An Roinn Sláinte
Department of Health
Office of the Chief Medical Officer

Mr. Stephen Donnelly TD,
Minister for Health,
Department of Health,
Miesian Plaza,
50-58 Lower Baggot Street,
Dublin 2

2nd December 2021

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

Epidemiological update

- A total of 31,767 cases have been reported in the 7 days to 1st December 2021 (cases notified to midnight 30th November), which is a 2% increase from last week when 31,109 cases were reported in the 7 days to 25th November.
- As of 1st December, the 14-day incidence rate per 100,000 population has increased to 1,320; this compares with 1,288 reported at the last NPHET meeting on 25th November. The 14-day incidence rate, at 1,320 per 100,000, is 86% of its highest value to date (1,531 in January 2021).
- Nationally, the 7-day incidence/100,000 population as a proportion of 14-day incidence/100,000 population is 51%, 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 4,477 as of today, a 4% decrease from that reported at the last NPHET meeting on 25th November (4,665).
- Of the 62,870 cases notified in the 14 days to midnight 30th November 2021, 72% have occurred in people under 45 years of age; and 7% were aged 65 years and older. Incidence remains high across all age groups and is highest in those aged 5-12 years. This is likely to be driven by very high levels of infection in adults, primarily through household and community transmission, along with the fact that children under 12 are not vaccinated. The impact of recent booster vaccination on incidence in those aged 75 and older is clear, with an effect also emerging in those aged 70-74.
- Of the cases reported in the 14 days to 1st December 2021, 0.6% (372) were healthcare workers.
- From 24th – 30th November, there have been approximately 215,385 laboratory tests reported in community, private and acute laboratories**.** The 7-day test positivity rate in the community has decreased from 19.5% last week to 17.4%.
- Testing rates are very high in those aged 12 and under, at approximately 1,000 tests per 100,000 people per day, which is at or above the unprecedented level of early September 2021. The next highest level of testing is in the age group, 35-44 years. This means that case ascertainment in these age groups will be elevated. Test positivity is reducing across most age groups.
- The HSE Test and Trace system is now operating at surge capacity and is under severe pressure. Overall, total referrals have increased by 5% in comparison to the same time-period in the previous week. In the past week 215,385 laboratory tests were completed, this is the highest volume of laboratory tests completed to date in a 7-day period
- According to the Contact Management Programme (CMP), from 22nd – 28th November 2021, the total number of close contacts was 66,433, an increase of 10.5% on 60,109, in the previous week. The average number of cases managed per day decreased from 4,653 to 4,555, a decrease of 2% over the same time period.

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- For close contacts created the week ending 14th November, Test 1 results were available at the time for 7,584 close contacts; 1,570 (20.7%) of these had a positive result. Test 2 results were available for 1,763 close contacts, 174 (10%) of these had a positive result.
- The highest proportion of close contacts testing positive by circumstances of contact was amongst household contacts (31%). For the 2,118 household close contacts created the week ending 14th November 31.4% (665) had a positive result.
- The mean number of close contacts per case (including cases with zero close contacts) for the week ending 28th November was 2.2, unchanged from the previous week (week ending 21st November). The mean number of close contacts per case (excluding cases with zero close contacts) for the week ending 28th November was 3.1, a decrease from the previous week.
- Rapid antigen testing of close contacts who are fully vaccinated and have no symptoms is ongoing since 28th October. As of 25th November, the numbers of close contacts referred through this pathway has decreased with an average of 3,868 tests dispatched daily for the previous 7 days, a decrease of 7% on the previous week. In total, 31,850 antigen test results have been reported by close contacts – 21,579 "not detected"/negative antigen results and 10,271 "detected"/positive antigen results, with 5,741 (56%) cases confirmed positive on PCR testing.
- There were 547 confirmed COVID-19 cases in hospital this morning, compared with 598 last week on 25th November.
- There have been 70 newly confirmed cases in hospital in the 24 hours preceding this morning, there have been on average of 69 newly confirmed cases in hospital per day over the last 7 days.
- There are currently 117 confirmed cases in critical care as of this morning, compared with 126 last week on 25th November. There were 6 new admissions to critical care in the 24 hours preceding this morning.
- Of the 552 COVID-19 patients (aged 12 and over) admitted to ICU between 27th June and 20th November 2021, 313 (57%) were unvaccinated and 196 (36%) were considered to be fully vaccinated, and of these 147 (75%) were aged over 60 (had an epidemiological date 14 days or more after receiving all recommended doses of vaccine).
- As of 1st December, there have been a total of 5,707 COVID-19 related deaths notified in Ireland. This is an increase of 55 notified deaths since the previous weekly update on 24th November. To date, 160 deaths have been notified which occurred in November 2021, 205 deaths in October, 176 in September, and 84 in August. Deaths are increasing very slowly at approximately 7 per day or 200 deaths per month.
- Over the period 27th June and 20th November 2021, 194 out of 561 (34.6%) COVID-19 related deaths were in people who were not fully vaccinated (including those who had an epidemiological date less than 14 days after receiving all recommended doses of vaccine).
- On 26 November 2021, WHO designated the variant B.1.1.529 a variant of concern (VOC) on the basis of advice from WHO's Technical Advisory Group on Virus Evolution. The variant has been given the name Omicron. On 1st December 2021 the first confirmed case of Omicron variant (B.1.1.529) in Ireland was identified through whole genome sequencing and notified to the HPSC. The confirmed Omicron case was identified in real time and is associated with travel from one of the scheduled States
- In total, 77 cases of Beta (B.1.351) and 33 cases of Gamma (P.1) have been confirmed through whole genome sequencing in Ireland as of 1st December 2021.
- Other cases of variants of interest that have been confirmed in Ireland as of 1st December 2021: 247 B.1.1.318, 4 Lambda (C.37), and 4 Mu (B.1.621). There have been 156 confirmed cases of the AY.4.2 Delta sublineage.
- According to a recent CSO analysis on the current employment status of COVID-19 cases notified up to 13th November 2021, 14-day incidence rates in workers across every sector of employment was higher than the preceding 14-day period. The highest 14-day incidence rates were observed in the following employment sectors: 'Accommodation and Food Service Activities', 'Administrative and Support Service Activities', 'Construction' and 'Public Administration &

Defence'. These data do not indicate that cases were linked to workplace outbreaks or that infection acquisition occurred in these settings.
- A range of mobility data suggest that mobility across a range of settings remain at or close to levels observed pre-pandemic.

Outbreaks for week 47 (21st – 27th November) are based on those reported up to midnight on 27th November 2021.

In Week 47 there were a total of 151 COVID-19 outbreaks notified. It should be noted that regional Departments of Public Health are prioritising public health risk assessments and outbreak investigations in settings that have the greatest clinical need or would benefit most from public health intervention such as healthcare settings. For this reason, outbreaks in some settings may be underestimated. Detail on outbreaks in prioritised settings:

Healthcare setting outbreaks:
- There were 10 new nursing home and one new community hospital/long-stay unit outbreaks reported in week 47. A total of 40 cases were linked to outbreaks in these settings in week 47.
- There were 12 new acute hospital outbreaks reported in week 47 with a total of 13 cases linked to outbreaks in acute hospital settings.
- There were 30 new outbreaks reported in residential institution settings (20 in centres for disabilities, 4 in mental health facilities, 2 in direct provision centres, 1 in a centre for older people, 1 in a children's/TUSLA residential centre, 1 in a homeless facility and 1 in other /not specified residential centre) in week 47. A total of 57 cases were linked to outbreaks in these settings.
- There were 12 new outbreaks in 'other healthcare services' (3 among clients of disability day services, 3 among clients of homecare services, 1 among clients of a mental health facility and 5 in other healthcare services). A total of 22 cases were linked to outbreaks in these settings.

Outbreaks associated with school children and childcare facilities:
- There were 6 outbreaks newly reported in childcare facilities in week 47 with a total of 9 cases linked to outbreaks in childcare settings in week 47.
- There were 45 new outbreaks associated with schools notified in week 47 (32 in primary schools, 13 in special education schools and 1 in a post-primary school). A total of 72 cases were linked to outbreaks associated with schools in week 47.

Workplace outbreaks:
- There were 6 new outbreaks associated with workplaces (1 associated with meat processing and 5 in 'other' workplace settings) reported in week 47. A total of 70 cases were linked to workplace outbreaks in week 47.

Additional details are available in relation to outbreaks in vulnerable groups and key populations:
- There were 11 new outbreaks reported involving members of the Irish Traveller community in week 47 with 31 cases linked.

COVID-19 incidence across the country is very high, and while it is stable at present, the situation remains precarious. Following a period of rapid growth in late October and early November, growth rate for cases has reduced over the last three weeks and is now close to zero, with R estimated at approximately 1. Incidence is highest in children aged 5-12 years old. Incidence in most other age groups has been relatively stable or reducing. There continues to be an increasing age gradient in incidence in children under 12 years of age, with incidence in the 9-11-year-old age group three times that in the 0-4-year-old age group, and 50% higher than the 5-8-year-old age group. Incidence has

been reducing in older adult age groups, with evidence of clear impact of recent booster vaccination in those aged 75 and older, as well as an emerging effect in those aged 70-74.

Demand for testing is higher than it has been at any point in the pandemic and continues to increase. All pillars of the testing pathway are operating at maximum capacity (referrals, swabbing, laboratory testing and contact tracing). Testing rates are very high in those aged 12 and under, at approximately 1,000 tests per 100,000 children per day, which is at levels close to the unprecedented levels of early September 2021. The next highest level of testing is in those aged 35-44 years old. Test positivity is reducing across most age groups.

The very high number of COVID-19 cases currently in the community and in hospitals continues to place a very significant burden on care being delivered by staff and services across the wider health and social care system, noting also that these pressures are likely to further increase over the course of the coming weeks and months. The number of confirmed cases in hospital remains high, and while there has been a reduction in recent days it should be noted that this is not yet an established trend and such fluctuations have occurred previously. The average number of daily newly confirmed cases in hospital also remains high. The number of confirmed cases in ICU is high, and while this total number has reduced slightly, the number of cases requiring mechanical ventilation is increasing. Deaths per day have been increasing very slowly at approximately 7 per day, or 200 deaths per month. This may rise further, given the very high case counts, though booster vaccination in older age groups may mitigate against this. There continues to be a significant number of outbreaks reported in settings with vulnerable populations.

In summary, the overall epidemiological situation in Ireland remains concerning and delicately balanced. Ireland remains vulnerable to a further deterioration in the disease profile depending on a number of factors, including levels of social contact in the coming weeks and over the festive period, adherence to basic public health protective measures and levels of immunity across the population, and the potential impact of the recently identified Omicron variant which remains uncertain at present.

ECDC Rapid Risk Assessment – Delta Variant 24th November

The ECDC Rapid Risk Assessment (17th update, 24th November), stated that modelling scenarios indicate that the potential burden of disease risk in the EU/EEA from the Delta variant is expected to be **very high** in December and January 2022 unless Non Pharmaceutical Interventions (NPIs) are applied now in combination with continued efforts to increase vaccine uptake. **It is important to note that this Rapid Risk Assessment did not take account of the Omicron variant, as it was published in advance of its designation as a variant of concern.**

In recognition that the end-of-year festive season is traditionally associated with activities such as social gatherings, shopping and travelling, which pose significant additional risks for intensified transmission of Delta, **the ECDC advises that NPIs should be implemented or reinforced now to reduce contacts and mixing during the festive season. It further states that the timely implementation of NPIs is critical for their success** and countries should anticipate that NPIs may need to be retained for a prolonged period of time after the festive/holiday period to effectively control virus circulation. The ECDC also advises that increasing vaccination coverage rates is the highest priority while booster campaigns, risk communication, prevention and preparedness in the educational system, genomic sequencing and testing, contact tracing, monitoring and reporting, remain vital.

WHO and ECDC Advice - Omicron Variant

As you are aware, the novel Omicron variant (B.1.1.529) has recently been identified and reported to the World Health Organization (WHO). The decision by WHO to designate Omicron as a variant of concern was informed by evidence that the variant has a number of mutations of potential concern. Omicron has also been designated a variant of concern by the European Centre for Disease Prevention and Control (ECDC). Over recent days Omicron cases have been identified in multiple countries globally, including in a number of European countries. On 1st December 2021 the first confirmed case of Omicron variant (B.1.1.529) in Ireland was identified through whole genome sequencing and notified to the HPSC. The confirmed Omicron case was identified in real time and is associated with travel from a scheduled State. In light of the recent emergence of Omicron, the current epidemiological situation needs to be considered within the wider context of the potential risks this variant poses to the pandemic response in Ireland.

Current evidence on the Omicron variant is limited. It is not yet clear whether Omicron is more transmissible or whether infection with Omicron causes more severe disease compared to other variants, including Delta. There is currently no information to suggest that symptoms associated with Omicron are different from those from other variants. The WHO reports that understanding the level of severity of the Omicron variant will take days to several weeks. In addition, it noted that preliminary evidence suggests there may be an increased risk of re-infection with Omicron (i.e., people who have previously had COVID-19 could become re-infected more easily with Omicron), as compared to other variants of concern, but information is limited.

In light of the emergence of the Omicron variant, the WHO recommends enhancing surveillance and sequencing of cases; and the continued implementation of the effective public health measures to reduce COVID-19 circulation overall, emphasising the importance physical distancing; mask wearing; improving ventilation; avoiding poorly ventilated or crowded spaces; maintaining respiratory etiquette, and taking up vaccination or boosters when offered.

Furthermore, on 2nd December (today), the ECDC published an updated Threat Assessment Brief on the Omicron variant which states that current evidence on transmissibility, severity and immune escape is highly uncertain for the Omicron variant but that preliminary data from South Africa suggests that it may have a substantial growth advantage over the Delta variant. The ECDC states that based on the currently available limited evidence and considering the high level of uncertainty, **the overall level of risk for EU/EEA countries associated with the further emergence and spread of the Omicron variant is assessed as high to very high.** Given the current limited evidence around this new variant and the concerns about its immune escape properties in relation to available COVID-19 vaccines and treatments, the ECDC advocates for a multi-layered approach to delay the spread of this VOC in the EU/EEA is needed. The ECDC states that NPIs should continue to be implemented by countries based on an assessment of their epidemiological situation regarding the Delta variant and considering the uncertainty of the situation regarding the Omicron variant. Genomic surveillance, vaccinations, and boosters remain vitally important and enhanced contact tracing measures could help slow down the establishment of the variant. Temporary travel-related measures should be carefully considered and should be regularly reviewed as new evidence emerges.

Modelling

IEMAG have revised models to take into account the extension of booster vaccination to those aged 16 and older and primary vaccination to those aged 5-11 years and have examined scenarios with different levels of effective social contact over the Christmas period. Furthermore, the group have examined scenarios where the Omicron variant comes to dominate in early January 2021, vaccines are less effective against the Omicron variant, and it is more transmissible. This is challenging, given that we do not yet have reliable estimates of vaccine effectiveness or possible transmission advantage

for this new variant. However, the scenarios show that if Omicron becomes dominant over the coming weeks and is associated with even moderate reductions in vaccine effectiveness and increases in transmissibility, **the risk of a surge in disease is high to very high, and any such surge is amplified by increased effective social contact over the Christmas period**. The risk is increased further if the level of infection-induced immunity in the population is lower (or if Omicron evades immunity from prior infection with other variants). The more pessimistic (but plausible) scenarios show 750 to 1300 people requiring general hospital care and 200-400 people requiring critical care, or 950-1700 in total requiring hospital care, in January 2022. Further details are included in the appendix below.

Health System Preparedness

The position across the health system remains challenging. While there may be early signs that case numbers are beginning to plateau, they are doing so at a high level, which will lead to sustained pressure being seen across the health service. As of 8pm on 1st December, there were 520 patients with COVID-19 receiving care in acute hospitals, with a further 142 cases awaiting results. Vacant bed capacity across the system at 8am on 2nd December was reported at 141. There is a poor distribution of these beds across a number of sites, with 16 sites reporting <5 vacant beds available at 8am.

As of 1st December, there 117 patients with COVID-19 in ICU, with only 13 critical care beds available nationally, with no critical care beds available in the Dublin region and in a number of other hospitals nationally. As of 1st December, 276 patients were receiving advanced respiratory support outside of critical care units, which places additional demands on staff on wards and also reduces the amount of staff available for redeployment to support critical care. Of these 276, 143 were COVID patients, with 133 non-COVID patients receiving care. The potential for the numbers of COVID patients requiring this level of care in a ward setting to increase and for the number of non-COVID patients to remain at a similar level for the foreseeable future is of deep concern.

The Critical Care Major Surge Working Group is continuing to meet regularly to manage the situation, and hospitals are seeking to maximise any surge capacity available, although it must be emphasised that available levels of surge capacity are dependent on a range of factors, including staff availability, significant curtailment of surgery and ED general demand, among others.

The number of patients presenting to hospitals for non-COVID care, including through EDs, remains high, notwithstanding the fact that significant cancellation of elective work has been seen across the acute hospital system. Additionally, the number of patients on waiting lists has risen substantially throughout the pandemic, with the ongoing cancellations expecting to impact further on the number of patients waiting for appointments. While the SafetyNet arrangement with the private hospitals remains in place and is being used, the ongoing detrimental impact of the pandemic on the delivery of non-COVID care cannot be overstated.

Outbreaks are continuing to be seen across hospital and community settings, with 12 new hospital outbreaks reported in the week ending 27 November and 41 outbreaks seen across nursing homes, community hospitals/long stay units and residential institutions in the same week. Current rates of community transmission are continuing to impact on the levels of COVID related absence amongst staff, with the resulting challenges in maintaining levels of service. It remains critical that all long-term residential care service providers continue to meticulously apply the necessary infection prevention and control measures and public health guidance.

Primary care services are also under pressure with service capacity adversely impacted by the need for infection prevention and control, the need to maintain and bolster COVID-19 services (including Long COVID response), the delivery of the vaccination programme and staffing challenges. These pressures are reflected in a reduced number of clients being seen and rising waiting lists. The total

number of people waiting for assessment or treatment across the four main primary care therapies (SLT, OT, physio and psychology) is now in excess of 131,000.

This level of ongoing demand is extremely difficult for the health system, and critical care units in particular, to sustain. While there has been intensive work over the course of the pandemic to increase capacity, even the most well-resourced health system would find it difficult to cope with levels of demand above what is currently being seen. A reduction in the levels of disease in the community remains the only solution to reducing the pressure on the healthcare system and on staff.

Key Considerations and Advice

As set out above, the most recent epidemiological data suggests that there has been a stabilisation across most indicators over the last week which is encouraging. However, this stabilsation is occurring in the context of a very high incidence of infection. Notwithstanding the high levels of protection afforded through high levels of vaccination we are experiencing case numbers and hospitalisations that are much higher than was experienced at this time last year. Of note, the numbers in ICU are five times higher than at the end of November 2020.

Furthermore, NPHET is very concerned that we are in a period of significant uncertainty, with a number of key risk factors identified, which will have significant influence over the trajectory of the disease over the coming weeks;

- The impact of the Omicron variant will not be known for some time. It remains unclear if the Omicron variant is more transmissible, and the extent to which it escapes vaccine or natural immunity or results in more severe infection remain uncertain. Consequently, the potential impacts of this new variant on disease trajectory, on public health and the healthcare system remain highly uncertain.
- Typically, December and the Christmas/New Year period is a time of higher levels of socialisation. The experience of last December and the Christmas/New Year period shows that the improved compliance with public health advice that we have observed in recent weeks may not persist. Furthermore, the nature of mobility and socialisation that can be expected over this period may bring significant risks for increased transmission. This includes inter-household and inter-generational social mixing, largely occurring indoors, domestic and international travel, and the significant reforming of 'households' as students and those working away from home return to those homes over the festive period.
- Influenza activity during the 2020–2021 season was low. The timing and intensity of the current influenza season is uncertain, although it can be anticipated that there will be an increase of influenza illness this winter, given that that there is a lower level of community protection in the population following last year's low levels and given the reduction in social and economic restrictions compared to the winter of 2020-2021.

Each of these factors on their own provide a very real but as yet unquantifiable risk to our management of COVID-19 over the coming weeks. Taken together and set in the context of an already significant burden of disease and force of infection, they have the capacity to present serious challenges in the weeks ahead as illustrated in the modelling projections. Unfortunately, it is impossible to quantify the level of risk, either in terms of likelihood or scale of impact. This will only become known in time, when it may be too late to take mitigating measures. Despite the high uptake of vaccination, the risks that existed as, we enter the winter period with the level of infection that we have been experiencing for a sustained period of time, have now been further amplified by the emergence of the Omicron variant.

The NPHET therefore advises, despite the recent stabilisation in the profile of the disease, that the continuing high force of infection and level of hospitalisations and the potential multiple risks over the coming weeks strongly warrant a proactive and precautionary approach at this time and recommends that the following additional measures should be considered by Government:

- Nightclubs should close,
- There should be strict social distancing for all indoor hospitality (all bars & restaurants, including in hotels), returning to those measures that were in place before 22nd October. This includes:
    - Table service only
    - Max of 6 people per table
    - No multiple table bookings
    - No intermingling between tables
    - Customers should wear masks at all times when not seated at a table
- Attendance at indoor events, including entertainment, cultural, community and sporting events, should be no more than 50% of the venue's capacity and all events should be seated only. Masks should be worn at all times including during the performance/event, and only removed if eating or drinking,
- The COVID Certificate system should be extended to other high-risk settings, including gyms and hotels (with appropriate exemptions as required),
- It is strongly advised that, over the coming weeks, visits to private homes should be kept to a maximum of three other households, recognising the need for some flexibility depending on individual circumstances. In general, people are advised to limit their contacts throughout this period, keeping celebrations small and taking particular cognisance of protecting those aged 50 years and older and those with underlying conditions who may not yet have received their booster vaccine.
- There should continue to be strong, clear communications to the public in relation to the importance of fully adhering to all basic public health measures, including working from home where possible. The NPHET noted the intention of the Department of Health to issue targeted public health communications for the Christmas period in the coming weeks.
- All sectors should redouble their efforts to ensure that all appropriate protective measures are in place to ensure the protection of staff and patrons. In this regard, the NPHET noted with concern, that compliance by many sectors with the public health measures already in place, is not optimal - examples include use of hand sanitizer and social distancing retail setting, the wearing of masks on public transport and the facilitation of employees to work from home, and the checking of the COVID pass across the hospitality sector.
- In light of ongoing very high disease incidence and the emergence of, and uncertainties associated with, the Omicron variant, the booster vaccination programme should be accelerated to the greatest extent possible.

The NPHET advises that these measures should be implemented as soon as possible and should remain in place until at least the 9th January 2022.

The NPHET believes that these are a targeted set of measures focused on those activities and settings that are likely to have the biggest impact over the coming weeks, while maintaining as much economic and societal activity as possible. The focus of these measures is to further strengthen protective measures in higher risk settings by reducing capacity and providing for more controlled environments.

In making these recommendations, the NPHET once again emphasises that our approach to the management of COVID-19 must continue to be underpinned by our core national priorities of protecting the most vulnerable to the severe impacts of COVID-19, minimising the burden on the healthcare system and continuing to keep schools and childcare facilities open.

In addition, the NPHET endorsed advice from HIQA , that at present the evidence does not support a population-level recommendation for the use of respirator masks (FFP2 or equivalent, or respirator masks with higher filtration efficacy) by those who are classed at higher risk from COVID-19, while noting that that this does not preclude their use at an individual level. The NPHET reiterate the need for continued clear communications on the appropriate use of face masks. The NPHET also agreed in principle to progressing further work and considerations on self-testing and/or self-swabbing testing modalities in symptomatic individuals.

Given the current uncertain epidemiological situation, the NPHET intends to closely monitor the profile of the disease over the coming weeks and, 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: Additional Modelling Information

Model structure and assumptions

Model structure

The scenarios have been implemented in the homogeneous population SEIR model and the age-cohorted SEIR model, and the outputs of these models translated into healthcare demand using the ESRI CHUP model, as previously described and published. The assumptions in regard to the dynamics of SARS-CoV-2 infection and transmission are as published. This includes the assumption, validated in prior model runs, that children under 12 years of age contribute less to overall transmission (50% less) of the virus than adults. The delta variant is assumed to have a transmission advantage of 1.97 over ancestral (wild-type) SARS-CoV-2, that is, delta is almost twice as transmissible. The results presented here are from the homogeneous model, and the baseline scenarios have been validated with the age-cohorted model. The models are calibrated to 28 November 2021.

Assumptions

Vaccine effectiveness

The models assume high baseline levels of vaccine effectiveness against symptomatic infection (95% for Pfizer-BioNTech and Moderna, 80% for AstraZeneca and 67% for Janssen) and higher effectiveness against severe outcomes (97% for Pfizer-BioNTech and Moderna, 94% for AstraZeneca and 67% for Janssen). The delta variant is associated with reduced vaccine effectiveness against symptomatic infection (a 37% reduction in effectiveness with one dose only, a 10% reduction with two doses). Vaccine protection against severe outcomes is not altered for delta. Vaccine effectiveness wanes over time: starting 28 days after vaccination, effectiveness in preventing symptomatic infection declines exponentially to 40-60% of peak effect with a half-time of 90 days; vaccine effectiveness against severe disease declines to 80-90% of peak with a similar time course. Booster vaccination rapidly restores effectiveness against symptomatic infection to above 90% and severe disease to above 95%.

Vaccination

The data on uptake of primary vaccination, and additional doses administered to date, are taken from the HSE CoVax system. It is assumed that booster vaccination of those aged 60 and older will be substantially complete by end-December 2021, those aged 50-59 years by 10 January 2022, with the remaining cohorts complete in February and March. The uptake of booster vaccination ranges from 50% in those aged 16 years to 90% in those aged over 85 years. Vaccination of children aged 5-11 years is assumed to effectively begin from 10 January 2022 with uptake of 60% achieved over three months.

Effective social contact

The models examine 4 different scenarios with respect to effective social contact over the Christmas period:

- effective social contact remains at the level estimated for the week ending 28 November 2021;
- effective social contact decreases by 10% from 29 November 2021 and is maintained at that low level;
- effective social contact increases by 10% in early December, and further increases, for late December and early January 2021, to the levels seen at Christmas 2020; and,
- effective social contact increases by 10% in early December, and further increases, for late December and early January 2021, to 20% above the levels seen at Christmas 2020

It should be noted that 'effective social contact' in these models is an estimate not only of the level of close social contact, but also the risk of transmission associated with those contacts, including the non-pharmaceutical interventions (NPI) taken to reduce transmission, and the changing risk of social contact in the winter compared to the summer.

Infection-induced immunity

The scenarios explore two possibilities, within a relatively narrow range, in relation to the level of infection-induced immunity in the population:

- a high-immunity scenario where 60% of infections are not detected as cases (because they are asymptomatic or did not come forward for testing) so that the level of immunity in the population would be higher than estimated from case numbers; and
- a low-immunity scenario where 40% of infections are not detected as cases, so there is less 'hidden' infection-induced immunity.

This range is based on an analysis of test positivity data, calibrated to seroprevalence data, to estimate the undetected fraction. It should be noted that infection-induced immunity does not wane in these models. This is being added, but early sensitivity analysis suggests that waning infection-induced immunity does not make a material difference to the short-term scenarios presented here.

Omicron

While early data suggest that omicron has a significant growth advantage over delta, it is not clear to what extent this is due to immune escape or increased transmissibility. We have no reliable estimates of how transmissible omicron is, how effective vaccines are in preventing infection or severe disease with omicron, the extent to which it can infect and cause illness in people previously infected with other variants, or the severity of disease associated with this variant.

IEMAG have examined some exploratory scenarios, where it is assumed that omicron comes to dominate in January 2022, accounting for 50% of transmissions by 6 January 2022 and 90% of transmissions 28 days later. This is similar to the profile of introduction of alpha in late December 2020 and early January 2021. Vaccine effectiveness against symptomatic infection is assumed to be 30% less with omicron compared to delta, but vaccine protection against severe disease is maintained. We explore two different scenarios for transmission advantage, one where omicron only has a marginal transmission advantage over delta (1.05 or 5% more transmissible) and one where it has a greater transmission advantage (1.4 or 40% more transmissible)

Results

Figure 1 shows a baseline scenario, where omicron does not become dominant, or has marginal vaccine escape and transmission advantages. The increased levels of vaccine-induced immunity achieved through booster vaccination are highly protective, but increased mixing over Christmas causes a moderate surge in the low-prior-immunity scenario, with a peak of cases between 6000 and 8000 cases per day in early January, and considerable uncertainty around these estimates. It should be noted that in this, and in all other scenarios, if omicron evades the immunity conferred by prior infection with other variants, infection levels will track closer to the "low immunity" scenarios.

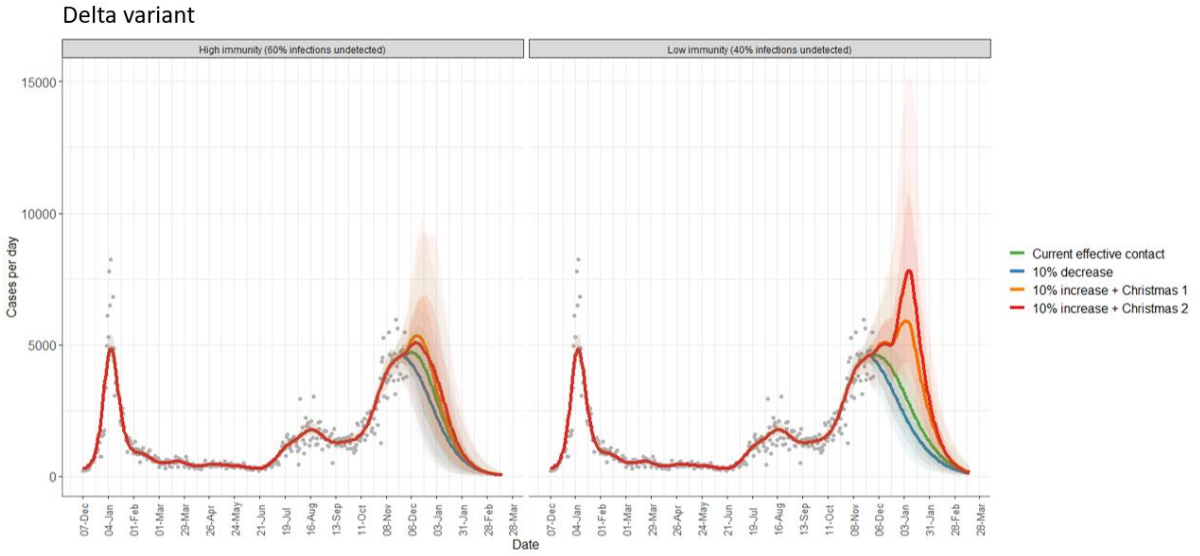

Figure 1: Homogeneous population SEIR model scenarios for case numbers with different levels of effective social contact and infection-induced immunity where omicron does not become dominant (or has marginal vaccine escape and transmission advantages). The increased levels of vaccine-induced immunity achieved through booster vaccination are highly protective, but increased mixing over Christmas causes a moderate surge in the low prior immunity scenarios. Christmas 1 = effective social contact over Christmas period similar to Christmas 2020; Christmas 2 = effective social contact over Christmas period 20% greater than Christmas 2020.

Figure 2 and Figure 3 show scenarios where omicron comes to dominate in early January 2021, vaccines are 30% less effective in preventing infection with omicron, and omicron is either 5% or 40% more transmissible compared to delta. These clearly show the very significant risk associated with increased effective social contact over the festive season. If effective social contact can be maintained at current levels or even marginally decreased, the level of infection will remain below 5,000 cases per day under most scenarios, though there is a wide range of uncertainty around these estimates. However, if effective social contact increases to the levels seen in December 2020, even for a short period, under optimistic scenarios with high infection-induced immunity (and no evasion of this immunity by omicron) cases approach 6,000 to 8,000 per day at the peak of a prolonged wave, and

more pessimistically, if infection-induced immunity is low, or evaded by omicron, a very large surge is possible, peaking at 8,000-15,000 cases per day at peak

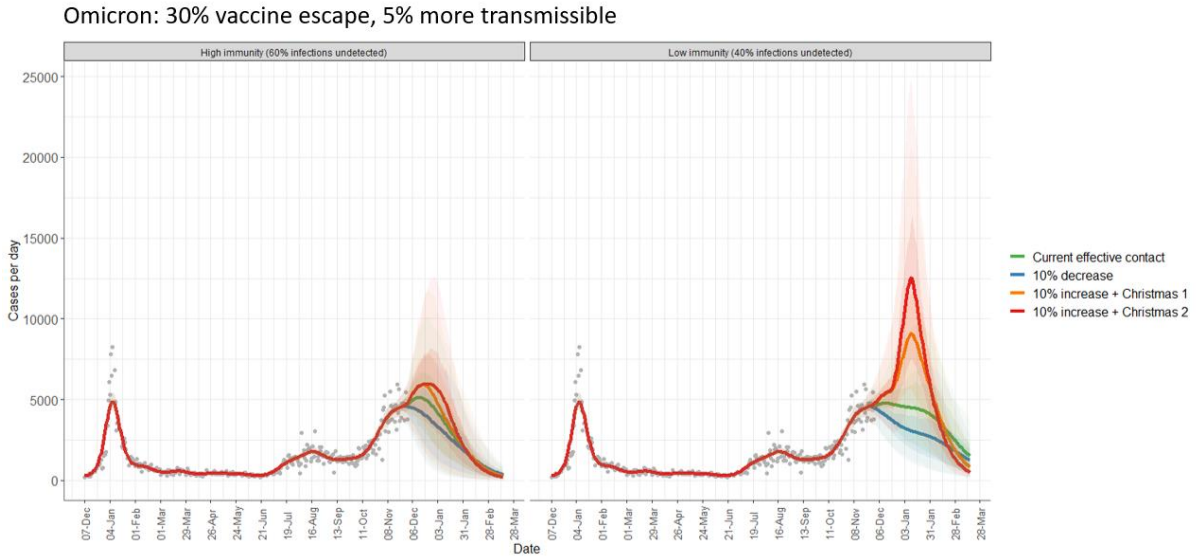

Figure 2: Homogeneous population SEIR model scenarios for case numbers with different levels of effective social contact and infection-induced immunity where omicron becomes dominant, vaccines are 30% less effective in preventing infection with omicron, and omicron is 5% more transmissible, compared to delta. The current wave is prolonged in the high infection-induced immunity scenarios, and the low infection-induced immunity scenarios include a large spike of infection where there is high effective social contact over Christmas, in the region of 10,000 cases per day at peak, with considerable uncertainty. Note expanded y-axis. Christmas 1 = effective social contact over Christmas period similar to Christmas 2020; Christmas 2 = effective social contact over Christmas period 20% greater than Christmas 2020.

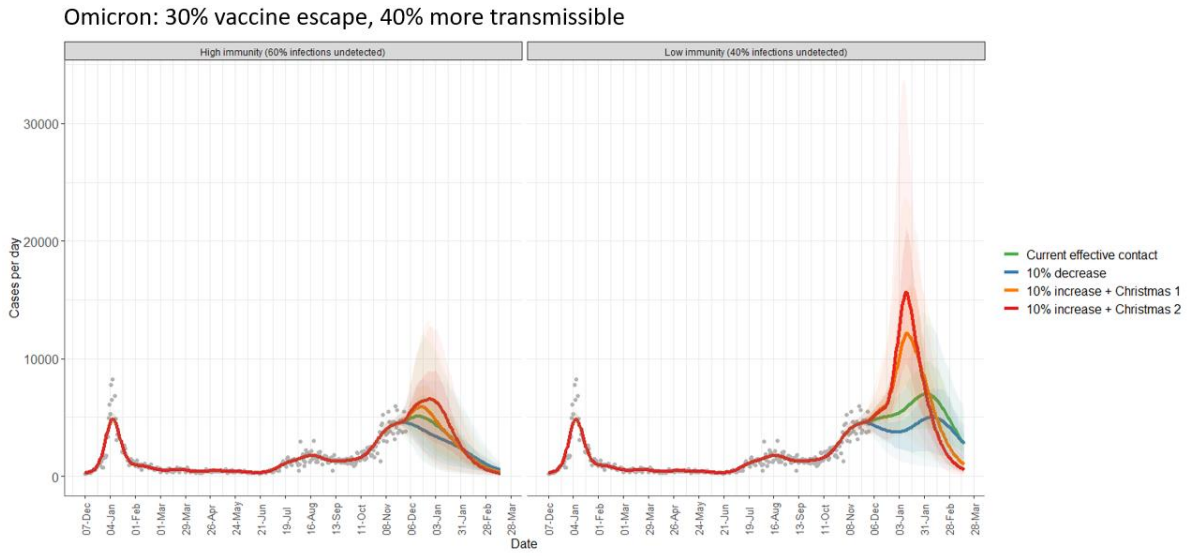

Figure 3: Homogeneous population SEIR model scenarios for case numbers with different levels of effective social contact and infection-induced immunity where omicron becomes dominant, vaccines are 30% less effective in preventing infection with omicron, and omicron is 40% more transmissible, compared to delta. The current wave is prolonged in the high infection-induced immunity scenarios with case counts in excess of 7,000 per day in high social mixing scenarios. The low infection-induced immunity scenarios include a large spike of infection with effective social contact over Christmas, with daily case numbers in the region of 12,000-15,000 per day at peak. Note y-axis further expanded. Christmas 1 = effective social contact over Christmas period similar to Christmas 2020; Christmas 2 = effective social contact over Christmas period 20% greater than Christmas 2020.

Figure 4 and Figure 5 show how these scenarios would translate into demand for general hospital and critical care. These can be read as a risk matrix, with the lowest risk scenarios (high infection-induced immunity, omicron not a significant threat) at the top left, and high-risk scenarios (low infection-induced immunity, omicron significantly more transmissible) at the bottom left. It can be seen, as for levels of infection, that if omicron is more transmissible and infection-induced immunity low (or omicron evades immunity due to infection with other variants) the risk of dangerous levels of healthcare demand is high to very high, and the risk associated with increased social contact in December is amplified. The more pessimistic (but plausible) scenarios show 750 to 1300 people requiring general hospital care and 200-400 people requiring critical care, or 950-1700 in total requiring hospital care.

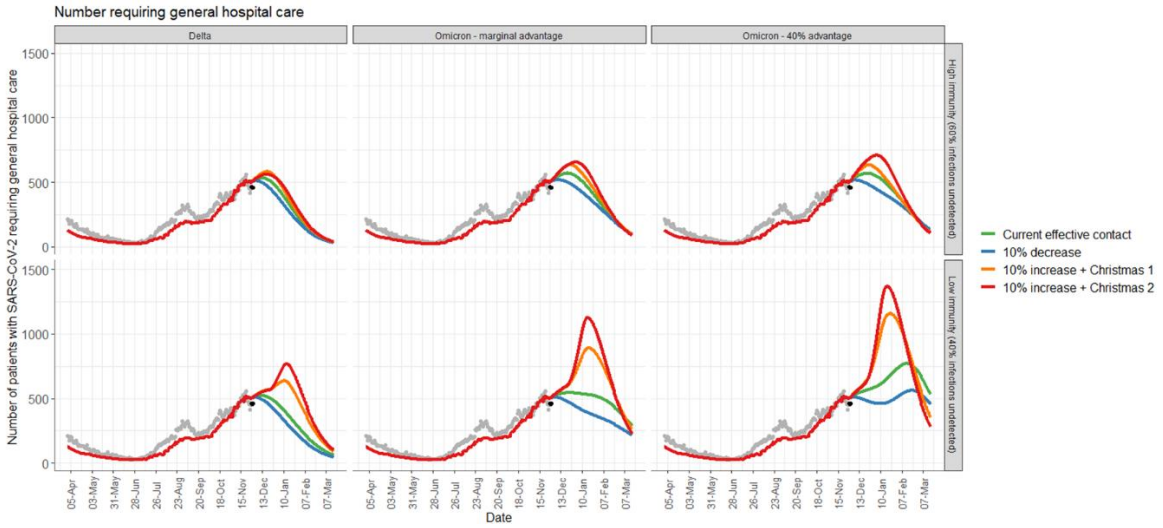

Figure 4: The estimated number of people requiring general hospital care (excluding those requiring critical care) for all scenarios. If omicron does not become dominant (or has marginal vaccine escape and transmission advantages, top left) the models show healthcare demand continuing close to current levels for two weeks and then declining. However, lower infection-induced immunity, omicron evading infection-induced immunity, omicron evading vaccine protection against infection, or omicron being more transmissible all increase healthcare demand and amplify the effect of increased social mixing over Christmas. The more pessimistic scenarios show 1,000 people or more requiring general hospital care in early January 2022.

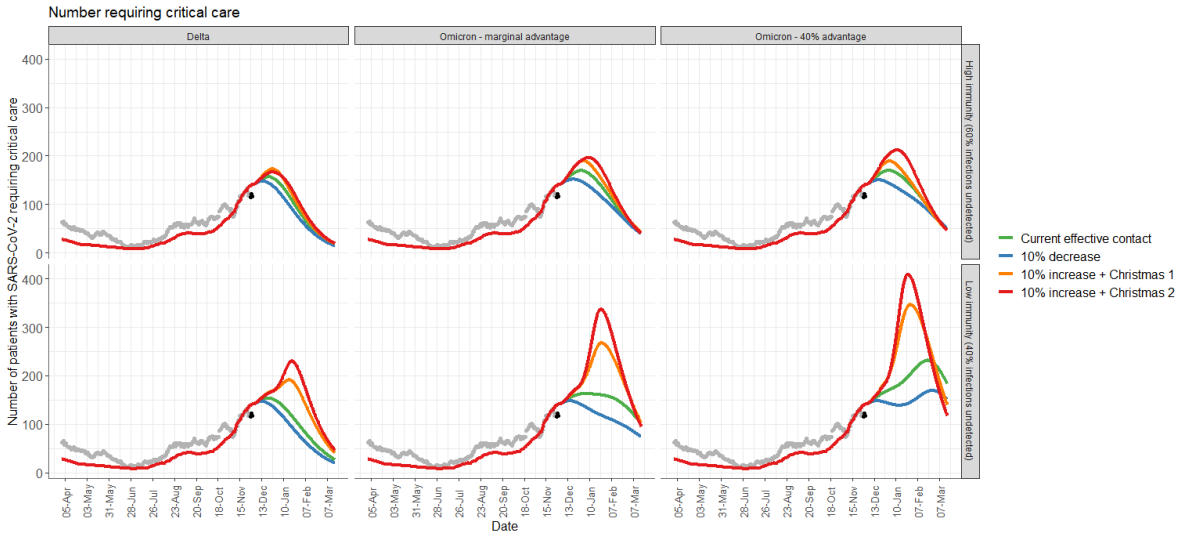

Figure 5: The estimated number of people requiring critical care for all scenarios. If omicron does not become dominant (or has marginal vaccine escape and transmission advantages, top left) the models show healthcare demand peaking in late December 2021 and then declining. However, lower infection-induced immunity, omicron evading infection-induced immunity, omicron evading vaccine protection against infection, or omicron being more transmissible all increase healthcare demand and amplify the effect of increased social mixing over Christmas. The more pessimistic scenarios show 200-400 people or more requiring critical care in through January and February 2022.

If omicron becomes dominant over the coming weeks and is associated with even moderate reductions in vaccine effectiveness and increases in transmissibility, **the risk of a surge in disease is high to very high**, **any such surge is amplified by increased effective social contact over the Christmas period, and this would translate into very high demand for general hospital and critical care.**