Coronavirus (COVID-19): modelling the epidemic in Scotland (Issue No. 62)

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 22nd July 2021. The estimates in this document help the Scottish Government, the health service and the wider public sector plan and put into place what is needed to keep us safe and treat people who have the virus.

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

In Scotland, the modelled estimate for R is between 0.8 and 1.0, with the growth rate between -3% and 1% based on the period up to 26th July.

The epidemic in Scotland appears to be at a turning point. Cases have been decreasing over the past few weeks. There remains uncertainty about the epidemic in future weeks.

Key Points

- The reproduction rate R in Scotland is currently estimated as being between 0.8 and 1.0, based on the period up to 26th July. The lower and upper limits have decreased since last week.
- The number of new daily infections for Scotland is estimated as being between 89 and 165, per 100,000 people, based on the period up to 26th July.
- The growth rate for Scotland is currently estimated as being between -3% and 1%, based on the period up to 26th July.
- Average contacts have increased slightly in the last two weeks by 5% (comparing surveys pertaining to 1st July - 7th July and 15th July - 21st July) with a current level of 4 daily contacts.

- Contacts within the work, home and other setting (contacts outside of the work, school and home) have all increased compared to two weeks prior. With work contacts increasing by approximately 7% and contacts within the home and other setting increasing by approximately 6%.
- Mean contacts across all age groups have shown a rise in comparison to two weeks prior with the exception of those aged between 60-69 who have reported a decrease. Those aged 30-39 have shown the biggest increase, by 22%, which is largely driven by a rise in contacts within the work place.
- Contacts 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.
- There has been increases in interactions between every age group within the last two weeks, with those aged between 18-29 reporting the most interactions with each other followed by those over 70 interacting with each other.
- 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 37% to 41% in the last two weeks.
- Hospitalisations from the increase in cases during the last few weeks have likely plateaued, and the future increase or decrease in hospital occupancy and intensive care use is uncertain, and depends on both current infection levels and the impact of the recent move to level 0 nationally.
- Unvaccinated Delta variant[1] cases in the community are more likely to be admitted to hospital than unvaccinated Alpha variant cases. Compared to the Alpha variant, the Delta variant is associated with an increase in the risk of Covid-19 hospitalisation by 76% (95% CI 35%-129%).
- Vaccinated individuals at least 28 days after the first dose, are less likely to be admitted to hospital, even though they test positive.
- The reduction in the risk of hospitalisation is slightly greater for Pfizer than AstraZeneca vaccines, though the confidence intervals overlap. At least 28 days after the first dose, the risk of hospitalisation is reduced by 72% (95% CI 65%-78%) for Astra Zeneca and 81% (95% CI 74%-91%) for Pfizer vaccines.

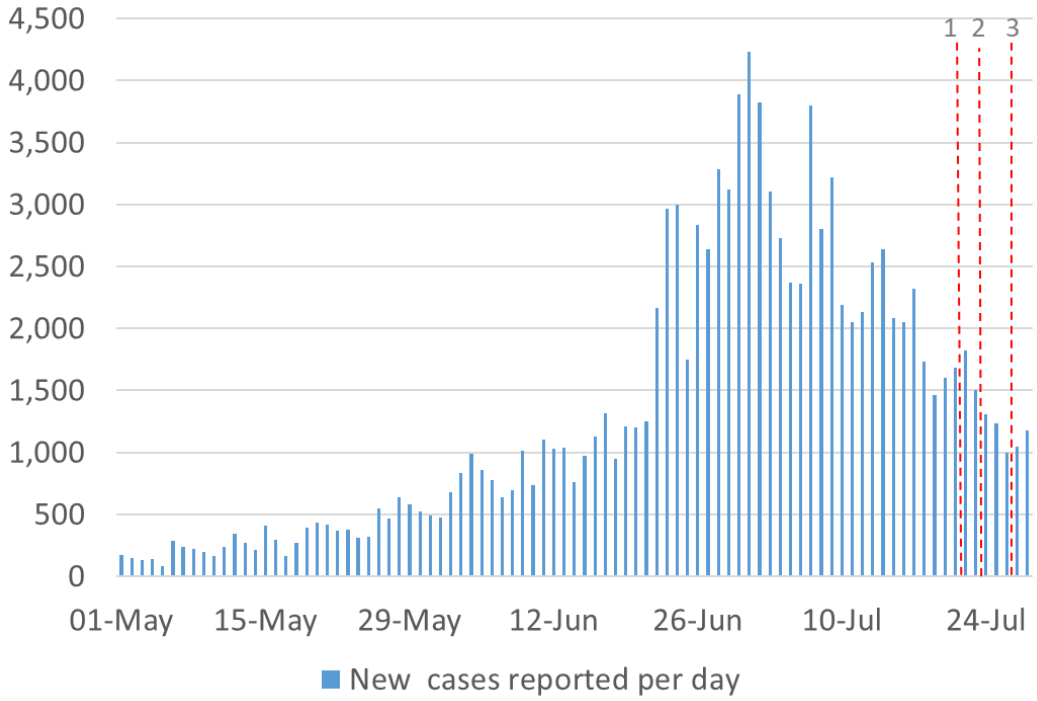
[1] A detectable S gene in a positive SARS-CoV-2 sample has been established as a useful proxy for the Delta variant in England since mid-May 2021 (SARS-CoV-2 variants of concern and variants under investigation (publishing.service.gov.uk).

- Vaccines were found to reduce the risk of being admitted to hospital amongst those who have tested positive for Covid-19. However, strong protective effects against the Delta variant were not seen until at least 28 days after the first vaccine dose.
- Modelled rates of positive tests per 100K using data to 26th July indicate that, for the week commencing 8th August 2021, there are 10 local authorities with at least a 75% probability of exceeding 50 cases per 100k. These are Clackmannanshire, Dumfries & Galloway, East Ayrshire, Glasgow, Moray, North Lanarkshire, South Lanarkshire, Stirling, West Dunbartonshire and West Lothian.
- There are no local authorities which are expected to exceed 100 cases per 100k with at least a 75% probability.
- Overall, wastewater (WW) Covid-19 levels have dropped since the peak of several weeks ago, but still remain slightly higher than cases.
- However at a number of locations, WW Covid-19 levels remain high. This includes Nigg (covering Aberdeen), Kirkcaldy and Levenmouth in Fife, Daldowie, Carbarns and Hamilton in Lanarkshire, and Paisley in Renfrewshire. In the case of Paisley, as cases decline, WW Covid-19 levels appear to be increasing. These sites need to be monitored closely to see if the situation persists.
- The Scottish Government has started to model the number of people likely to experience long Covid symptoms. This modelling estimates that, on 9th August 2021, between 0.7% and 1.9% of the population are projected to experience symptoms for 12 weeks or more after their first suspected Covid infection in Scotland.

Recent cases

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

Figure 1: Cases reported in Scotland to 28th July 2021.



This report covers the period up to 21st July for contact patterns (indicated by dashed line 1). Wastewater data is provided to 23rd July (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 26th 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 UK Health Security Agency (UKHSA) consensus[2] 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.

[2] 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).

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.

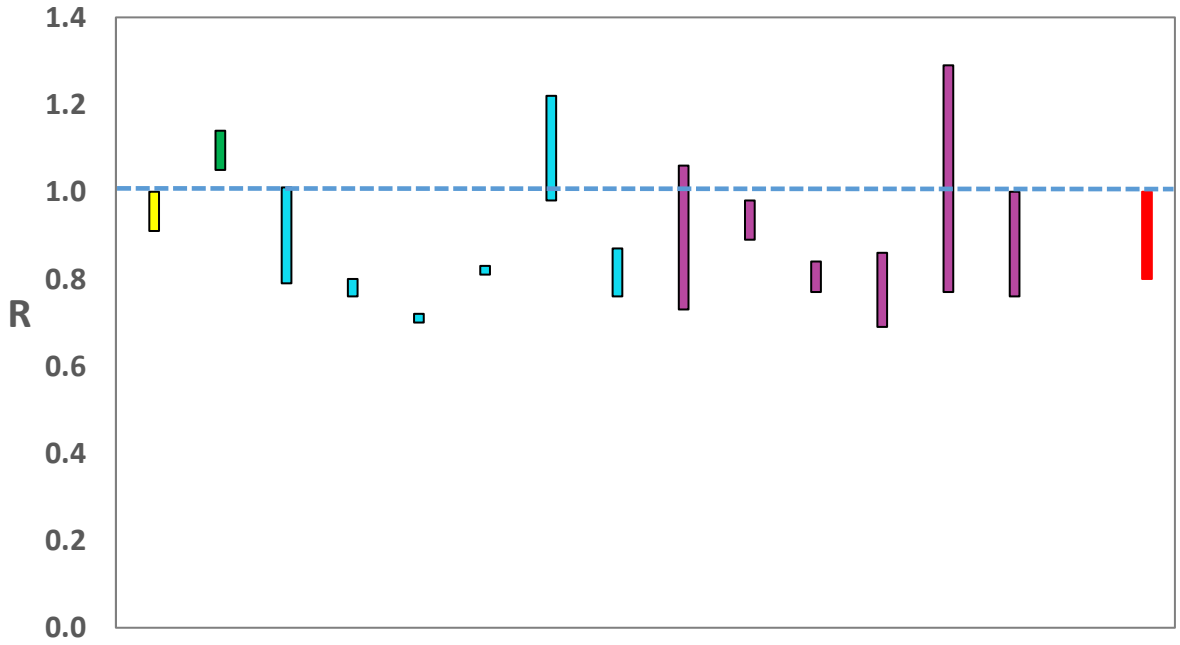
R is an indicator that lags by two to three weeks and therefore does not reflect any behavioural changes that have happened during this time.

UKHSA's consensus view across these methods as of 28th July, using data to 26th July, was that the value of R in Scotland was between 0.8 and 1.0 (see Figure 2)[3].

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.

[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.

Figure 2. Estimates of R_t for Scotland, as of 28th July, including 90% confidence intervals, produced by EMRG[4]. Data to 26th July.

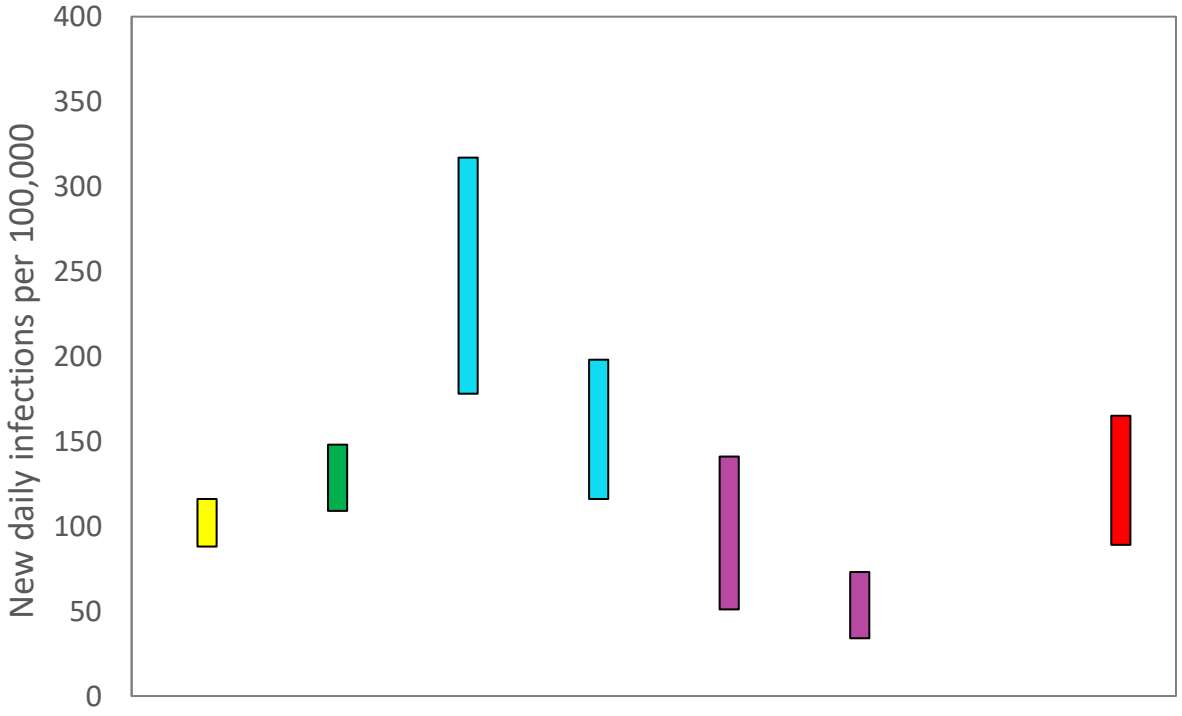


Source: EMRG

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 26th July, was that the incidence of new daily infections in Scotland was between 89 and 165 new infections per 100,000. This equates to between 4,900 and 9,000 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 28th July, including 90% confidence intervals, produced by EMRG[2]. Data to 26th July.



Source: EMRG

The consensus from UKHSA for this week is that the growth rate in Scotland is between -3% and 1% per day using data to 26th July. The lower and upper limits have decreased since last week.

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

Average contacts have increased slightly in the last two weeks by 5% (comparing surveys pertaining to 1st July - 7th July and 15th July - 21st July) with a current level of 4 daily contacts as seen in Figure 4. Contacts within the work, home and other setting (contacts outside of the work, school and home) have all increased compared to two weeks prior. Work contacts have increased by approximately 7% and contacts within the home and other setting have increased by approximately 6%.

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

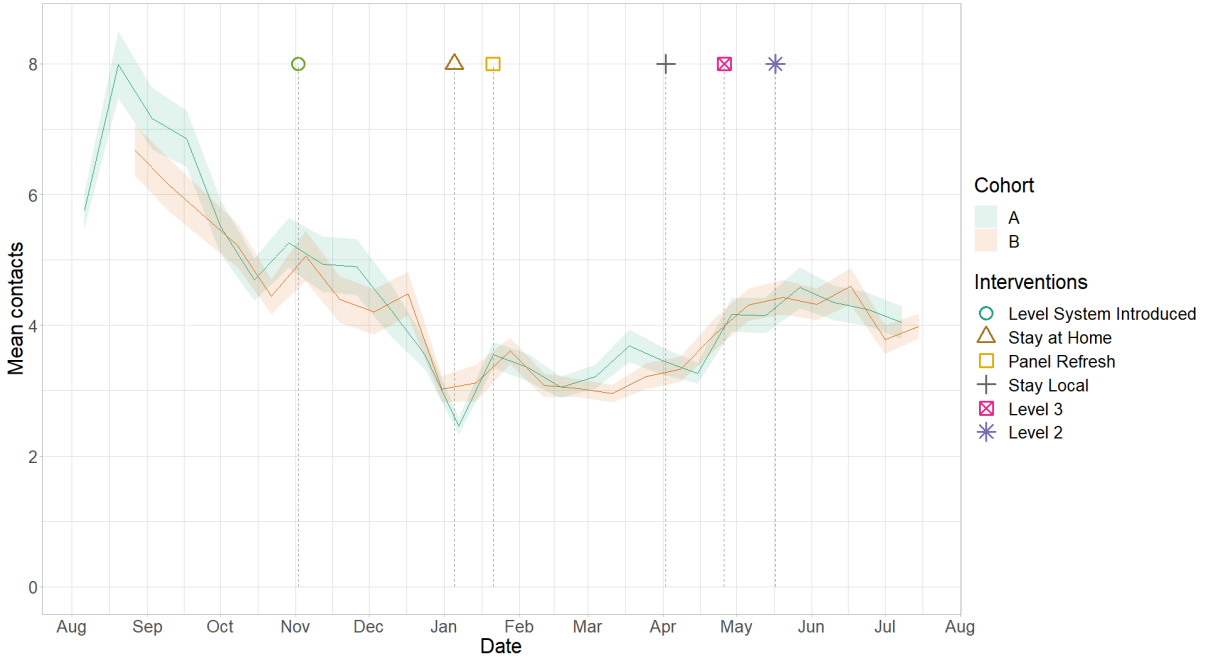


Figure 5 shows how contacts change across age group and setting. Mean contacts across all age groups have shown a rise in comparison to two weeks prior with the exception of those aged between 60-69 who have reported a decrease. Those aged 30-39 have shown the biggest increase, by 22%, which is largely driven by a rise in contacts within the work place.

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

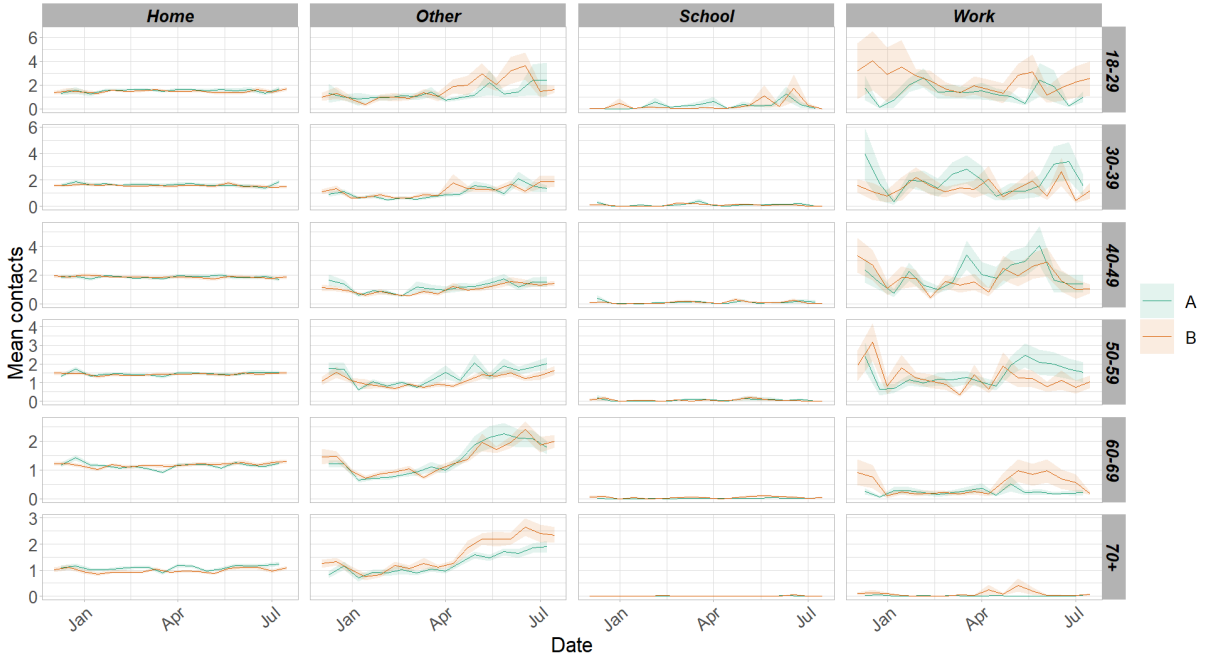
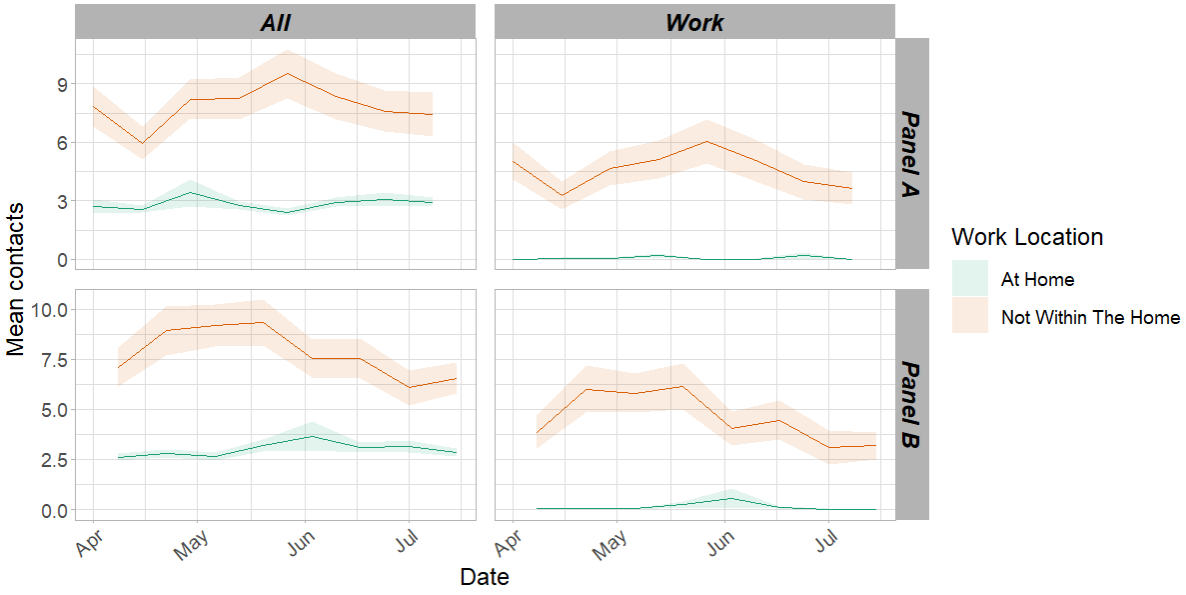


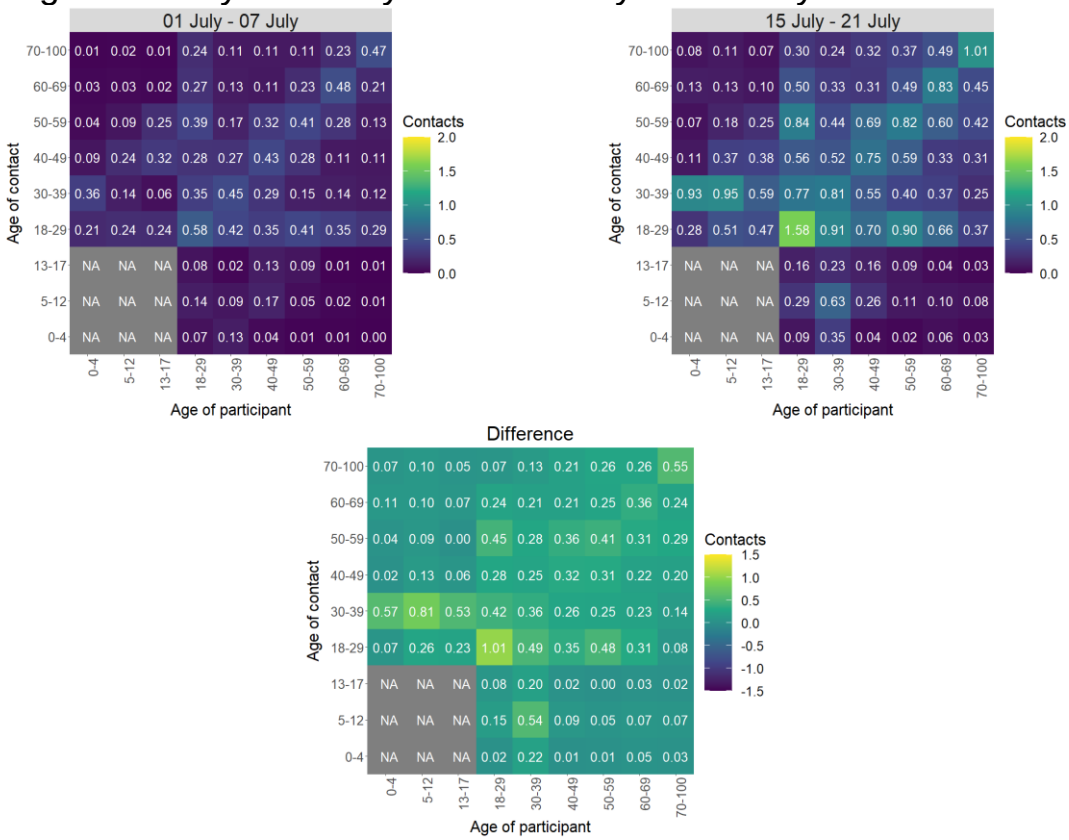
Figure 6 shows the difference in contacts between those who work from home compared to those who have a workplace outside of the home. This shows that those who do not work from home have higher and more variable contacts than those who work from home. This also shows that contacts had within the work 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: Overall mean 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 1st July - 7th July and 15th July - 21st July and the difference between these periods. There has been increases between every age group within the last two weeks with those aged between 18-29 reporting the most interactions with each other followed by those over 70 interacting with each other.

Figure 7: Overall mean contacts by age group before for the weeks relating to 1st July - 7th July and 15th July - 21st July.



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 37% to 41% in the last two weeks.

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

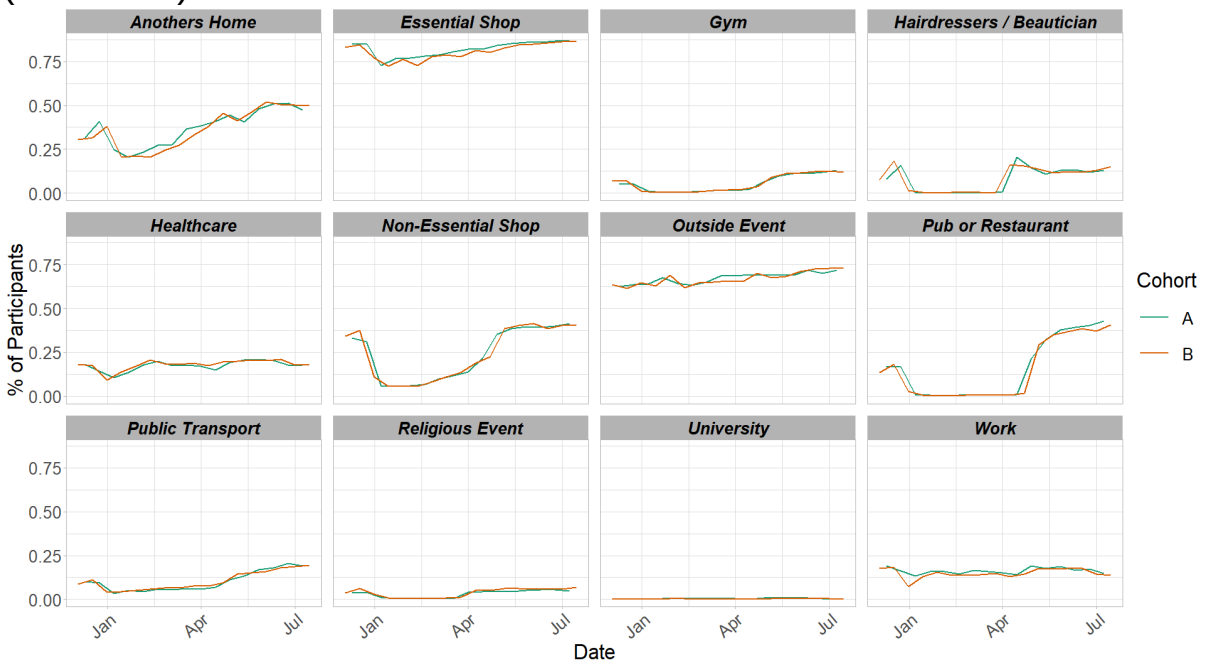
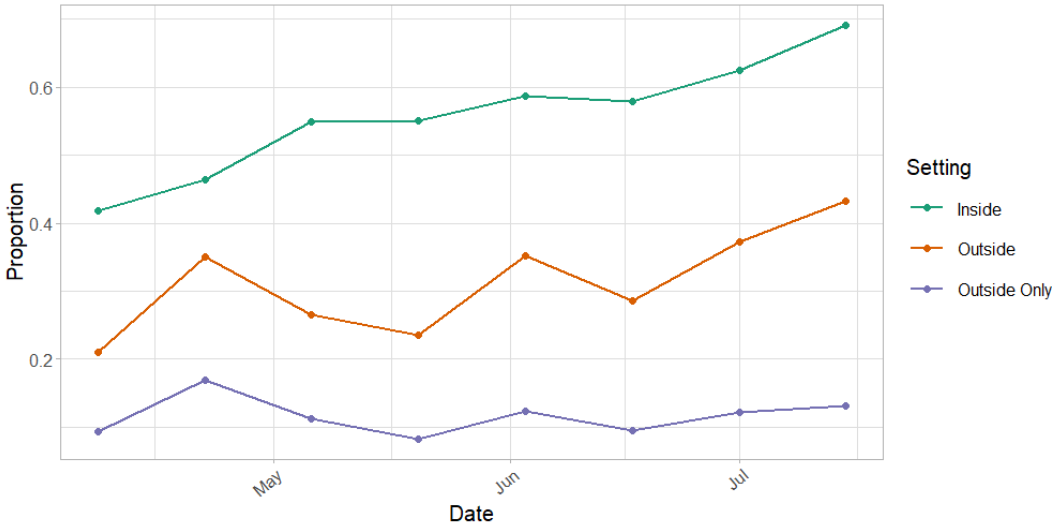


Figure 9 shows the proportion of contacts which occurred indoors and outdoors for panel B. A contact can be recorded as both indoor and outdoor. The graph also shows contacts reported as outside only. The proportion of contacts reported to have been at least partially indoors has steadily increased since the start of April. Since the middle of June, the proportion of contacts reported to have been at least partially outdoors has also increased.

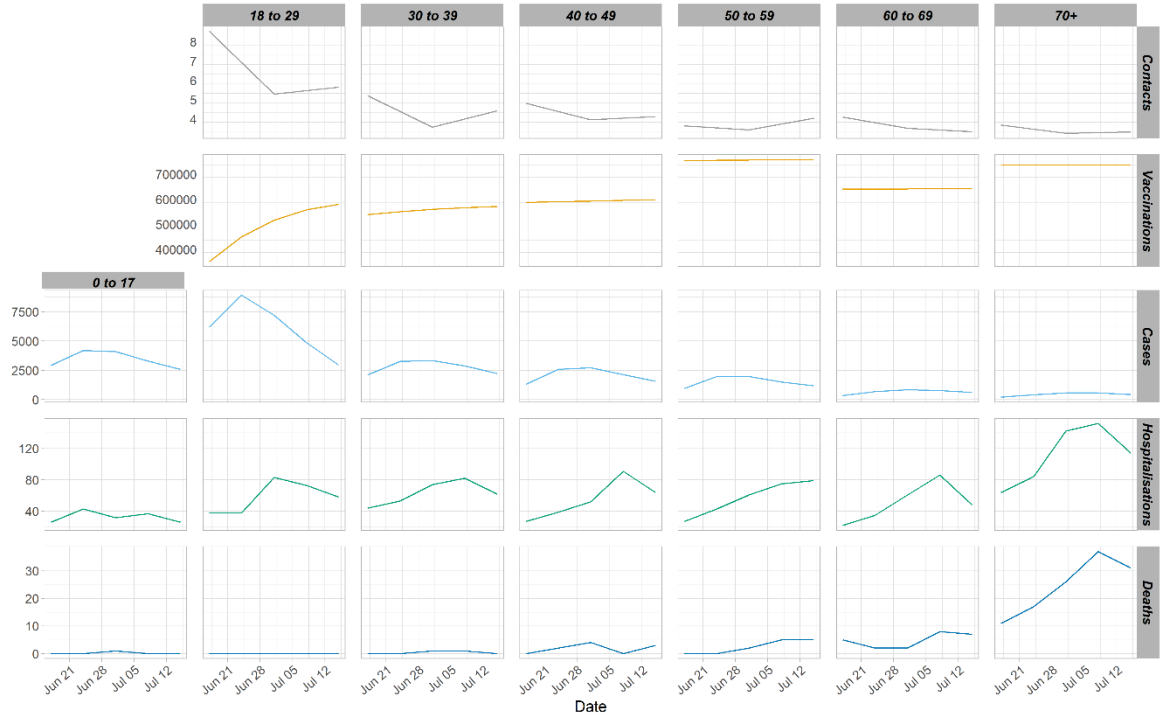
Figure 9: Proportion of contacts which occurred indoors and outdoors (panel B)



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 B, weekly cases, covid-19 hospital admissions and deaths[5] and cumulative vaccinations by age band[6]



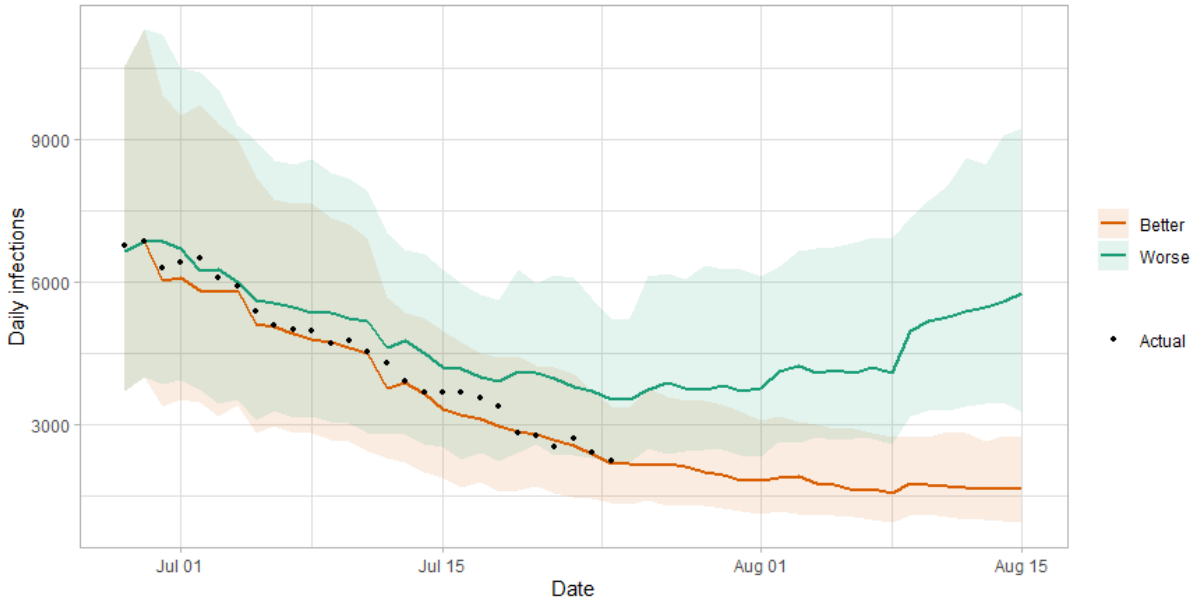
What the modelling tells us about estimated infections as well as Hospital and ICU bed demand

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 11 shows two projections.

'Worse' assumes a behaviour change over a two month period following the change in restrictions on the 19th July. 'Better' assumes this behavioural change happens more gradually over a five to six month period leading to lower transmission[7].

[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.
[7] Both scenarios are based on current vaccine roll-out plans and efficacy assumptions.

Figure 11. 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 26th July.



In comparison to last week, our confidence in the recent fall in infections has increased, so the 'Worse' projection now broadly follows that fall in infections. We have also assumed a less immediate impact from the relaxations on 19 July than was assumed last week for 'Worse'.

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

Figure 12 shows the impact of the projections on the number of people in hospital. The modelling includes all hospital stays, whereas the actuals only include stays up to 28 days duration that are linked to Covid-19.

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

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

Figure 12. Medium term projections of modelled hospital bed demand, from Scottish Government modelling, based on positive test data reported up to 26th July.

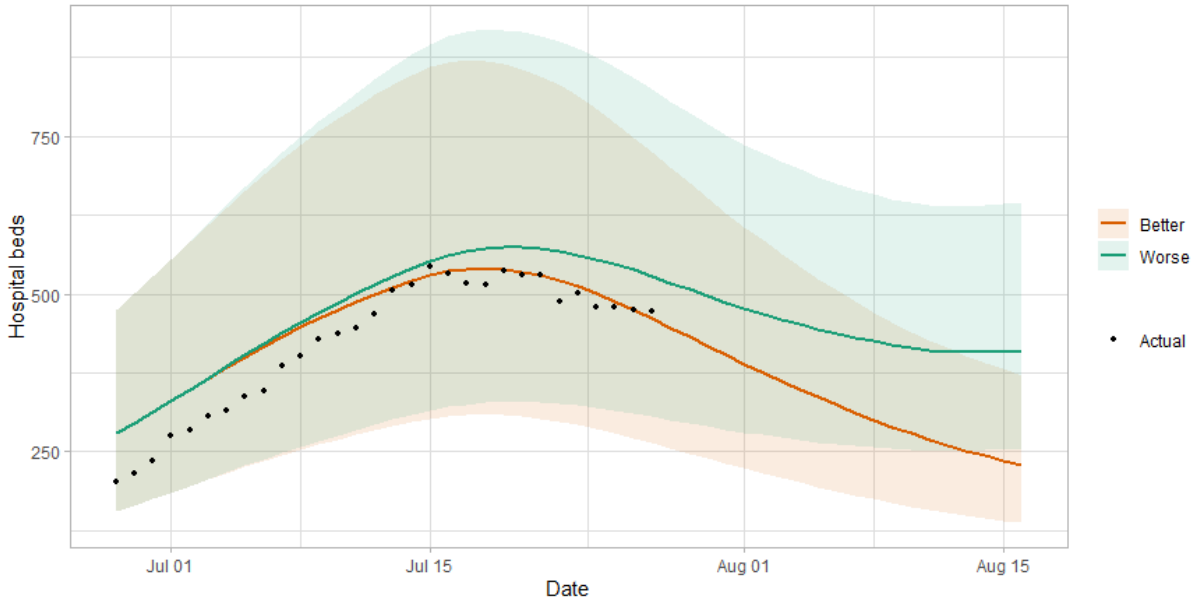
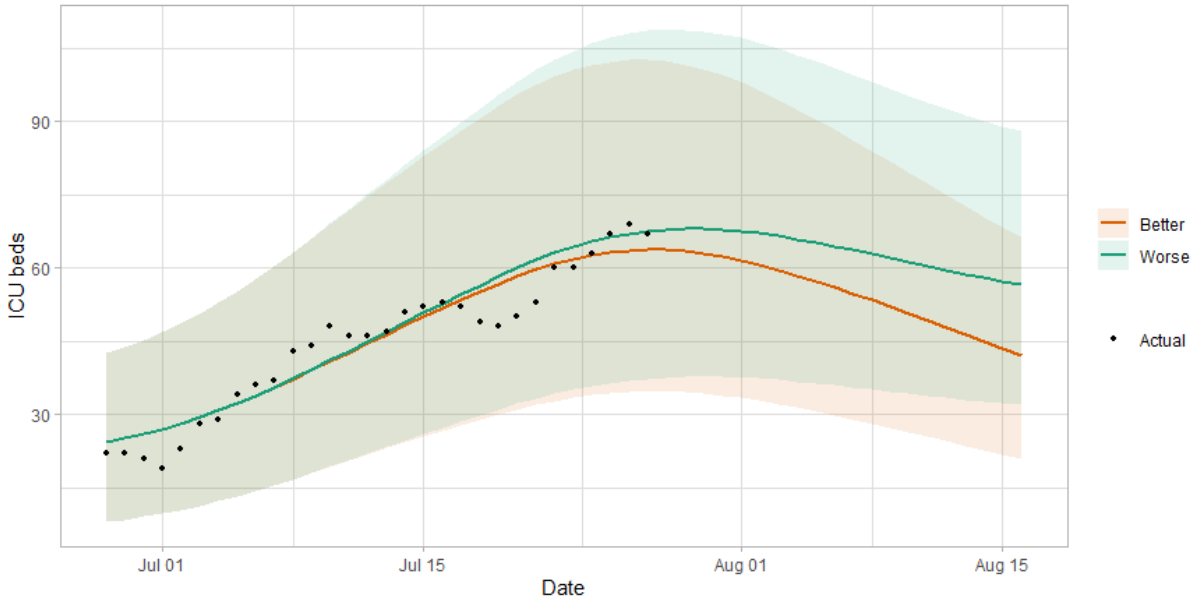


Figure 13 shows the impact of the projection on ICU bed demand.

Figure 13. Medium term projections of modelled ICU bed demand, from Scottish Government modelling[9], based on positive test data reported up to 26th July.



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

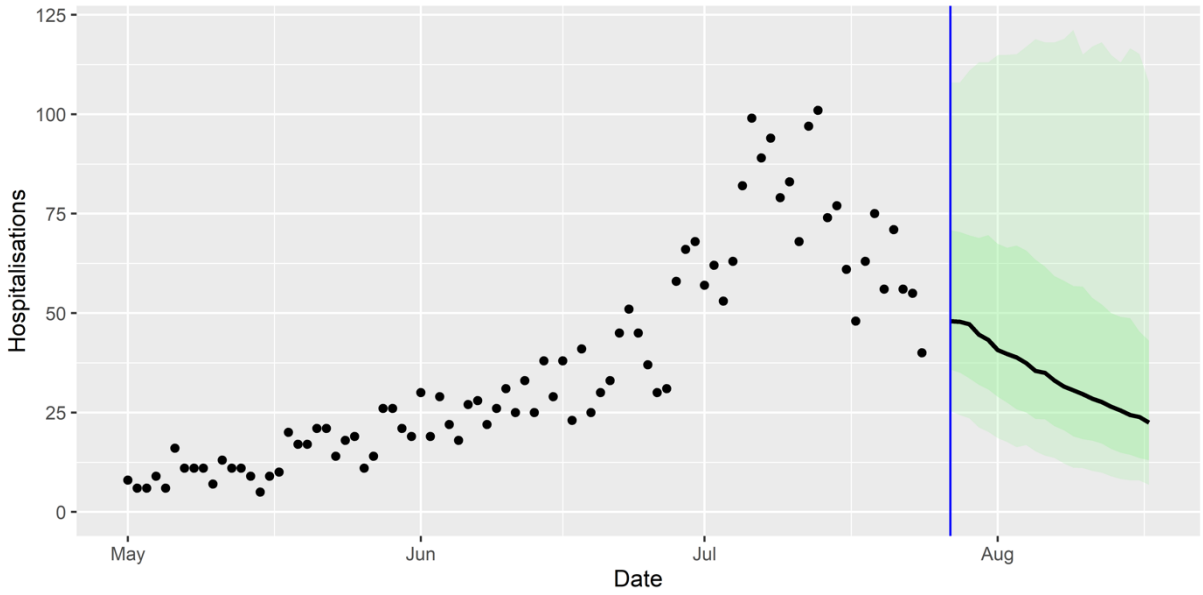
SPI-M produces projections of the epidemic[10] (Figure 14), combining estimates from several independent models (including the Scottish Government's logistics modelling, as shown in Figures 11-13). These projections are not forecasts or predictions. They represent a scenario in which the trajectory of the epidemic continues to follow the trends that were seen in the data up to 26th 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 26th July. Projecting forwards is difficult when the numbers of admissions and deaths fall to very low levels, which can result in wider credible intervals reflecting greater uncertainty. The interquartile range can be used, with judgement, as the projection from which estimates may be derived until the 17th 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 14. 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 the risk of hospitalisation and vaccine effectiveness associated with the Delta variant of Covid-19

The Early Pandemic Evaluation and Enhanced Surveillance of Covid-19 (EAVE) 2 Study Group[11] has investigated the risk of hospitalisation from Covid-19 and estimated vaccine effectiveness in preventing hospital admissions in Delta variant cases.

Testing data is linked to the EAVE study data of GP clinical conditions. Hospital admission is derived from the Rapid Preliminary Inpatient Data (RAPID) database only.

As part of EAVE II – a BREATHE-associated project – researchers from the Universities of Edinburgh and Strathclyde, and Public Health Scotland (PHS) analysed a dataset covering the entire Scottish population of 5.4 million people to track the pandemic and vaccine roll-out in real time.

[11] Based at Edinburgh University, Strathclyde University Aberdeen University and Public Health Scotland.

Genomic sequencing data for Scotland shows that from 1st April to 28th May 2021, 97% of S gene-positive cases sequenced in Scotland were the Delta variant. S gene-positive is a proxy for the Delta variant.

Unvaccinated Delta variant[12] cases in the community are more likely to be admitted to hospital than unvaccinated Alpha variant cases. Compared to the Alpha variant, the Delta variant is associated with an increase in the risk of Covid-19 hospitalisation by 76% (95% CI 35%-129%).

Two vaccine doses still provide strong protection against the Delta variant – but it may be at a lower level compared with the Alpha variant, the early evidence suggests.

Vaccines were found to reduce the risk, among those who have tested positive for Covid-19, of being admitted to hospital. The reduction in the risk of hospitalisation is slightly greater for Pfizer than AstraZeneca, though the confidence intervals overlap. At least 28 days after the first dose the risk of hospitalisation is reduced by 72% (95% CI 65%-78%) for Astra Zeneca and 81% (95% CI 74%-91%) for Pfizer.

Amongst individuals tested in hospital labs vaccination is still associated with a reduced hazard of admission. At least 14 days after the second dose the risk of admission is reduced by 60% (95% CI 52%-77%) which is less than the corresponding figure for community tested individuals; 76% (95% CI 70%-82%).

Because of the observational nature of the study, data about vaccine effectiveness should be interpreted with caution and it is not possible to make a direct comparison between both vaccines.

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

This week we are using modelling based on Covid-19 cases and deaths, conducted by Imperial College London[13], to give us an indication of whether a local authority is likely to experience high levels of Covid-19 in

[12] A detectable S gene in a positive SARS-CoV-2 sample has been established as a useful proxy for the Delta variant in England since mid-May 2021 (SARS-CoV-2 variants of concern and variants under investigation (publishing.service.gov.uk).

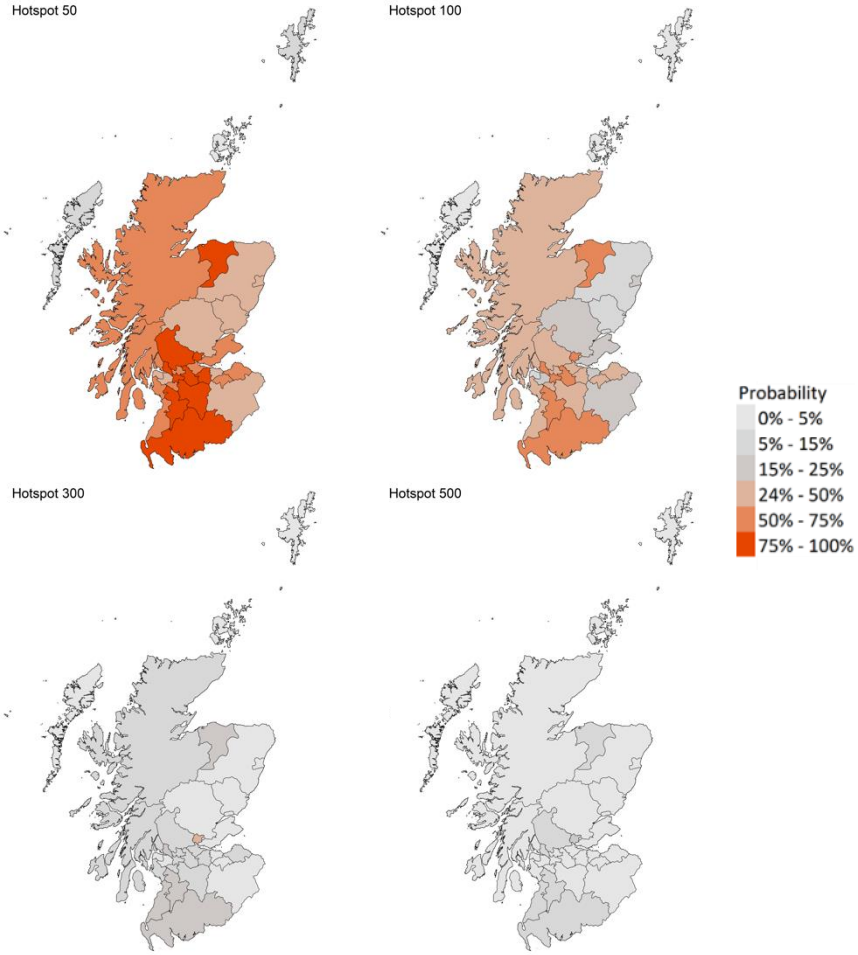
[13] Swapnil Mishra, Jamie Scott, Harrison Zhu, Neil M. Ferguson, Samir Bhatt, Seth Flaxman, Axel Gandy, "A COVID-19 Model for Local Authorities of the United Kingdom," medRxiv https://doi.org/10.1101/2020.11.24.20236661, "COVID-19 UK website" http://imperialcollegelondon.github.io

the future. 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. We hope to provide a consensus next week, which means that results may differ from the individual model output below.

Modelled rates of positive tests per 100K using data to 26th July (Figure 15) indicate that, for the week commencing 8th August 2021, there are 10 local authorities with at least a 75% probability of exceeding 50 cases per 100k. These are Clackmannanshire, Dumfries & Galloway, East Ayrshire, Glasgow, Moray, North Lanarkshire, South Lanarkshire, Stirling, West Dunbartonshire and West Lothian.

There are no local authorities which are expected to exceed 100 cases per 100k with at least a 75% probability[14].

Figure 15. Probability of local authority areas exceeding thresholds of cases per 100K (8th to 14th August 2021), data to 26th July.



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

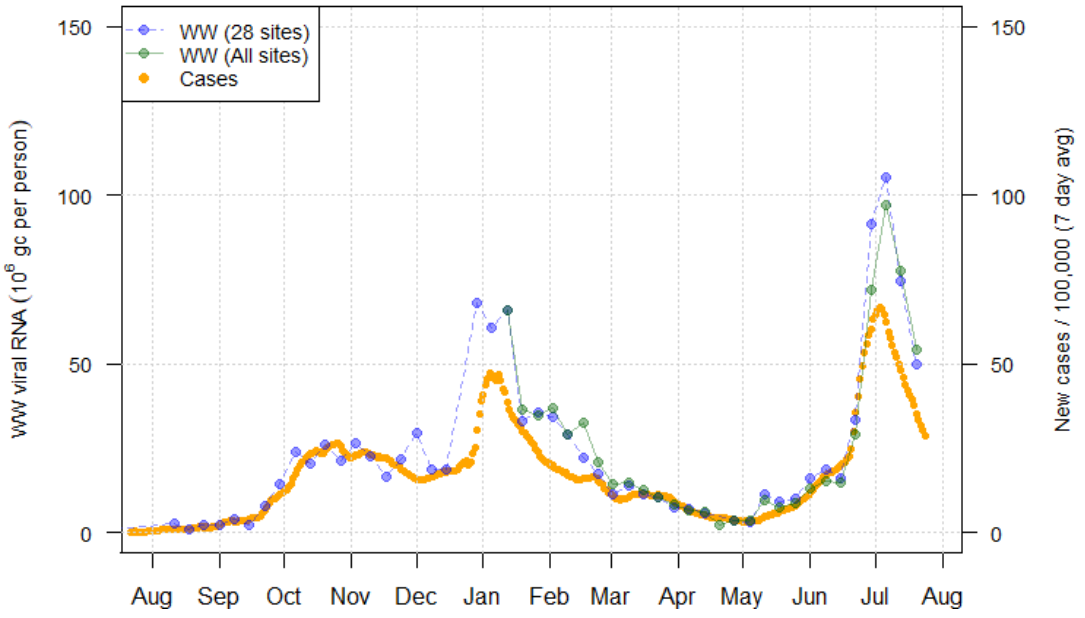
What can analysis of wastewater samples tell us about local outbreaks of Covid-19 infection?

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 newest levels of wastewater (WW) Covid-19 averaged around 50-55 million gene copies per person per day, representing a decline in levels from last week. However, a number of sites maintained high levels of wastewater virus even as the number of new cases declined.

Figure 16 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[15]. This has been adjusted from what was published in last week's research findings.

Figure 16. National average trends in wastewater Covid-19 and daily new case rates (7 day moving average)[16].

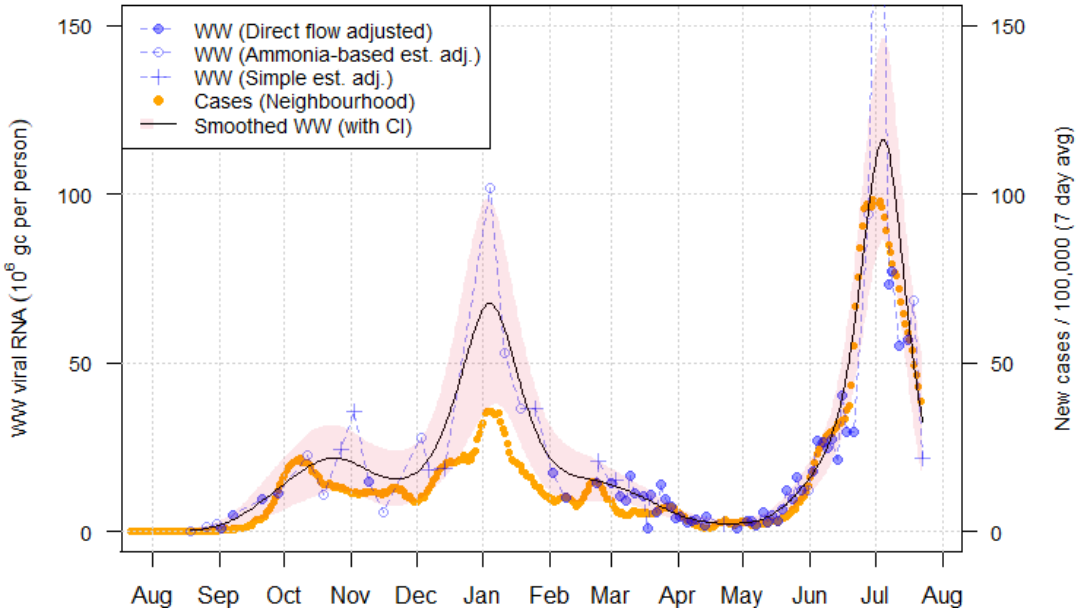


[15] Note that data in this report overlaps that shown in last week's publication.
[16] Anomalously high values, one in Seafield (Edinburgh) in mid-February (see Issue 40), one in Dunblane in mid-June, and two in Daldowie in January, were removed.

WW Covid-19 aggregate trends appear to be following cases on a downward path. However high levels remain.

Figure 17 shows Seafield (a sampling site covering Edinburgh), which is one of many larger sites that show a large decline in WW viral Covid-19 levels compared to previous weeks. Other examples include Shieldhall (covering much of Glasgow) and Hatton (covering Dundee).

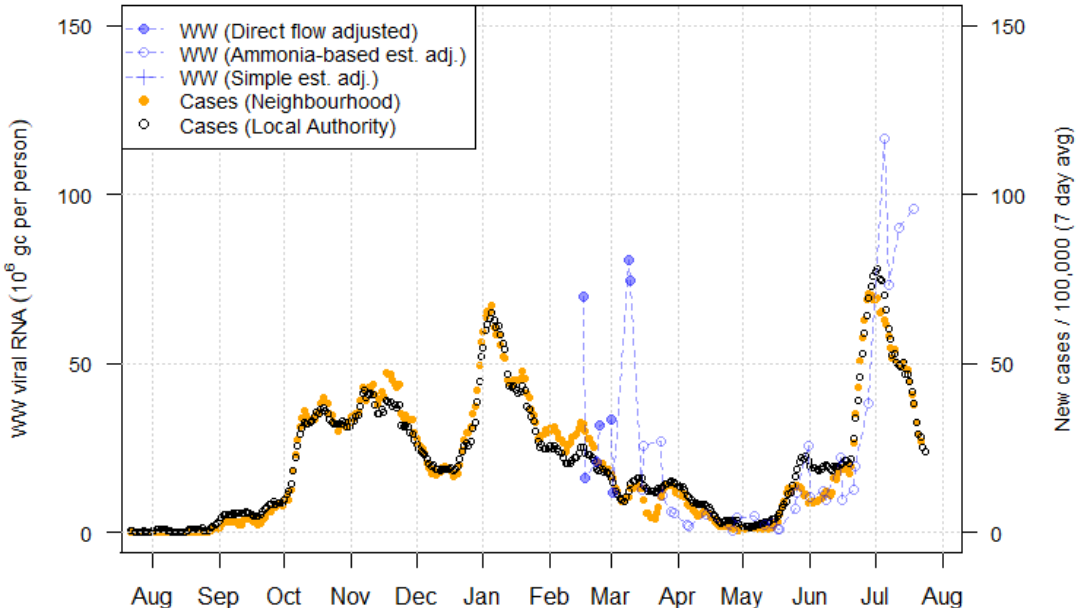
Figure 17. Wastewater Covid-19 and daily case rate (7 day moving average) for Seafield (covered pop: 606k) in Edinburgh[17].



However, at a number of locations, WW viral Covid-19 levels do not appear to be falling from high levels, despite declines in new case rates. This includes Nigg (covering Aberdeen), Kirkcaldy and Levenmouth in Fife, Daldowie, Carbarns and Hamilton in Lanarkshire, and Paisley in Renfrewshire (Figure 18). In the case of Paisley, as cases decline, WW COVID-19 levels appear to be increasing. These sites need to be monitored closely to see if the situation persists.

[17] The black line and red shaded area provide a smoothed curve and confidence interval for WW Covid-19 that is estimated from a generalised additive model based on a Tweedie distribution.

Figure 18. Wastewater Covid-19 and daily case rate (7 day moving average) for Paisley (covered pop: 82k) in Renfrewshire.



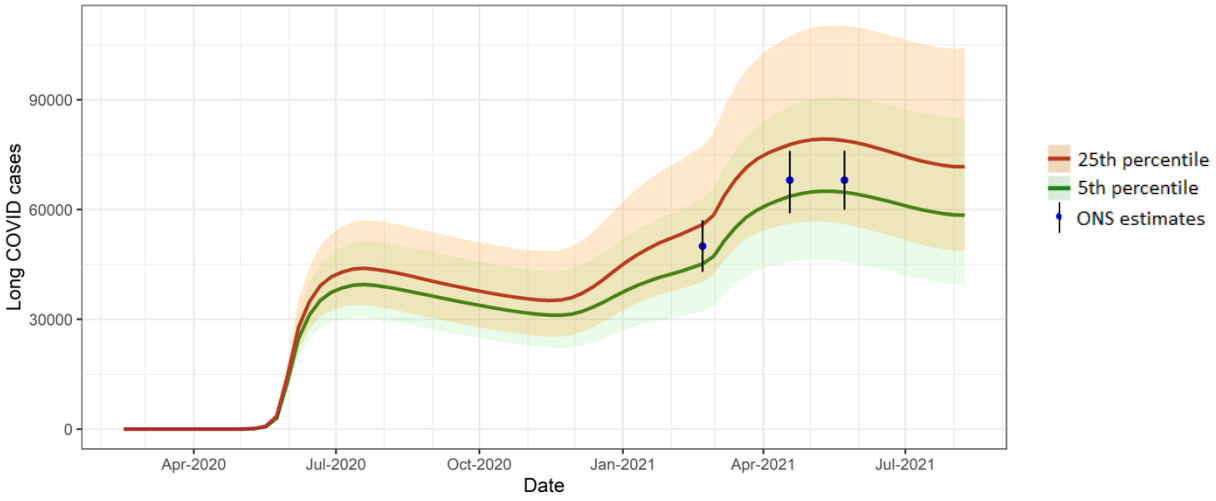
What estimates do we have of the number of people experiencing long Covid symptoms?

The Scottish Government has started to model the number of people likely to experience long Covid symptoms. This has then been projected forward to estimate long Covid rates in the future based on Scottish Government medium term projection modelling as set out in Figure 19.

This modelling estimates that, at 9th August 2021, between 39,000 (0.7% of the population) and 104,000 (1.9%) people were projected to experience symptoms for 12 weeks or more after their first suspected Covid infection in Scotland.

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

Figure 19: Estimates of long Covid prevalence at 12 weeks from 16th February 2020 to 9th 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.

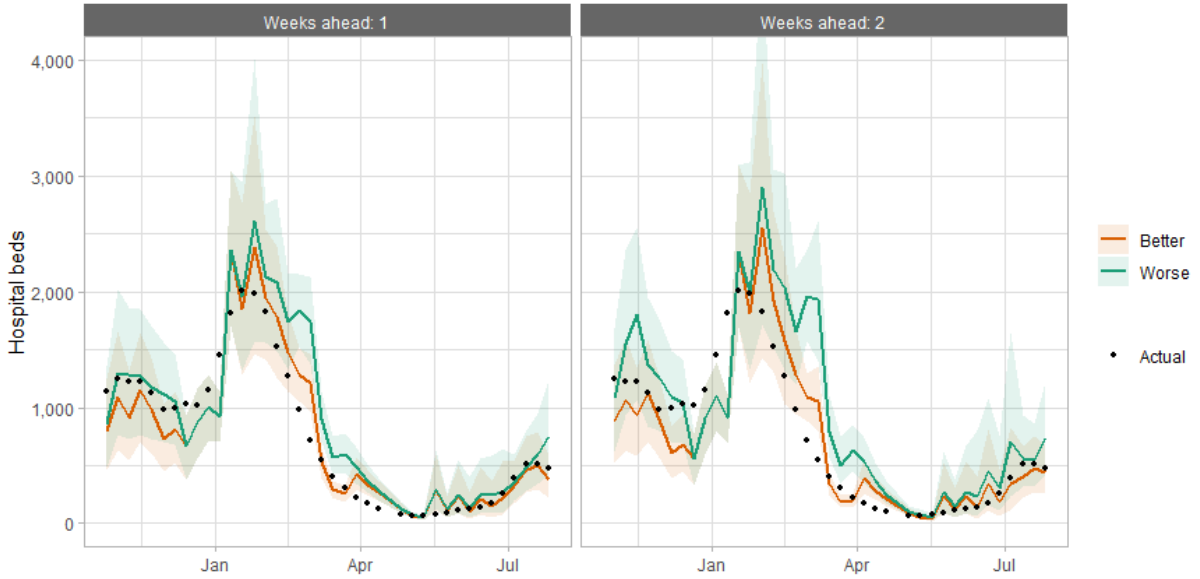
Modelling also allows us to make short-term forecasts of what may happen with a degree of uncertainty. These can be used in health care and other planning. The modelling in this research findings is undertaken using different types of data which going forward aims to both model the progress of the epidemic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

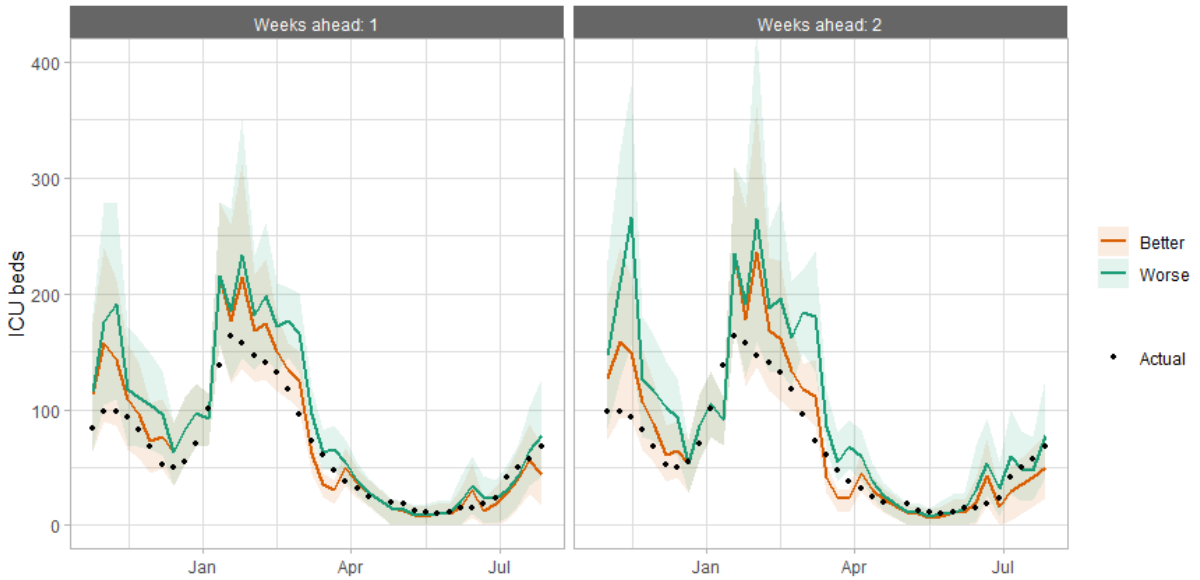
The following charts show the history of our modelling projections in comparison to estimates of the actual data. The infections projections were largely accurate during October to mid-December and from mid-January onward. During mid-December to mid-January, the projections underestimated the number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

Figure 20. 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 21. 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 22. ICU bed projections versus actuals, for historical projections published between one and two weeks before the actual data came in.

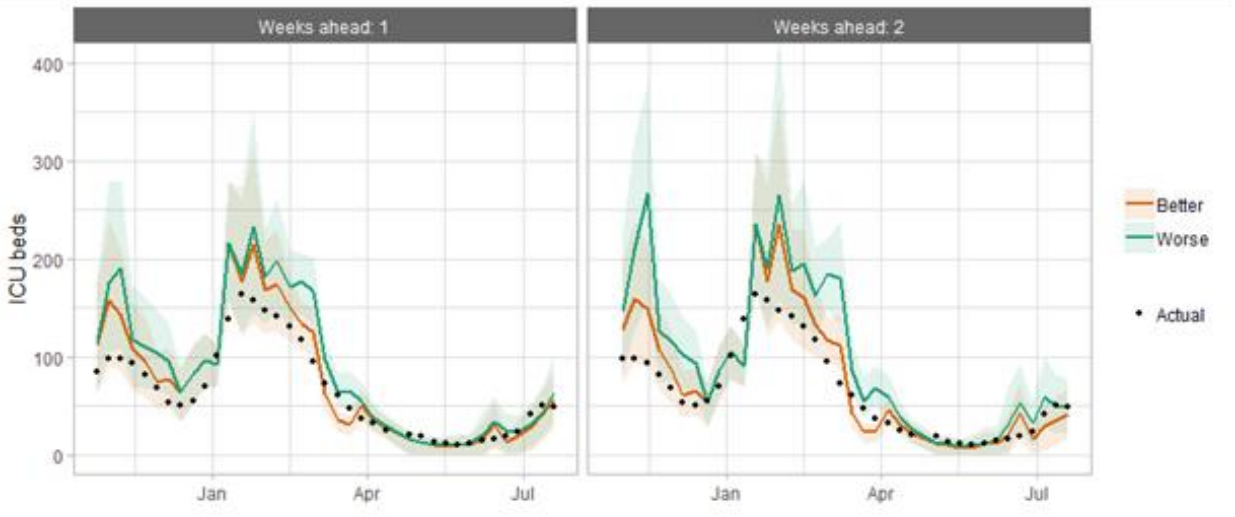


Table 1. Probability of local authority areas exceeding thresholds of cases per 100K (8th to 14th August 2021), data to 26th July.

	Probability of exceeding (cases per 100k)			
Local Authority (LA)	50	100	300	500
Aberdeen City	25-50%	15-25%	0-5%	0-5%
Aberdeenshire	25-50%	5-15%	0-5%	0-5%
Angus	25-50%	5-15%	0-5%	0-5%
Argyll and Bute	50-75%	25-50%	5-15%	0-5%
City of Edinburgh	25-50%	15-25%	0-5%	0-5%
Clackmannanshire	75-100%	50-75%	25-50%	15-25%
Dumfries & Galloway	75-100%	50-75%	15-25%	5-15%
Dundee City	25-50%	5-15%	0-5%	0-5%
East Ayrshire	75-100%	50-75%	15-25%	5-15%
East Dunbartonshire	50-75%	25-50%	5-15%	0-5%
East Lothian	50-75%	25-50%	5-15%	0-5%
East Renfrewshire	50-75%	25-50%	5-15%	0-5%
Falkirk	50-75%	25-50%	5-15%	0-5%
Fife	50-75%	15-25%	0-5%	0-5%
Glasgow City	75-100%	50-75%	5-15%	0-5%
Highland	50-75%	25-50%	5-15%	0-5%
Inverclyde	25-50%	5-15%	0-5%	0-5%
Midlothian	50-75%	25-50%	0-5%	0-5%
Moray	75-100%	50-75%	15-25%	5-15%
Na h-Eileanan Siar	5-15%	0-5%	0-5%	0-5%
North Ayrshire	50-75%	25-50%	5-15%	0-5%
North Lanarkshire	75-100%	50-75%	5-15%	0-5%
Orkney Islands	0-5%	0-5%	0-5%	0-5%
Perth and Kinross	25-50%	15-25%	0-5%	0-5%
Renfrewshire	25-50%	15-25%	0-5%	0-5%
Scottish Borders	25-50%	15-25%	0-5%	0-5%
Shetland Islands	5-15%	0-5%	0-5%	0-5%
South Ayrshire	50-75%	25-50%	15-25%	5-15%
South Lanarkshire	75-100%	25-50%	5-15%	0-5%
Stirling	75-100%	25-50%	5-15%	5-15%
West Dunbartonshire	75-100%	50-75%	15-25%	5-15%
West Lothian	75-100%	25-50%	5-15%	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 10th and 17th 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[18].

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[19]
	w/b 10th July	w/b 17th July	w/b 10th July	w/b 17th July	
Aberdeen City	27.0	51.0	27.0	51.0	80%
Aberdeenshire	27.0	33.0	27.0	30.0	52%
Angus	93.0	46.0	93.0	46.0	56%
Argyll and Bute	2.0	27.0	2.0	27.0	18%
City of Edinburgh	56.0	45.0	56.0	45.0	96%
Clackmannanshire	96.0	55.0	96.0	39.0	92%
Dumfries & Galloway	10.0	25.0	10.0	24.0	36%
Dundee City	92.0	45.0	92.0	45.0	100%
East Ayrshire	32.0	43.0	32.0	43.0	72%
East Dunbartonshire	140.0	60.0	140.0	60.0	99%
East Lothian	79.0	45.0	79.0	45.0	65%
East Renfrewshire	82.0	53.0	82.0	53.0	95%
Falkirk	61.0	33.0	61.0	33.0	69%
Fife	70.0	64.0	70.0	64.0	81%
Glasgow City	129.0	66.0	129.0	66.0	98%
Highland	47.0	32.0	37.0	32.0	37%
Inverclyde	29.0	22.0	29.0	22.0	92%
Midlothian	87.0	45.0	87.0	45.0	73%
Moray	33.0	23.0	32.0	23.0	56%
Na h-Eileanan Siar	–	13.0	–	13.0	21%
North Ayrshire	28.0	22.0	28.0	22.0	93%
North Lanarkshire	138.0	98.0	138.0	98.0	95%
Orkney Islands	29.0	6.0	29.0	6.0	34%
Perth and Kinross	72.0	27.0	72.0	27.0	45%
Renfrewshire	88.0	86.0	88.0	86.0	57%
Scottish Borders	16.0	19.0	16.0	17.0	51%
Shetland Islands	3.0	8.0	3.0	8.0	29%
South Ayrshire	27.0	45.0	27.0	45.0	88%
South Lanarkshire	88.0	60.0	71.0	56.0	84%
Stirling	33.0	15.0	33.0	15.0	63%
West Dunbartonshire	77.0	37.0	77.0	37.0	98%
West Lothian	69.0	57.0	69.0	48.0	85%

[18] 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.

[19] Coverage as at the week beginning 17th July 2021.

This publication will be available in accessible HTML on the gov.scot website

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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