



Mr. Stephen Donnelly TD,
Minister for Health,
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Miesian Plaza,
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Dublin 2.

28th June 2021

Via email to Private Secretary to the Minister for Health

Dear Minister,

I write further to today's meeting of the COVID-19 National Public Health Emergency Team (NPHE). The NPHE reviewed the latest epidemiological data, and the following key points were noted.

Please note the reported epidemiology of COVID-19 as it relates to COVID-19 cases, associated deaths, and outbreaks is normally based on notifications to the Computerised Infectious Disease Reporting (CIDR) system. The cyber-attack on the HSE on 14th May 2021 has prevented the routine notification of these data to CIDR. As an interim measure, epidemiological case data are based on the information captured by the HSE COVID Care Tracker. Please note that these data do not represent notified cases and have not undergone the data validation procedures undertaken through CIDR. As soon as all COVID-19 surveillance systems are restored, COVID-19 cases, associated mortality, and outbreak data will be validated and updated for the relevant period.

- A total of 2,414 cases have been reported in the 7 days to 28th June 2021, which is a 4% increase from the last NPHE meeting on 17th June when 2,317 cases were notified in the 7 days to 16th June 2021.
- As of 28th June, the 14-day incidence rate per 100,000 population has decreased to 97; this compares with 101 at the last NPHE meeting on 17th June.
- Nationally, the 7-day incidence/100,000 population as a proportion of 14-day incidence/100,000 population is 52%, demonstrating that there have been more cases in the last 7 days compared with the preceding 7 days.
- The 5-day rolling average of daily cases is 359 as of today, which is a 15% increase from that of 16th June (312).
- Of cases notified in the past 14 days, 84% have occurred in people under 45 years of age; and 3% were aged 65 years and older. The median age for cases notified in the same period is 26 years. Disease incidence remains highest in the 19-24 year old age group.
- Of the 4,629 cases reported in the last 14 days, 2.2% (102) were healthcare workers.
- Over the 7-day period 21st – 27th June, there have been approximately 86,625 laboratory tests completed (this excludes testing through the acutes pathway). This compares with 87,061 laboratory tests in the 7-day period (9th – 15th June) prior to the last NPHE meeting. The positivity rate for tests completed in community and private settings was 2.7%.
- From 20th – 26th June, there were 71,050 community test referrals. This total has increased by 26% compared to the previous week ending 19th June (56,387). From 19th – 25th June, the group

with the largest number of referrals was the 21-30 years age group, which made up 21.5% of all referrals. The detected rate for the 21-30 years age group was c.4.3%.

- Recent COVID-19 GP Community Tracker (GP Buddy/TCD/ICGP) data indicate a broadly stable trend in terms of the average number of patients contacting respondent GPs that were deemed to be clinically likely to have COVID-19.
- According to the Contact Management Programme (CMP), from 21st-27th June, the total number of close contacts was 9,535, compared with 9,195 the previous week, meaning the daily average has increased by 4% from 1,314 to 1,362 per day.
- According to the HSE, from 21st – 27th June, of those tested with close contacts, the average number of close contacts per case was 3.8.
- There were 49 confirmed COVID-19 cases in hospital this morning, compared with 54 on 17th June. There have been 6 newly confirmed cases in hospital in the 24 hours preceding this morning.
- There are currently 16 confirmed cases in critical care, compared with 18 on 17th June. There was 1 admission in the previous 24 hours.
- Since the cyber-attack, 53 COVID-19 deaths have been reported to the HPSC and verified with Departments of Public Health (as of 28th June 2021).
- In total, 220 cases of Delta (B.1.617.2), 72 cases of Beta (B.1.351) and 29 cases of Gamma (P.1) have been confirmed through whole genome sequencing in Ireland to date.
- Other cases of variants of note/under investigation that have been confirmed in Ireland to date: 158 Kappa (B.1.617.1), 73 Eta (B.1.525), 15 Zeta (P.2), 11 Iota (B.1.526), 7 Epsilon (B.1.429), 222 B.1.1.318, and 2 A.27.
- Taqpath S-gene PCR target results by specimen week show that the prevalence of S-gene positivity (proxy for Delta) has increased from 28% in week 24 to 55.5% in week 25.

Outbreaks and associated cases are based on those reported up to midnight on 25th June. Week 24 refers to 13th – 19th June 2021). Due to the earlier meeting of the NPHEt this week, week 25 is a partial week (Sunday 20th – Friday 25th June 2021). Due to the cyber-attack on system networks, data are limited to an aggregate summary of outbreaks reported weekly to HPSC.

Healthcare setting outbreaks:

- There was 1 new nursing home outbreak and 1 new acute hospital outbreak in week 25 of 2021, with no new outbreaks in community hospitals/long-stay units. There were no outbreaks in these settings in week 24.
- There were no new outbreaks reported in residential institution settings in week 24 or week 25.

Vulnerable Groups/ Key Populations outbreaks:

- There were 2 new outbreaks reported involving members of the Irish Traveller community in each of week 24 and week 25.

Outbreaks associated with school children and childcare facilities:

- There were 4 outbreaks newly reported in childcare facilities in week 25, with 2 newly reported in week 24.
- There were 14 newly reported outbreaks associated with school children (+/- staff) in week 25, similar to week 24 when there were 15 newly reported outbreaks.

Workplace outbreaks:

- There were 8 workplace outbreaks reported in week 25 across a variety of settings.
 - 7 outbreaks were in other workplace settings and did not have a setting defined, 1 was related to a food processing setting.
- There were 14 workplace outbreaks reported in week 24.

- 8 outbreaks were in other workplace settings and did not have a setting defined, 3 were in construction settings, and 3 were related to food or meat production settings.

Other Locations:

- The remaining 16 outbreaks in week 25 were across a number of other locations:
 - 4 in social gatherings;
 - 4 in public houses;
 - 3 in restaurant/café settings;
 - 1 in transport;
 - 1 in religious/other ceremony setting;
 - 1 in community outbreak setting.

COVID-19 outbreaks (with two or more cases) involving probable or confirmed Delta variant across a range of settings were reported to the HPSC from 14th May 2021 up to and including 25th June 2021 as follows*:

- 47 confirmed Delta outbreaks associated with 80 confirmed cases (based on whole genome sequencing).
- 25 probable Delta outbreaks associated with 80 probable cases (based on S-gene positivity which is a proxy for Delta).

*A number of Delta outbreaks have additional cases linked to them that have not yet been confirmed as Delta or deemed probable Delta cases through S-gene positivity.

Disease incidence is currently stable or increasing. Incidence in those aged 19-24 years remains high, while incidence continues to be low in the older age groups. Community test positivity is stable although community test referrals have increased. The total number of confirmed cases of COVID-19 in hospital and ICU is currently stable. A number of key measures of population mobility have continued to increase or remained steady over recent weeks.

In summary, the current epidemiological situation in Ireland is broadly stable in terms of disease incidence and numbers of cases in hospital and ICU, along with significantly lower mortality associated with COVID-19 compared to previous months. However, this is set against a background of rapidly increasing prevalence in Ireland of the Delta variant which is significantly more transmissible and less susceptible to vaccines than previous variants. This poses a very substantial threat, particularly to those who are not yet fully protected through vaccination.

Situation in UK

The deteriorating epidemiological situation in the United Kingdom, where the Delta variant is now thought to account for 97% of cases, was noted. In the week ending 27 June, the 7-day incidence was 65.4/100,000 population in Wales, 78.9/100,000 in Northern Ireland, 149/100,000 in England and 304/100,000 in Scotland representing 114%, 52%, 50%, and 120% increases, respectively, from the previous week. An increase in hospitalisations in all but Northern Ireland has been seen and, while deaths are also increasing, they remain at very low levels in absolute terms. As at 27 June 2021, of the population aged 18 and over, 84% were partially vaccinated and 62% were fully vaccinated.

Recent ECDC Advice

The NPHET noted the recent assessment from the ECDC¹ which states that *“Modelling scenarios indicate that any relaxation over the summer months of the stringency of nonpharmaceutical measures that were in place in the EU/EEA in early June could lead to a fast and significant increase in daily cases in all age groups, with an associated increase in hospitalisations, and deaths, potentially reaching the same levels of the autumn of 2020 if no additional measures are taken.”* The ECDC further advise that *“entering autumn with such high incidence could pose an additional risk as school re-opening and associated adult contact patterns together with climate factors, are expected to further increase transmission rates.”*

Overview of Modelling Projections

The profile of SARS-CoV-2 infection, of severe COVID-19 disease requiring hospital or critical care, and resultant mortality over the coming weeks is very uncertain. What is clear is that the delta variant, with its clear transmission advantage over the alpha variant, is rapidly becoming the dominant strain, and in our partially-vaccinated population, the increased risk of onward transmission associated with this variant makes a significant fourth wave of infection likely. What is uncertain is the magnitude of this fourth wave, and its severity in terms of hospitalisation, mortality, and long-term sequelae.

This uncertainty largely relates to our estimates of how much more transmissible the delta variant is compared to antecedent variants. When the alpha variant became dominant in the UK and subsequently in Ireland, its transmission advantage was estimated as between 40% and 90%. Subsequently, as the delta variant emerged, Public Health England estimated it as having a further transmission advantage of 50%-60% over alpha. However, more recently, the ECDC have used more conservative estimates of the transmissibility of delta, suggesting that delta is 55% more transmissible than alpha, but that alpha is only 25%-30% more transmissible than preceding variants. The rate at which a fourth wave might develop, and its scale, depend on this transmission advantage, and model scenarios vary widely depending on assumptions about transmission.

It should also be noted that vaccines appear to offer somewhat less protection against infection by delta: for those individuals with only one dose of a two-dose vaccine, vaccine effectiveness in preventing symptomatic infection with the delta variant is about 60-65% of vaccine effectiveness against alpha. However, the difference is smaller following the second dose, with vaccine effectiveness against delta being about 90% of the effectiveness against symptomatic infection with alpha. Fortunately, vaccines appear to be equally effective in preventing severe disease following infection with alpha or delta. Nonetheless, the difference in vaccine effectiveness in preventing infection means that as delta comes to dominate there is a fraction of the population with only one dose of vaccine who are at increased risk of becoming infected, of transmitting that infection to others, leading to a surge of disease in an incompletely protected cohort.

We have, given this uncertainty, modelled five scenarios, with two fundamental types of assumption, on indoor social mixing and transmission advantage:

- a *moderate level of indoor social mixing* from 5 July 2021 increasing the opportunity for viral transmission to the level seen in late July and early August 2020;
- a *higher level of indoor social mixing* from 5 July 2021 increasing the opportunity for viral transmission to the level seen in late August and early September 2020;

¹ *Threat Assessment Brief: Implications for the EU/EEA on the spread of the SARS-CoV-2 Delta (B.1.617.2) variant of concern, ECDC, 23 June*

- *conservative estimates of transmission advantage*, with transmissibility for alpha being 1.27 times that for antecedent variants and the transmissibility of delta being 1.55 times that of alpha;
- *higher estimates of transmission advantage*, with transmissibility for alpha being 1.5 times that for antecedent variants and the transmissibility of delta being 1.6 times that of alpha.

The vaccination programme is included in the model according to the latest available estimates of vaccine supply and administration, and published estimates of vaccine effectiveness in preventing infection and severe disease.

Table 1 summarises the mean case counts, admissions, and deaths for each scenario.

It is noteworthy across all scenarios that case counts rise very slowly during July 2021. However, the seeds of future growth are sown at this time, and case counts increase exponentially through August 2021 until a combination of vaccine-induced and infection-induced immunity slows growth through September and October 2021.

The infections occur largely in the young, unvaccinated population, but as the force of infection grows, a significant number of infections also occur in older, vaccinated people. The optimistic scenario is associated with 81,000 (23,000 – 231,000) cases between 1 July 2021 and 30 September, 1,530 (1,400-1,660) admissions to hospital, 195 (150-250) admissions to ICU, and 250 (215-290) deaths. While 75% of the cases are in people under 40 years of age, 99.9% of the deaths are in people over 40 years of age.

The first central and subsequent scenarios see higher case counts and significantly more people requiring hospital and critical care.

There is an additional important uncertainty in relation to these model scenarios. The latter part of the infection curve, beyond September 2021, is sustained by infection in children and adolescents, who are not currently eligible for vaccination. If children are less susceptible, and/or less likely to transmit infection, or a decision is made to vaccinate those under 16 years of age, the wave of infection will peak earlier and decline more rapidly.

Table 1: Mean number of cases, hospital admissions, ICU admissions and deaths from 1 July 2021 to 30 September 2021 under each scenario

	Cases	Hospital admissions	ICU admissions	Deaths
No delta variant	21,000	405	55	80
Optimistic	81,000	1,530	195	165
Central 1	187,000	3,490	450	545
Central 2	408,000	7,690	985	1,230
Pessimistic	681,900	12,985	1,685	2,170

Overall Assessment and Advice

The epidemiological situation has been improving or stable over the last number of months, and the gradual relaxation of measures has not to date resulted in any noticeable increase in incidence of infection at a population level. There has also been considerable improvement in the level of hospitalisations and mortality. In addition, there continues to be very significant progress made by the COVID-19 Vaccination Programme, with high uptake across all cohorts to date. As referenced in previous letters, the protection provided by vaccination is already changing the relative risk profile at a population level and will continue to do so over the coming months.

If the alpha variant had remained the dominant variant, modelling indicates that we would have been in a strong position to continue to control transmission of the disease while progressing to further reopening as planned in July. However, the outlook has unfortunately changed substantially in recent weeks given the emergence of the delta variant here and in other countries, the dominance of which is projected to grow sharply over the coming weeks. Estimates of delta's increased transmissibility and impact on vaccine effectiveness, particularly for those who have not been fully vaccinated, its impact on the epidemiological situation in the UK, and modelling of its potential impact in Ireland suggests that the progression to dominance of the delta variant will have significant implications for the likely trajectory of the disease in the period ahead. While there remains significant uncertainty about the full scale of increase, experience in other countries indicates that the level of transmission here will grow very quickly over the coming weeks as a result of:

- The current relatively high baseline of cases (4th highest 14-day incidence in the EU)
- Higher transmissibility of the delta variant (estimated at 40-60% greater than the alpha variant)
- A significant proportion of the population remain unvaccinated (42% of the eligible cohort fully vaccinated)
- A number of sectors/activities are already open presenting significant scope for transmission; large, complex, multi-setting and cross-community outbreaks are already being reported by public health.

A high level of transmission of infection over the coming weeks/months presents a number of risks:

- Vulnerable groups are not yet fully vaccinated and remain at significant risk to the severe impact of COVID-19 (75% of 60-69 year olds and 46% 50-59 year olds have not yet received second dose; cohort 7 not yet complete)
- The hospital system continues to be in a fragile position, with a significant backlog of non-Covid care arising from the demand for Covid care in the early part of this year. This is being exacerbated by the ransomware attack of 14 May. Attendances at EDs have increased steadily since the start of 2021 and were almost back to 2019 levels in the weeks before the attack. While data have been limited since then, the HSE has advised that the number of people on trolleys has increased. The number of available inpatient acute beds has declined significantly in recent weeks, with just 171 vacant beds across the system this morning at 8 am, and 176 people on trolleys awaiting admission. The number of COVID-19 patients in critical care as of today is 16, and overall today there are 258 critical care beds occupied from a total of 300 available. Manual workarounds and reduced access to labs due to the ransomware attack, coupled with Covid-related patient safety protocols still in place, are all contributing to slower progress of patients through the system.
- Evidence of the long-term health consequences of COVID-19 continue to emerge. A recent study in the UK reports that 37.7% of symptomatic people post COVID-19 experienced at least one symptom, while 14.8% experienced three or more symptoms, lasting 12 weeks or more.
- There is an ongoing risk of new variants emerging and subsequent impact on vaccine effectiveness.

- A high level of transmission in late summer could have significant impacts on the reopening of schools and the tertiary education sector in Autumn.

In light of national modelling projections, ECDC advice and emerging evidence of the impact of the Delta variant in the UK and other countries, the NPHET recommends the following:

- The increase in the numbers permitted at outdoor events can proceed as planned from the 5th July, increasing to a maximum of 200 attendees for the majority of stadia, and to 500 for stadia/venues with capacity greater than 5,000. This is in recognition that outdoor activities, when carried out in controlled environments, remain relatively safer than indoor activities. It is again advised that organisers of outdoor events should ensure that all appropriate protective measures are taken. Linked activities before or after the event which involve mixing with others in indoor environments, including social activities and travel in private transportation, should be avoided by those that are not fully protected by vaccination.
- The other measures which were due to be eased on the 5th July which, by their nature are high risk activities which will involve significant levels of social mixing in indoor environments, should only be permitted for those who have been fully protected by vaccination or who have had COVID-19 infection in the previous nine months. The planned easing of these measures should only proceed once a robust, non-reproducible and enforceable system of verification of vaccination or immunity status can be put in place to support this. If this is not deemed feasible, the Government should consider pausing further easing of these measures until such a system can be instituted.
- The current vaccine bonus applicable to household visits should be revised as follows:
 - There should be no limit on the numbers of people that can visit together once they are all fully protected by vaccination or have had COVID-19 infection in the previous nine months i.e. the limit of three households can be removed. The advice for household visiting remains unchanged for those who are not fully protected by vaccination.
 - Given emerging evidence in relation to the effectiveness of one dose of the AstraZeneca vaccine against the Delta variant, the vaccine bonus measure should only apply two weeks after the second dose of the AstraZeneca vaccine i.e. it should no longer apply 28 days after the first dose.
- Given the possible deterioration in the epidemiological situation through July and August 2021, and the potential impact that that could have on educational settings in Autumn 2021, the NPHET further recommended that the HSE complete its review of the epidemiological profile and public health response to COVID-19 in educational settings to date, and put measures in place so as to ensure that the public health response to COVID-19 in these settings remains robust and responsive to emerging trends in those settings.
- There should be ongoing work to strengthen communications, with targeted messaging for vaccinated and unvaccinated people, ensuring that both groups have clear information and advice on safe activities.

The NPHET is conscious of the impact that some of these recommendations may have on the sense of national and intergenerational solidarity that has been a hallmark of the public's response to COVID-19 to date. However, it remains critical that we continue to protect the progress made over recent months, and continue to protect those most vulnerable to the severe impacts of COVID-19 and our core priorities of protecting health and social care, education, and childcare services. The future trajectory of the disease is very uncertain at this point in time given the very recent emergence of the Delta variant. The NPHET will keep all emerging evidence under review.

It is expected that there will be fuller information in relation to the impact of the Delta variant on transmission, severity of disease and vaccine effectiveness over the coming weeks, especially from the experience of those countries where it has already become dominant. In the meantime, the public

health advice remains that higher risk activities, including international travel for those who are not fully vaccinated or immune, are recommended against.

Separately, I have today received advice from the NIAC in relation to the potential role of heterologous vaccination and viral-vector vaccines as part of the COVID-19 vaccination programme. As part of their considerations NIAC reviewed age-related incidence of COVID-19; the evidence of the rapid displacement of the Alpha variant by the highly transmissible Delta variant and the probable increased associated virulence; as well as the impact on the effectiveness of partial and full vaccination, including heterologous vaccination.

In light of the threat posed by an increase in the delta variant, the NIAC have recommended that any person over 50 years of age and those in at-risk groups of severe disease who are not fully vaccinated should complete vaccination as scheduled. It is the view of NIAC that while preliminary studies indicate that heterologous vaccination results in robust antibody and cellular responses, until there has been an opportunity to consider clinical trial data including from the ComCov study, those individuals who are currently scheduled for a second dose of the AstraZeneca vaccine are strongly recommended to receive their second dose of the AstraZeneca vaccine to ensure the earliest protection against severe COVID-19. On the same basis, where practicable, the dose interval for the AstraZeneca vaccine should be reduced to 4 weeks.

Further, based on an examination of the benefit-risk ratio of adenoviral vector vaccines in those under 50 years of age, taking into account the risk of Thrombosis with Thrombocytopenia Syndrome (TTS) as well as the current impact of the Delta variant on disease burden and severity, the NIAC consider that mRNA vaccines remain preferable for those aged under 50 years of age. However, in line with previous NIAC advice from May 13th 2021, when COVID-19 rates are high or increasing and/or the availability of mRNA vaccines is limited, adenoviral vector vaccines may be recommended for those aged 18-49 years to provide early protection. Should case numbers increase in line with the higher estimates of 60% increased transmissibility of the delta variant, the benefit of all vaccines will be favourable to all age groups including those aged 18-50 years. In that context, the NIAC have recommended that those aged 18-49 years who wish to opt for earlier vaccination can be offered an adenoviral vector vaccine subject to informed consent. The HSE should now seek to put in place appropriate organisation and consent arrangements as soon as possible such that those who can benefit from this updated advice are afforded the opportunity to do so.

The NPHET, of course, remains available to provide any further advice and recommendations that may be of assistance to you and Government in relation to ongoing decision-making processes in respect of the COVID-19 pandemic. As always, I would be happy to discuss further, should you wish.

Yours sincerely,



Dr Tony Holohan
Chief Medical Officer
Chair of the COVID-19 National Public Health Emergency Team

cc. Ms Elizabeth Canavan, Department of the Taoiseach and Chair of the Senior Officials Group for COVID-19

Appendix 1: Further Detail on Modelling Approach and Projections

A range of scenarios have been modelled, with two fundamental types of assumption, on indoor social mixing and transmission advantage:

- a *moderate level of indoor social mixing* from 5 July 2021 increasing the opportunity for viral transmission to the level seen in late July and early August 2020;
- a *higher level of indoor social mixing* from 5 July 2021 increasing the opportunity for viral transmission to the level seen in late August and early September 2020;
- *conservative estimates of transmission advantage*, with transmissibility for alpha being 1.27 times that for antecedent variants and the transmissibility of delta being 1.55 times that of alpha;
- *higher estimates of transmission advantage*, with transmissibility for alpha being 1.5 times that for antecedent variants and the transmissibility of delta being 1.6 times that of alpha.

This yielded 5 scenarios

- a *counterfactual* scenario, where the delta variant is not introduced
- an *optimistic* scenario with moderate indoor social mixing and conservative estimates of transmission advantage
- a *first central scenario*, with higher levels of indoor social mixing and higher estimates of transmission advantage
- a *second central scenario*, with moderate levels of indoor social mixing and higher estimates of transmission advantage
- a *pessimistic scenario*, with higher levels of indoor social mixing and higher estimates of transmission advantage

Table 1 summarises the mean case counts, admissions and deaths for each scenario.

Table 1: Mean number of cases, hospital admissions, ICU admissions and deaths from 1 July 2021 to 30 September 2021 under each scenario

	Cases	Hospital admissions	ICU admissions	Deaths
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Optimistic Scenario

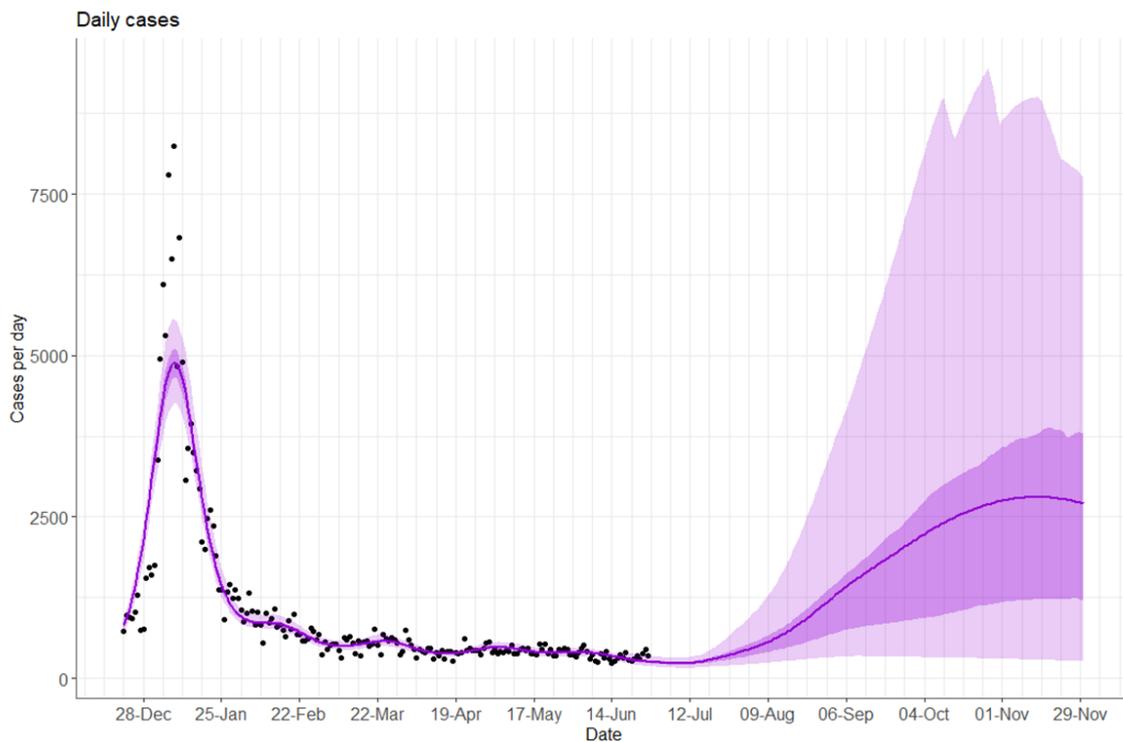


Figure 1: Homogeneous population SEIR model scenario of **cases per day using optimistic assumptions**, with moderate social mixing, equivalent to that seen in late July and early August 2020, alpha 1.27 times more transmissible than antecedents, and delta 1.55 times more transmissible than alpha. Ensemble of 1000 model runs using varying assumptions, mean (line) 25th-75th centile (dark ribbon) and 2.5th-97.5th centile. Points are actual case counts.

The optimistic scenario is associated with 81,000 (23,000 – 231,000) cases between 1 July 2021 and 30 September, 1,530 (1,400-1,660) admissions to hospital, 195 (150-250) admissions to ICU, and 250 (215-290) deaths. While 75% of the cases are in people under 40 years of age, 99.9% of the deaths are in people over 40 years of age.

Figure 2 shows the estimated number of people in hospital and ICU under the optimistic scenario.

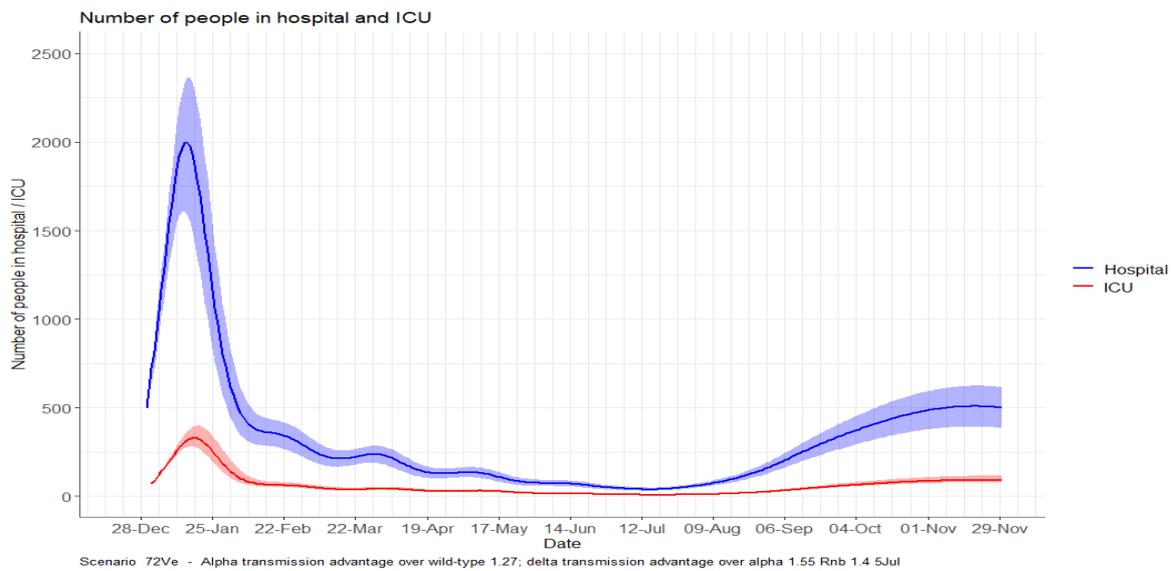


Figure 2: Number of people in hospital and ICU in optimistic scenario

There is an additional important uncertainty in relation to these model scenarios. The latter part of the infection curve, beyond September 2021, is sustained by infection in children and adolescents, who are not currently eligible for vaccination. If children are less susceptible, and/or less likely to transmit infection, or a decision is made to vaccinate those under 16 years of age, the wave of infection will peak earlier and decline more rapidly.

Central Scenario

The first central scenario sees higher case counts (Figure 3) and significantly more people requiring hospital and critical care (Figure 4).

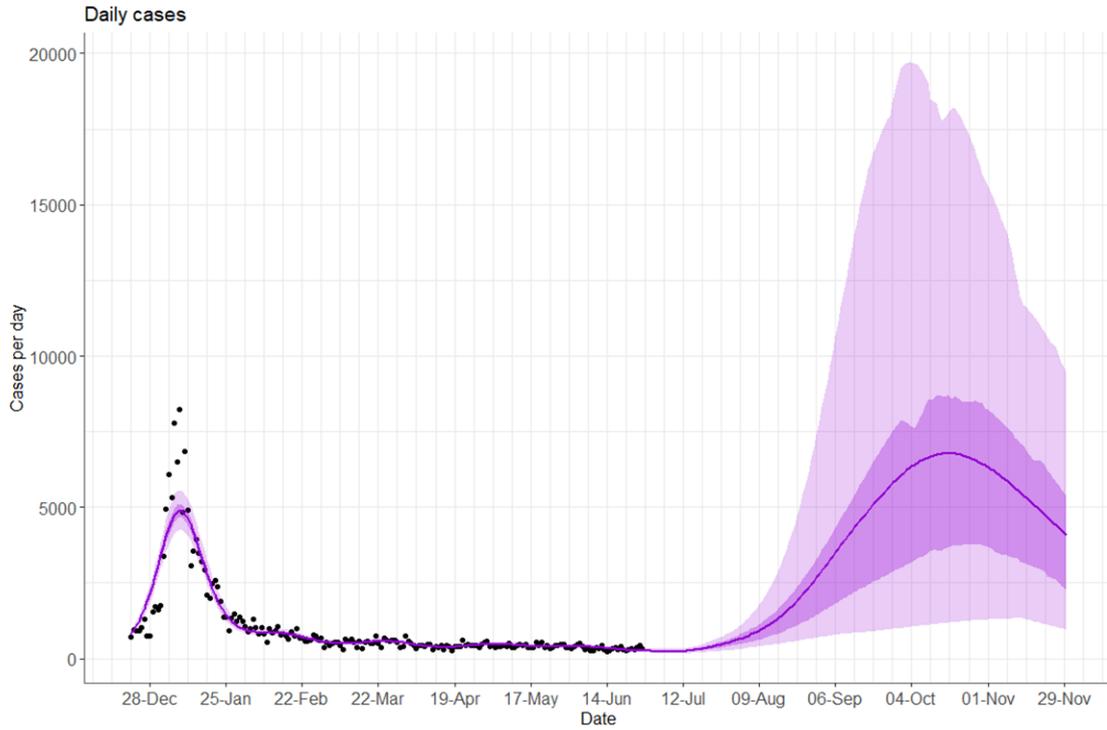


Figure 3: Homogeneous population SEIR model scenario of cases per day using first central scenario assumptions, with higher social mixing, equivalent to that seen in late August and early September 2020, alpha 1.27 times more transmissible than antecedents, and delta 1.55 times more transmissible than alpha. Ensemble of 1000 model runs using varying assumptions, mean (line) 25th-75th centile (dark ribbon) and 2.5th-97.5th centile. Points are actual case counts.

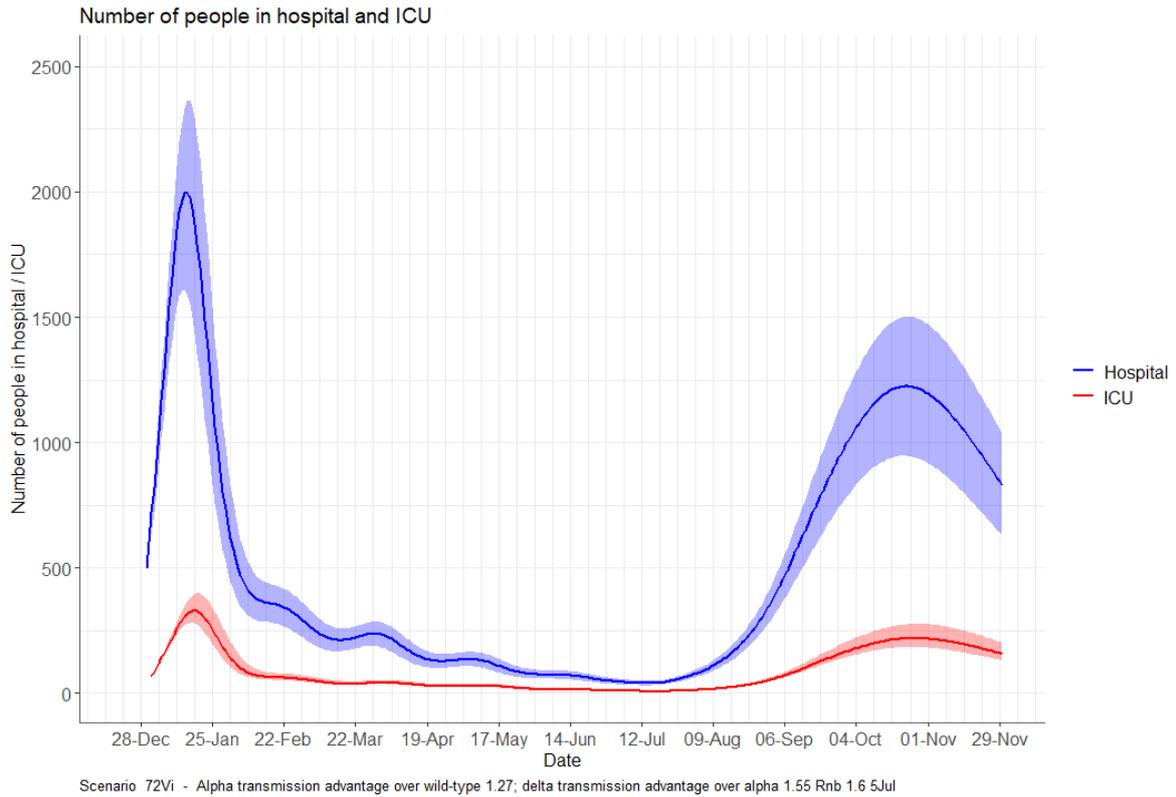


Figure 4: Number of people in hospital and ICU in first central scenario.

Age-cohorted SEIR and agent-based models confirm and expand the overall picture from the homogenous population SEIR model. Specifically, they highlight:

- the dominance of younger age groups in overall case numbers but a significant level of infection in older age groups leading to severe disease;
- the importance of assumptions on susceptibility and infectiousness of children and adolescents in determining the level of transmission and for how long it is sustained;
- the importance of random and super-spreader events in seeding larger surges of infection.