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

Current estimate of R (hospital inpatients): 1.4 – 1.8 (definitely above 1)

Current estimate of R (new positive tests): 1.2 - 1.6 (definitely above 1)

Average number of new positive tests per day last 7 days: 144.9 (up from 90.3)

7 day incidence based on new positive tests: 53.4 / 100k (up from 33.3)

14 day incidence based on new positive tests: 85.9 / 100k (up from 64.9)

7 day average of total tests (pillar 1 and 2) which are positive – 2.78% (up from 1.81)

Tests per 7 days per 1000 population – 19.9 (unchanged from 20.5)

Number of new positive tests in over 60s in last 7 days – 125 (up from 92)

Proportion of total positive tests occurring in over 60s - 12.3% (from 16.5)

First COVID +ve hospital admission in last week – 18 (unchanged from 21)

7 day average number COVID occupied hospital beds – 29.0 (up from 21.1)

Over the last week, there has been a marked increase in cases in the context of stable testing along with a progressive rise in COVID hospital patients, although the latter remains at a low level compared with wave 1. R is clearly above 1, both for cases and hospital admissions. The number of cases in individuals aged >60 yrs has risen to 125 from 92/seven days and remains at 10 – 15% of total case, still significantly below wave 1 of the epidemic where around 50% of cases were in this age group. It is likely that in wave 1 of the epidemic that the testing strategy failed to identify the large majority of cases in younger people, who tend to be less ill or symptomatic. If this is correct, then the current increase in cases should be viewed as the precursor of increasing cases in the over sixties with resulting pressure on the hospital system and increasing deaths, as has been observed in many European countries including France and Spain.

Community transmission remains widespread, associated with multiple small clusters rather than a small number of larger outbreaks. There have been substantial increases in border postcodes for reasons which remain unclear, although in a number of cases these areas are contiguous with ROI counties which also have a high incidence.

Regional variation in cases:

There is marked variation in COVID cases in Local Government Districts, with Causeway Coast and Glens the lowest, while 4 LGDs are now over 70/100k over the last 7 days.

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

24th Aug	31-Aug	6-Sep	14-Sep	21-Sep	LGD
30.9	33.0	45.6	49.1	36.4	Antrim and Newtownabbey
7.5	7.5	18.0	20.5	40.4	Ards and North Down
6.1	43.4	37.4	41.6	72.5	Armagh City, Banbridge and Craigavon
22.2	41.0	62.0	43.6	77.4	Belfast
21.5	11.8	15.3	4.2	13.2	Causeway Coast and Glens
19.2	8.0	11.9	27.9	80.3	Derry City and Strabane
1.7	3.4	13.7	13.7	31.7	Fermanagh and Omagh
19.4	22.2	47.1	38.8	50.3	Lisburn and Castlereagh
68.5	31.0	46.8	25.9	32.5	Mid and East Antrim
6.8	6.1	8.8	6.8	19.7	Mid Ulster
7.8	21.7	24.4	20.6	77.1	Newry, Mourne and Down

Further insight is possible from looking at a postcode level. COVID cases for the all postcodes with a population above 10k and an incidence of >40/100k over the last seven days are indicated below, with postcodes which were previously the subject of local restrictions highlighted in red. Of note, BT43 has now fallen to 36.7/100k over the last 7 days.

Postcode	Cases	Cases/100k
BT82	69	267.83
BT3	1	239.81
BT34	105	176.02
BT92	21	137.92
BT7	24	126.67
BT25	18	120.39
BT17	38	117.46
BT68	1	114.29
BT62	34	110.98
BT35	48	110.76
BT11	29	103.44
BT29	13	97.85
BT9	27	94.21
BT4	24	93.98
BT14	29	91.1
BT12	26	90.27
BT48	53	89.83
BT66	27	84.03
BT60	25	83.16
BT63	16	82.87
BT10	10	79.51

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BT65	6	76.88
BT21	6	76.79
BT15	20	74.31
BT18	10	73.98
BT27	15	70.04
BT67	16	67.68
BT19	24	65.48
BT93	6	62.14
BT13	14	60.54
BT36	27	59.88
BT56	4	59.37
BT8	15	52.07
BT61	8	51.42
BT47	29	48.54
BT28	19	47.54
BT38	19	47.2
BT23	25	47.11
BT64	1	45.72
BT5	17	43.8
BT69	1	42

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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.

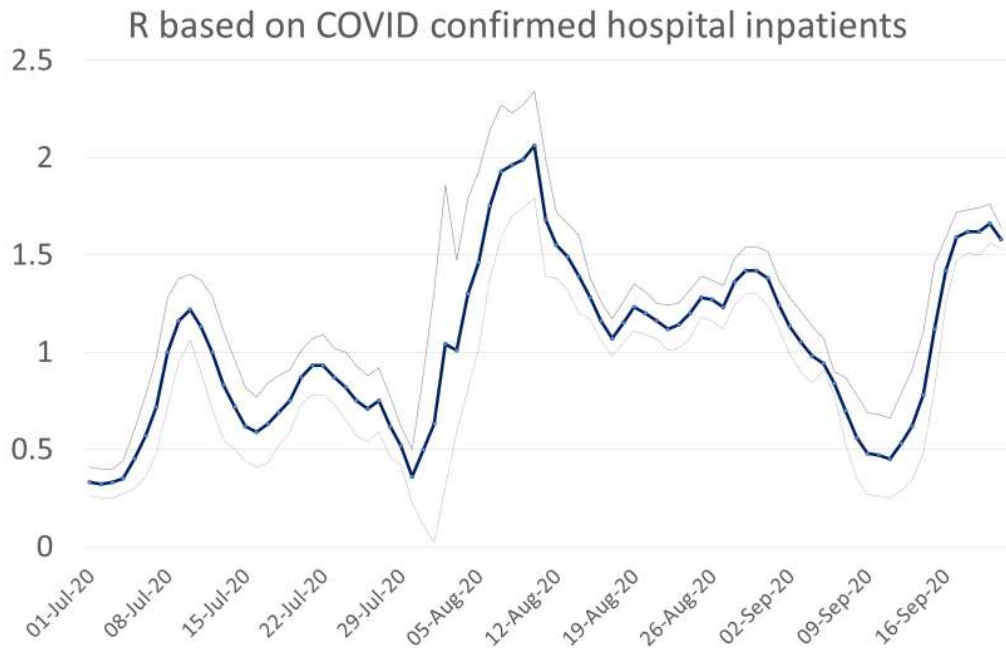
In addition to the impact of the mathematical model used, the calculated value of R is also influenced by the choice of input variable. R calculated for new COVID-19 cases will not be the same as R calculated for hospital admissions, or ICU occupancy, or deaths. There may be a significant lag (2-3 weeks)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

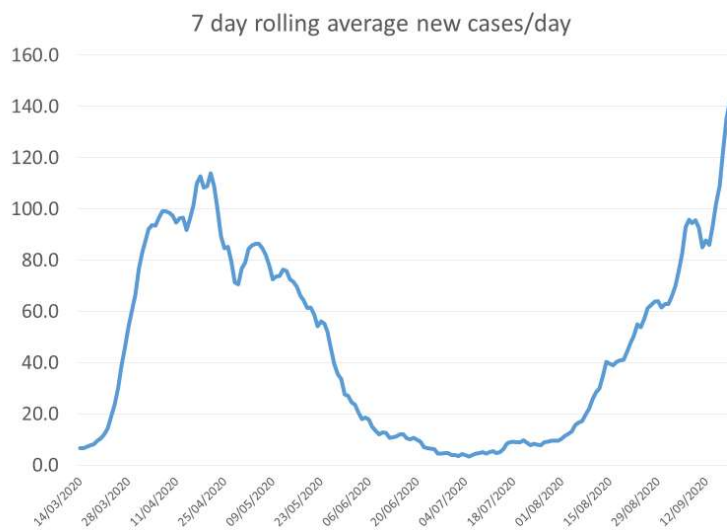
The modelling group determines R each day using a bespoke Northern Ireland SIR model. As its primary input the group uses hospital in-patients with community acquired COVID-19, but also uses a range of other inputs. We therefore have several different values for R each day, each of which has a midpoint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

Trends 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, and is currently likely to be above 1 for both cases and hospital admissions.

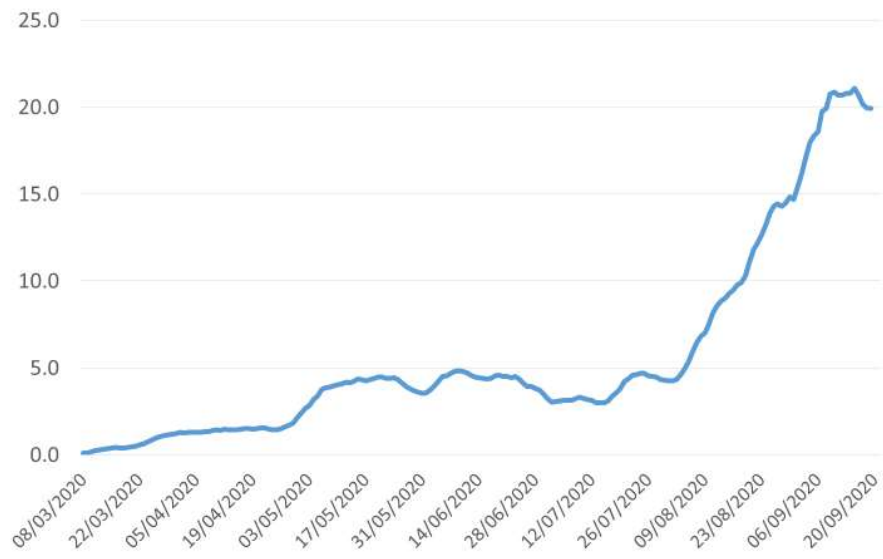


The graphs below shows that the number of new COVID 19 cases and test positivity have increased substantially over the last week, while testing has been constant.

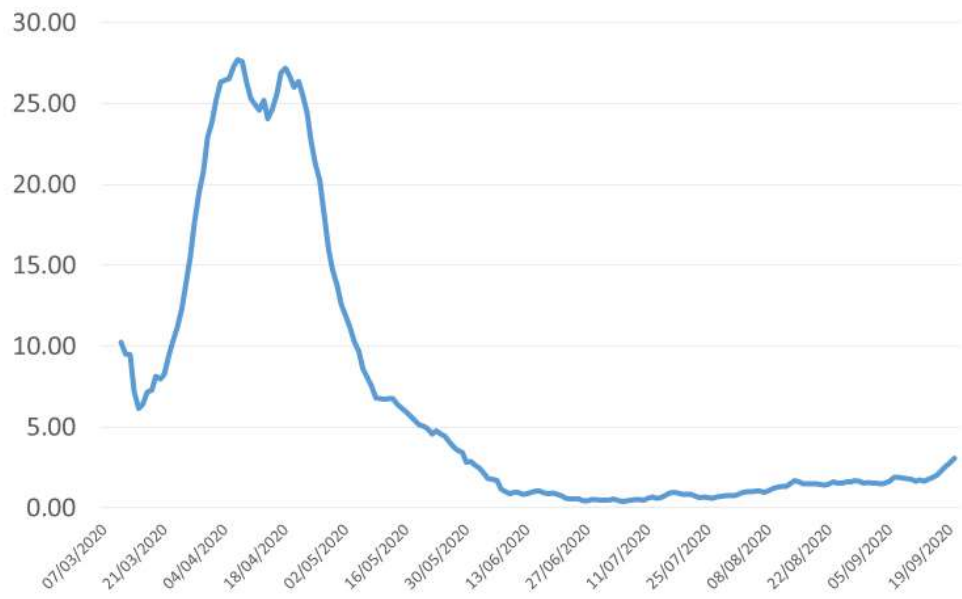


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7 day rolling average tests per 1000 population



7 day rolling average test positivity (%)



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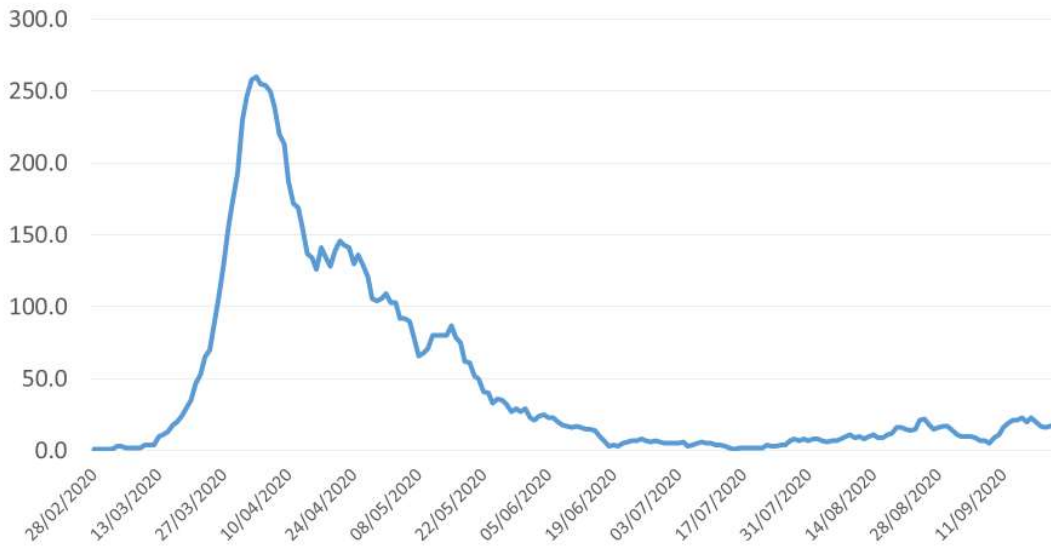
7 day rolling average test positivity (%)



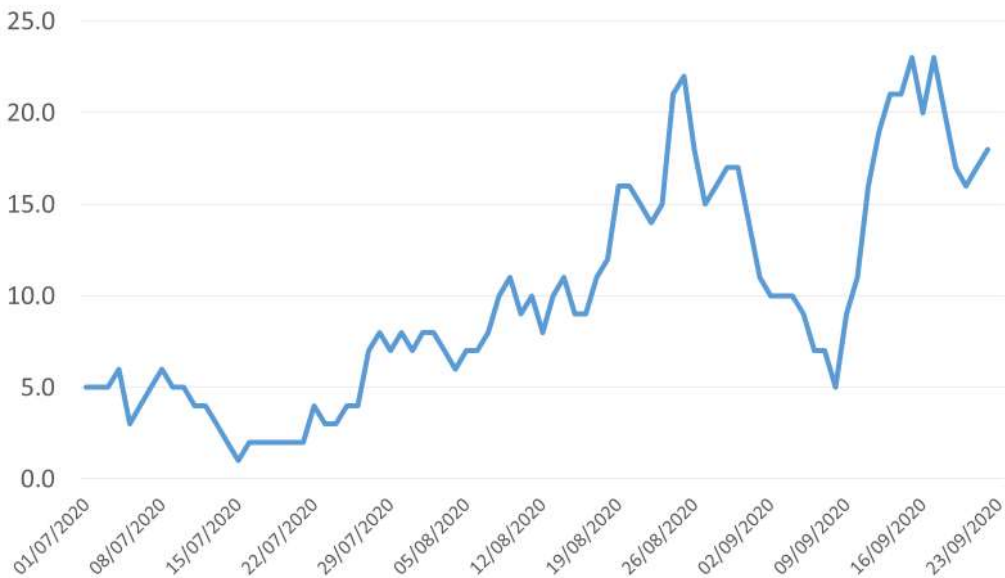
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The following graphs show first hospital admission of COVID +ve patients over a rolling 7 day period. To give context, this peaked at 260 during wave 1. In addition, the seven day rolling average of hospital inpatients is shown, which peaked at around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

7 day rolling total first COVID +ve hospital admission

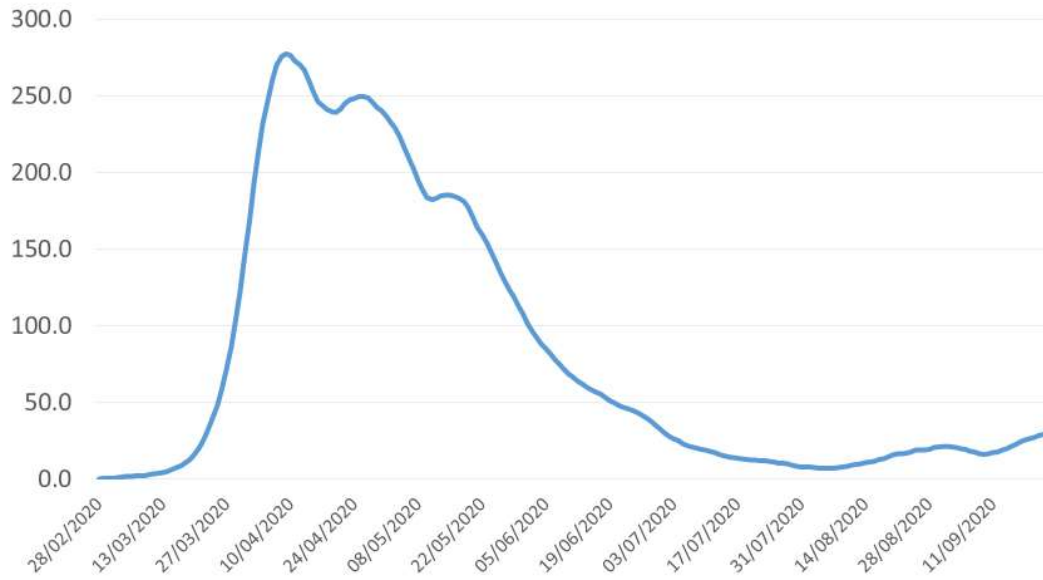


7 day rolling total first COVID +ve hospital admission

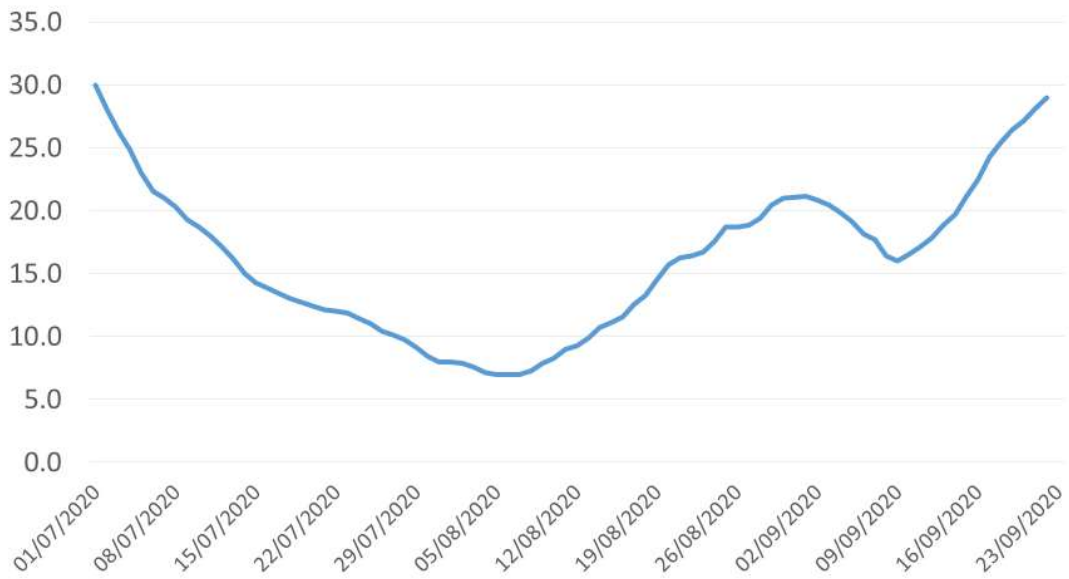


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7 day rolling average COVID +ve inpatients



7 day rolling average COVID +ve inpatients



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NI, UK, ROI comparison:

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

