

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

Current estimate of Rt (hospital admissions): 1.05 – 1.25 (above 1)

Current estimate of Rt (new positive tests): 1.0 – 1.2 (above 1)

Average number of new positive tests per day last 7 days: 475 (up from 447)

7 day incidence based on new positive tests: 175 / 100k (up from 165)

14 day incidence based on new positive tests: 340 / 100k (up from 297)

7 day average of total positive tests (pillar 1 and 2) – 8.5% (up from 8.1%)

Tests per 7 days per 1000 population – 21.7 (unchanged from 21.4)

Number of new positive tests in over 60s in last 7 days – 768 (up from 652)

Proportion of total positive tests occurring in over 60s - 23.9% (down from 25.1%)

First COVID +ve hospital admission in last week – 191 (up from 168)

Number of community acquired COVID inpatients – 345 (up from 327)

COVID +ve ICU patients – 31 (up from 30)

Over the last week, the number of cases has slowly increased, including in the over 60s. This reflects Rt for cases of around 1.15, indicating a disappointing response to the recent two weeks of restriction. It is likely that this is due to two factors; firstly, a seasonal upward trend in virus transmission and secondly relatively poor adherence to the stay at home message. Hospital admissions have also be rising slowly, with Rt likely to be slightly above 1. Hospital inpatient numbers show signs of plateauing at a high level. ICU occupancy is also stable at around 30 and deaths continue to vary from day to day but are not falling.

Testing has stabilised over the last week, and the percentage of % tests has risen slightly. NI continues to have a lower incidence than Wales and England at present and higher than Scotland and ROI.

We anticipate that cases numbers will continue to rise as we approach Christmas, with a more rapid increase as we near the holiday period. There is likely to be a decrease over the holiday period as a result of reduced testing, but this will not be indicative of reduced community transmission. Hospital admissions will remain stable or increase slightly until shortly before Christmas when they will begin to rise again. The rate of increase will depend on how much Rt increases during the current two week period. Based on experience during early October and seasonal effect on virus transmission it is reasonable to anticipate that Rt will be between 1.4 and 1.8.

This will lead to a significant rise in all aspects of the epidemic on top of a high baseline, in contrast to the position in the first two waves of the epidemic. The impact of Christmas arrangements on R_t is difficult to predict; there is likely to be an overall decrease in contacts but increased household and intergenerational mixing.

The Executive has previously determined that its policy is to keep R_t at or below 1.0. Any intervention will need a number of weeks to have maximum impact and therefore to influence the trajectory of the course of the epidemic.

Community transmission remains widespread, associated with multiple small clusters and some larger outbreaks.

Regional variation in cases:

Incidence per LGD is shown over the last week in the table below. There has been a particular rise in Mid and East Antrim.

07-Dec	08-Dec	09-Dec	10-Dec	11-Dec	12-Dec	13-Dec	14-Dec	LGD
155.8	143.2	143.9	139.0	159.3	155.8	162.1	171.9	Antrim and Newtownabbey
104.4	104.4	111.3	94.5	83.3	82.1	79.6	64.0	Ards and North Down Armagh City, Banbridge and Craigavon
129.4	133.1	129.4	140.1	153.2	157.4	157.9	167.7	Belfast
118.5	116.1	120.8	111.4	105.3	104.4	112.3	111.2	Belfast
171.2	173.3	183.7	180.9	185.1	196.9	199.0	196.9	Causeway Coast and Glens
196.4	179.2	183.2	175.2	167.2	175.2	170.6	172.6	Derry City and Strabane
171.2	178.0	195.1	202.0	191.7	177.2	187.4	193.4	Fermanagh and Omagh
137.8	138.5	130.2	129.5	135.8	132.3	134.4	125.4	Lisburn and Castlereagh
245.7	216.2	229.2	254.4	263.0	279.6	290.4	312.7	Mid and East Antrim
220.5	186.6	183.2	187.3	192.7	189.3	190.6	194.7	Mid Ulster
187.8	177.8	181.7	186.1	187.2	194.4	198.3	202.2	Newry, Mourne and Down

Determining the value of R_t :

The most common approach to determining R_t 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.

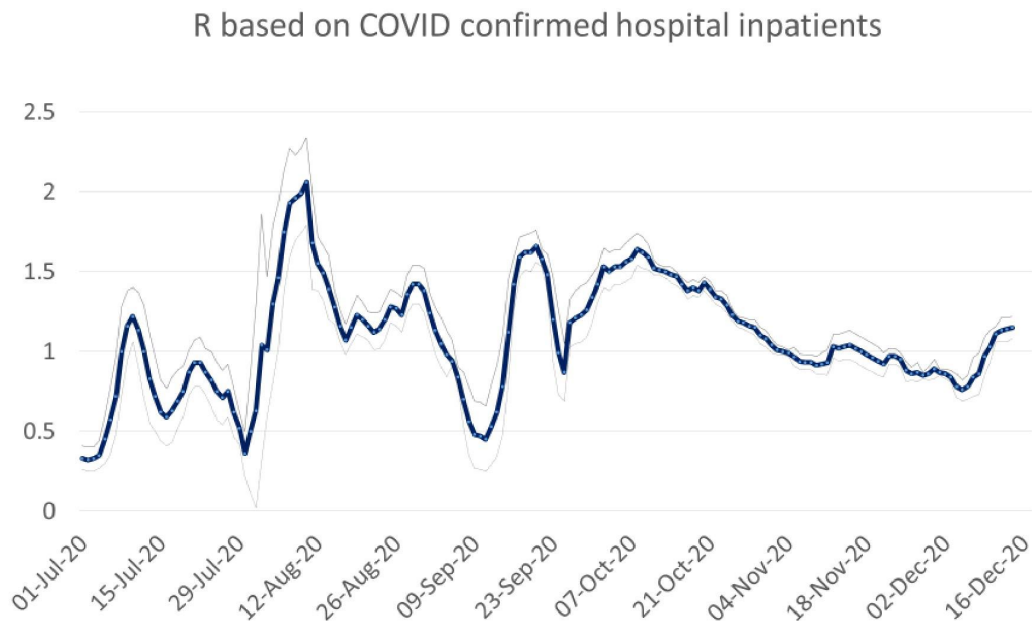
In addition to the impact of the mathematical model used, the calculated value of R_t is also influenced by the choice of input variable. R_t calculated for new COVID-19 cases will not be the same as R_t calculated for hospital admissions, or ICU occupancy, or deaths. There may be a significant lag (2-3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

The modelling group determines R_t each day using a bespoke Northern Ireland SIR model. As its primary input the group uses hospital in-patient admissions with community acquired COVID-19, but also uses a range of other inputs. We therefore have several different values for R_t 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_t for Northern Ireland. R_t 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.

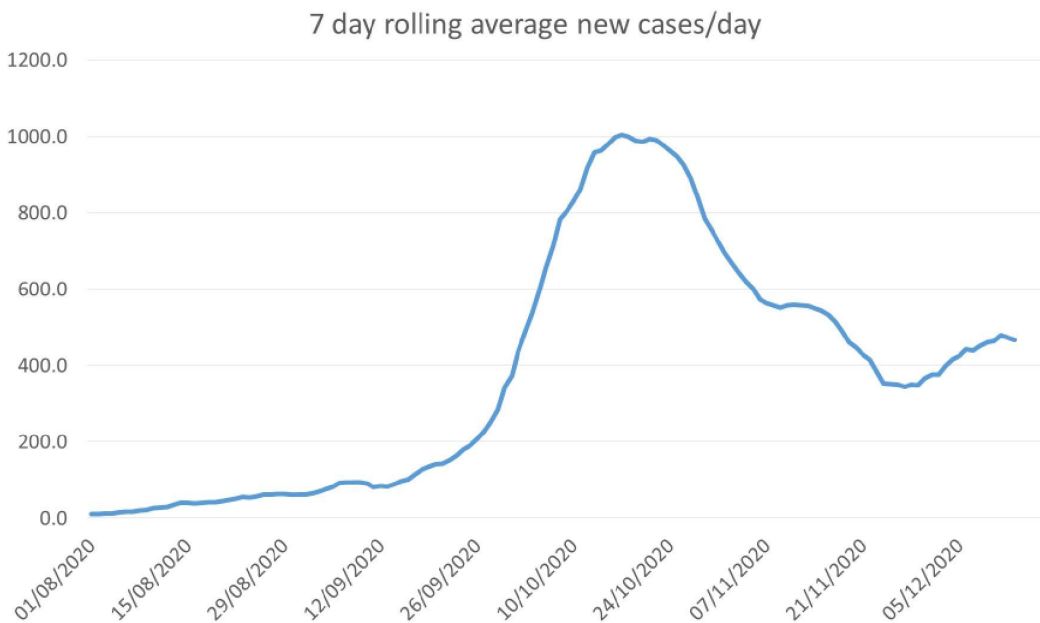
Trends for Northern Ireland:

The graph below shows how R_t has changed over time during the course of the COVID-19 epidemic in Northern Ireland using hospital admissions with community acquired COVID-19 as an example. The value of R_t differs somewhat when other inputs are used, and is currently around 1.1 for hospital admissions and 1.15 for cases.

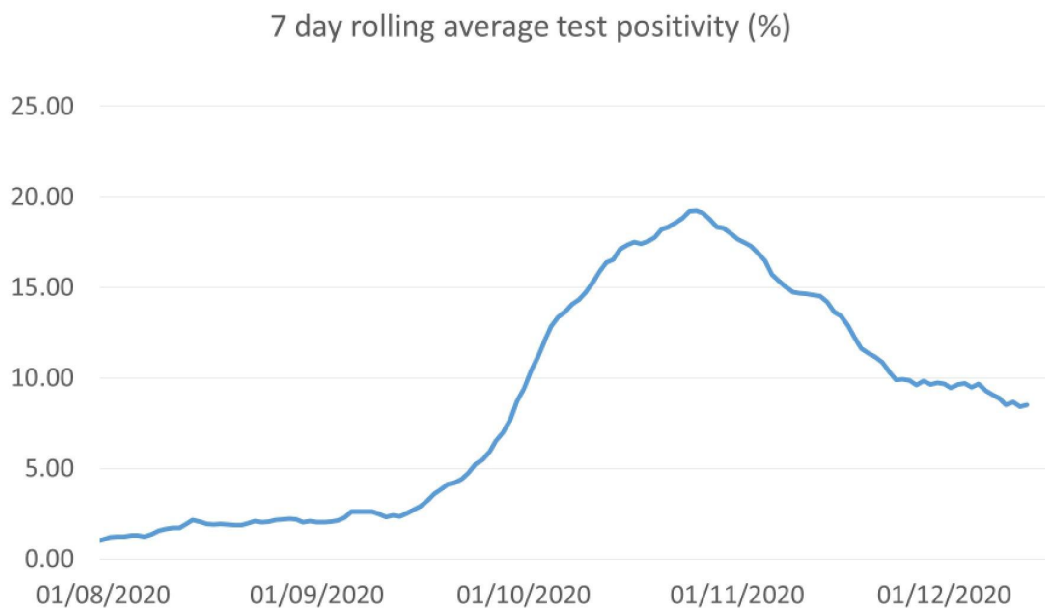
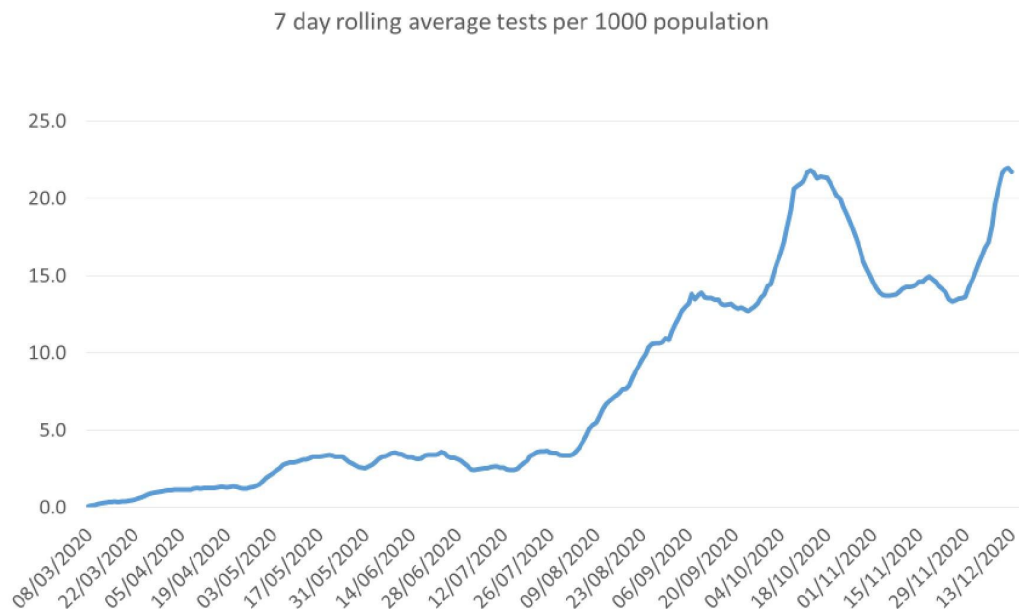
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The graphs below shows that the number of new COVID 19 cases has increased gradually in the last week. Testing has also increased, and test positivity has plateaued at a relatively high level.



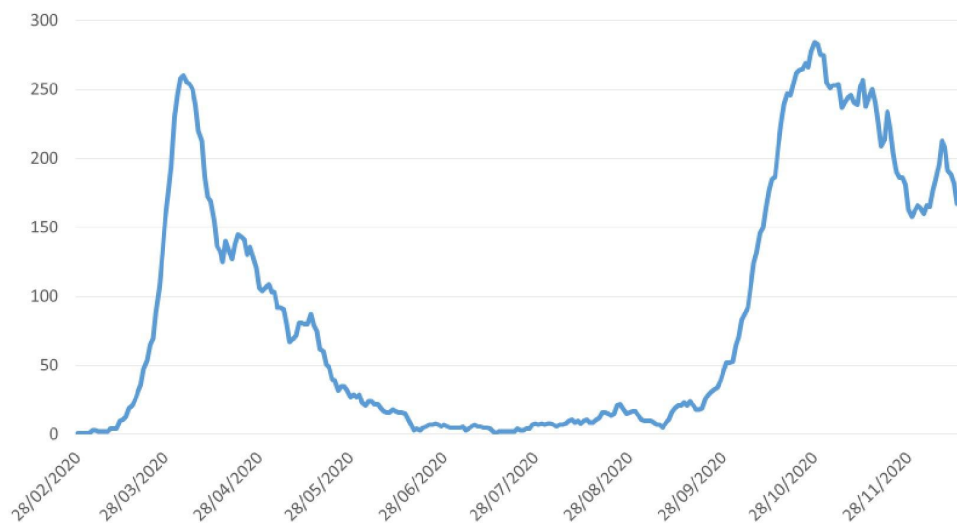
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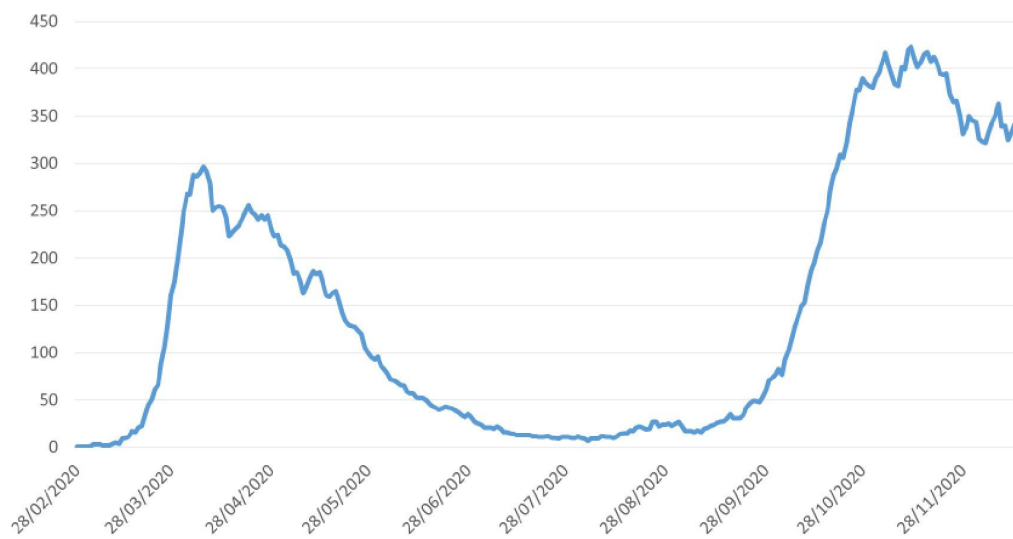
The following graphs show first hospital admission of COVID +ve patients over a rolling 7 day period and the number of hospital inpatients. Admissions currently remain at a relatively high level, as do inpatient numbers. ICU occupancy and in-hospital deaths are roughly stable.

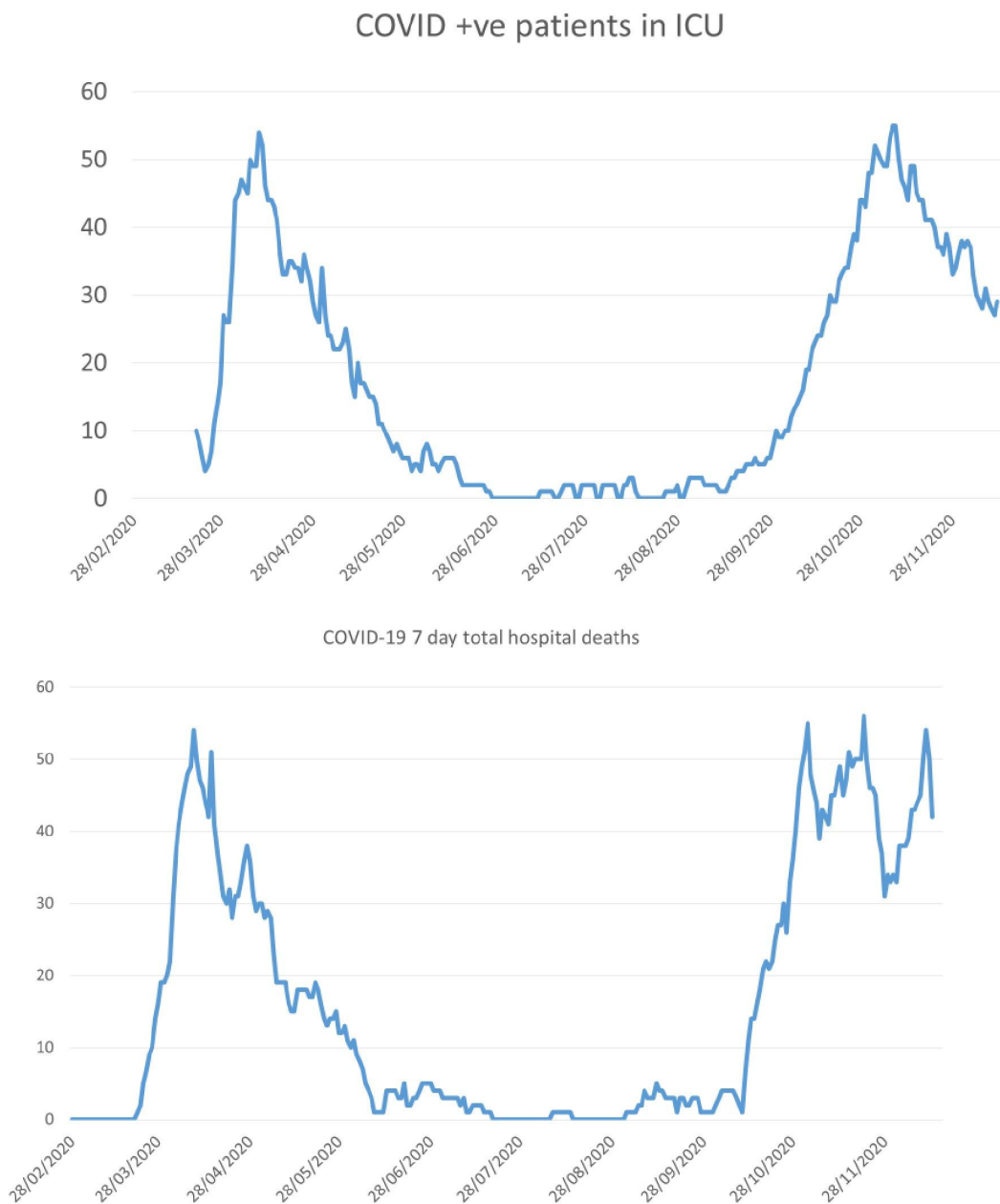
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7 day rolling total first COVID +ve hospital admission



COVID +ve inpatients



**NI, UK, ROI comparison:**

The following chart shows cases per 7 days / 100 k population across the Common Travel Area. NI continues to have a lower incidence than Wales, and is similar to England at present and higher than Scotland and ROI.

08/12/20

