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**Modelling the COVID-19 epidemic; the Reproduction Number and other indicators**

**Current estimate of R (hospital inpatients):  1.1 – 1.4** (definitely above 1)

**Current estimate of R (new positive tests): 1.1 - 1.6** (definitely above 1)

**Average number of new positive tests per day last 7 days:  66.3** (increased from 56.3)

**7 day incidence based on new positive tests: 24.4 / 100k population** (up from 20.7)

**14 day incidence based on new positive tests: 45.3 / 100k population** (up from 36.9)

**7 day average of total tests (pillar 1 and 2) which are positive – 1.45%** (up from 1.34)

**Tests per 7 days per 1000 population – 17.2** (up from 15.9)

**First COVID +ve hospital admission in last week – 17** (up from 14)

**7 day average number COVID occupied hospital beds – 21.0** (up from 17.0)

It is important to model the COVID-19 epidemic in Northern Ireland in order to plan the delivery of Health and Social Care services and to inform decision making with regard to social distancing and other restrictions which may be required.  The Reproduction Number (R) has been central to modelling the course of the epidemic to date.  R is the number of individuals who, on average, will be infected by a single person with the infection.  R does not have a fixed value but varies with time, and is likely to be different every day.

When R is above 1, the transmission of the epidemic will increase, resulting in more cases, hospital admissions and deaths.  The greater the value of R above 1, the more rapid the increase.  When R is below 1, there will be a fall in the number of cases, hospital admissions and deaths.   The further R is below 1, the more rapid the fall will be.   The Executive has indicated that keeping R below 1 is a key objective as we move forwards in the epidemic.

However, when community transmission of the virus is very low, R will no longer be the most important number for the purpose of policy decisions.   In particular, once the number of new cases is sufficiently low in the presence of a robust testing programme and test/trace/protect strategy, number of positive tests per day is likely to be a more important parameter in the context of planning.

**At present R remains stable at around 1.3, and is definitely above 1.   The above indicators generally show a further increase in transmission in the last week. The 7 day rolling average for new cases has increased, as has test positivity.  14 day cases per 100k have increased and remain higher than UK and ROI.  This is likely to be partly explainable by increased testing in the context of the Test / Trace / Protect service.  However, there is also likely to be a more widespread increase in community**

**transmission which is associated with multiple small clusters rather than a small number of larger outbreaks.**

**Hospital admissions continue to increase very slowly and are still at a low level in comparison to the point in the first wave when there was a comparable number of cases.  This is likely to be because only around 10% of cases are currently in the over 60s, whereas at a comparable stage of wave 1 up to 50% of cases were in this age group.  We will continue to keep this trend under close review.  However, the view from both the Modelling Group and the Strategic Intelligence Group is that hospital admissions will inevitably rise further as cases continue to do so, and this will accelerate if cases spread more into the over 60s. .**

**Regional variation in cases:**

There is marked variation in COVID cases in Local Government Districts, with Fermanagh and Omagh the lowest.  Main concerns are currently in relation to Armagh City, Banbridge and Craigavon (partly explained by a hospital cluster) and Belfast, where no predominant cluster has been identified.

New COVID cases per 100K population over the last 7 days:

| 24th August | 31st August | LGD |
|---|---|---|
| 30.9 | 33.0 | Antrim and Newtownabbey |
| 7.5 | 7.5 | Ards and North Down |
| 6.1 | 43.4 | Armagh City, Banbridge and Craigavon |
| 22.2 | 41.0 | Belfast |
| 21.5 | 11.8 | Causeway Coast and Glens |
| 19.2 | 8.0 | Derry City and Strabane |
| 1.7 | 3.4 | Fermanagh and Omagh |
| 19.4 | 22.2 | Lisburn and Castlereagh |
| 68.5 | 31.0 | Mid and East Antrim |
| 6.8 | 6.1 | Mid Ulster |
| 7.8 | 21.7 | Newry, Mourne and Down |

**Determining the value of R:**

The most common approach to determining R during an epidemic is to use mathematical modelling, in particular a compartmental model using a SIR (susceptible-infectious-

recovered) approach or a variation of it.  Dozens of such models have been published and are in use throughout the world; there is no single standard model which everyone uses.

In addition to the impact of the mathematical model used, the calculated value of R is also influenced by the choice of input variable.  R calculated for new COVID-19 cases will not be the same as R calculated for hospital admissions, or ICU occupancy, or deaths.   There may be a significant lag (2-3 weeks) before a fall in R is apparent depending on the input variable(s) used.

Once the activity of the epidemic is at a low level (as at present) marked fluctuations in R may be observed over short periods of time as a result of localised outbreaks or clusters. Local measures to address the cluster or outbreak will represent the most appropriate response in those circumstances, rather than general measures which are more appropriate when there is widespread community transmission.

**Determining R for NI:**

The modelling group determines R each day using a bespoke Northern Ireland SIR model. As its primary input the group uses hospital in-patients with community acquired COVID-19, but also uses a range of other inputs.   We therefore have several different values for R each day, each of which has a midpoint value and a lower and upper boundary (95% confidence intervals).  In addition a number of academic groups, both in the UK and ROI, model the COVID-19 epidemic and we have access to their estimates of R for Northern Ireland.   R can also be determined based on a contact matrix survey, and this approach may be more reliable when levels of community transmission are very low.
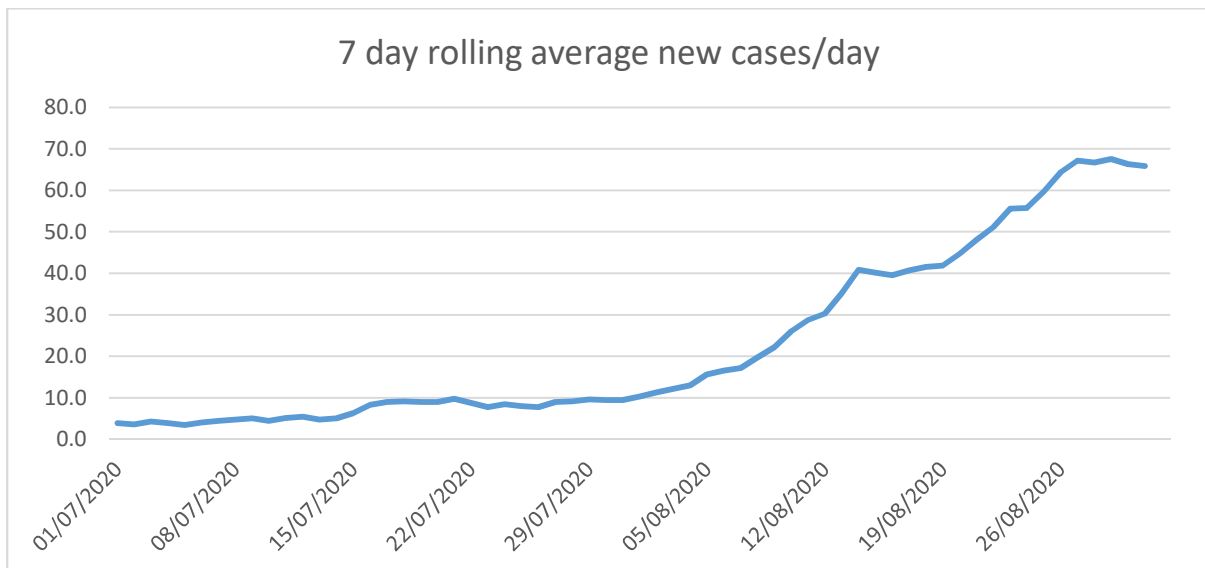
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**Trends for R for Northern Ireland:**

The graph below shows how R has changed over time during the course of the COVID-19 epidemic in Northern Ireland using hospital in-patients with community acquired COVID-19 as an example.   The value of R differs somewhat when other inputs are used.

R based on COVID confirmed hospital inpatients
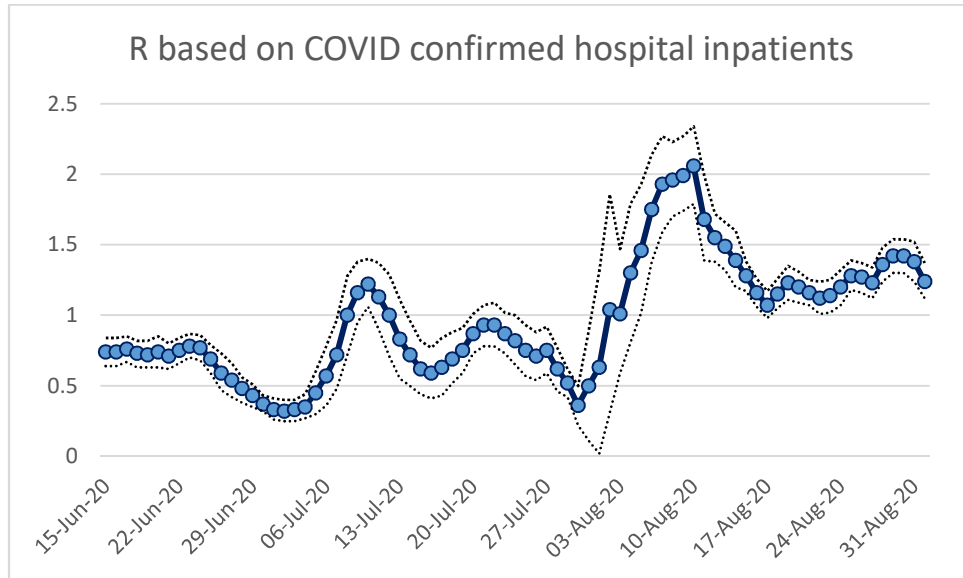
The graphs below shows that the number of new COVID 19 cases have increased over the last week.  Cases and % test positivity are both trending significantly upwards.   Data are taken from the DoH Dashboard report 18/8/20.

7 day rolling average new cases/day

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## 7 day rolling average test positivity (%)
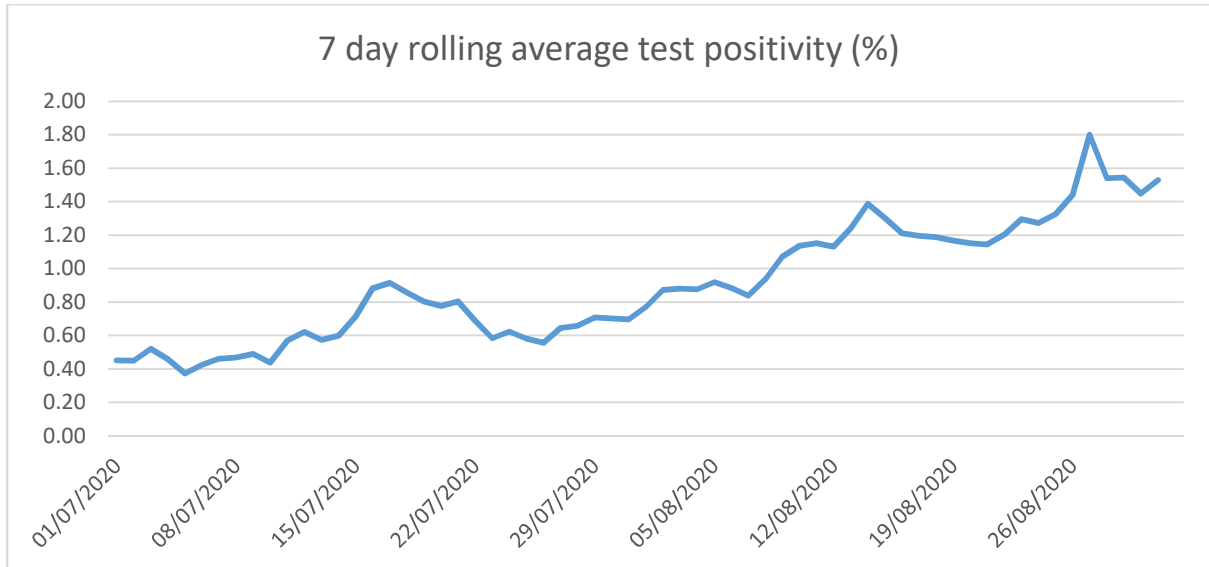


The following graph shows first hospital admission of COVID +ve patients over a rolling 7 day period. To give context, this peaked at 260 during wave 1.   In addition, the seven day rolling average of hospital inpatients is shown, which peaked at around 290 during wave 1.

## 7 day rolling total first COVID +ve hospital admission

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## 7 day rolling average COVID +ve inpatients
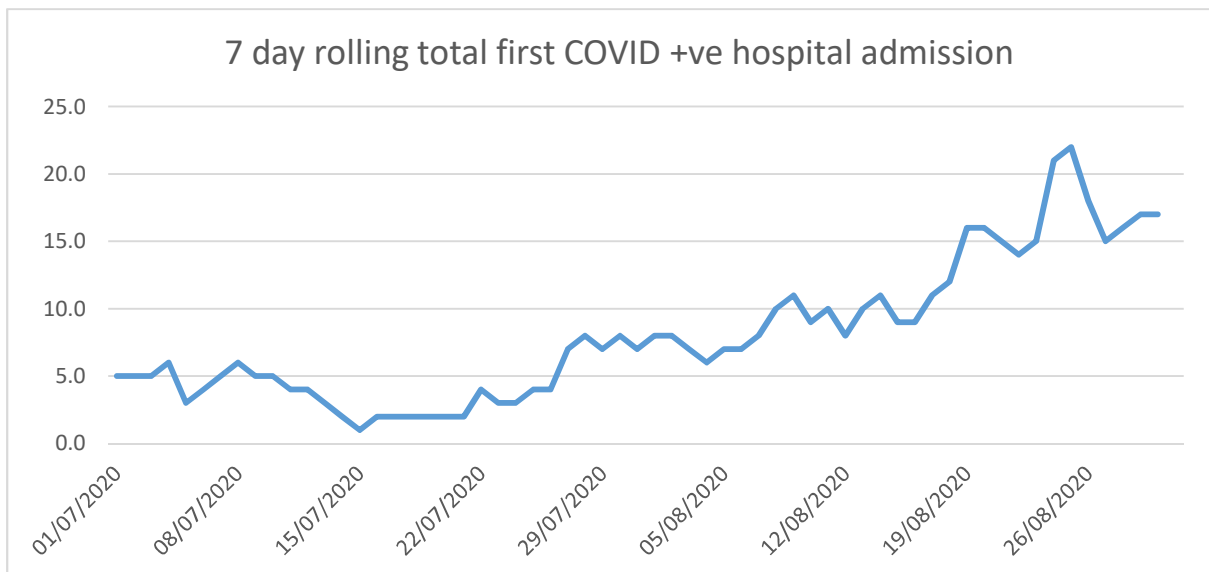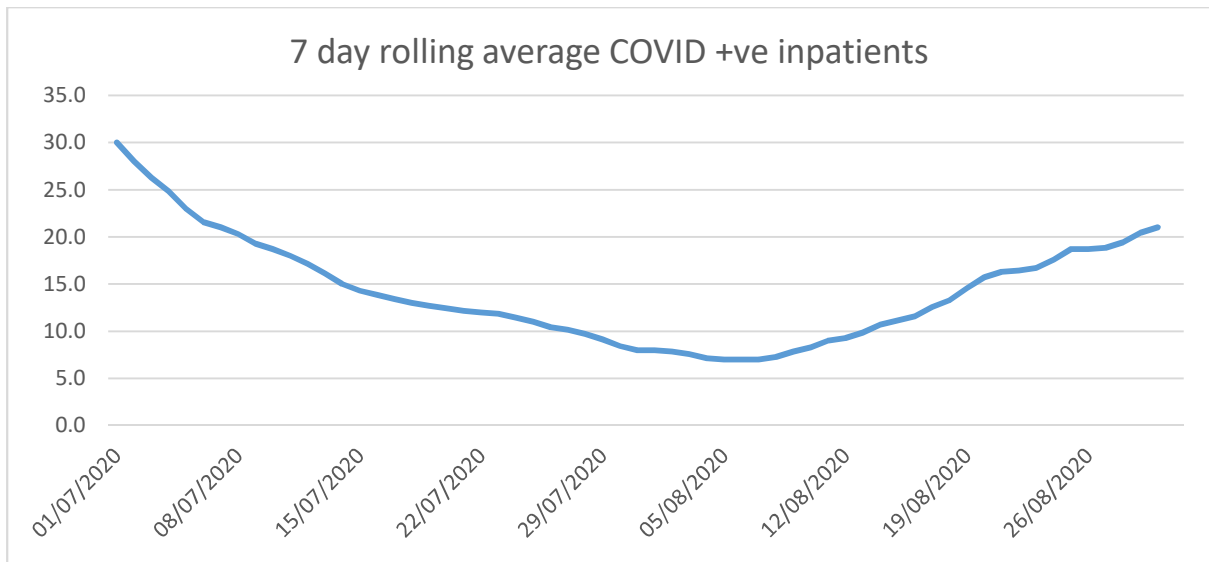


**NI, UK, ROI comparison:**

The following chart shows cases per 14 days / 100 k population across the Common Travel Area.

## 14 cumulative total cases / 100k population