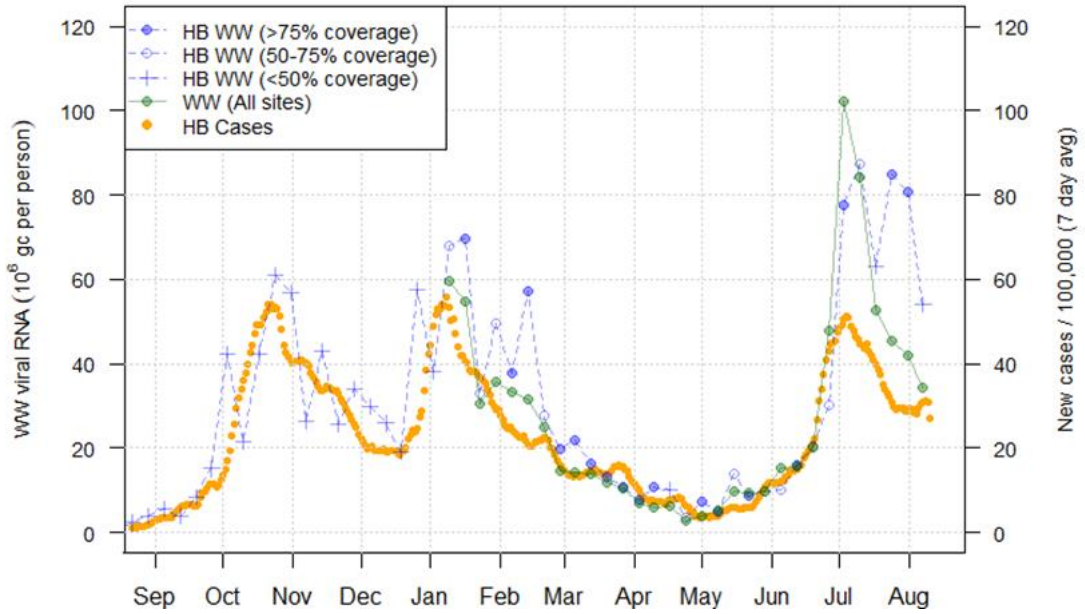
Figure 19. Wastewater Covid-19 and daily case rate (7 day moving average) for Shieldhall (covered pop: 377k) in Glasgow.



[14] 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.

In NHS Lanarkshire (Figure 20) WW Covid-19 levels remain higher than would be expected given the number of cases. In South Lanarkshire, the level has declined from around 80 to about 50 Mgc/p/d.

Figure 20. Average trends in wastewater Covid-19 and daily case rates (7 day moving average) in NHS Lanarkshire (pop: 668k)



The most recent measurement from Paisley in Renfrewshire is slightly higher than the one reported last week but still well below the peak reported in July. Peebles in the Borders has recorded two consecutive high WW measurements, counter to case records. Note that with the reduced number of samples measured, many smaller sites were not covered this week.

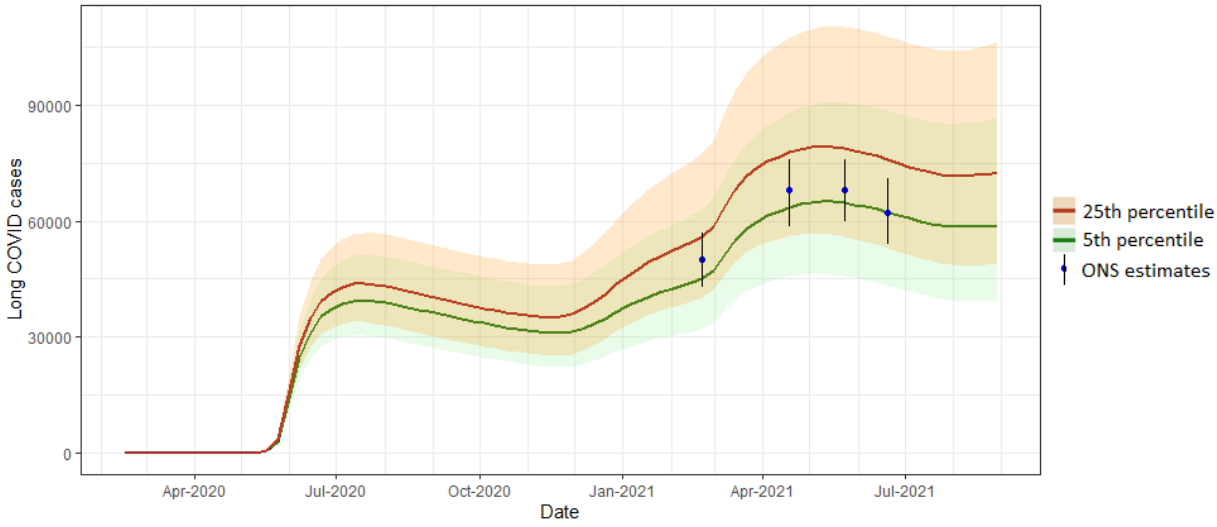
What estimates do we have of the number of people experiencing long Covid symptoms?

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 29 August 2021 between 40,000 (0.7% of the population) and 106,000 (1.9%) people were projected to experience symptoms for 12 weeks or more after their first suspected Covid-19 infection in Scotland.

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

Figure 21: Estimates of long Covid prevalence at 12 weeks from 16th February 2020 to 29th August 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.

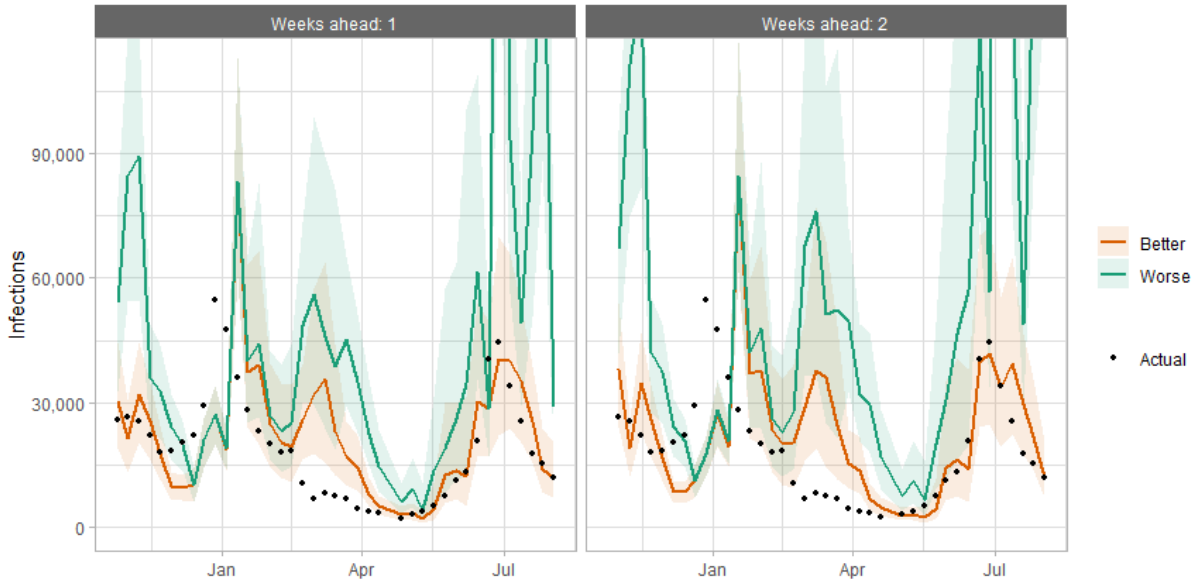
Modelling also allows us to make short-term forecasts of what may happen with a degree of uncertainty. These can be used in health care and other planning. The modelling in this research findings is undertaken using different types of data which going forward aims to both model the progress of the epidemic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

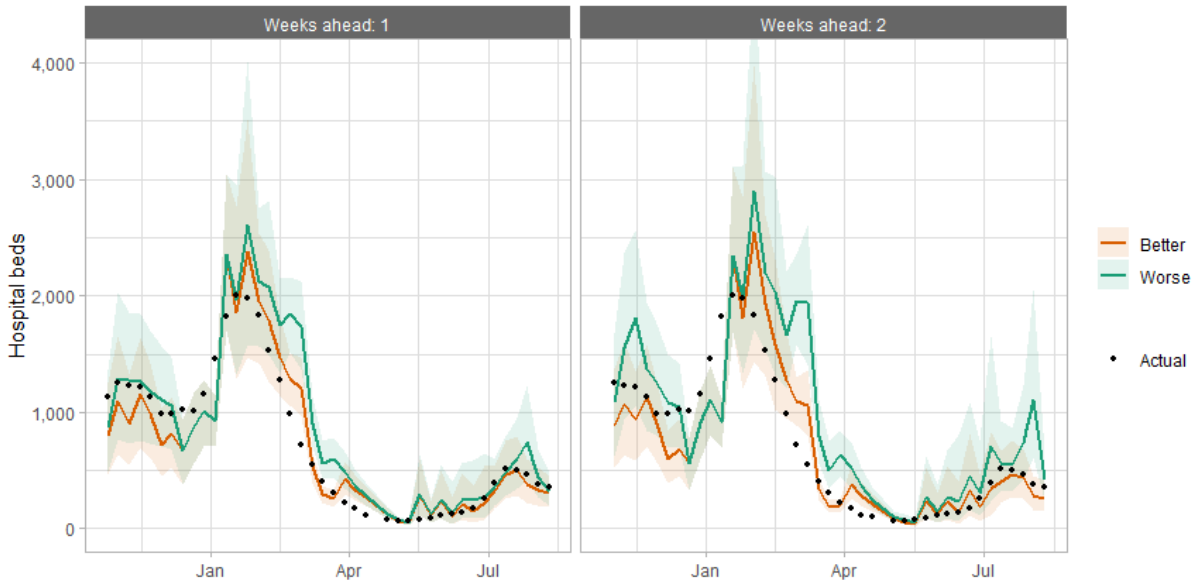
The following charts show the history of our modelling projections in comparison to estimates of the actual data. The infections projections were largely accurate during October to mid-December and from mid-January onward. During mid-December to mid-January, the projections underestimated the number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

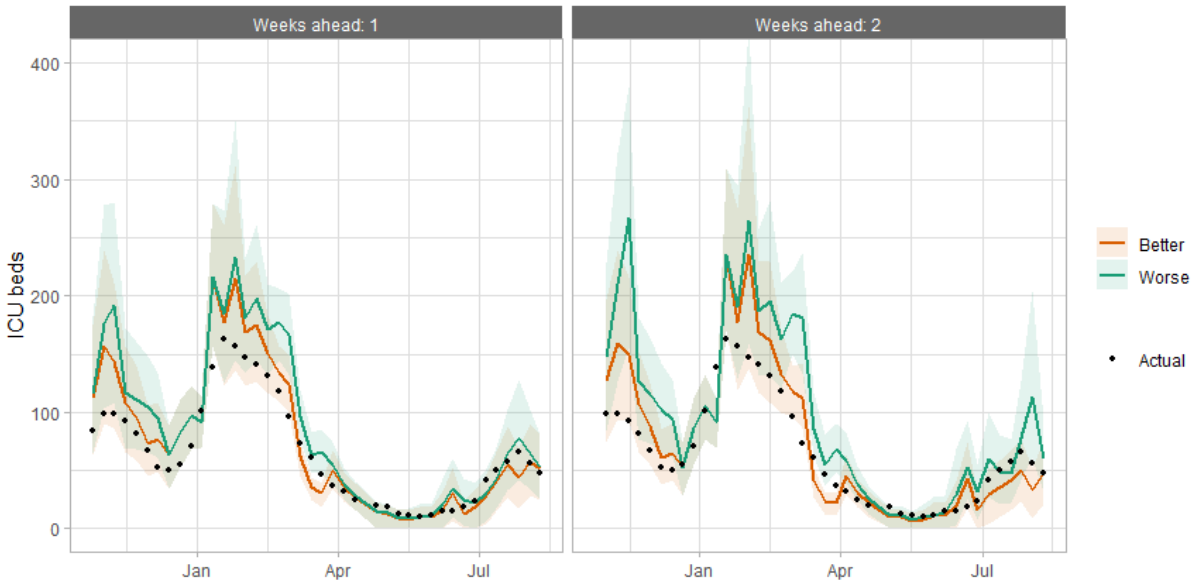


Table 1. Probability of local authority areas exceeding thresholds of cases per 100K (22nd to 28th August 2021), data to 9th August.

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

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 24th July and 31st 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 28th July	w/b 4th August	w/b 28th July	w/b 4th August	
Aberdeen City	40	18	40	18	80%
Aberdeenshire	22	16	21	15	35%
Angus	31	35	31	35	56%
Argyll and Bute	–	–	–	–	0%
City of Edinburgh	26	46	26	46	97%
Clackmannanshire	41	55	41	36	70%
Dumfries & Galloway	13	29	13	29	27%
Dundee City	35	44	35	44	100%
East Ayrshire	27	23	27	23	57%
East Dunbartonshire	30	38	30	38	99%
East Lothian	26	46	26	46	56%
East Renfrewshire	32	–	32	–	0%
Falkirk	17	26	17	26	62%
Fife	59	30	59	30	47%
Glasgow City	49	38	49	38	35%
Highland	42	20	38	20	37%
Inverclyde	58	–	58	–	0%
Midlothian	26	46	26	46	73%
Moray	17	20	17	14	55%
Na h-Eileanan Siar	10	–	10	–	0%
North Ayrshire	21	13	21	13	83%
North Lanarkshire	84	58	78	58	30%
Orkney Islands	6	12	6	12	34%
Perth and Kinross	21	0	21	0	9%
Renfrewshire	42	–	42	–	0%
Scottish Borders	20	29	20	26	40%
Shetland Islands	3	2	3	2	29%
South Ayrshire	27	23	27	23	77%
South Lanarkshire	75	50	75	50	33%
Stirling	16	17	16	17	63%
West Dunbartonshire	27	38	27	38	48%
West Lothian	92	25	27	25	53%

[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 31st July 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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