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Hospital admission probability and length of stay among Covid-19 confirmed cases

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Introduction

The volumes of Covid-19 confirmed cases and hospital admissions have varied across the course of the pandemic in Ireland. Three broad waves can be identified; March through July, August through November, and December onwards. The majority of confirmed cases and hospital admissions have been recorded since December. This briefing note examines how the relationship between cases, hospital and critical care admissions, and hospital length of stay, may have varied over the course of the pandemic. Particular attention is paid to variation in age-specific distributions of admission probabilities and average length of stay across waves of the pandemic.

Data and Methods

Data on number of Covid-confirmed cases and admissions to general hospital and critical care are taken from the HPSC CIDR database. This file records all confirmed COVID-19 cases in the country up until a particular time point on the latest date of case notification. The CIDR data also provide information on length of stay in critical care.

To capture length of stay in general hospital beds we rely on the HPO HIPE dataset. The Covid-19 extract of the HIPE dataset captures administrative and clinical information on deaths and discharges of Covid-19 cases from all acute public hospitals nationally. Both CIDR and HIPE databases are accessed securely through the CSO Virtual Desktop Infrastructure (VDI).

We adjust the analysis, as far as possible, to focus mainly on community acquired cases[1]. In the CIDR dataset we exclude cases flagged as healthcare workers or cases with an outbreak location flag of “Nursing home” “Comm. Hosp/Long-stay unit” or

[1] A proportion of these cases that may have contracted Covid-19 in hospital. Future refinements may consider the best approach to adjusting for these cases.

"residential institution". Similarly, in the HIPE dataset we exclude Covid-19 discharges with an admission source of "Nursing home/convalescent home or other long stay accommodation". No information on the occupational status of discharges is recorded on the HIPE dataset.

A lag may often exist between case notification and hospital and critical care admission. For this reason, when examining hospitalisations and critical care admissions, we cap case notifications two weeks prior to the file date (in this analysis 16th February 2021).

The distribution of length of stay for both critical care stay and those admitted to general hospital beds only, is heavily skewed (see Appendix, Figure A1). To avoid outliers excessively influencing average values, we trim length of stay in this analysis at the 1st and 99th percentile of respective distributions.

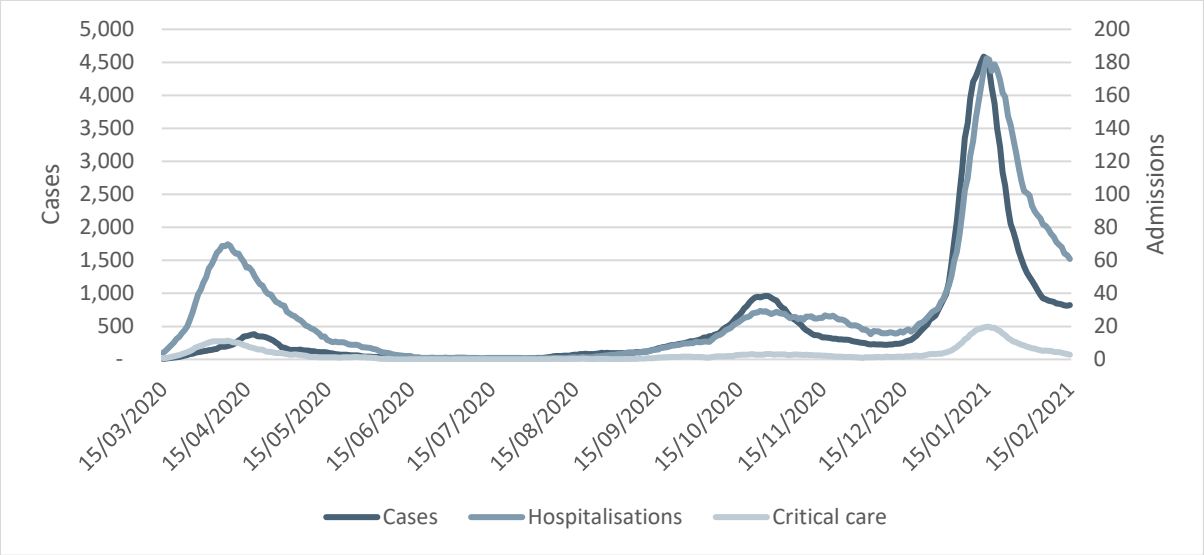
All parameters are presented with associated 95 percent confidence intervals calculated through resampling observations (500 replications) with replacement from the data.

Findings

Cases, hospitalisations, and critical care

Figure 1 provides trends in confirmed cases, hospitalisations and critical care admissions notified to HPSC over the course of the pandemic in Ireland. As can be seen, cases and admissions have varied through time. Based on these distributions, three broad waves of the pandemic can be identified; March through July (wave 1), August through November (wave 2), and December onwards (wave 3). The third wave is particularly notable given the volume of cases and admissions that have been associated with it. For the data under consideration, 68.6 percent of cases, 58.5 percent of hospital admissions, and 50.1 percent of critical care admissions were recorded since 1st December 2020.

FIGURE 1 Cases, hospitalisations, and critical care admissions by day (14-day rolling average)

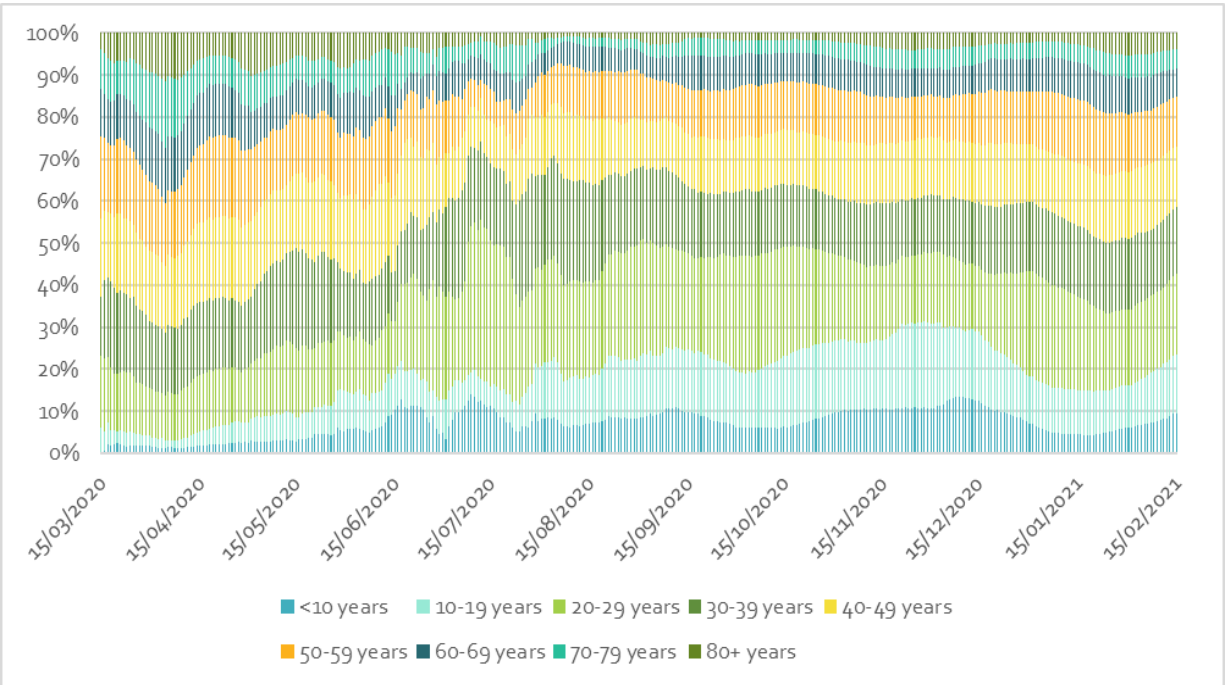


Source: *CIDR database*

The age distribution of cases has also fluctuated over the course of the pandemic; it is likely to have been influenced both by variations in the pattern of transmission over time and also in rates of testing in each of the age groups.

Variations in the age distribution of cases over time are illustrated in Figure 2. As can be seen, relatively high case shares of older individuals at the beginning of the pandemic were progressively replaced by younger age groups as the pandemic progressed. In recent weeks there appears to have been an increase in shares of cases made up from the youngest age groups. This is in contrast to a brief increase in shares of cases in older age groups observable in early January.

FIGURE 2 Share of new Covid-19 cases by age group (14-day rolling average)



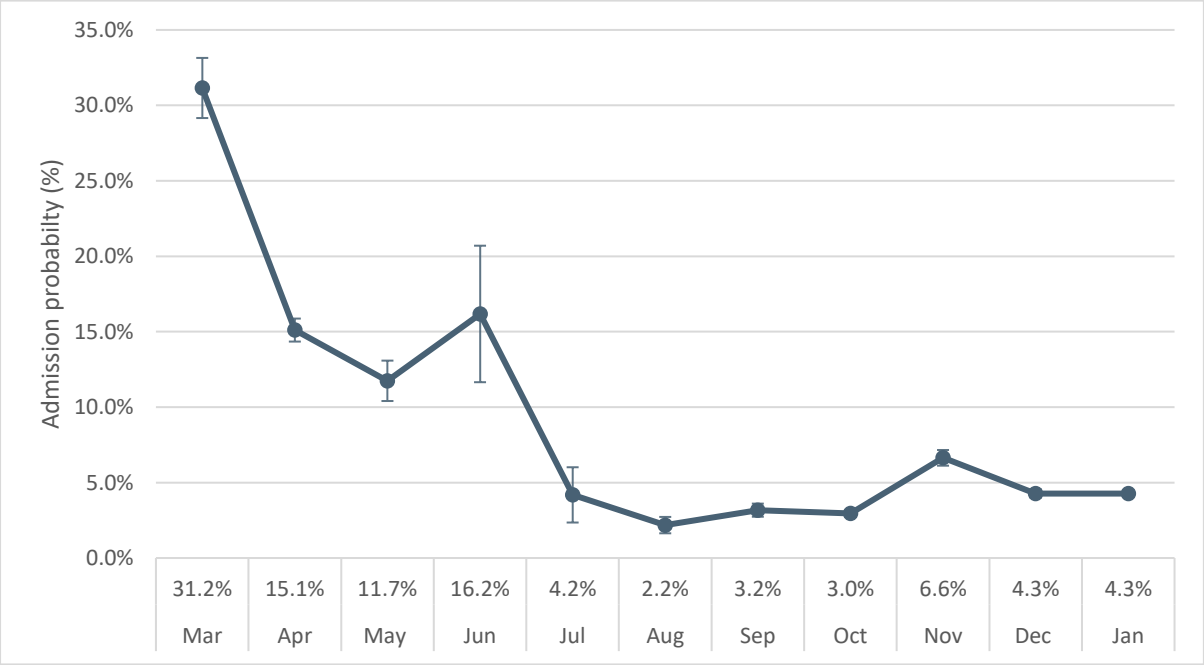
Source: ESRI analysis of HPSC, CIDR file

Admission probability

Figure 3 charts general hospital admission probability by month since the beginning of the pandemic in March 2020[2]. Admission probability was highest in March 2020 (31.2%) and declined to a low of 2.2 percent in August. Notably, the probability of admission rose to 6.6 percent in November and has remained at 4.3 per cent since December. The rise in admission probabilities during this period does not seem explained by significantly higher shares of cases arising in older age groups (see Figure 2).

A similar trend is observable for critical care admission probabilities (Figure 4). The probability of critical care admission was highest in March at 7.3 percent, declining to a low of 0.3 percent of cases in August and remaining relatively stable since then. From December onwards the probability of critical care admission has been 0.5 per cent.

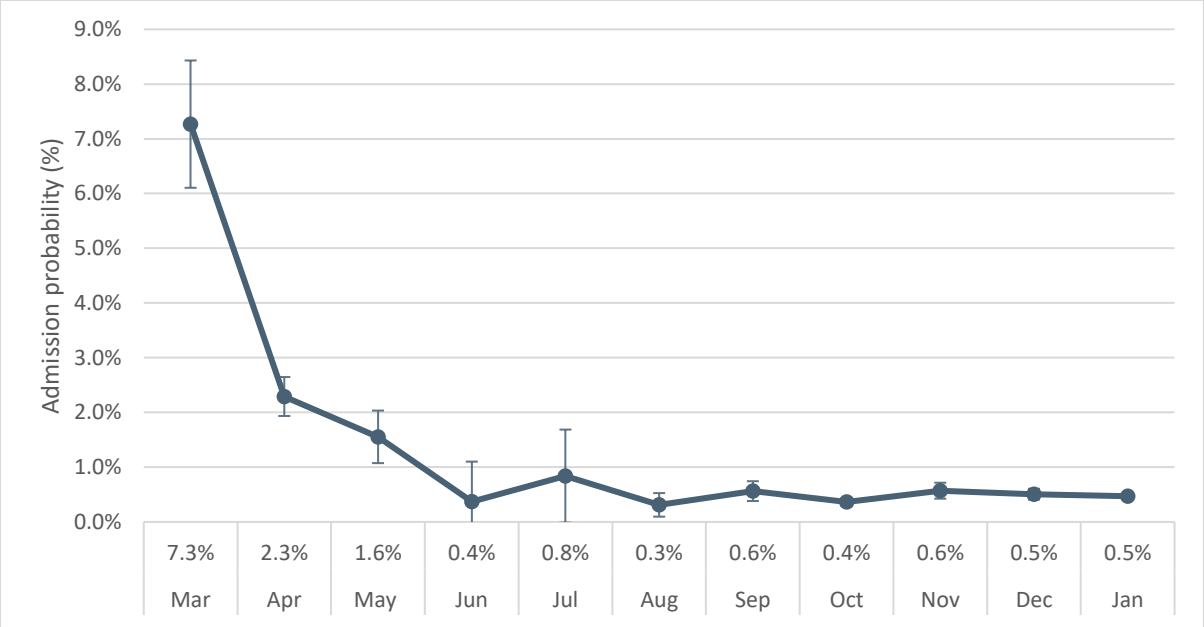
FIGURE 3 General hospital only (non-critical care) admission probability, by month



Source: CIDR database

[2] Here an admission may refer to cases of hospital-acquired Covid-19.

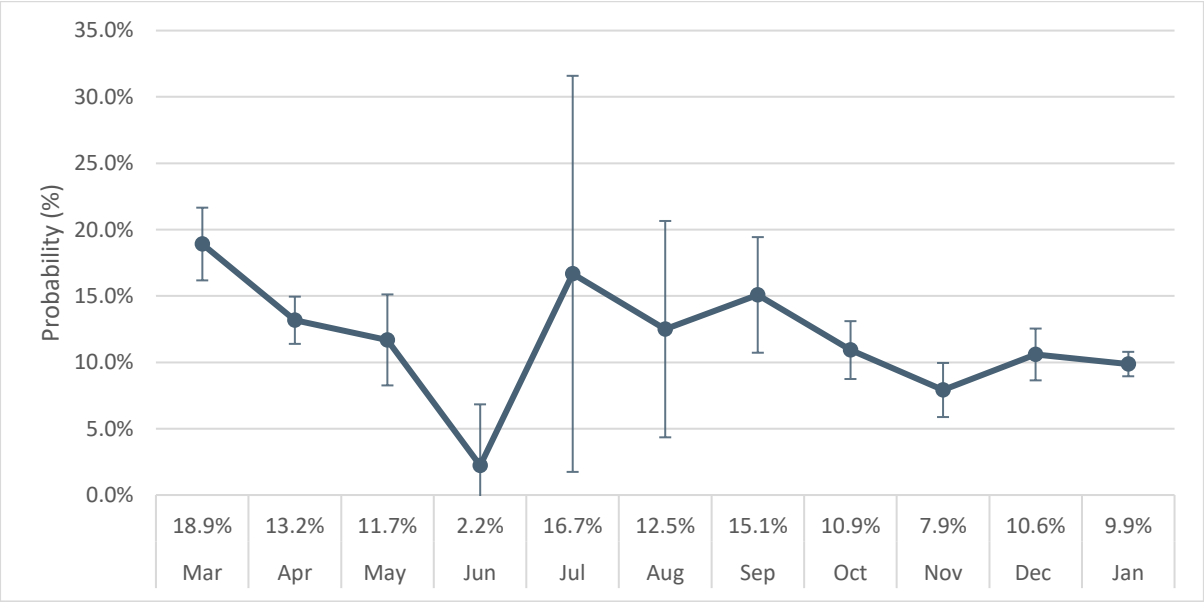
FIGURE 4 Critical care admission probability, by month



Source: *CIDR database*

Figure 5 tracks the probability of critical care admission following hospitalisation, by month. As both hospital admission and critical care admission probabilities follow similar trajectories over the course of the pandemic, the probability of critical care admission following hospitalisation has remained reasonably uniform over the course of the pandemic. Apart from June (2.2 percent) and November (7.9 per cent), between 10 and 20 percent of hospitalisations each month have resulted in critical care admission.

FIGURE 5 Probability of critical care admission given hospitalisation, by month



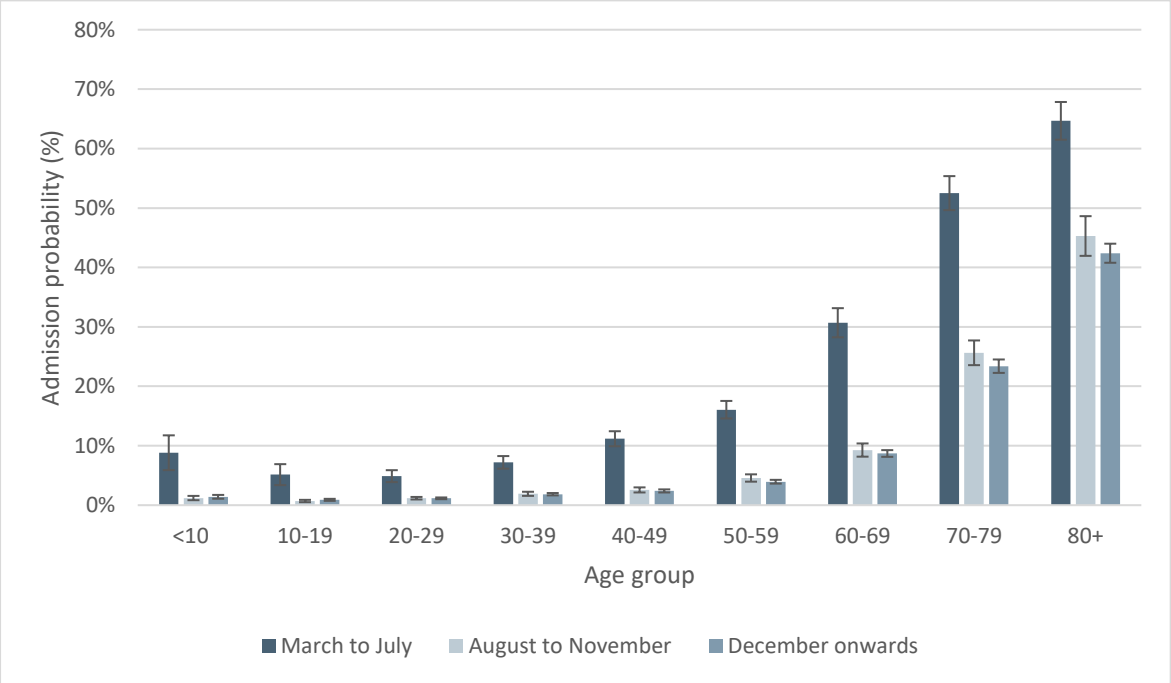
Source: *CIDR database*

Average admission probabilities may vary over time due to changing clinical practices (i.e. the model of care), but they may also be affected by the composition

of cases. In particular, if the proportion of cases made up by older age groups increases, average admission probabilities tend to rise as these groups are more likely to require hospital care. This broad pattern has held throughout the pandemic to date, although there have been some changes over time in age-specific probabilities of admission.

Figure 6 illustrates the probability of hospital admission by age for three periods waves of the pandemic. Across all waves, the probability of hospital admission rises with age, peaking for those aged 80 and over. In the period March through July, for this age group, 65 percent of notified cases to CIDR recorded hospitalisation, this fell to an average of 45 percent in the period August through November, and to 42 percent from December on. Figure 6 shows significantly higher admission probabilities across all age groups in the period March through July.

FIGURE 6 Hospital admission probability by age and pandemic period

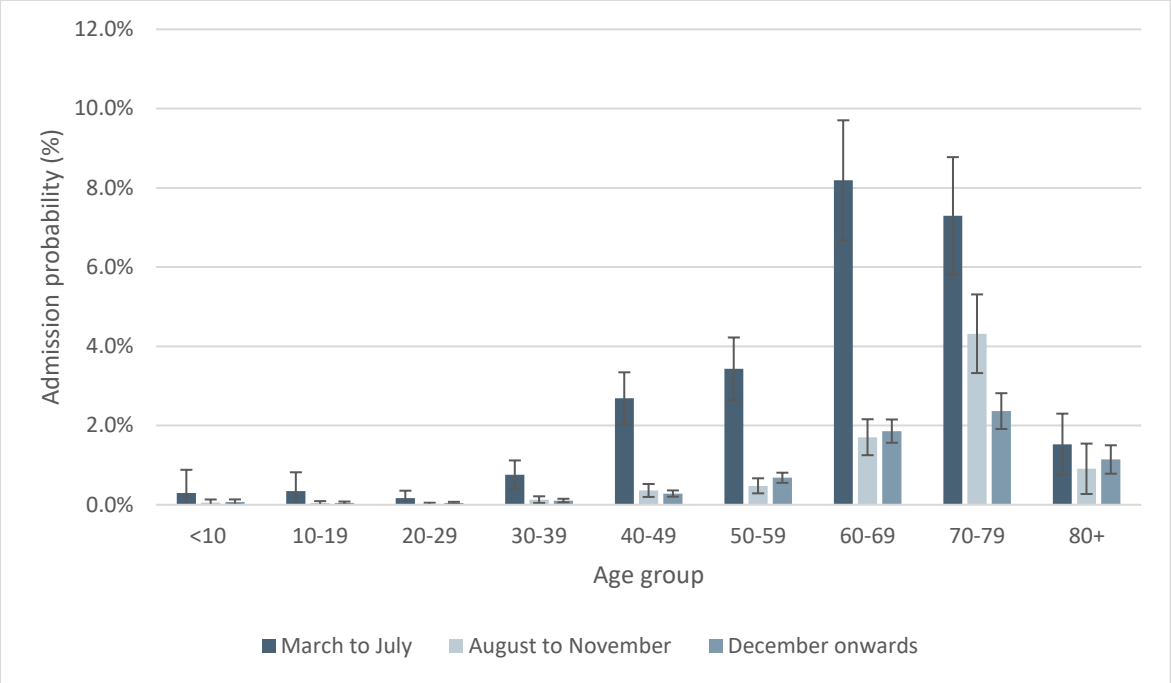


Source: CIDR database

Figure 7 illustrates the probability of critical care admission by age for the same three periods of the pandemic. Similar to Figure 6, there is a strong age gradient evident in terms of the probability of critical care admission. However, in the periods March through July, and August through November, the probability of critical care admission is much lower for those aged 80 and over.

While Figure 4 showed higher critical care admission probabilities in the early months of the pandemic, Figure 7 shows that this also applied across age groups. In the period March to July, 8.2 percent of 60-69 years old and 7.3 per cent of 70-79 years old Covid-19 cases notified to HPSC received critical care.

FIGURE 7 Critical care admission probability by age and pandemic period

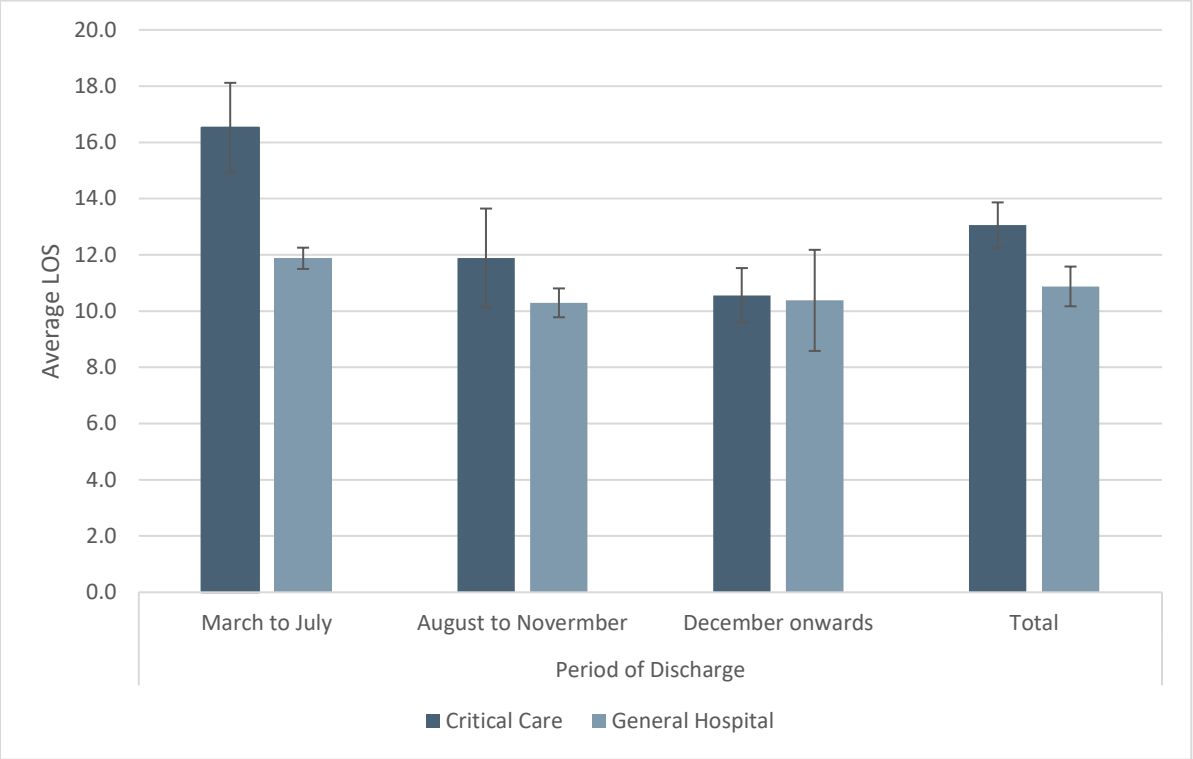


Source: *CIDR database*

Length of stay

Figure 8 charts average length of stay (ALOS) for those admitted to general hospital beds only, and for those in critical care. Over the entire pandemic period ALOS for general hospital only discharges was 10.9 (median 6 days) and 13.1 (median 9 days) for critical care stay. Some variation, however, is observable over the course of the pandemic. Average length of stay for general hospital only discharges (16.5 days) and critical care (11.9) was greatest in the period March through July and has since declined. Since December, similar ALOS has been reported for general hospital only discharges (10.4 days) and for a stay in critical care (10.6 days).

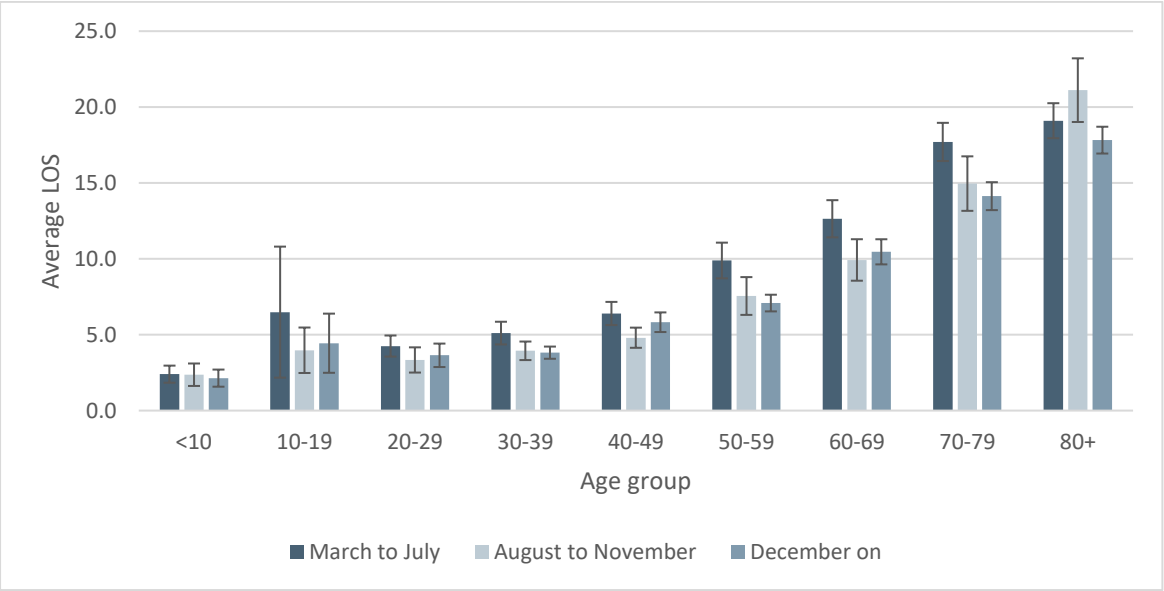
FIGURE 8 Average length of hospital stay for general hospital discharges (non-critical care) and critical care discharge, by pandemic period



Source: *CIDR and HIPE databases*

Figure 9 illustrates ALOS in general hospital beds by age group and pandemic period. Similar to admission probabilities, across all periods, there is a strong age gradient observed. The ALOS in a general hospital bed increases, on average, with the age of discharges. The higher overall ALOS between March and July observed in Figure 8, applies to most age groups also. A noticeable exception is the 80 years and older age group where ALOS in the August through November (21.1 days) period exceeded that of March through July period by 2 days (19.1 days).

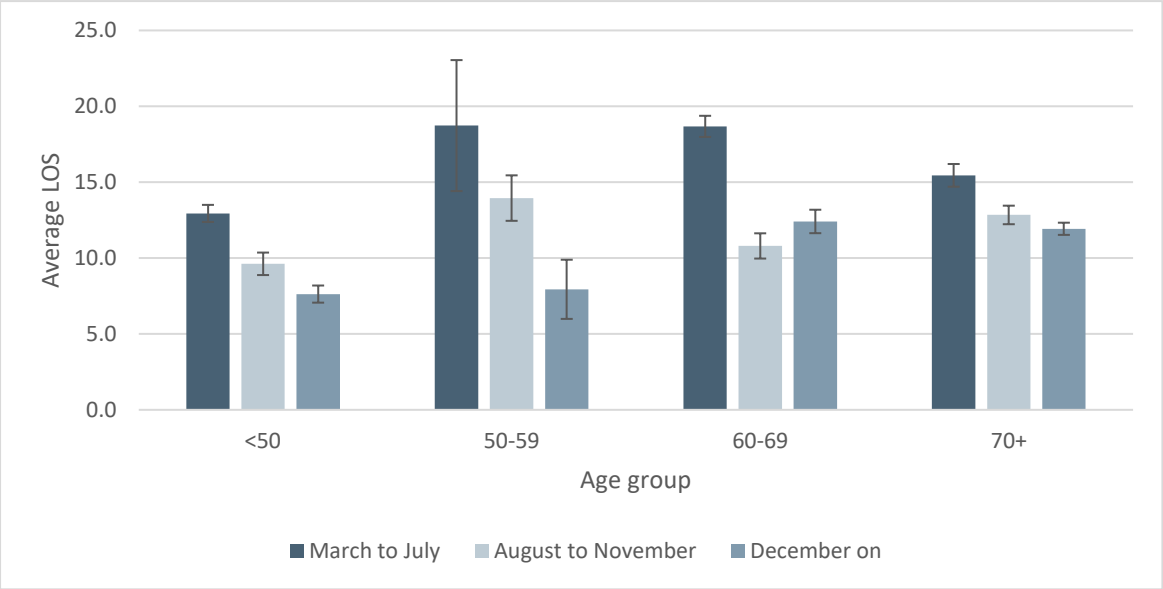
FIGURE 9 General hospital average length of stay, by age and pandemic period



Source: HIPE database

Figure 10 charts the ALOS of critical care patients by age[3] and pandemic period. In contrast to Figure 9, no obvious relationship is observable between age and average length stay in critical care. It may be that age plays less of a role in resource use within the severely ill group of patients in critical care. The higher overall ALOS observed in the early months (Figure 8) of the pandemic is, however, consistent across age groups.

FIGURE 10 Critical care average length of stay by age and pandemic period



Source: CIDR database

It is important to note that ALOS does not fully describe the length of stay distribution for Covid-19 patients. Many cases have a very short length of stay, but there is also a long tail of cases with lengths of stay well in excess of the average. In the appendix we present length of stay distributions by wave.

Summary

The volumes of Covid-19 confirmed cases and hospital admissions have varied across the course of the pandemic in Ireland. Three broad waves were identified; March through July, August through November, and December to date.

The first wave was associated with a higher share of cases made up of older age groups. Reflecting this, the first wave was also associated with significantly higher admission probabilities and average length of stay compared to subsequent waves. However, it is also important to note that age-specific admission probabilities and length of hospital stay were also higher in the first wave.

[3] Age groups have been combined for younger and older ages due to small numbers.

The third wave has been significantly different to previous waves in terms of volume of cases and admissions recorded. However, admission probabilities and average lengths of hospital stay recorded in the third wave are broadly similar to those in the second wave. Recent weeks have seen higher proportions of cases arising in the youngest age groups (on a 14-day rolling average basis).

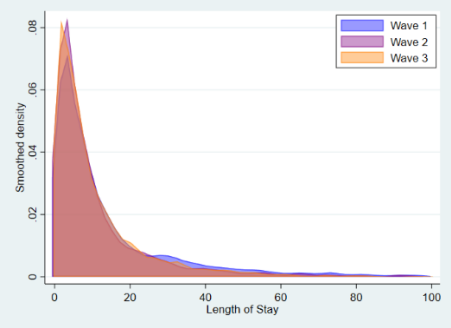
Factors including the rollout of vaccination to at-risk groups, the impact of new Covid-19 strains, and changing policy and behaviours, are likely to impact on the relationships examined over the coming weeks and months. We plan to issue further updates to track these changes.

Appendix

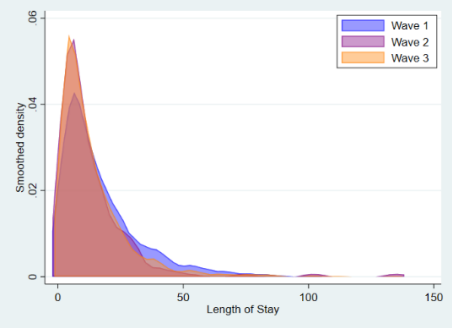
The analysis above focused on examining how average length of stay varied across the pandemic. Figure A1 plots the total (untrimmed) distribution of length of stay for general hospital only and critical care discharges. Across waves, the densities appear broadly similar.

FIGURE A1 Critical care average length of stay by age and pandemic period

General hospital only



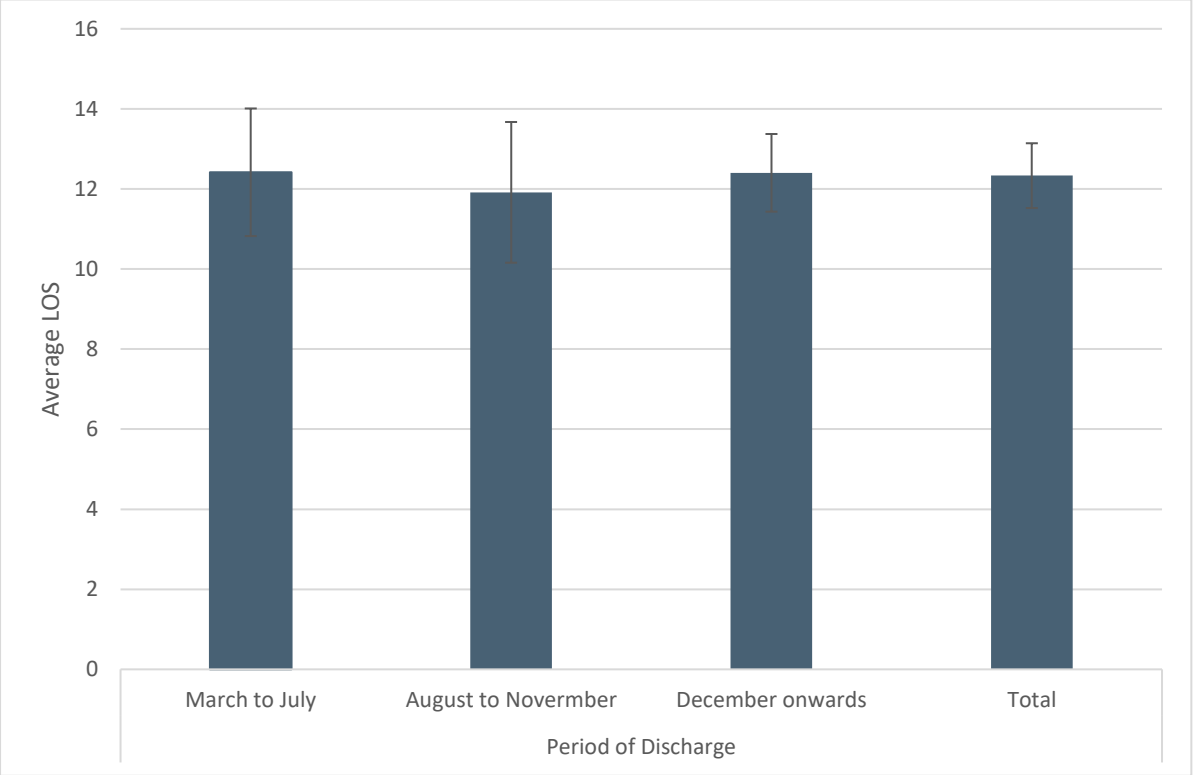
Critical care



Source: CIDR and HIPE databases
Note: Untrimmed LOS

One category of length of stay excluded from the analysis above was general hospital length of stay for critical care patients. This is presented in the Figure below but represents a somewhat imprecise measure. It is estimated as a residual from the HIPE data through subtracting total hospital bed days for ITU (intensive treatment unit) discharges from their ITU bed days. In HIPE it is not possible to split this by pre and post ITU stay.

FIGURE A2 General hospital average length of stay for critical care discharges



Source: HIPE database