

Coronavirus (COVID-19): Analysis

Coronavirus (Covid-19): modelling the epidemic in Scotland (Issue No. 91)

Background

This is a report on the Scottish Government modelling of the spread and level of Covid-19 in Scotland. This updates the previous publication on modelling of Covid-19 in Scotland published on 17th February 2022. 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.

Key Points

- The reproduction rate R in Scotland is currently estimated as being between 0.9 and 1.1, as at 8th February 2022. The lower and upper limits have increased since last week.
- The daily growth rate for Scotland is currently estimated as between -2% and 1% as at 8th February. The lower limit has increased since last week.
- The number of new daily infections for Scotland is estimated as being between 252 and 498 as at 8th February, per 100,000 people.
- Average contacts from the most recent Panel B cohort of the Scottish Contact Survey (week ending 16th February) indicate an average of 5.0 contacts. This has remained at a similar level compared to the previous Panel B of the survey (week ending 2nd February).
- Mean contacts have decreased within the work and other setting (contacts outside home, school and work) by 41% and 7% respectively within the last two weeks. Contacts within the home have remained at a similar level over the same period.
- Those within the 30-59 reported an increase in mean contacts within the last two weeks by at least 13%. All remaining age groups reported

a reduction in contacts over the same period, with the 18-29 decreasing the most by 19%. This decrease was largely driven by fall in mean contacts within the workplace.

- The biggest decrease in interactions between age groups is between those aged 18-29 with individuals under 18.
- The biggest change in the proportion of people visiting different locations is seen in those visiting a gym, up from 16% to 19% in the last two weeks.
- The proportion of contacts reported to have been indoors only has reached its highest recorded since the start of the Scottish Contact Survey, at 76%.
- The number of people wearing a face covering where they have at least one contact outside of the home has remained at a similar level in the last two weeks, currently at 83%.
- Approximately 79% of individuals had taken at least one lateral flow test within the last 7 days.
- Approximately 23% of individuals believe they have had Covid-19 at least once since March 2020.
- Modelled rates of positive tests per 100K using data to 21st February indicate that, for the week commencing 6th March 2022, all 32 local authorities are expected to exceed 50 cases per 100K with at least 75% probability. These local authorities are also expected to exceed 100 cases per 100K with at least 75% probability.
- 26 of the 32 local authorities are expected to exceed 300 cases per 100K, with at least 75% probability. The exceptions are Dumfries & Galloway, East Ayrshire, Na h-Eileanan Siar, North Ayrshire, Scottish Borders and South Ayrshire.
- Five local authorities are expected to exceed 500 cases per 100K, with at least 75% probability. These are Aberdeenshire, Angus, Highlands, Orkney Islands and Shetland Islands.
- Analysis indicates that there remains a substantial variation in risk of infection by age. Deprivation in this period is not a substantial factor.
- The distribution of lateral flow/LFD tests being reported continues to vary substantially by both age and deprivation status, with many fewer tests reported in younger adults across all deciles of deprivation, and for children in more deprived deciles. The high level of LFD positivity in the latter category is marked, and when compared to the high number of positives amongst the least deprived, suggests this may reflect under ascertainment.
- Nationwide, wastewater Covid-19 RNA levels did not continue the upturn seen last week. The week ending on 21st February saw levels

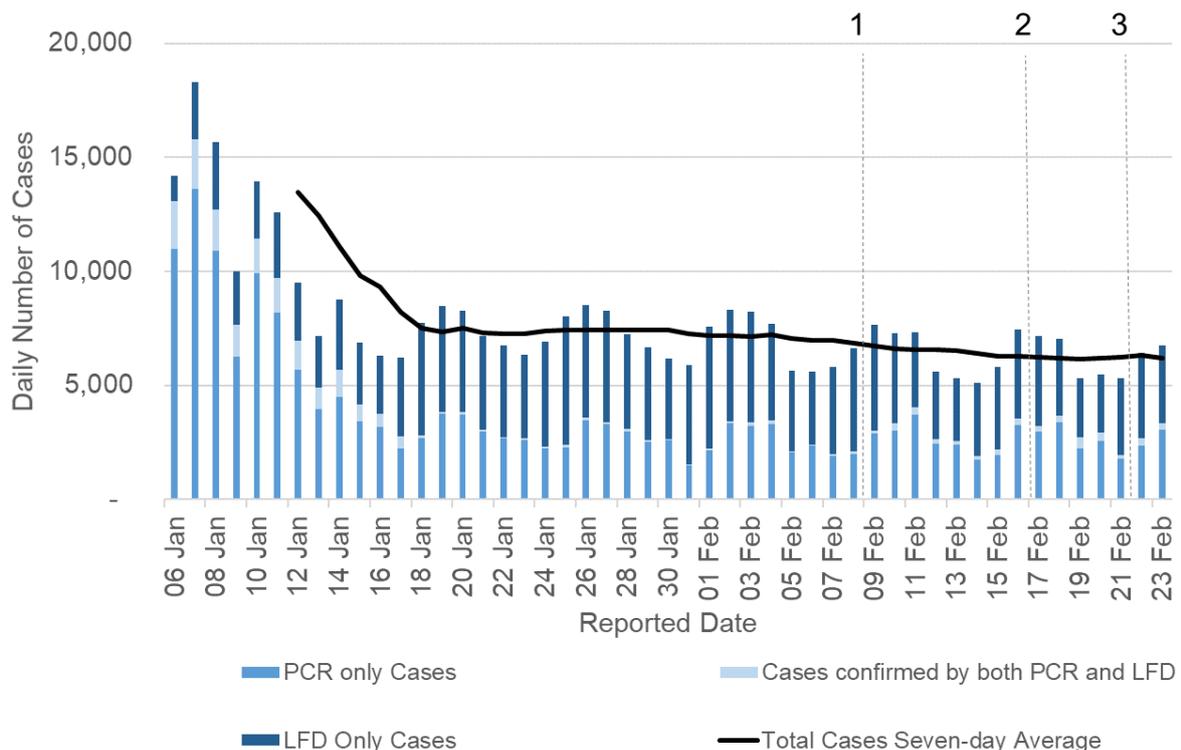
of around 76 million gene copies per person per day (Mgc/p/d), somewhat lower than 90 Mgc/p/d the previous week.

- In this research findings we also include a new section looking at what may happen in the future around Covid-19 using a range of plausible scenarios.

Recent cases

Figure 1 shows the number of Covid-19 cases (from either PCR or LFD) in Scotland between January and February 2022. 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: PCR and LFD positive daily and weekly case numbers by reporting date¹



R, growth rate and incidence are as of 8th February 2022 (dashed line 1). The Scottish Contact Survey uses data to 16th February 2022 (dashed line 2). The modelled rates of positive tests per 100K and the wastewater analysis use data to 21st February (dashed line 3).

¹ [Coronavirus \(Covid-19\): trends in daily data - gov.scot \(www.gov.scot\)](https://www.gov.scot/coronavirus-covid-19-trends-in-daily-data)

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 change in the epidemic.

This week the Scottish Government presented two outputs to EMRG. The first uses the number of positive LFD or PCR tests, as published by PHS Scotland. The second uses wastewater data. These outputs are included in Figures 2 and 3.

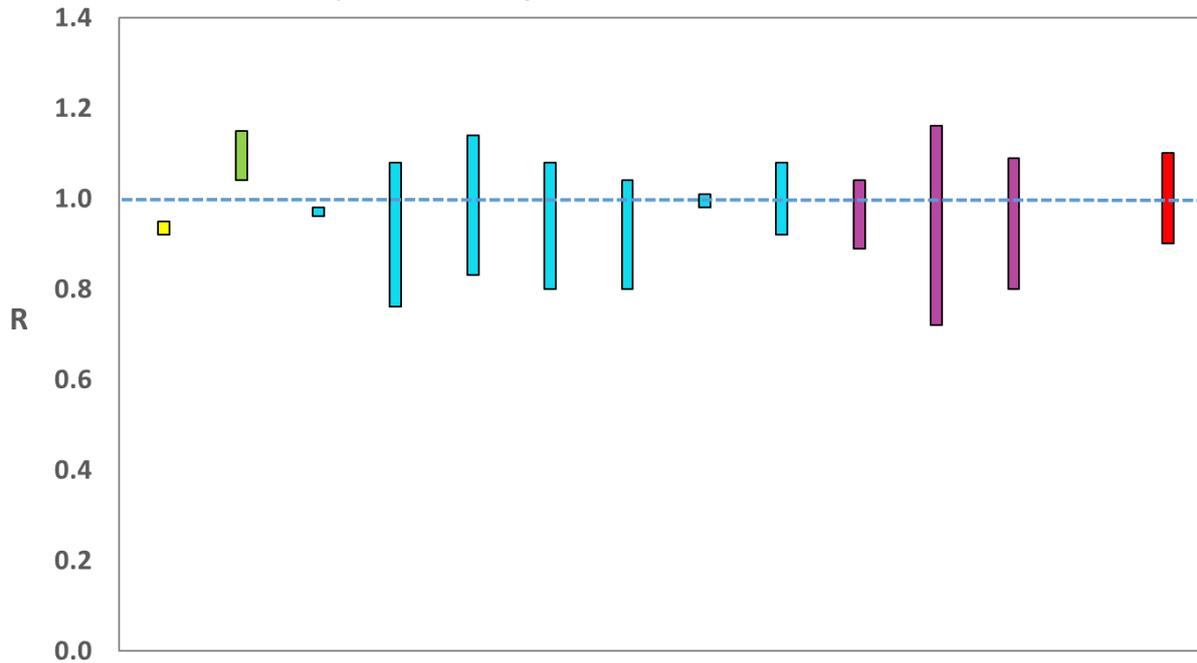
The R value and growth rates are estimated by several independent modelling groups based in universities and the UKHSA. Estimates are considered, discussed and combined at the Epidemiology Modelling Review Group (EMRG), which sits within the UKHSA. These are based on data to 21st February.

UKHSA's consensus view across these methods was that the value of R in Scotland² is between 0.9 and 1.1, as of 8th February 2022³ (Figure 2). R is an indicator that lags by two to three weeks.

² Using data to 21st February.

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 8th February, including 90% confidence intervals, produced by EMRG⁴.

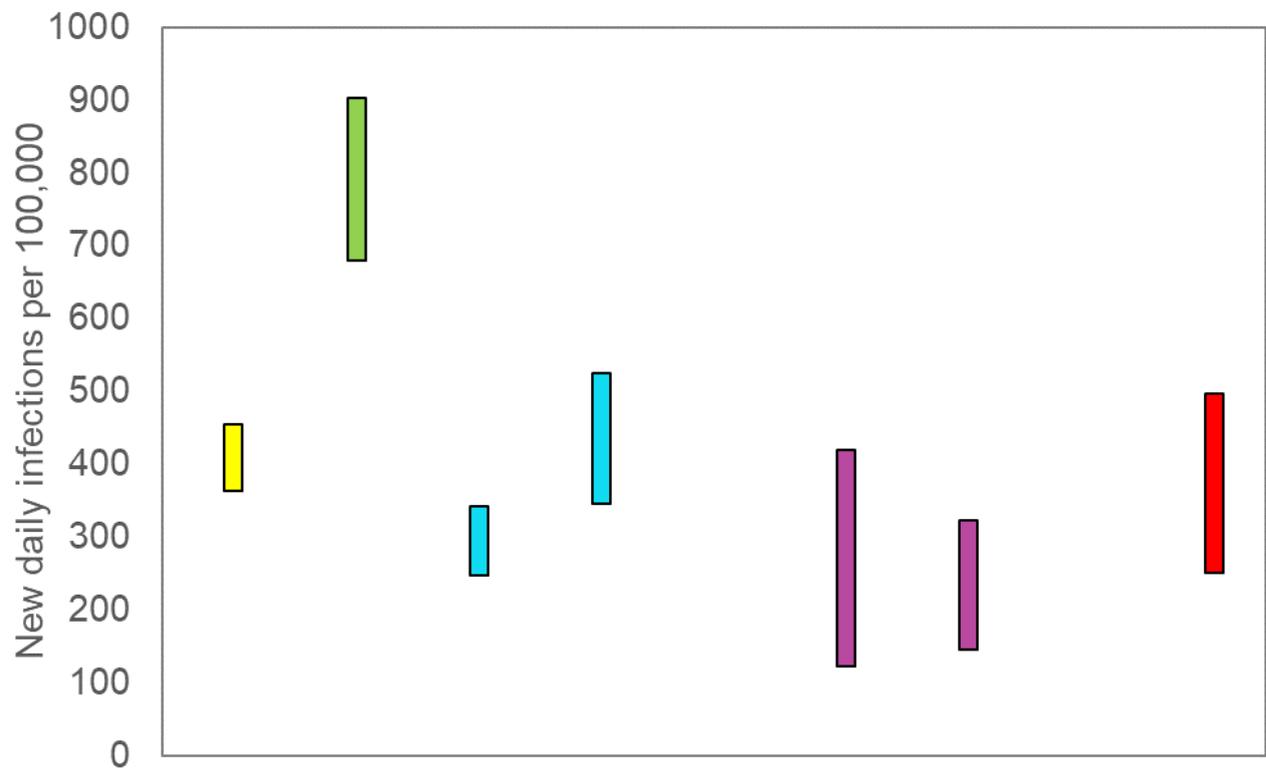


Source: EMRG

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, as at 8th February, was that the incidence of new daily infections in Scotland was between 252 and 498 new infections per 100,000. This equates to between 13,800 and 27,200 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). Data to 21st February 2022. R, incidence and growth rate as of 8th February 2022.

Figure 3. Estimates of incidence for Scotland, as at 8th February, including 90% confidence intervals, produced by EMRG.



Source: EMRG

The consensus from UKHSA for this week is that the growth rate in Scotland is between -2% and 1% per day as at 8th February. The lower limit has increased since last week.

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

Average contacts from the most recent Panel B cohort of the Scottish Contact Survey (week ending 16th February) indicate an average of 5.0 contacts. This has remained at a similar level compared to the previous Panel B of the survey (week ending 2nd February), as seen in Figure 4. Mean contacts have decreased within the work and other setting (contacts outside home, school and work) by 41% and 7% respectively within the last two weeks. Contacts within the home have remained at a similar level over the same period but contacts within the school setting have almost tripled in the last two weeks.

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

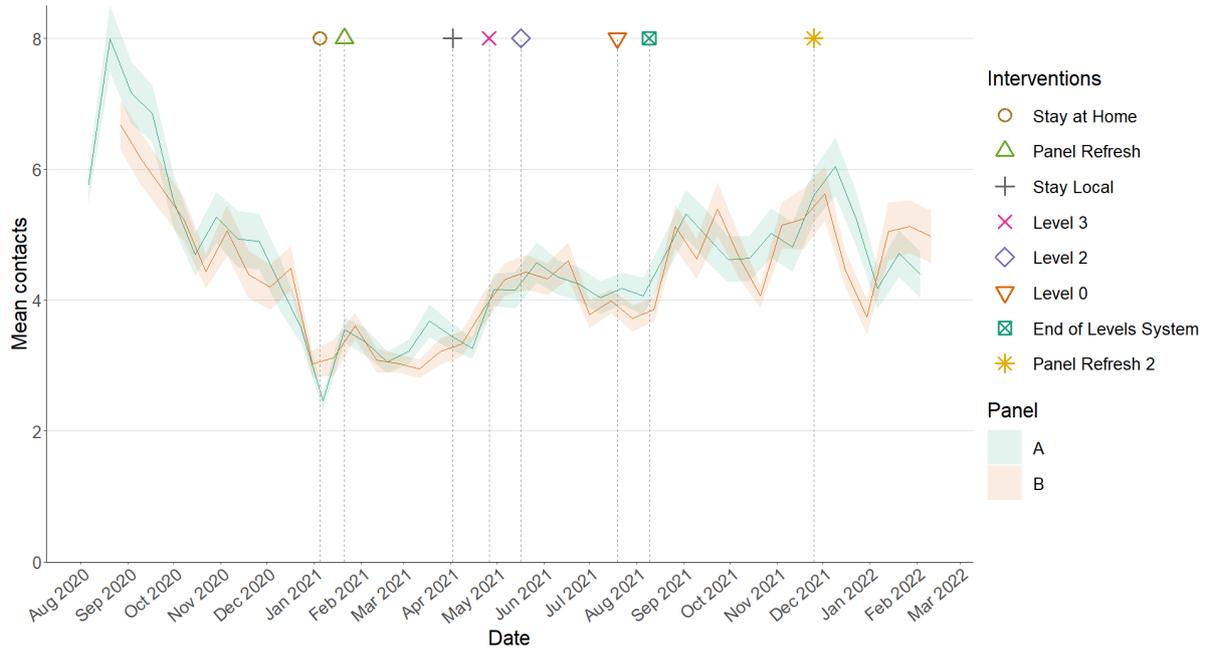
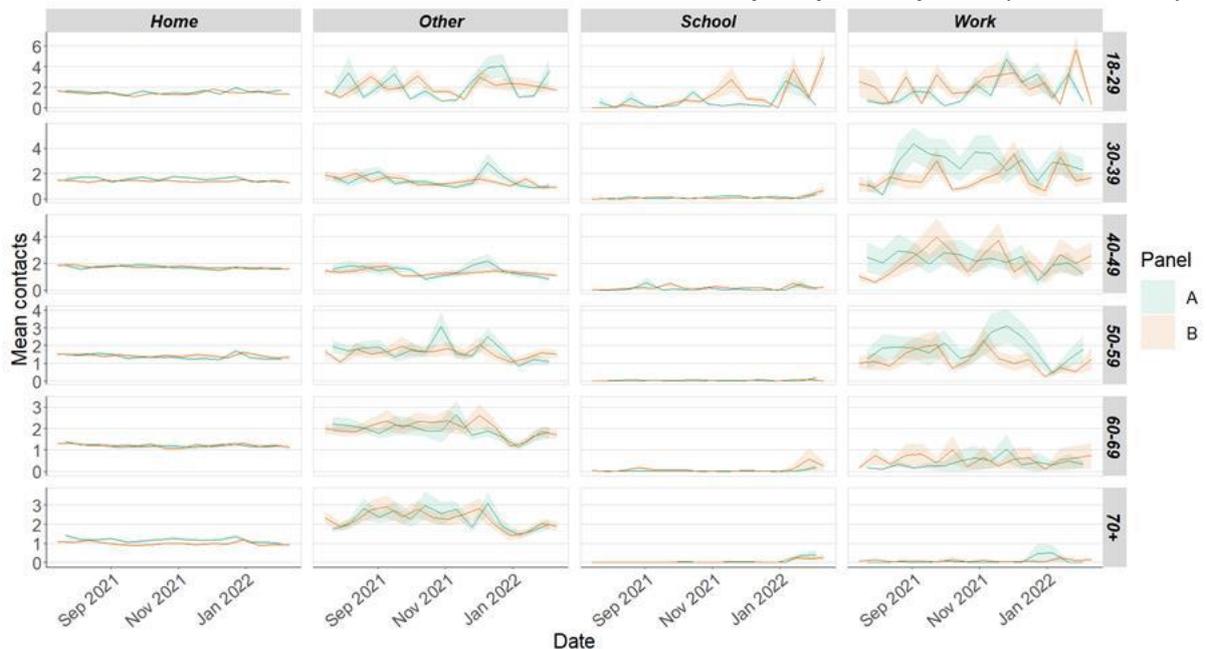


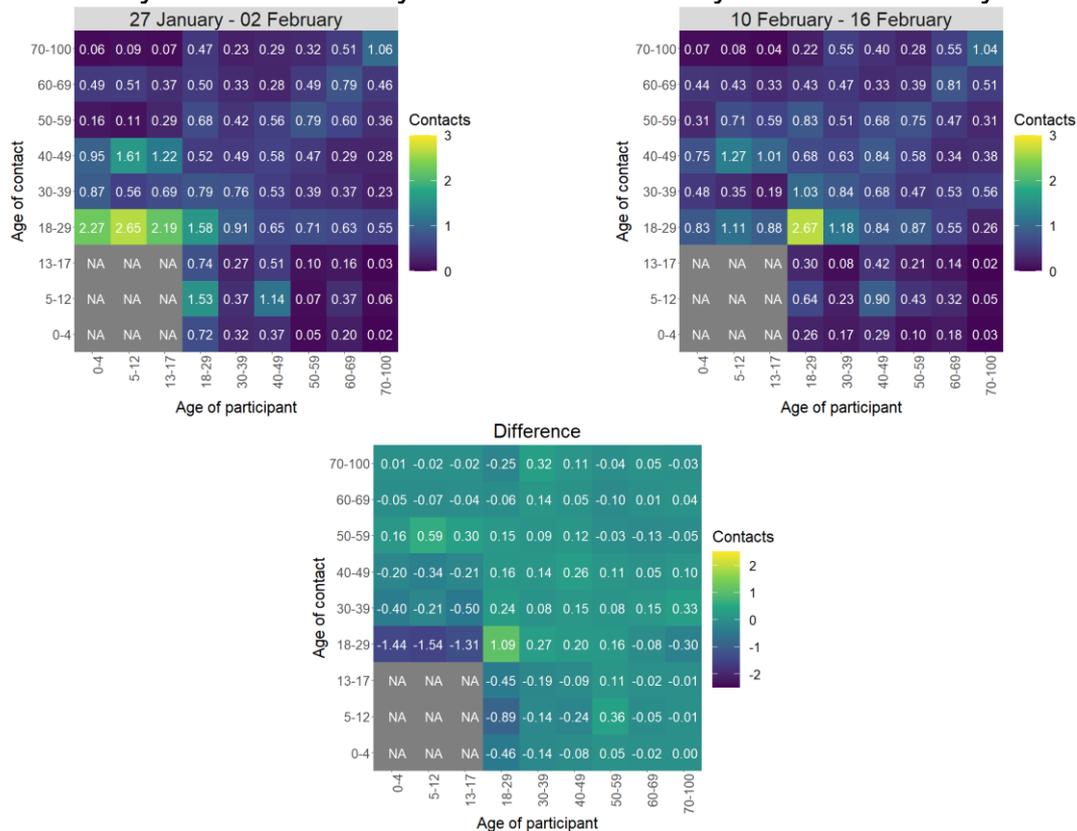
Figure 5 shows how contacts change across age group and setting. Those within the 30-59 age group reported an increase in mean contacts within the last two weeks by at least 13%. All remaining age groups reported a reduction in contacts over the same period, with the 18-29 age group decreasing the most by 19%. This decrease was largely driven by a fall in mean contacts within the workplace.

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 27th January - 2nd February and 10th February - 16th February, and the difference between these periods. The biggest decrease in interactions between age groups is between those aged 18-29 with individuals aged under 18.

Figure 6. Overall mean contacts by age group for the weeks relating to 27th January - 2nd February and 10th February - 16th February.



As shown in Figure 7, there has been little change in the number of participants visiting settings in the last two weeks. The biggest change is seen in the proportion of people visiting a gym, up from 16% to 19% in the last 2 weeks.

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

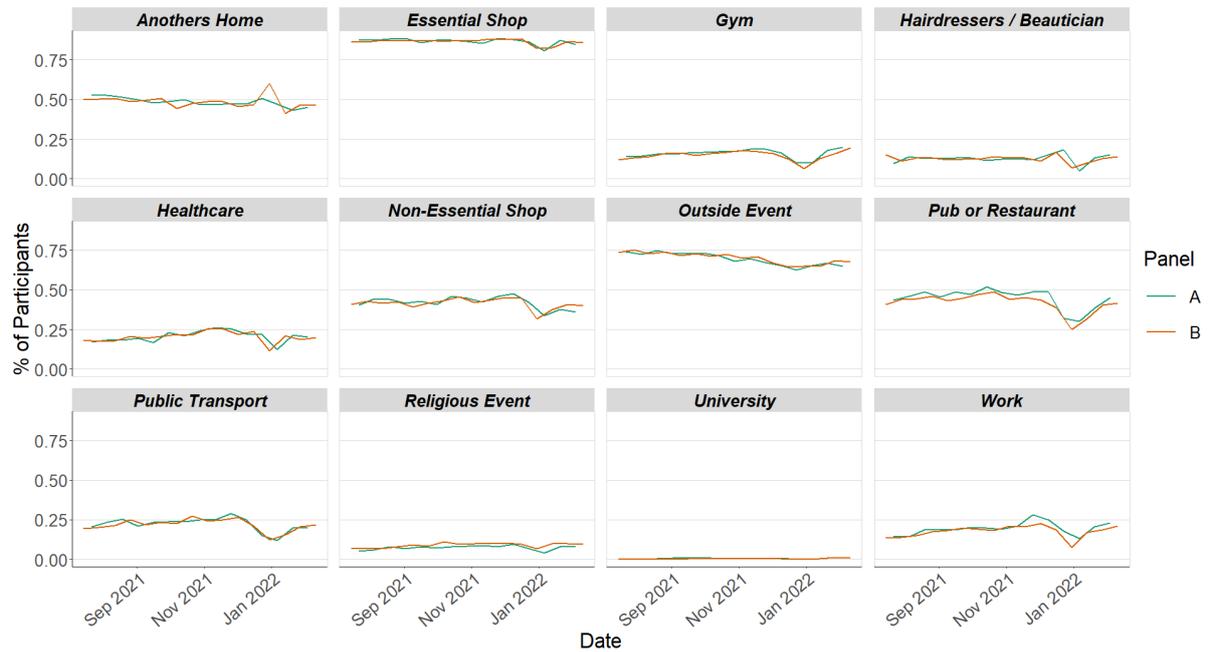


Figure 8 shows the proportion of participants that reported indoor and outdoor for contacts for panel A. A contact can also be recorded as both indoor and outdoor. The proportion of contacts reported to have been indoors only has reached its highest recorded since the start of the Scottish Contact Survey, at 76%

Figure 8. Proportion of participants reported indoors and outdoors for contacts individually reported for panel B.

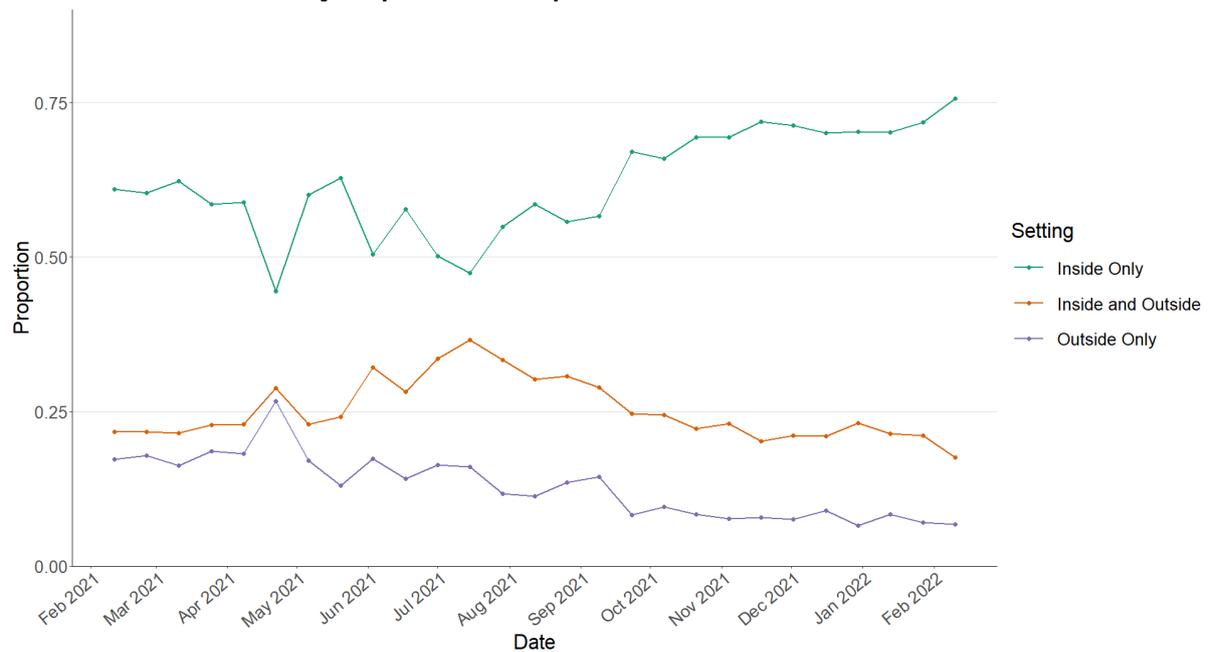
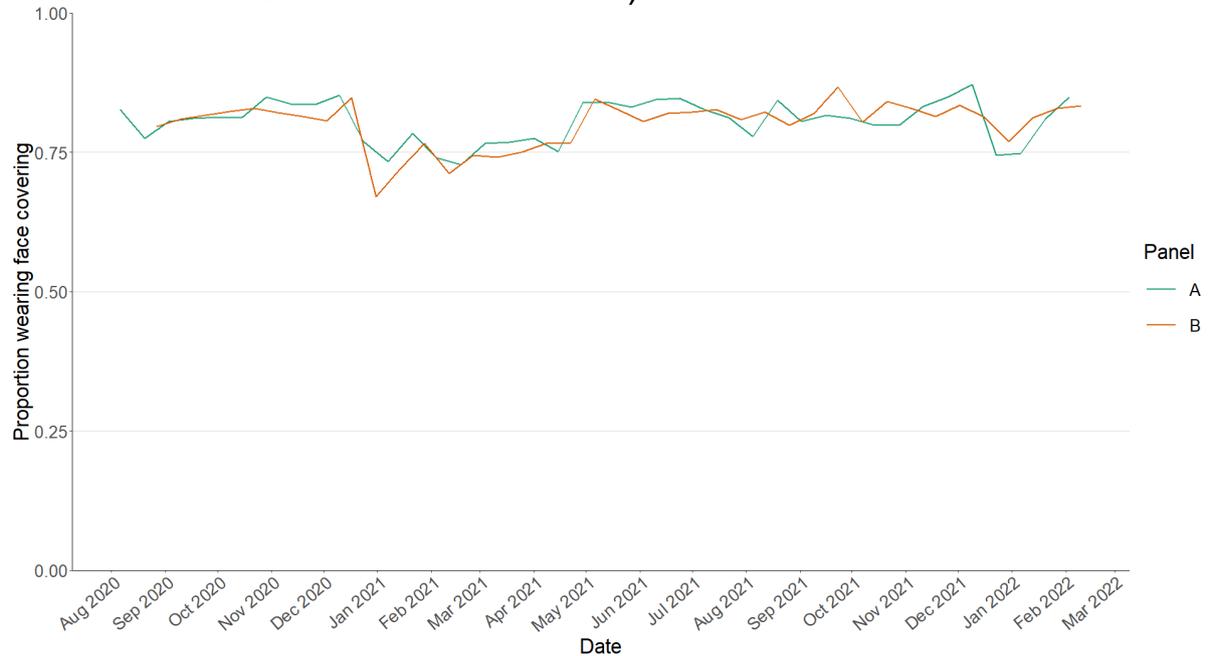


Figure 9 shows the number of people wearing a face covering where they have at least one contact outside of the home. This has remained at a similar level in the last two weeks, currently at 83%.

Figure 9: Proportion of adults wearing a face coverings over time (with at least one contact outside of the home).



Approximately 79% of individuals had taken at least one lateral flow test within the last 7 days for the survey pertaining to the 10th February - 16th February, increasing from 74% two weeks prior as shown in Figure 10.

Figure 10: Number of days participants taken a lateral flow in last 7 days.

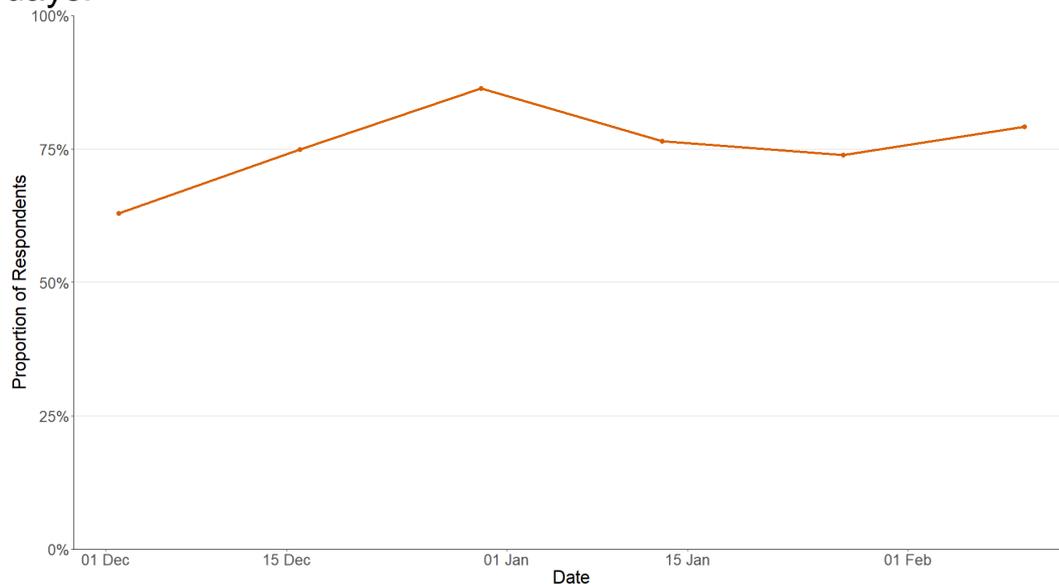
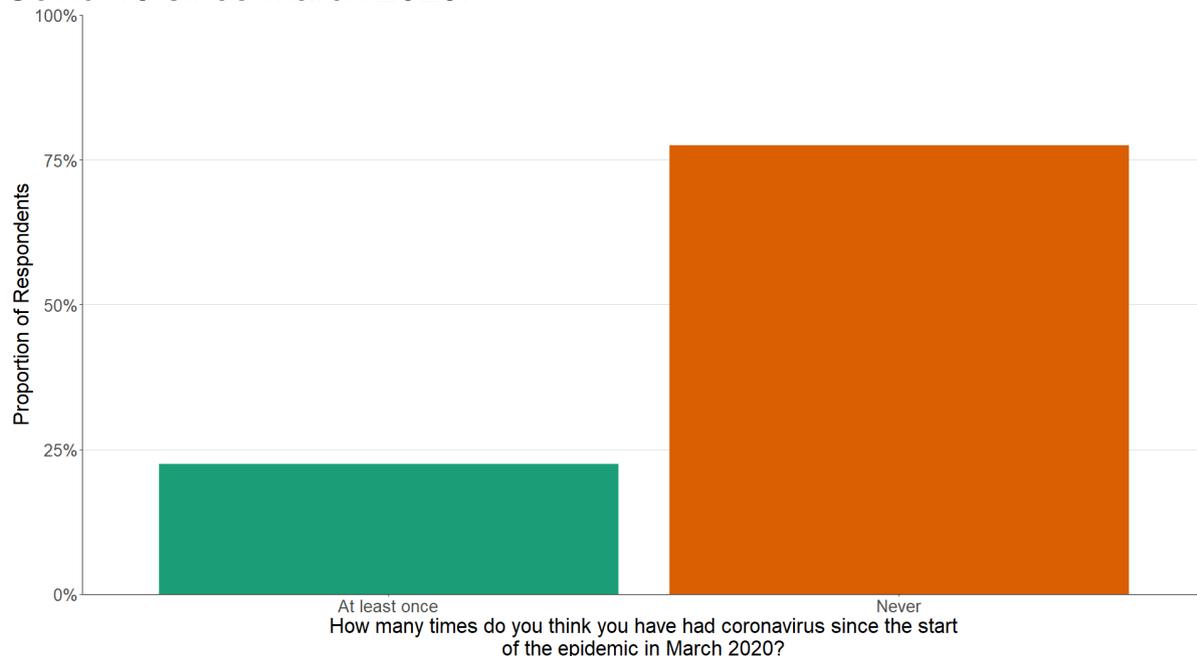


Figure 11 shows that approximately 23% of individuals believe they have had Covid-19 at least once since March 2020. Of those who think they have had Covid-19, 75% have had this confirmed through a test.

Figure 11: Proportion of participants who believe they have had Covid-19 since March 2020.



Medium-term projections

Due to the different timings of the publication of Scottish data streams, SPI-M-O has been unable to produce a consensus for hospital admissions and deaths in Scotland over the next four weeks. A change in data trend between Friday 18th February and Monday 21st February affected the individual modelling outcomes, and so different projections were outputted depending on the time in which the data was downloaded. SPI-M-O will look to produce projections for Scotland again next week.

In the absence of the SPI-M-O consensus we have not been able to corroborate the Scottish Government's Medium Term Projections and will therefore look to produce these projections again from next week.

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 21st February 2022 from several academic groups to give

us an indication of whether a local authority is likely to experience elevated levels of Covid-19 in the future. This has not been compiled via UKHSA into a consensus this week and is based on one modelling group due to issues with some of the models converging. 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.

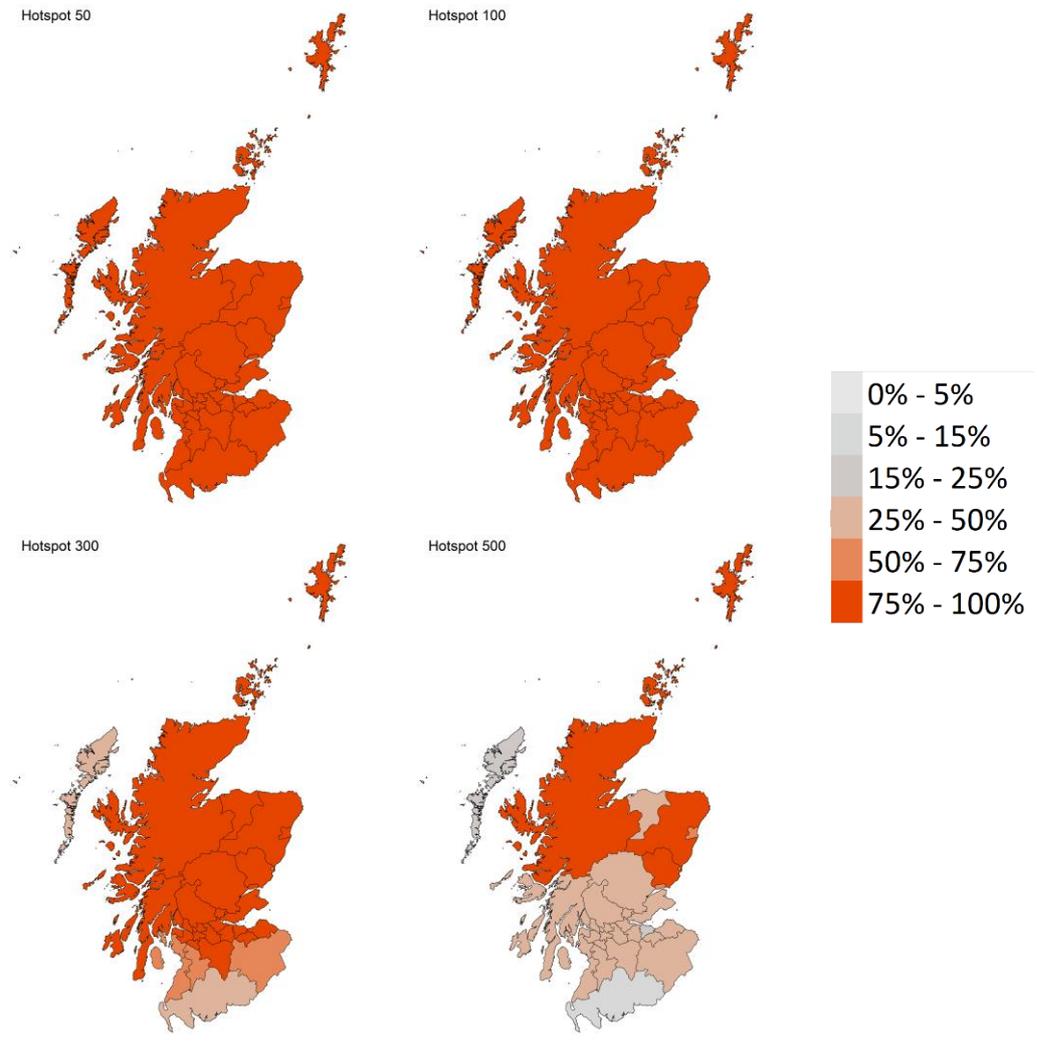
Some of the models contributing to this analysis are informed by both PCR and LFD positive tests whilst others are currently informed by PCR only.

Modelled rates of positive tests per 100K using data to 21st February (Figure 12) indicate that, for the week commencing 6th March 2022, all 32 local authorities are expected to exceed 50 cases per 100K with at least 75% probability. These local authorities are also expected to exceed 100 cases per 100K with at least 75% probability.

26 of the 30 local authorities included are expected to exceed 300 cases per 100K, with at least 75% probability. The exceptions are Dumfries & Galloway, East Ayrshire, Na h-Eileanan Siar, North Ayrshire, Scottish Borders and South Ayrshire.

Five local authorities are expected to exceed 500 cases per 100K, with at least 75% probability. These are Aberdeenshire, Angus, Highlands, Orkney Islands and Shetland Islands.

Figure 12. Probability of local authority areas exceeding thresholds of cases per 100K (6th March to 12th March 2022), data to 21st February.



Looking to the future

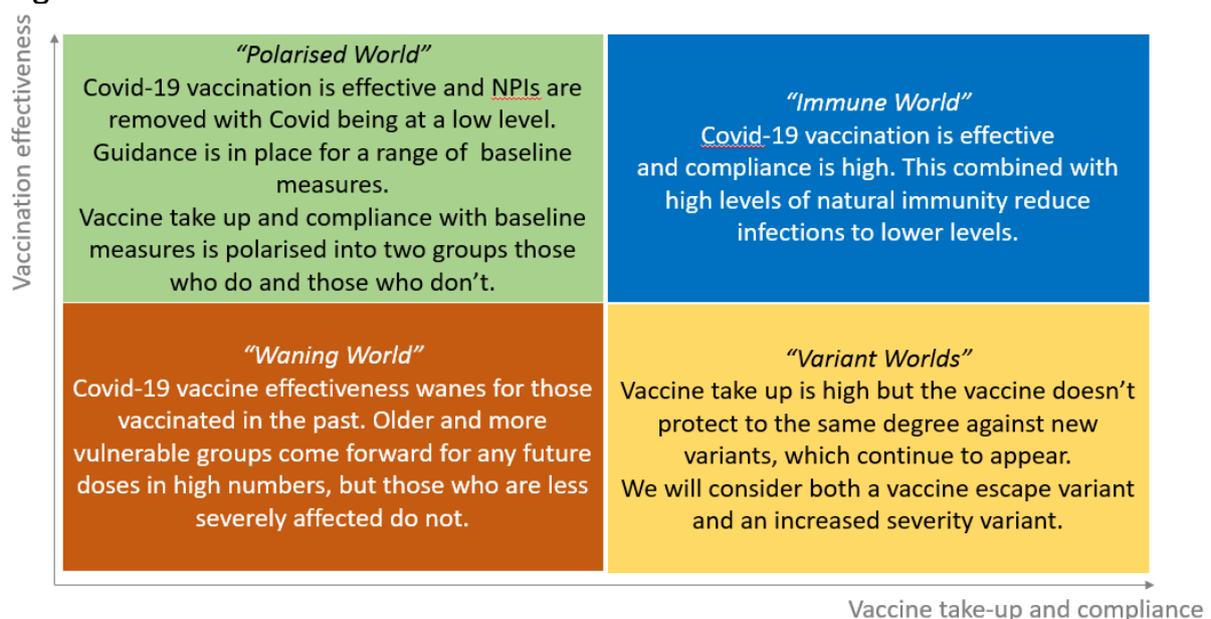
What may happen in the future around SARS-CoV-2 is uncertain and therefore there are a number of possible Covid-19 futures that may occur in the future. For example, the current Omicron wave may dissipate leaving low levels of Covid-19, or a new variant may emerge potentially having vaccine escape or increased severity, or people's behaviours may change. One approach to this uncertainty is to model alternative versions of the future through the development of different Covid-19 scenarios. See the Technical Annex for more details on how we do this modelling.

This analysis was included in our recent evidence paper accompanying the Scottish Government’s strategic framework⁵. We repeat this analysis here and will update in future publications.

Given what we know about Covid-19 these possible futures range from a world where immunity reduces Covid-19 hospitalisations and deaths to low levels, through to variant world where a variant with immune escape enters Scotland and Covid-19 hospitalisations and deaths could increase. In between these two extremes could be possible futures where vaccine effectiveness wanes or where people’s behaviour becomes polarised between those who continue with Covid-19 precautions e.g. hand washing etc. and those who do not (see Figure 13).

The scenarios we provide in the next section look at what could happen for planning purposes, not to forecast what will happen. These scenarios include no changes from the current baseline measures. The assumptions are based on our most up to date knowledge, but do not include the effect of future changes in treatment of Covid-19 e.g. widespread use of antivirals or changes in behaviour in response to high levels of infections e.g. in variant world. Therefore, in the most extreme scenarios the peak may be lower than suggested if behaviour or restrictions changed.

Figure 13. Potential scenarios for the future



⁵ [Evidence paper to accompany: Coronavirus \(COVID-19\) Scotland's Strategic Framework Update – February 2022 - gov.scot \(www.gov.scot\)](https://www.gov.scot/resources/documents/2022/02/Evidence-paper-to-accompany-Coronavirus-COVID-19-Scotland's-Strategic-Framework-Update-February-2022.pdf)

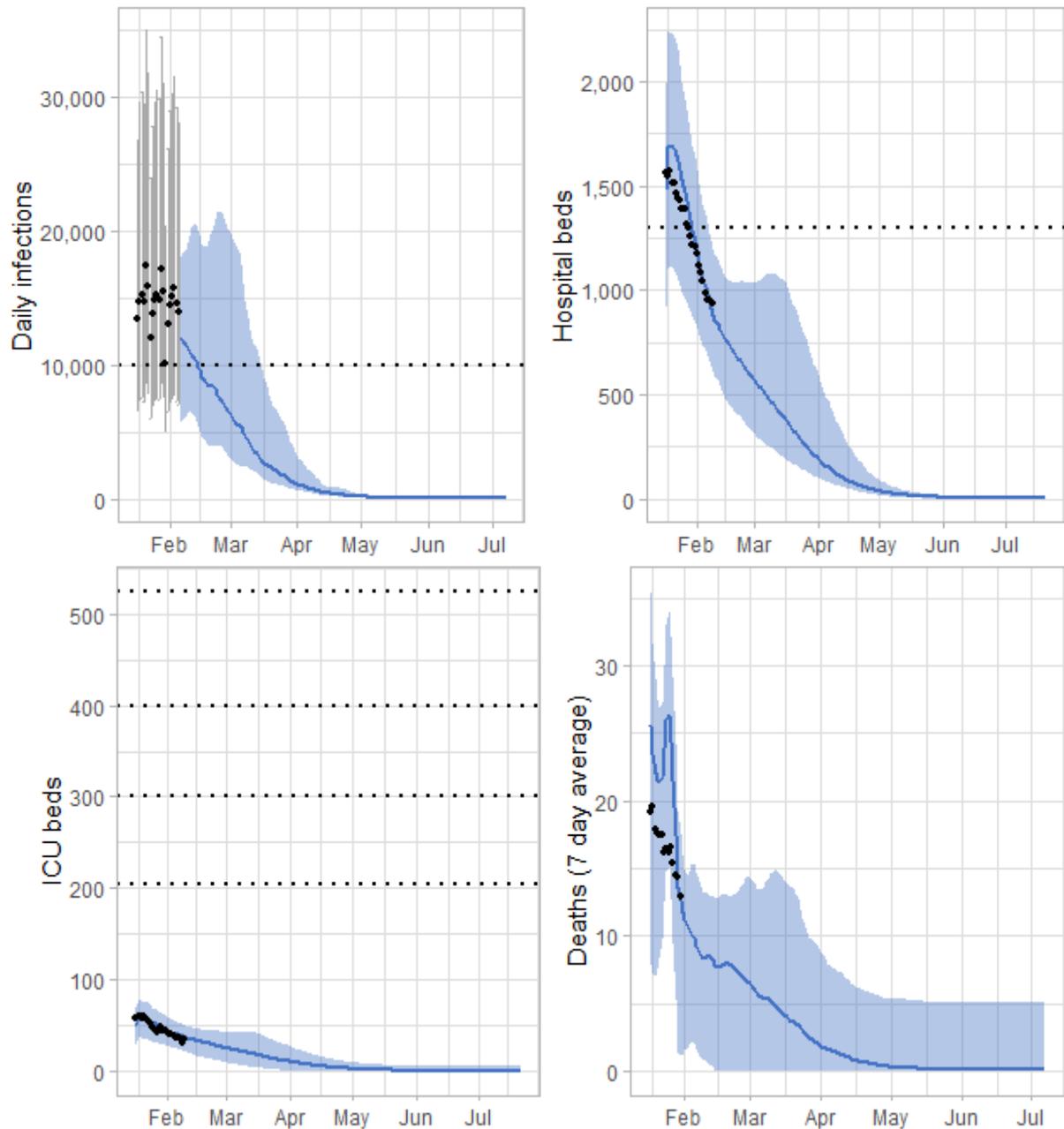
There is no linear progression between the worlds and all are plausible. Each world inherently contains a different threat level requiring a different approach to management.

Immune World

In this possible future vaccines and natural immunity are effective at keeping Covid-19 at low levels. Baseline measures and LFD testing are in place to protect the vulnerable e.g. elderly and immune compromised and adhered to by the public to high levels. New variants may emerge in Scotland but for the foreseeable future infections are based around Omicron.

Infections may decrease from current levels over the coming weeks and months to very low levels. Likewise hospital and ICU occupancy may follow this trend relieving the pressure on healthcare services. Issues with vaccine waning and new variants are not considered in this world and therefore levels of infections remain low (<1,000 per day).

Figure 14. Potential infections, hospital occupancy, ICU occupancy, and deaths trajectory in Immune World⁶



In Immune world Covid-19 in Scotland reduces below epidemic levels, becoming endemic. Cases of Covid-19 therefore spring up only as rare outbreaks which are controlled through public health measures. People's lives return to something close to normality e.g. physical distancing is not needed but people still choose to self-isolate and hygiene is good. As vaccines are effective, take-up of first/second/third doses are good and boosters become part of an annual cycle like flu. The numbers of

⁶ [Coronavirus \(Covid-19\): trends in daily data - gov.scot \(www.gov.scot\)](https://www.gov.scot/coronavirus-trends-daily-data)

people who need medical treatment or hospitalisation for Covid-19 remain low.

The focus moves away from Covid-19 response and into recovery. This includes addressing learning losses, treating Long Covid and working through the hospital backlog. Wellbeing measures improve with reduced anxiety and increased happiness. Those from the highest risk groups feel they can reintegrate without government interventions. The economy begins to recover from the effects of Covid-19. Travellers do not face significant issues with trips overseas.

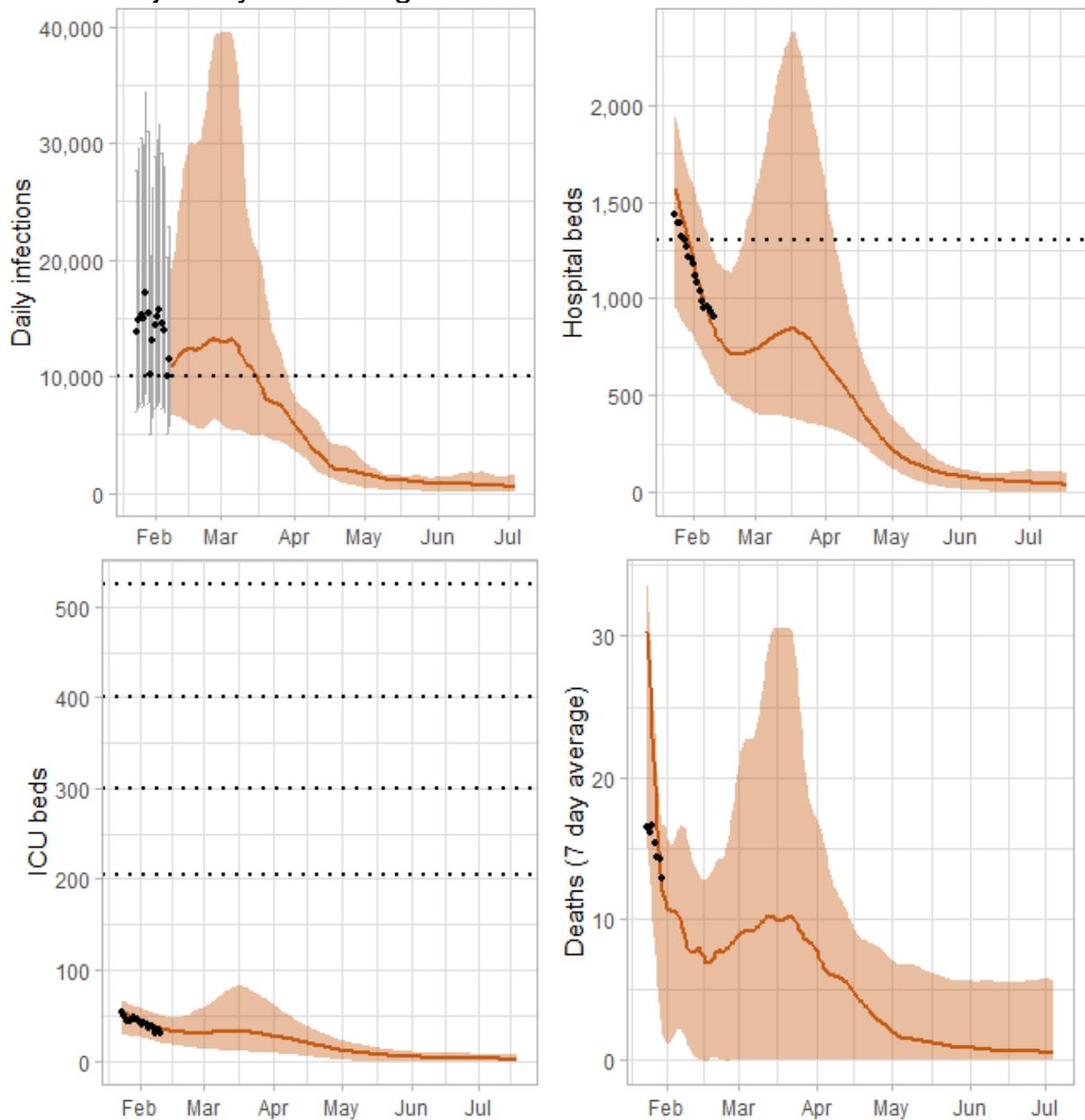
Waning world

In this world Covid-19 vaccines are effective over several months, but waning then occurs. It is hard to keep pace with booster vaccinations which become increasingly difficult to justify. Demands for vaccines throughout the rest of the world and the increasing reluctance of people in Scotland to keep being boosted reduces the overall immunity levels of the population.

Infections may not substantially decrease from current levels initially before falling in March as the natural immunity begins to offset the waning of vaccine acquired immunity.

Impacts on hospital/ICU occupancy and deaths are uncertain. While at relatively low levels infections may be between 500 – 2,000 per day by summer. These levels would be higher than has been observed in summer 2020 and 2021 and higher than what may happen in immune world (see Figure 15).

Figure 15. Potential infections, hospital occupancy, ICU occupancy, and deaths trajectory in Waning World⁷



The number of people who need medical treatment or hospitalisation for Covid-19 rises particularly in vulnerable/older age groups where it is increasingly difficult to deliver an effective booster regime.

The focus continues to be on Covid-19 response and it is harder to shift on to recovery. Hospitals are still dealing with increasing cases of Covid-19 putting pressure on healthcare services and workforce which also puts pressure on other public services and budgets. Work is

⁷ [Covid-19 vaccine weekly surveillance reports \(weeks 39 to 7, 2021 to 2022\) - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/collections/covid-19-vaccine-weekly-surveillance-reports)

ongoing on rectifying learning loss but continued cases of Covid-19 within education settings with children and staff being off school slows the effectiveness of this work.

The population becomes segmented as the most vulnerable due to vaccine waning lead restricted lives or accept significant risk of serious illness and experience high levels of anxiety and low levels of wellbeing. The rest of the population live a more normal life accepting the possibility of infection with mild illness. Anxiety reduces but does not disappear, likewise wellbeing increases but there is still concern about infection. The economy continues to be impacted by workforce absences, the self-shielding actions of a proportion of the population and risk adverse behaviours.

Polarised world

In this world, vaccines and natural immunity are effective at reducing infections. Baseline guidance remains in place, with face coverings, physical distancing and some testing. The approach followed relies on individual risk assessment and behaviours. However society becomes polarised as some continue to take up vaccines and follow guidance while others are more reluctant. Covid-19 becomes a disease associated with those who do not or cannot get full vaccine benefit and do not or cannot adopt a risk based approach maintaining baseline measures.

Infections may decrease from current levels over the coming weeks and months to low levels but more slowly than in other scenarios due to various groups behaving differently across society.

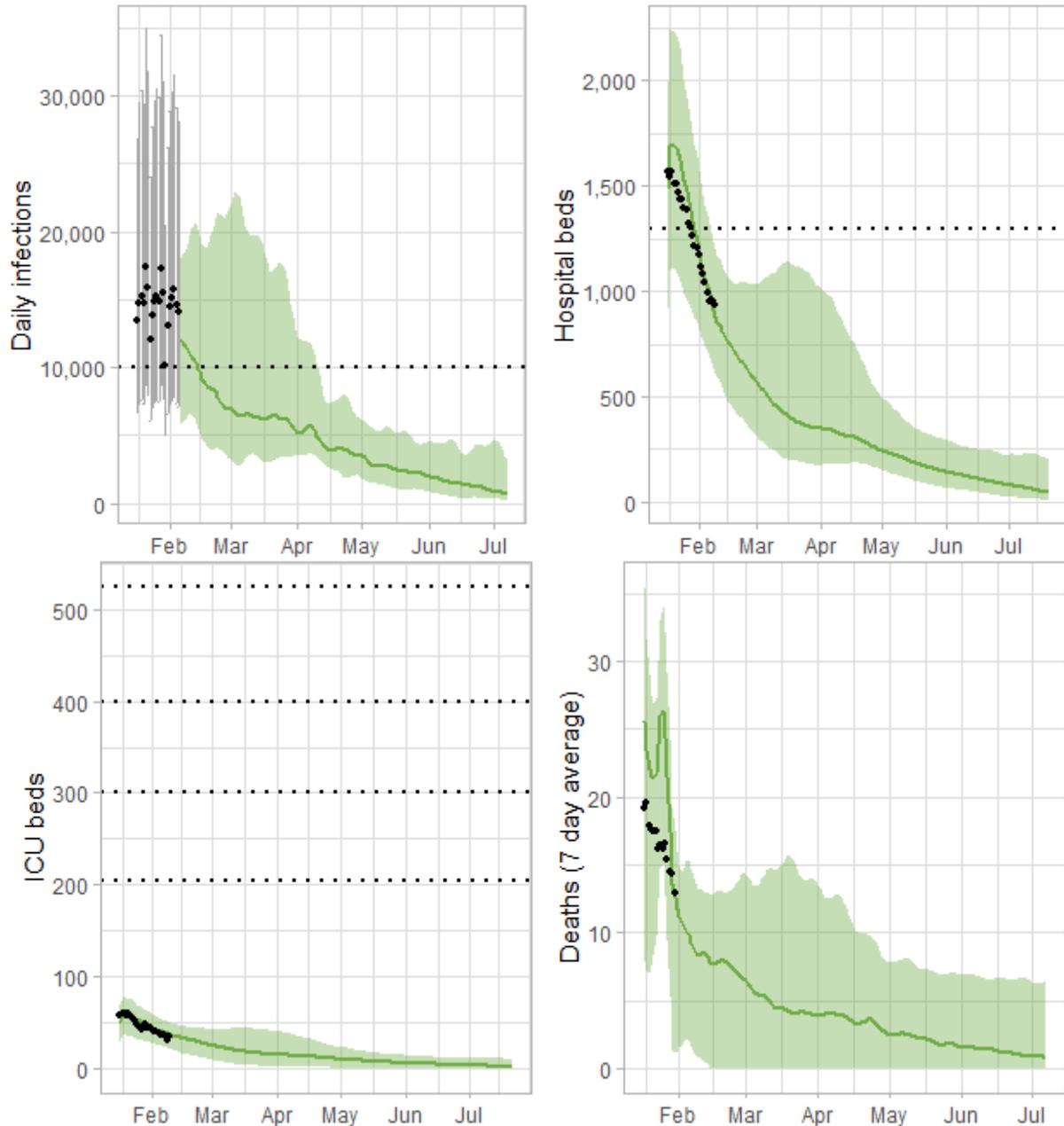
This world assumes that infections continue to decrease in the coming weeks with behavioural changes beginning to occur in response to this and to the better weather from March. Unvaccinated adults and those with one dose are assumed to return to pre-pandemic behaviours within six weeks. Adults with two doses are assumed to return to these behaviours over 12 weeks, with those with three doses assumed to have no significant changes in behaviour.

Vaccine waning is included in this world whereby only some of those with three doses come forward for a potential fourth dose.

While at relatively low levels infections may be between 1,000 – 5,000 per day by summer. These levels would be higher than has been

observed in summer 2020 and 2021 and higher than what may happen in immune world (see Figure 16).

Figure 16. Potential infections, hospital occupancy, ICU occupancy, and deaths trajectory in Polarised World⁸



Cases of Covid-19 spring up and are hard to control in those who are not vaccinated or vulnerable. People’s lives return to a “new normal” but, due to polarised groups in society with some following and some not following the guidance on baseline restrictions, infections remain.

⁸ [Covid-19 vaccine weekly surveillance reports \(weeks 39 to 7, 2021 to 2022\) - GOV.UK](https://www.gov.uk/government/collections/covid-19-vaccine-weekly-surveillance-reports)
(www.gov.uk)

Vaccines are effective so older and more vulnerable people come forward for future doses in high numbers but those who are less severely affected do not. Vulnerable groups such as the very elderly and immune compromised are at risk from infection from those not vaccinated or boosted.

The focus remains on Covid-19 and the shift onto recovery is slower. Existing learning losses are harder to rectify and continue to accrue due to infections within education settings. The hospital backlog is difficult to address as hospitals are still dealing with Covid-19 cases. The population becomes polarised in to those whose wellbeing improves e.g. lower risk people and those whose wellbeing deteriorates e.g. higher risk or poorer people whose levels of anxiety increase as Covid-19 circulates. They continue to experience greater illness, greater poverty or disruption to their income. The economy continues to be impacted from the effects of Covid-19. Unvaccinated travellers continue to face significant uncertainty with trips.

Variant world – vaccine escape with same severity as Delta

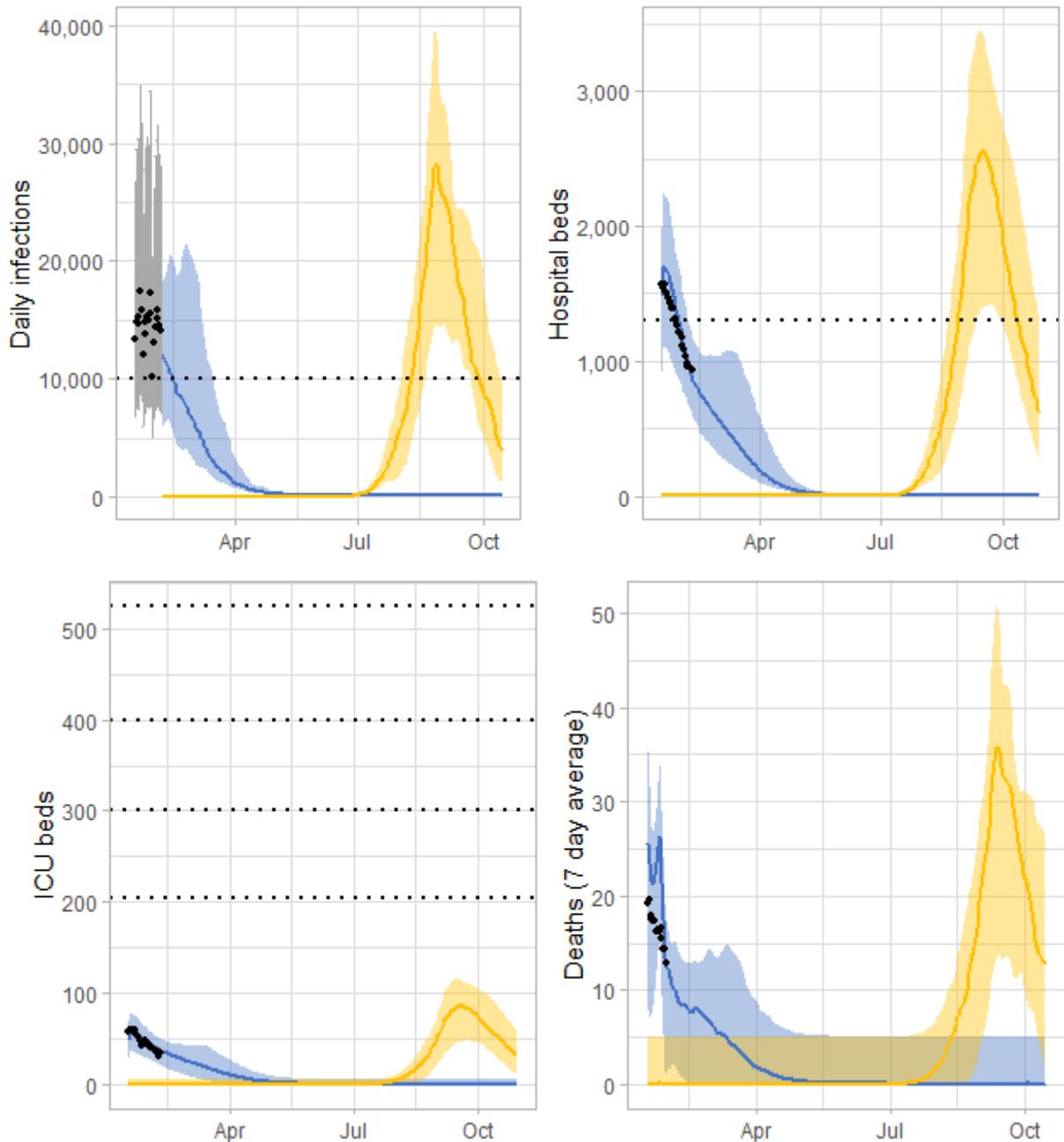
In this possible future a variant with vaccine escape emerges in Scotland presenting a challenge even for fully vaccinated people. This new variant leads to increased transmission, but not to increased severity. Baseline measures – face coverings, LFD, physical distancing remain and, in this scenario other NPIs may need to be put in place for a short time. This world is similar to what has happened in Scotland with the emergence of Omicron.

Omicron may be reduced to low levels within Scotland as a new variant takes over. This causes a new wave of Covid-19 infections. However this wave is not accompanied by significant numbers with serious illness and vaccines continue to protect. People's lives are disrupted due to the increasingly high levels of infections leading to time off work ill or isolating.

To show the potential impact assume a new variant appears in Scotland as people return from their summer holidays and return to work and school. The timing is uncertain and a potential new variant may appear sooner than the summer or significantly later but has currently been lined up with the summer holidays to show illustratively what could happen. The new variant may cause Omicron infections to decrease significantly or disappear entirely (Immune world has been used to illustrate this). The new variant is modelled with similar transmissibility

and vaccine escape as Omicron with severity characteristics similar to Delta. It could lead to high levels of infections leading to hospital occupancy rising above capacity restrictions. With sustained high levels of infection we could again see increased staff absences in a number of sectors that were affected by this in the recent Omicron wave.

Figure 17. Potential infections, hospital occupancy, ICU occupancy, and deaths trajectory in Variant World with the same severity as Delta⁹



⁹ [Coronavirus \(Covid-19\): trends in daily data - gov.scot \(www.gov.scot\)](https://www.gov.scot/coronavirus-trends-daily-data)

The focus remains on Covid-19 and it is hard to shift on to recovery. Continued infections within education settings and staff shortages make some school closures necessary. The Covid-19 strain on hospitals is high due to the very high numbers of infections and workforce pressures grow making it difficult to address the hospital backlog. Wellbeing measures deteriorate with people reporting low happiness and general 'tiredness with it all'. The economy continues to be impacted from the effects of Covid-19 with many people off work. Travellers may not want to come to the UK as the new variant sweeps through.

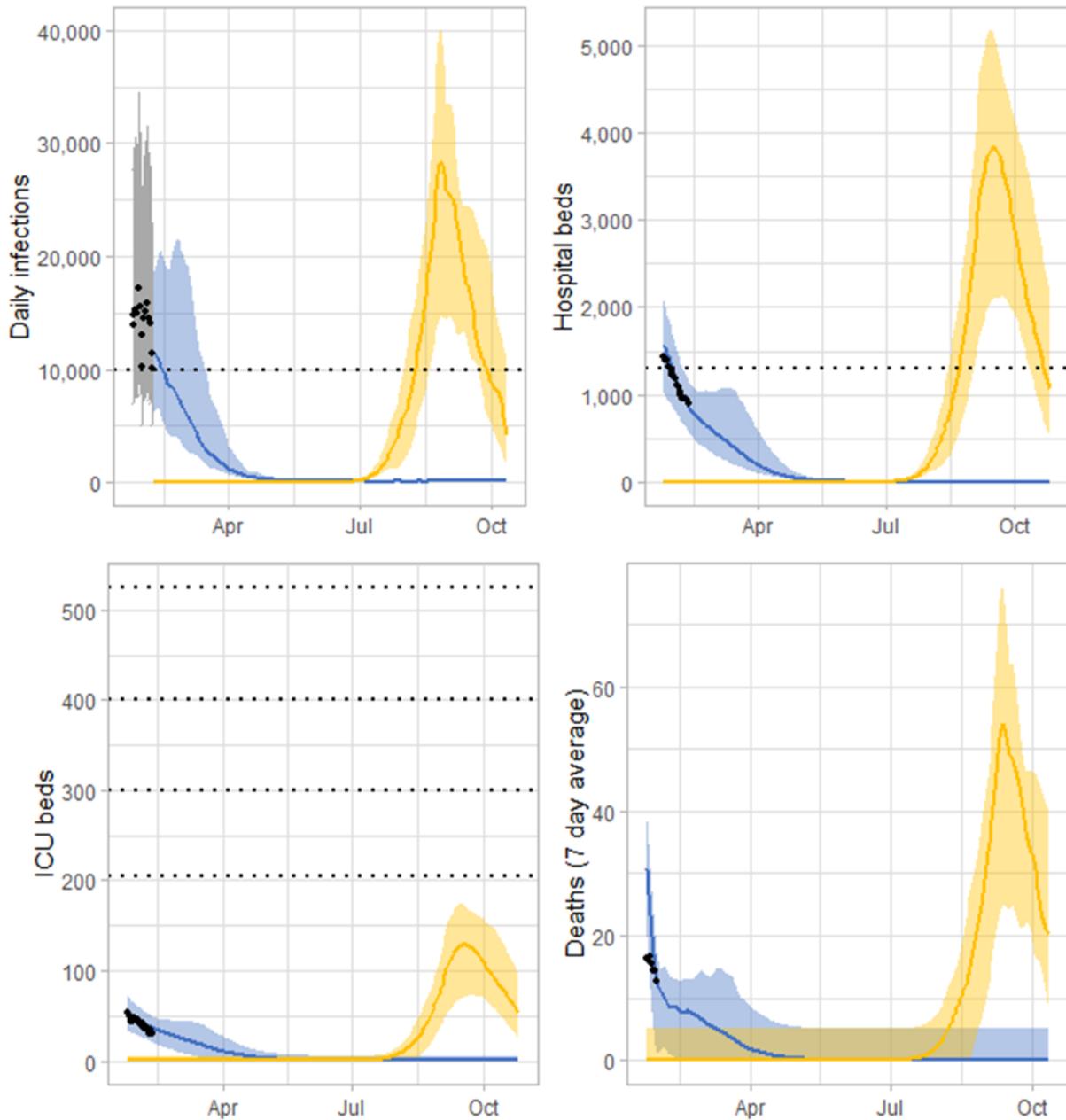
Variant world – vaccine escape with increased severity compared to Delta

As with the other example of Variant world, a new variant appears in Scotland as people return from their summer holidays and return to work and school. The timing is uncertain but has currently been lined up with the summer holidays where reduced travel restrictions may make it more likely that a new variant is brought into Scotland.

The new variant may cause Omicron infections to decrease significantly or disappear entirely. It is modelled with similar transmissibility and vaccine escape as Omicron with severity characteristics 50% higher than Delta, purely for illustrative purposes.

It could lead to high levels of infections leading to hospital occupancy rising well above capacity restrictions. With sustained high levels of infection we could again see increased staff absences in a number of sectors that were affected by this in the recent Omicron wave.

Figure 18. Potential infections, hospital occupancy, ICU occupancy, and deaths trajectory in Variant World with the increased severity compared to Delta¹⁰



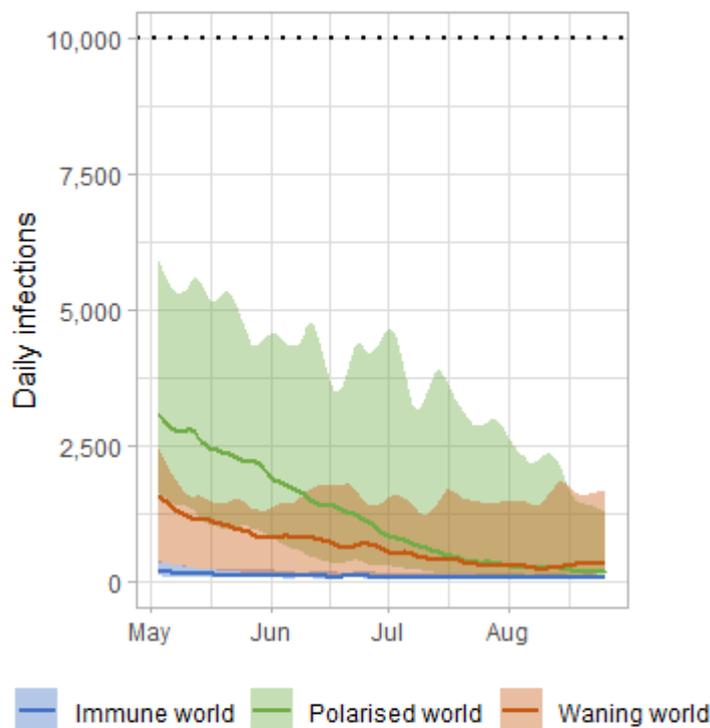
Background levels of Covid-19

In each of these possible futures there will be a background level of Covid-19 to plan for and manage. When comparing the worlds, Figure 19 shows the period May to September and what the background levels may look like. This ranges from under 1,000 Covid-19 infections in Scotland per day to over 5,000 in May, potentially dropping to below

¹⁰ [Coronavirus \(Covid-19\): trends in daily data - gov.scot \(www.gov.scot\)](https://www.gov.scot/coronavirus-trends-daily-data)

2,500 in August. If a new variant appeared it could be substantially higher. Depending on this background level of Covid-19 different levels of pressure will be put on the public sector in Scotland as different numbers of people become sick and need medical treatment.

Figure 19: Potential background level of infections over Summer 2022 under different Worlds scenarios¹¹



The four worlds plausible scenarios as presented in this section should not be considered predictions. It is difficult to ascertain which of these scenarios may be the more likely and in reality the situation is likely to move from one to the other and not in a linear fashion. Instead they provide some illustration of what each world could look like and the issues to be considered. Over the coming months they will be updated as circumstances change to support ongoing planning and management of the pandemic.

Summary of spatial analysis of Covid-19 spread in Scotland

Researchers at the Edinburgh Roslin Institute have conducted spatial analysis of Covid-19 Spread in Scotland. A summary of findings from the week from 16th February to 22nd February 2022 is included here.

¹¹ [Covid-19 vaccine weekly surveillance reports \(weeks 39 to 7, 2021 to 2022\) - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/collections/covid-19-vaccine-weekly-surveillance-reports-weeks-39-to-7-2021-to-2022)

In the period 16th February to 22nd February, an S-Gene Target Failure (SGTF) PCR result is assumed to be due to Omicron variant BA.1. In Scotland a test which is S-gene positive is taken to be a signature of Omicron variant BA.2, while acknowledging there may be some residual Delta variant cases contributing. To obtain estimates of the total spread of the two variants, we assign variant type in proportion to the observed SGTF results per day at the Local Authority level.

The modelling shows there remains a substantial variation in risk of infection by age. Deprivation in this period is not a substantial factor when comparing across local authorities. Risk factors remain stable, when comparing to previous weeks.

The distribution of lateral flow/LFD tests being reported varies substantially by both age and deprivation status, with many fewer tests reported in younger adults across all deciles of deprivation, and for children in more deprived deciles. The high level of LFD positivity in the latter category is marked, and when compared to the high number of positives amongst the least deprived, suggests this may reflect under ascertainment.

Numbers of PCR and LFD tests are both declining, but positivity is increasing suggesting some evidence of under-ascertainment.

Figure 20. Variation in testing outcomes comparing Lateral Flow and PCR testing considering age and deprivation status of the data zone of record.

Testing and positivity - week ending 2022-02-19

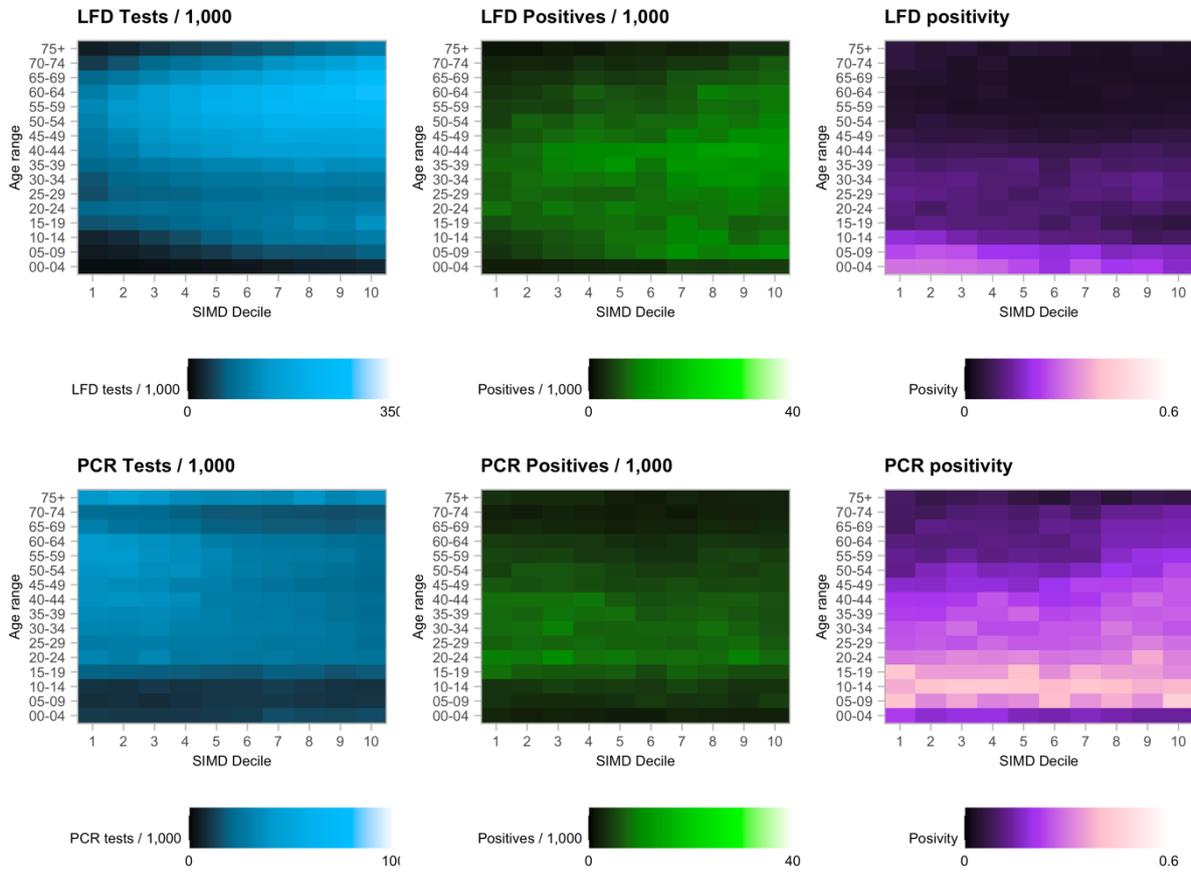
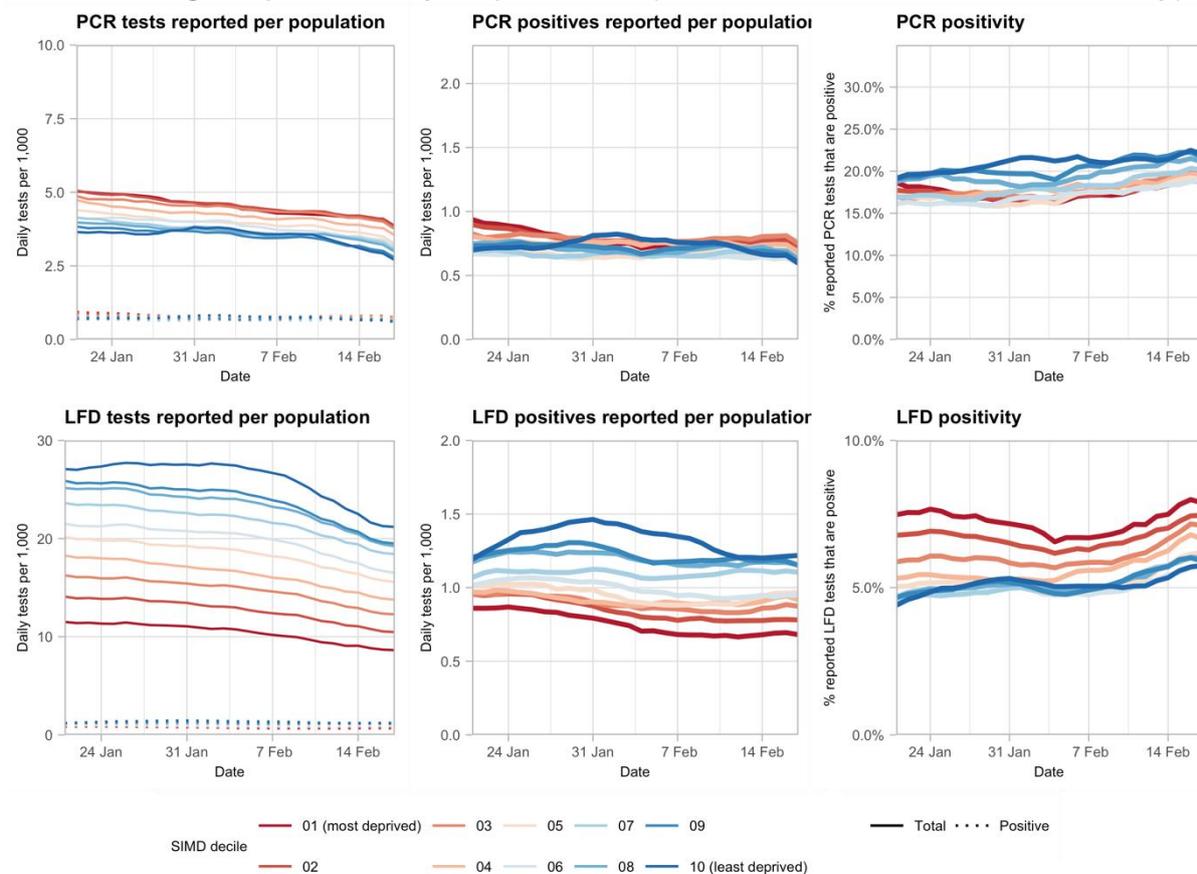


Figure 21. Variation in testing outcomes comparing Lateral Flow and PCR testing, separated by deprivation (Based on data to 17th February).



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

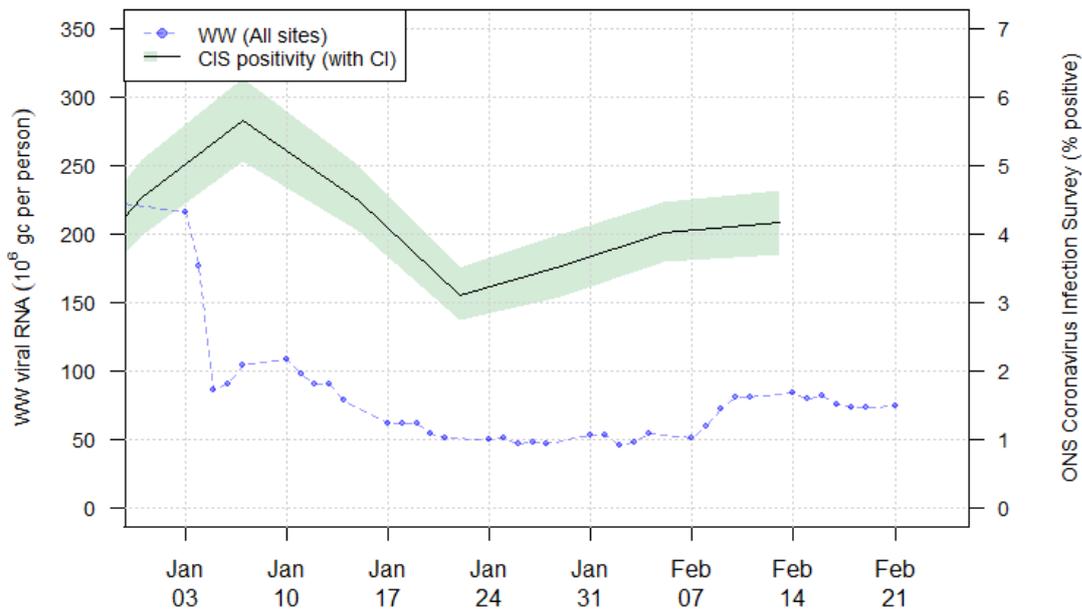
Levels of Covid-19 RNA in wastewater (WW) collected at a number of sites around Scotland are adjusted for population and local changes in intake flow rate (or ammonia levels where flow is not available). See Technical Annex in Issue 34 of these Research Findings for the methodology.

Nationwide, wastewater Covid-19 RNA levels did not continue the upturn seen last week. The week ending on 21st February saw levels of around 76 million gene copies per person per day (Mgc/p/d), somewhat lower than 90 Mgc/p/d the previous week (week ending 14th February).

In Figure 22, we restrict the plotting to the period after the end of 2021, at which point S-gene dropout testing data suggest that nearly all cases are from the Omicron variant. In this period WW testing should have a consistent relationship with Covid-19 prevalence, assuming that the change in relationship is due to the new dominant variant and there is no

shedding difference with the Stealth variant BA.2. In this more restricted graph, we see a flat trend in WW levels followed by a recent increase and little change over the last week. We also superimpose data from the ONS Coronavirus Infection Survey (CIS), with scaling chosen to match case and wastewater trends last year. This shows Covid-19 levels also appearing to level off.

Figure 22. National running average trends in wastewater RNA from 31st December 2021 to 21st February 2022¹².



Analysis (not shown here) suggests that LFD-based results are strongly influenced by gender, socioeconomic status, and geography. Furthermore, LFD-based results will be heavily impacted by future changes, such as the end of the provision of free LFD test kits. For these reasons, we will discontinue the use of case rate statistics in these wastewater reports. We will review the situation at a later date.

Long Covid

A report on the rate of long Covid has not been included this week. We will report the long Covid projections again once updated estimates of

¹² For this graph, a wastewater RNA average using the last 7 days of data is computed at every sampling date. Prevalence estimates and 95% confidence intervals from the ONS Coronavirus Infection Survey are overlaid, with a scale chosen to approximately match cases and wastewater COVID-19 levels in 2021.

self-reported long Covid prevalence amongst those infected with the less severe Omicron variant become available.

What next?

Modelling will continue to look at the impact of Omicron, particularly the variant BA.2. The UKHSA Risk Assessment for BA.2 (9th February 2022) stated that there is moderate confidence that BA.2 has a growth advantage compared to BA.1, from data reported by multiple countries. As the year progresses we will incorporate different models as and when it is appropriate to do so.

We hope to include our analysis on medium-term projections and long Covid next week.

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 have the Covid-19 scenarios been developed?

The Covid-19 scenarios have been developed using the same Scottish Government model used for our usual Medium Term Projections modelling. The scenarios we provide look at what could happen for planning purposes, not to forecast what will happen.

The scenarios take the actuals data and project these forward using the same underlying assumptions as are currently used to model Omicron and are included in the SPI-M-O consensus. These assumptions are then adapted as follows:

- Immune world – assumes a lower transmission than currently due to high levels of natural and vaccine acquired immunity.

- Waning world – assumes the same transmission level with vaccine effectiveness waning over time¹³.
- Polarised world - assumes that behavioural changes beginning to occur. Unvaccinated adults and those with one dose are assumed to return to pre-pandemic behaviours within six weeks. Adults with two doses are assumed to return to these behaviours over 12 weeks, with those with three doses assumed to have no significant changes in behaviour.
- Variant world (vaccine escape) – assumes a variant with similar transmissibility and vaccine escape characteristics as Omicron and same severity as Delta.
- Variant world (vaccine escape & increased severity) – assumes a variant with similar transmissibility and vaccine escape characteristics as Omicron and a higher severity than Delta.

The assumptions are based on our most up to date knowledge, but do not include the effect of future changes in treatment of Covid-19 e.g. widespread use of antivirals or changes in behaviour in response to high levels of infections e.g. in Variant world.

To reflect the uncertainty the modelling the graphs provide a range for possible outcomes.

As more information becomes available we will revise the modelling where appropriate.

¹³ [Covid-19 vaccine weekly surveillance reports \(weeks 39 to 7, 2021 to 2022\) - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/collections/covid-19-vaccine-weekly-surveillance-reports)

Which local authorities are likely to experience high levels of Covid-19 in two weeks' time

Table 1. Probability of local authority areas exceeding thresholds of cases per 100K (6th March to 12th March 2022).

Data to 21st February.

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

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

Table 2 provides population weighted daily averages for normalised WW Covid-19 levels in the weeks ending 14th February and 21st February 2022, with no estimate for error. This is given in Million gene copies per person per day. Coverage is given as percentage of LA inhabitants covered by a wastewater Covid-19 sampling site delivering data during this period¹⁴.

Table 2. Average Covid-19 wastewater levels (Mgc/p/d)¹⁵.

Local authority (LA)	w/e 14th February	w/e 21st February	Coverage
Aberdeen City	133	145	99%
Aberdeenshire	129	106	51%
Angus	105	163	56%
Argyll and Bute	61	56	23%
City of Edinburgh	126	81	98%
Clackmannanshire	170	159	81%
Dumfries & Galloway	54	61	30%
Dundee City	105	175	100%
East Ayrshire	64	38	69%
East Dunbartonshire	92	64	99%
East Lothian	109	83	74%
East Renfrewshire	37	32	95%
Falkirk	58	67	96%
Fife	96	68	82%
Glasgow City	66	50	98%
Highland	94	84	48%
Inverclyde	60	52	98%
Midlothian	117	83	88%
Moray	70	52	70%
Na h-Eileanan Siar	–	–	0%
North Ayrshire	22	25	93%
North Lanarkshire	88	70	92%
Orkney Islands	43	–	0%
Perth and Kinross	91	85	45%
Renfrewshire	41	47	97%
Scottish Borders	56	72	59%
Shetland Islands	22	74	29%
South Ayrshire	57	41	88%
South Lanarkshire	66	65	61%
Stirling	45	31	63%
West Dunbartonshire	86	72	98%
West Lothian	85	77	94%

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 3 provides population weighted daily averages for normalised WW Covid-19 levels with the outliers removed. See Technical Annex in Issue 60 of these Research Findings for further details.

¹⁵ Coverage as for week ending 21st February 2022.

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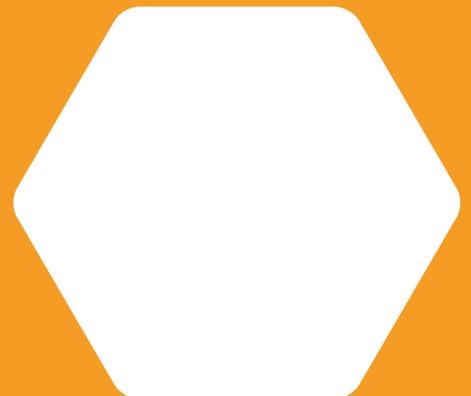
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