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

Current estimate of R (hospital inpatients): 1.3 – 1.8 (definitely above 1)
Current estimate of R (new positive tests): 1.3 - 1.8 (definitely above 1)
Average number of new positive tests per day last 7 days: 518.6 (up from 241.4)
7 day incidence based on new positive tests: 191.1 / 100k (up from 88.9)
14 day incidence based on new positive tests: 280.3 / 100k (up from 143.3)
7 day average of total tests (pillar 1 and 2) which are positive – 8.94% (up from 4.10%)
Tests per 7 days per 1000 population – 23.0 (up from 20.5)
Number of new positive tests in over 60s in last 7 days – 420 (up from 189)
Proportion of total positive tests occurring in over 60s - 11.5% (unchanged 12.5%)
First COVID +ve hospital admission in last week – 77 (up from 43)
7 day average number COVID occupied hospital beds – 76.1 (up from 44.7)
Number of community acquired COVID inpatients – 92 (up from 51)
ICU occupancy – 13 (up from 8)

Over the last week, there has been a further marked increase in cases (100%) in the context of a moderate increase in testing (15%) along with a progressive rise in COVID hospital patients, which are now around 33% of peak levels during wave 1. R is clearly above 1, both for cases and hospital admissions, and may have risen slightly since last week. The number of cases in individuals aged >60 yrs has risen to 420 from 189/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.

There has been a significant increase in ICU occupancy which now sits at 13 and in the context of the increase in hospital admissions and inpatients outlined above, we have now moved beyond the lag period between increased case and pressure on the health and social care system. Cases are currently doubling every 7 days and hospital admissions every 9 days, both reduced from last week; if current trends remain unabated hospital inpatients will exceed those of wave 1 in 2-3 weeks.

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 Mid and East Antrim the lowest; 9 of 11 LGDs are now over 100/100k over the last 7 days.

30-Sep	01-Oct	02-Oct	03-Oct	04-Oct	05-Oct	06-Oct	LGD
55.4	53.3	81.4	91.2	100.4	117.2	130.5	Antrim and Newtownabbey
37.9	40.4	55.9	57.8	57.2	61.5	73.4	Ards and North Down
62.1	65.9	90.6	108.4	110.7	115.8	124.7	Armagh City, Banbridge and Craigavon
133.1	124.3	161.2	191.6	214.4	240.7	281.4	Belfast
62.4	64.5	77.0	87.4	86.0	86.0	97.7	Causeway Coast and Glens
323.2	322.5	422.8	478.5	485.1	533.6	581.4	Derry City and Strabane
68.5	62.5	65.9	68.5	87.3	115.5	127.5	Fermanagh and Omagh
55.4	65.1	86.6	99.7	106.0	117.1	135.1	Lisburn and Castlereagh
25.9	26.7	33.1	36.8	37.5	46.8	54.0	Mid and East Antrim
133.0	131.6	155.4	171.7	180.5	185.9	211.7	Mid Ulster
122.8	132.2	213.9	268.9	289.4	321.6	320.5	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.

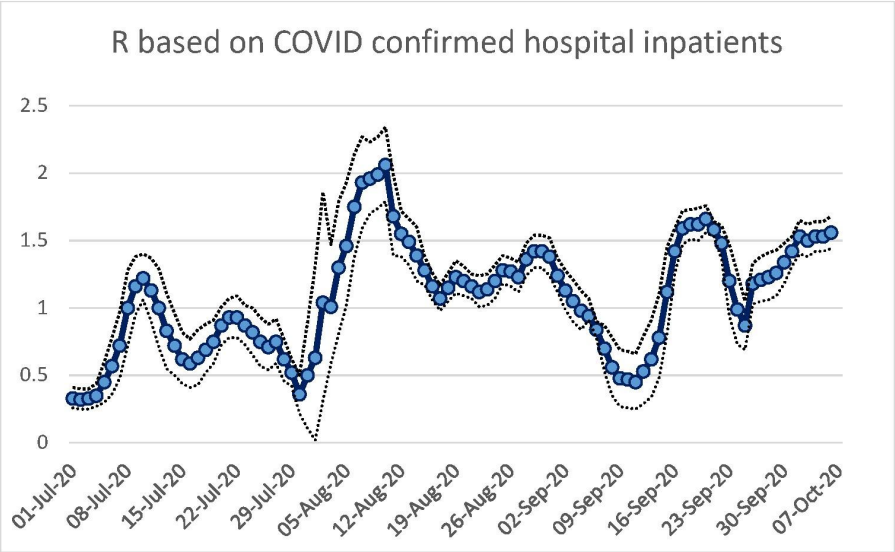
In addition to the impact of the mathematical model used, the calculated value of R is also influenced by the choice of input variable. R calculated for new COVID-19 cases will not be the same as R calculated for hospital admissions, or ICU occupancy, or deaths. There may be a significant lag (2-3 weeks)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

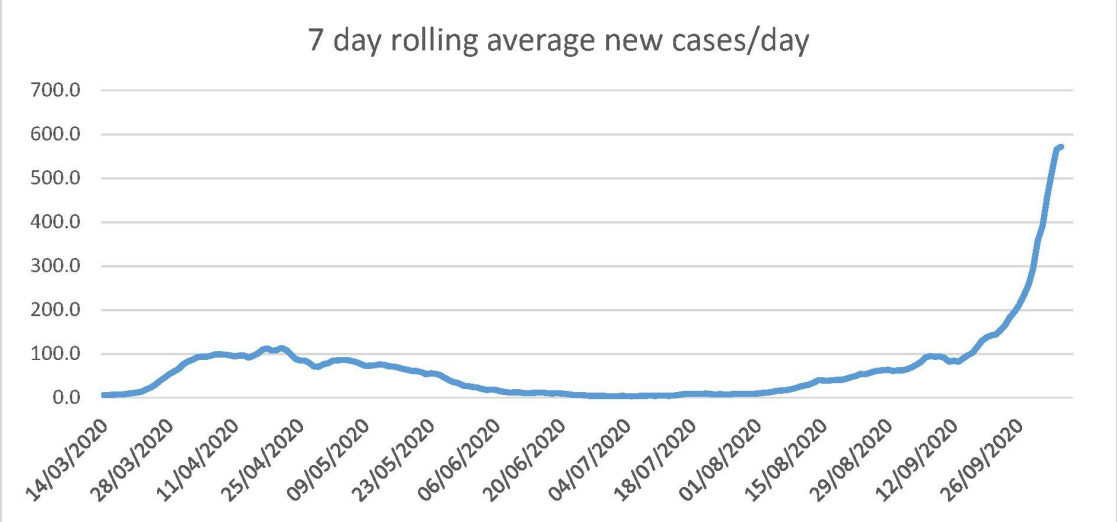
The modelling group determines R each day using a bespoke Northern Ireland SIR model. As its primary input the group uses hospital in-patients with community acquired COVID-19, but also uses a range of other inputs. We therefore have several different values for R each day, each of which has a midpoint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

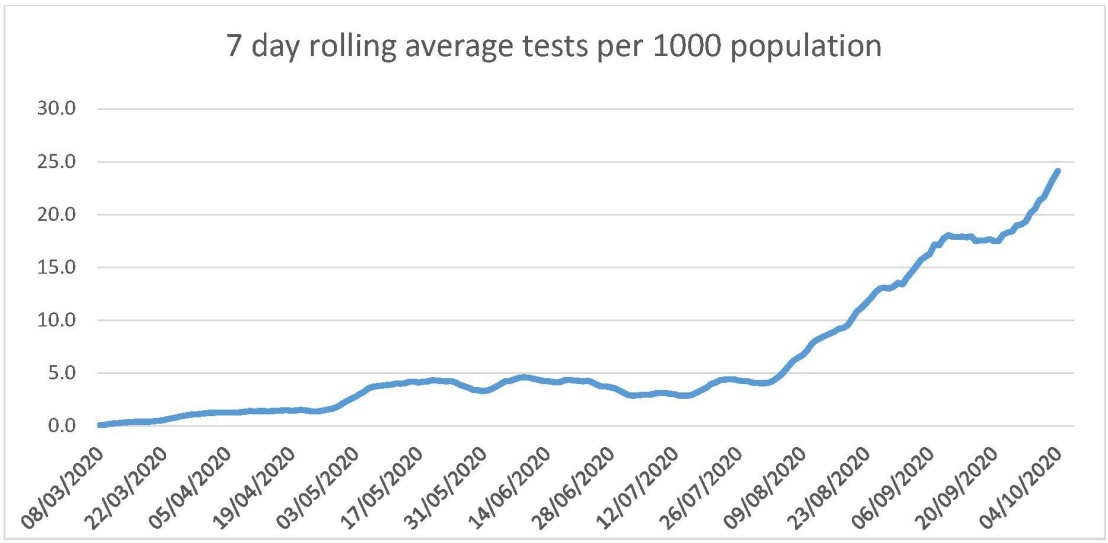
Trends for Northern Ireland:

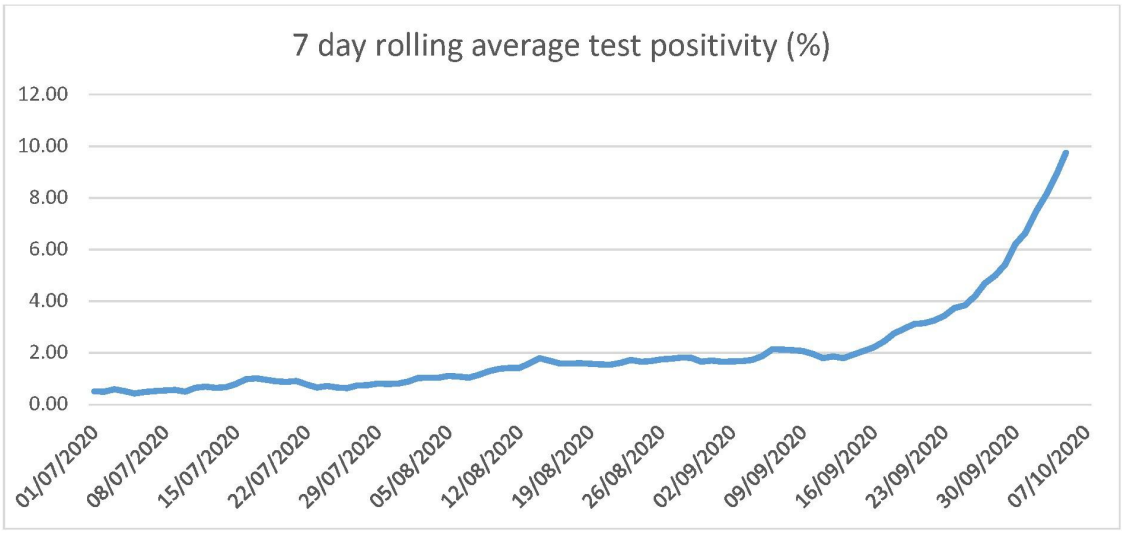
The graph below shows how R has changed over time during the course of the COVID-19 epidemic in Northern Ireland using hospital in-patients with community acquired COVID-19 as an example. The value of R differs somewhat when other inputs are used, and is currently likely to be above 1 for both cases and hospital admissions.



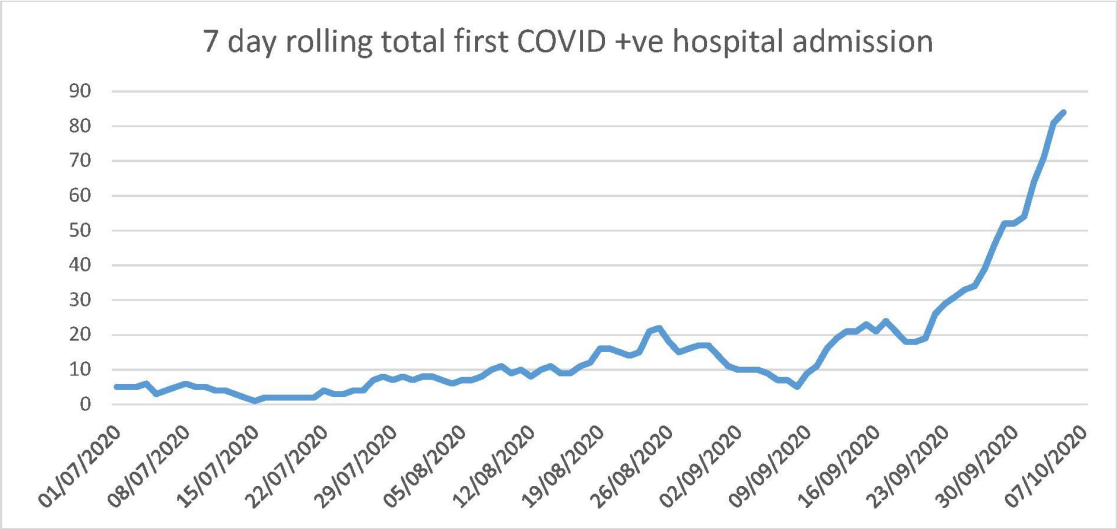
The graphs below shows that the number of new COVID 19 cases and test positivity have increased substantially over the last week, while testing has increased by around 15%.

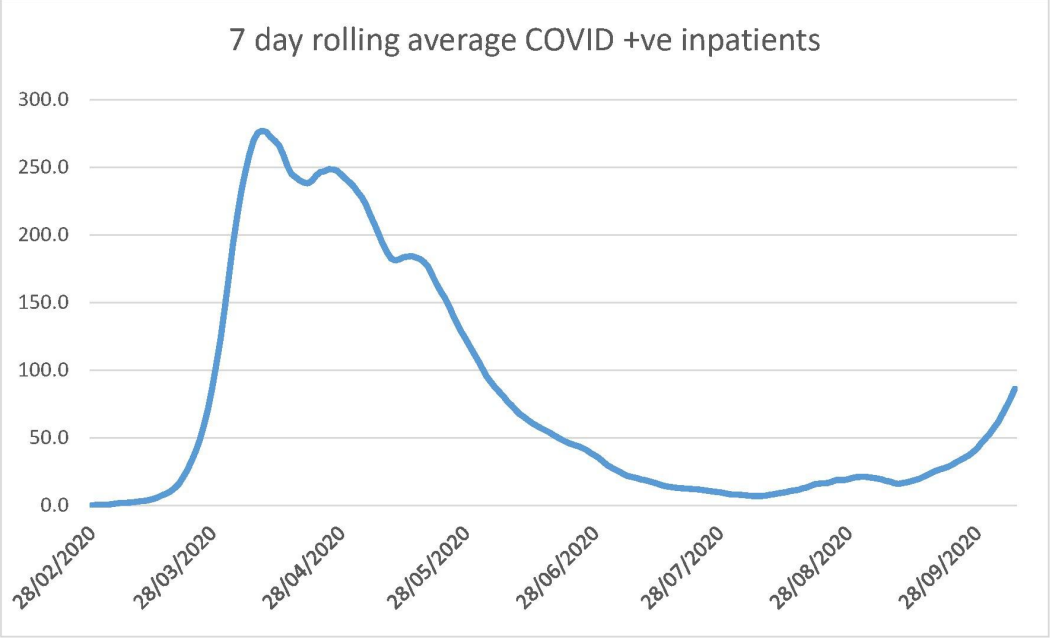



7 day rolling average tests per 1000 population
30.0
25.0
20.0
15.0
10.0
5.0
0.0
08/03/2020
22/03/2020
05/04/2020
19/04/2020
03/05/2020
17/05/2020
31/05/2020
14/06/2020
28/06/2020
12/07/2020
26/07/2020
09/08/2020
23/08/2020
06/09/2020
20/09/2020
04/10/2020


7 day rolling average test positivity (%)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
01/07/2020
08/07/2020
15/07/2020
22/07/2020
29/07/2020
05/08/2020
12/08/2020
19/08/2020
26/08/2020
02/09/2020
09/09/2020
16/09/2020
23/09/2020
30/09/2020
07/10/2020

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.





NI, UK, ROI comparison:

The following chart shows cases per 14 days / 100 k population across the Common Travel Area. Testing in ROI is currently around 18 / 1000 / 7 days compared with 23 in NI.