MEMORANDUM E (20) 243 (C)

From: **Robin Swann, MLA**

Date: **13 October 2020**

To: **Executive Colleagues**

FINAL EXECUTIVE PAPER: Modelling the course of the COVID epidemic and the impact of different interventions and recommendations.

1. The COVID epidemic in Northern Ireland has reached a phase of exponential growth. Immediate consideration and decisions are required by the Executive to prevent the hospital system being overwhelmed and to prevent adverse direct and indirect health consequences including significant morbidity and mortality from COVID and as non-COVID related conditions as a consequence of the impact on health and social care services.

2. At the Executive Meeting of the 8th of October 2020 I provided a paper modelling the course of the epidemic and recommended to Executive colleagues that an intervention to reduce Rt to 0.7 was required as soon as possible to prevent the hospital system being overwhelmed and to prevent deaths.

Background

3. Modelling the course of the COVID epidemic and the impact of different interventions depends on assumptions about the value of Rt (the reproductive number) at different time points in the future. The Executive has previously indicated that maintenance of Rt at less than 1 should be viewed as a key policy objective. However, Rt has been persistently above 1 since early July and is currently around 1.5, and it inevitably follows from this that there has been an increase in COVID cases and other markers of the epidemic (covered in the separate R paper). In the intervening period the Executive has agreed to enhanced local restrictions and NI wide restrictions in relation to households.

4. The value of Rt is determined by the extent of contacts between individuals (number, proximity and duration) and the impact of any mitigations which are in place (hand hygiene, face coverings, ventilation and effectiveness of the TTP system). It is also likely to be influenced by seasonal factors. In the case of the TTP system, this includes the rapidity with which close contacts are advised to self-isolate and the degree of compliance with that advice.

5. There is evidence of the effectiveness of previous interventions agreed by the Executive. Rt at the outset of the epidemic in NI was approximately 2.8 (2.5-3.0), and the impact of full "lockdown" in late March with the degree of

compliance seen at that time and the changes in behaviour that preceded this was to reduce Rt to approximately 0.7 (0.6-0.8). That is a reduction in Rt of about 2, or a reduction in transmission of 75%. The "lockdown" can be thought of as a combination of many different measures. All of the measures came in simultaneously, and the sum of each of their effects evidentially reduced Rt by about 2. The only intervention for which there is direct and consistent evidence of effectiveness in NI is the lockdown of March with the degree of compliance shown at that time.

6. My Executive paper of the 24th September indicated that a large number of individual measures are necessary to keep Rt below 1 as each measure has a relatively small effect. That paper summarised the evidence and recommendations of SAGE and attached a short-list of non-pharmaceutical interventions (NPIs) that should be considered for immediate introduction. It also summarised the potential impact of the different interventions, on transmission, severe disease and deaths from COVID-19, and the potential social and health harms from the measure and potential implementation issues. While the focus was on impact on transmission of the virus, other considerations were included. As I previously recommended consideration of the economic benefits / harms, needed to be reviewed carefully and required additional input from other Departments. This evidence has been considered by other jurisdictions and has informed the advice of SAGE and other UK Expert Advisory groups in respective UK jurisdictions and NPHET in the Republic of Ireland.

7. SAGE recommended a list of measures for immediate introduction based on available evidence, including:
    a. A short period of lockdown to return incidence to low levels
    b. Advice to work from home for all those who can
    c. Banning all contact within the home with members of other households (except members of a support bubble)
    d. Closure of all bars, restaurants, cafes, indoor gyms and personal services
    e. All university and college teaching to be online unless face-to-face teaching is essential.

8. NPHET recommended that all of ROI move immediately to level 5 of their schedule, which would allow crèches and schools to remain open.

9. There is clear evidence to suggest that recent measures agreed by the Executive such as household restrictions applied on a postcode basis, and more latterly NI wide, have had some impact on reducing transmission and slowing the rate of increase in new cases. However, we have also begun to see the counter effects of Executive decisions on the opening of higher and further education colleges and "wet" pubs, as well as some seasonal impacts.

10. From a scientific perspective it is unlikely that the current NI wide restrictions combined with an extension of the additional measures in Derry City and Strabane LGD will be sufficient to bring R back to less than 1 and highly improbable that this will reduce Rt to less than 0.7. A package of significant interventions will therefore be required to prevent a further exponential rise in the virus. Single wider interventions are unlikely to be sufficient.

11. There will only be a reduction in the number of cases and other aspects of the epidemic including: hospitalisation; impact on non-COVID health care; health care related outbreaks, and deaths if Rt is reduced to less than 1. The decrease in the epidemic will be greater the further Rt is below one and the longer that is maintained. While the peak number of hospitals admissions will be reduced provided that an intervention to reduce Rt to under 1 is made early this week, the duration and extent of the impact will be fundamentally determined by decisions of the Executive. Modelling from a range of UK groups suggests that full lockdown as before with schools open would result in Rt a little less than 1. Full lockdown with schools closed and the hospitality sector open (and current mitigations) would also result in a value of Rt a little less than 1 or possibly greater than 1. It is not considered likely that Rt can be less than 1 with both schools and hospitality open.

12. Effectively the stark choice before the Executive is one of NI wide significant interventions now to avoid the health service being overwhelmed, to prevent COVID and non-COVID health consequences including excess death or inevitably those same decisions and interventions being taken and implemented later when the health service is potentially overwhelmed and there are significant direct and indirect health consequences. The significant adverse impacts on wider society and the economy are likely be the same in either scenario and indeed may be even more profound as a full lockdown may be then required with significantly less benefit in terms of managing health service pressures and significantly greater morbidity and mortality from COVID and non-COVID disease

13. Any relaxations compared with full lockdown will raise Rt a little, with society working fully as normal equating to an R0 value of 2.8.

14. In terms of the TTP system, it is estimated that if 80% of contacts can be advised to self-isolate within 48 hrs of a symptomatic individual requesting a test, and if they comply with advice to self-isolate for 14 days, Rt can be reduced by approximately 30%. The implication of this is that an efficiently working TTP system would reduce Rt from 2.8 to around 1.9 – 2.0, and that ongoing restrictions are therefore likely to be required until a high level of population immunity is achieved.

15. Current data show that COVID cases in NI are significantly higher than Wales, Scotland, England or ROI, even allowing for somewhat higher testing in NI. The 14 day cases for NI are higher than any other country in Europe, with the possible exception of the Czech Republic. There is therefore a need for stronger intervention in NI than in other countries.

Compliance:

16. Available evidence shows that compliance with all aspects of existing restrictions is declining (see attached Cognisense survey results (Annex 1), particularly in younger segments of the population and those living in areas of social deprivation. There are likely to be multiple reasons for this, but in particular younger people do not perceive themselves to be at significant risk of adverse outcomes if they are infected and perceive the restrictions as placing overly onerous demands on their lives.

17. UK evidence suggests that compliance with advice by TTP to self-isolate is relatively poor (see attached paper on CORSAIR study Annex 2), and there is little reason to believe that adherence is better in NI.

18. The Executive on my recommendation previously agreed to the establishment of an Enforcement Group chaired by the Junior Ministers. My experience is that this has made significant progress. The Executive has recently agreed to increased penalties associated with failure to comply with current restrictions and DfC is considering support options to incentivise those required to self-isolate. Ensuring good compliance with restrictions over the next 6 months should be a key objective, and communication, enforcement, co-production and use of appropriate incentives are all likely to play a role in this. The extent to which this can be achieved is uncertain, and a detailed discussion of methods of doing so is beyond the scope of this paper.

19. The effectiveness of any intervention will be increased by good compliance and decreased by poor compliance. This will need to be factored in when determining what intervention may be required.

Approaches to modelling:

20. It is necessary to define the key objective for the health care system in relation to epidemic control as this will define the context for modelling. The Executive has previously confirmed that controlling transmission and protecting healthcare capacity as guiding principles when considering specific restrictions as outlined in Northern Ireland Executive: *"Coronavirus Executive Approach to Decision-Making"*, 12th May 2020. Various options have been discussed internationally, including COVID elimination (as in New Zealand). For the purpose of this paper, the key objective identified is to maintain the number of COVID patients in general acute medical beds as less than 20% of capacity (320 hospital inpatients). The rationale for this is provided in

Appendix 2.

21. The impact of non-pharmaceutical interventions (NPIs) is not expected to be fully apparent for between 2-3 weeks after implementation, subject to adherence by the population. With a sustained increase in the number of confirmed infections and hospitalisations, to avoid the health service being overwhelmed actions in the form of additional NPIs are therefore required a minimum of 21 days before the HSC would otherwise reach that point. For the purposes of this paper, the definition of overwhelmed describes "a situation in which the rate of COVID-19 hospitalisations results in multiple Trusts having to operate beyond their contingency capacity for COVID, placing a significant burden on the well-being of staff, and affecting the treatment of other acute, non-COVID patients with the associated indirect health consequences in terms of delays in planned treatment as in the first wave.

22. As of today (11/10/20) there are 144 hospital in-patients with community acquired COVID, of whom 19 are in critical care and approximately 125 in general acute medical beds. The doubling time is 7-8 days, and this would imply that the ceiling may be reached within 10 - 12 days. The impact of recent restrictions has not as yet been seen, but given that cases have continued to double in the last 7 days and that cases in the over 60s have more than doubled there seems little reason to assume that the increase in hospital admissions and inpatients will not continue for the foreseeable future.

23. As we move into a second surge, all of our hospitals are currently under significant additional pressure given the requirements to provide care for COVID patients and social distancing to prevent health care associated outbreaks all of which is significantly impacting on patients flow. In addition to the constraints related to providing COVID secure care, the limitations are related to the availability of skilled health care professionals and physical infrastructure neither of which are readily available in the independent sector. By way of example, to open 15 additional ICU beds requires more than 100 additional ICU nurses. To staff such additional capacity requires stopping planned elective theatre activity to ensure that sufficient anaesthetic and nursing staff with airway skills are available. These impacts and those on staffing are outlined at Appendix 2. As a consequence of these requirements already the Western Trust has suspended orthopaedic inpatient activity. Belfast Trust is preparing to cancel 28 theatre lists for ENT and ophthalmology to enable staff to support COVID patient care. The Southern Trust have cancelled routine general and breast surgery sessions planned for next week and are currently reprioritising their surgical services. The Northern and South Eastern Trusts are currently maintaining all elective services but are reporting a gradual increase in numbers of COVID patients. All Trusts are confirming no impact on red flag and urgent surgery at this stage.

24. In addition all Trusts are experiencing pressures at EDs and are struggling to maintain flow in the face of reduced capacity caused primarily by the number of staff self-isolating. In Belfast alone, as of 8th October there were 443 staff off work with COVID related issues, this equates to approximately 2% of all staff. In addition to the impact on elective activity, this is contributing to long waits in EDs and excessively long ambulance handover times with the associated risks to patient care. Without significant NI wide interventions in the form of restriction to reduce Rt to below 0.7 these increased pressure on hospitals services will become unsustainable. As a consequence Trusts operationally will be required to implement surge plans with the consequential impacts on routine and elective service with significant indirect health consequence of COVID. It is highly likely that in the absence of effective interventions to reduce Rt to below 0.7 the ability of the health service to maintain optimal patient flow and staffing levels will be significantly compromised and that this will be further impacted by healthcare related outbreaks of COVID in hospitals and care homes with the associated consequences.

25. During a comparable period in wave 1, R was significantly above 2 and decision to move to complete lockdown was made on 28th March. There had been some changes in population behaviours in the days leading up to this, the impact of which is difficult to quantify. The table below shows the trajectory of COVID inpatient numbers for community acquired disease. Inpatient numbers peaked 10 days after the introduction of full lockdown. In the second half of the table recent numbers are shown to indicate the current trajectory:

Date	Inpatients	Admissions	7 day average inpatients	7 day admissions
24/03/2020	63	9	39.7	70
25/03/2020	79	26	48.3	90
26/03/2020	95	23	58.9	107
27/03/2020	115	34	71.1	130
28/03/2020	149	39	86.6	156
29/03/2020	169	26	104.1	174
30/03/2020	188	36	122.6	193
31/03/2020	219	46	144.9	230
01/04/2020	244	42	168.4	246
02/04/2020	265	35	192.7	258

03/04/2020	258	36	213.1	260
04/04/2020	280	34	231.9	255
05/04/2020	273	25	246.7	254
06/04/2020	279	32	259.7	250
07/04/2020	290	35	269.9	239
08/04/2020	284	23	275.6	220
09/04/2020	275	28	277.0	213
10/04/2020	251	10	276.0	187
11/04/2020	254	19	272.3	172
12/04/2020	255	22	269.7	169
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26/09/2020	41	2	37.3	34
27/09/2020	45	7	39.7	39
28/09/2020	51	10	42.6	46
29/09/2020	63	15	46.4	52
30/09/2020	63	7	49.7	52
01/10/2020	68	9	53.3	54
02/10/2020	73	14	57.7	64
03/10/2020	70	9	61.9	71
04/10/2020	84	17	67.4	81
05/10/2020	92	13	73.3	84
06/10/2020	106	20	80.7	92
07/10/2020	119	22	88.6	107
08/10/2020	131	24	97.4	122
09/10/2020	141	22	107.0	130
10/10/2020	139	17	116.6	138
11/10/2020	144	9	124.9	128

26. Modelling has been conducted for a range of scenarios, including reducing Rt to 0.7 or 0.9 for varying periods of time (3 - 6 weeks). The purpose of this is

not to make a proposal but to illustrate for the Executive the impact of different decisions. The outputs of the modelling scenarios are provided in the separate Appendix, and include hospital inpatients only for simplicity. All models assume a single intervention and run to the end of January. Cases, admissions, ICU occupancy and hospital deaths will be in proportion with various lag times and peaking before or after hospital inpatients. All models show hospital deaths in the range of 250 – 800 depending on the scenario. Other scenarios can be modelled on request.

27. An intervention to decrease Rt to 0.7 (equivalent to complete lockdown) is more effective if it lasts longer, and if it is introduced earlier. A one week difference in the timing of intervention could result in 250 vs. 350 hospitalised patients.

28. A three week intervention to reduce Rt to 0.7 at an appropriate time would ensure that hospitals are not at risk of being overwhelmed until early December. A four week intervention would ensure under these assumptions that the hospital system would not be at risk of being overwhelmed until late December. A six week intervention would ensure that the hospital system is not at risk of being overwhelmed until January.

29. A single intervention is unlikely to be sufficient to protect the hospital system through the winter. Under all of the models considered an additional intervention or interventions would be required early in 2021 at the latest.

30. When emerging from a period of intervention, restrictions will be required to ensure that Rt remains at 1.3 under these scenarios. This implies more restrictions and/or significantly better compliance than at present. For the purposes of modelling we have allowed for R to rise to 1.4 in December, allowing for the likelihood of increased population mixing in the run up to Christmas.

31. In all models, better compliance with restrictions may lead to better numbers than shown, whereas worse compliance would lead to worse numbers.

Alternative approaches:

32. Measures to increase hospital capacity would allow an increased epidemic level to be managed, but this would inevitably be associated with increased deaths and might be limited by the need of staff to self-isolate if infected or contacts as a consequence of healthcare related outbreaks in hospitals or cluster and outbreaks in the community. It is also the case that the associated levels of community transmission would inevitably result in a further significant increase in outbreaks in care homes among extremely vulnerable older people as was experienced in the first wave which will result

in excess deaths in this population

33. Intensive efforts to ensure shielding of the elderly and extremely vulnerable with underlying health conditions could reduce pressures on the hospital system and may reduce mortality. However, this would require considerable sacrifice on the part of those shielding and those protecting them over at least a six month period with significant adverse impacts on their physical and mental health and well-being. A combination of this approach with some restrictions would allow more relaxed behaviours on the part of the younger part of the population (under 60s) but to avoid risk would require no mixing with the older population which is not considered feasible in practical or behavioural terms. A scientific paper and a SAGE discussion relating to this approach are attached at Annex 4.

34. In order to ensure that the capacity of the hospital system is not overwhelmed and to avoid non-COVID services being significantly downturned or ceased with the associated morbidity and mortality, an intervention to reduce Rt to 0.7 will be required, starting in the immediate to near future and certainly no later than the 16th October. Alternatively, a reduction in Rt to 0.9 plus extensive efforts to shield the elderly and vulnerable could be considered, though there is no certainty that this would be equally effective and given the adverse consequence such an alternative approach is not recommended. We continue to keep the advice to those who were previously shielding under review at a UK level and for the present this remains paused with advice for extreme caution given current levels of community transmission.

Modelling and options for Executive decision:

35. The following options for action are presented to the Executive from a Health Perspective, to arrest the transmission of the epidemic. **Under all of these scenarios hospital inpatients will rise to 450 – 600 at peak. Intervention even a few days before the 16th may reduce this significantly.**

We have assumed R = 1.3 after the intervention and 1.4 in December. Under these conditions only Scenario 3 (a six week intervention with R=0.7) offers a realistic prospect of avoiding the need for a further intervention until early in 2021.

Substantial efforts to improve population compliance and behaviours after the period of intervention will be required to avoid the need for another intervention before Christmas under any of the other scenarios modelled.

36. 1) An intervention to include the following components to commence as soon as possible but no later than October 16th, and lasting for between 3 - 6 weeks (Appendix scenarios 1 – 3) Intended Rt=0.7.

- Maintenance of current household restrictions

- Bubbling to be limited to a maximum of 10 people from 2 households

- No overnight stays in a private home unless in a bubble

- Work from home unless impossible to do so

- Closure of schools with delivery of distance learning

- Universities and further education to deliver distance learning to the maximum extent possible

- Closure of the hospitality sector apart from deliveries

- Closure of indoor shopping centres and retail which cannot be accessed from outside

- Closure of close contact services apart from those meeting essential health needs

- No indoor sport of any kind or organised contact sport involving household mixing other than at elite level,

- No mass events involving more than 25 people regardless of risk assessment (except for allowed outdoor sporting events)

- Churches remain open for private prayer.

- Wedding ceremonies to be limited to 25 people with no receptions

- Funerals to be limited to 25 people with no pre- or post-funeral gatherings

- No unnecessary travel

2) A four week intervention with the above characteristics, with schools open in weeks 1 and 4 (scenario 4)

3) A six week intervention with the above characteristics, but with schools open in week 1 and weeks 4-6 (scenario 6)

4) A six week intervention to allow for other minor relaxations or reduce compliance compared with wave 1 (scenario 5; Rt=0.9)

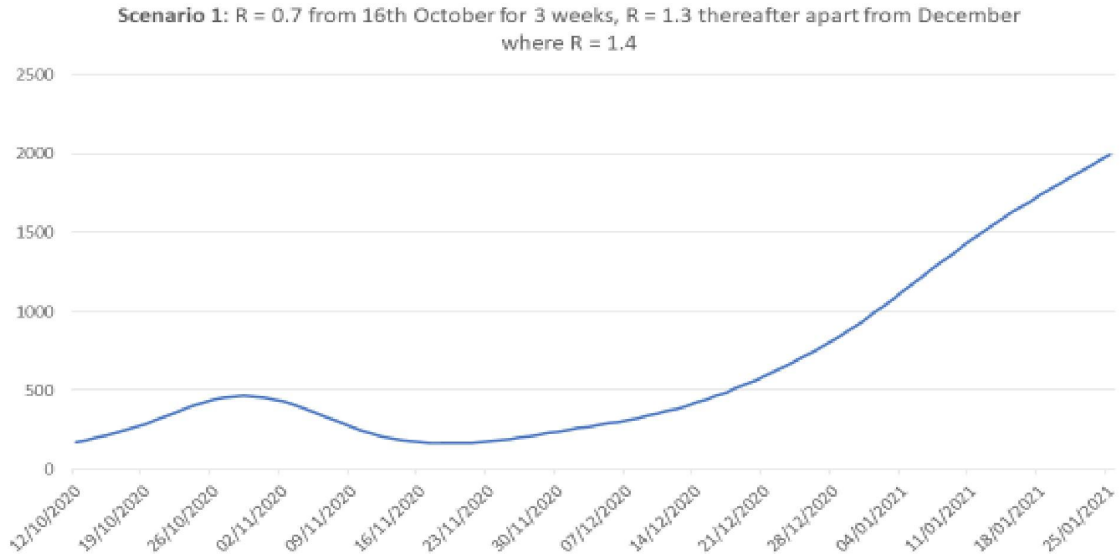
Recommendation

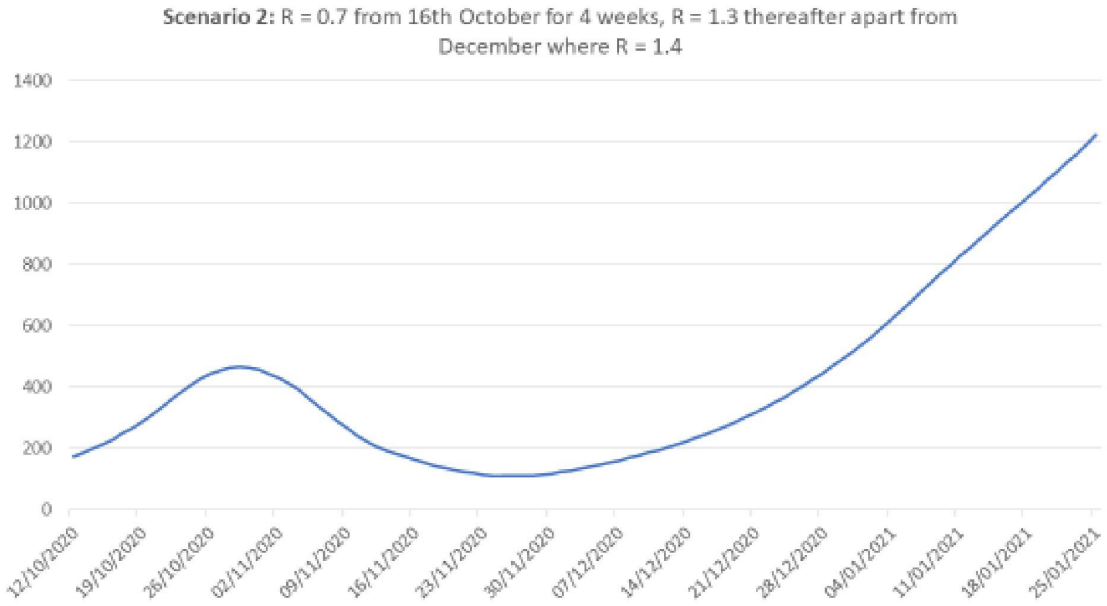
37. Considering the current exponential phase of the epidemic in NI and the modelling of the various interventions, both the Chief Medical Officer and Chief Scientific Advisor recommend an intervention to include the components at paragraph 36 (1) for implementation as soon as possible and no later than the 16th October for a period of 6 weeks ideally or between 4 and 6 weeks to prevent the health service being overwhelmed and to avoid direct and reduce indirect adverse health consequence including excess deaths.

38. This intervention will allow a reset following which the number of cases and pressures on the hospital system will be significantly reduced, and appropriate relaxation of restrictions and measures to encourage good population compliance can be implemented.

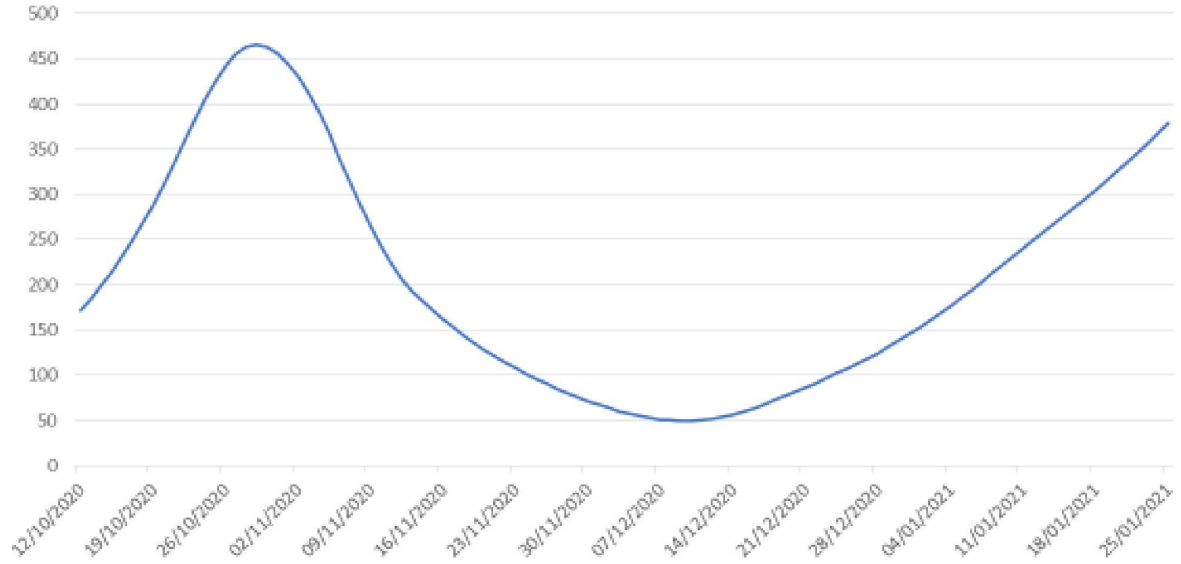
Robin Swann, MLA
Minister of Health

Appendix 1: Modelling results

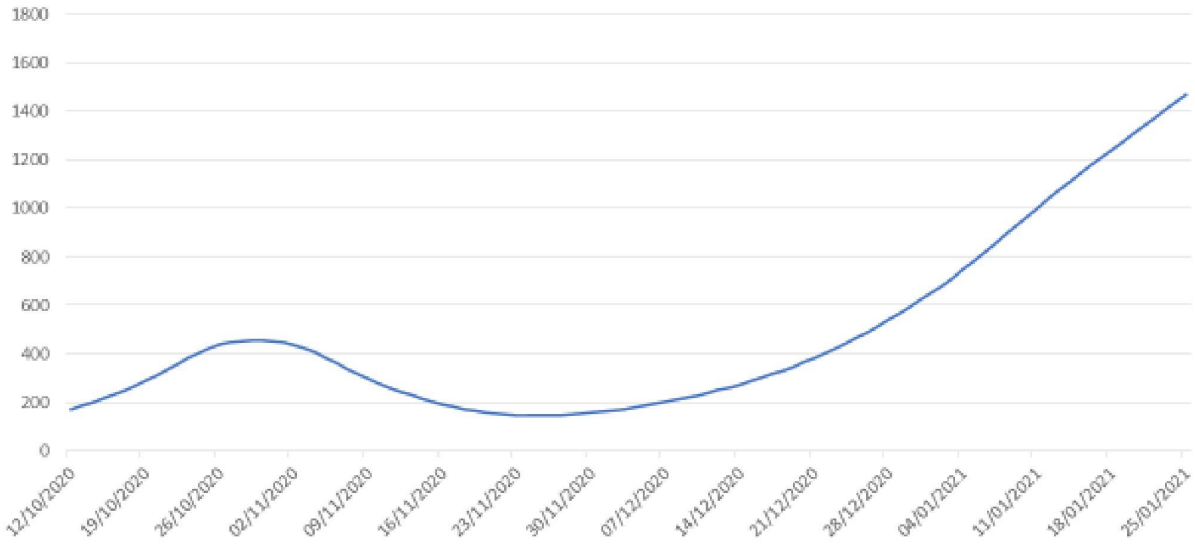




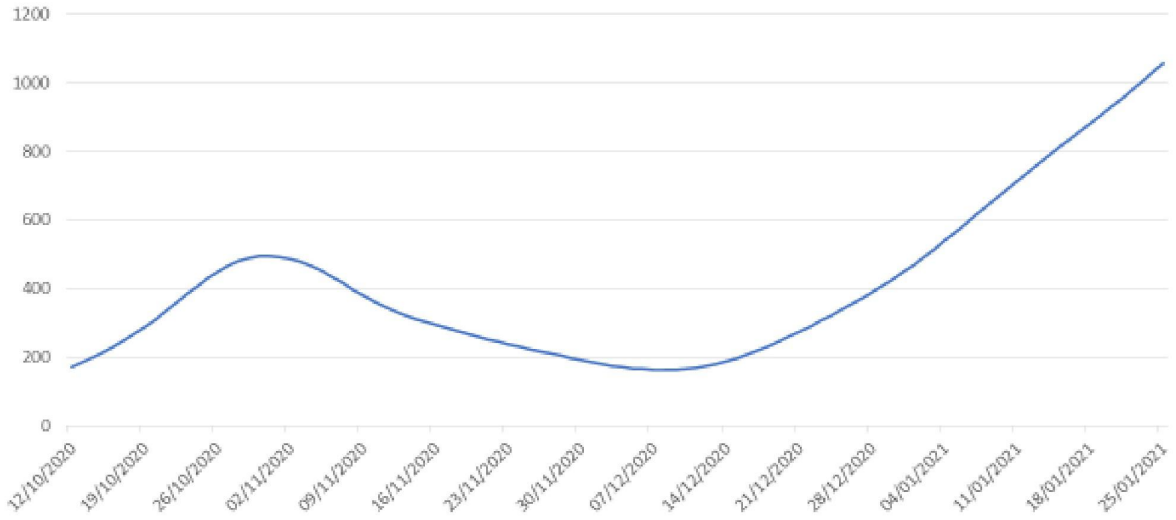
Scenario 3: R = 0.7 from 16th October for 6 weeks, R = 1.3 thereafter apart from December where R = 1.4



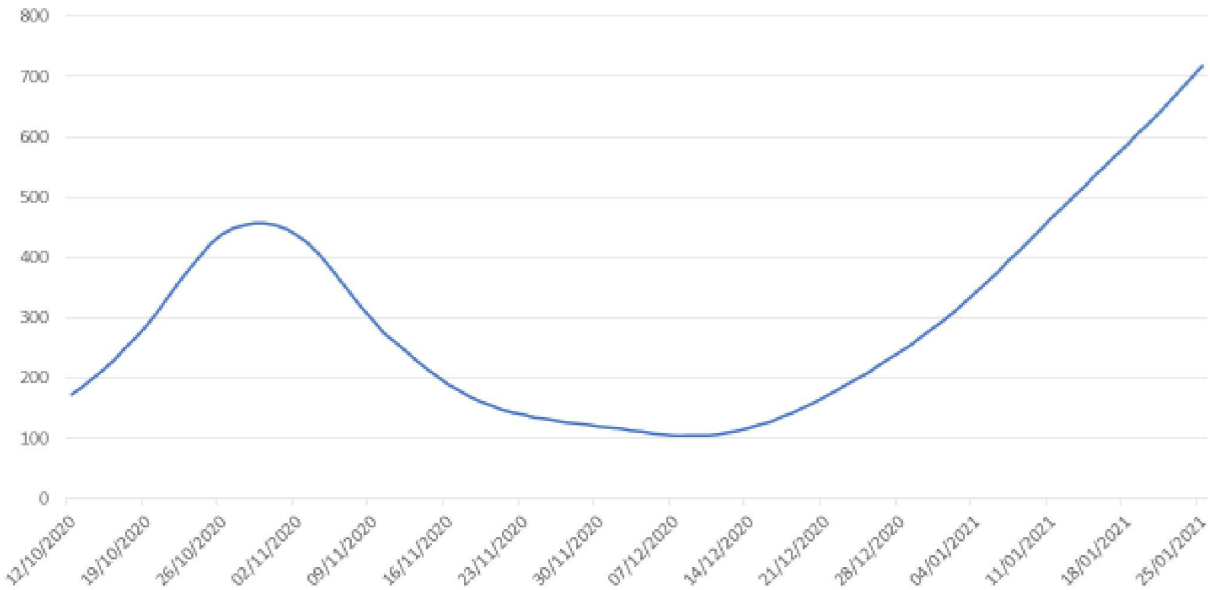
Scenario 4: R = 0.9 from 16th October for 1 week, R=0.7 for next 2 weeks, R=0.9 for next week, R = 1.3 thereafter apart from December where R = 1.4



Scenario 5: R = 0.9 from 16th October for 6 weeks, R = 1.3 thereafter apart from December were R = 1.4



Scenario 6: R = 0.9 from 16th October for 1 week, R=0.7 for next 2 weeks, R=0.9 for next 3 weeks, R = 1.3 thereafter apart from December were R = 1.4



Appendix 2: Hospital capacity in the context of COVID

Our hospitals have an overall capacity of roughly 3500 beds. Of these, many are dedicated to specialties such as stroke, cardiology, nephrology, neurology, major trauma or cystic fibrosis. There are 1600 beds that could be termed general medical and which are most likely to be used for covid patients. The overall number of beds fluctuates in response to staffing pressures, for example in response to the impact of staff self-isolating.

At peak in the first wave there were 322 Covid inpatients. At that time, given the large degree of uncertainty about what the impact of the pandemic would be, the HSC had taken steps to release as much capacity as possible. In practice, this meant that almost all routine elective activity had stopped. Many staff had also been redeployed to areas such as critical care in order to increase our capacity. At the same time, public concern about the pandemic led to significantly reduced numbers of patients attending hospital. Due to a combination of these factors, the system was able to deal with the first surge. Nevertheless, staff working some aspects of the service, such as critical care, were under intense pressure throughout the first surge.

As we move into a second surge, the situation is very different. Firstly, all of our hospitals are currently under significant pressure. Most hospitals are running at more than 85% capacity, with some over 90%. There are already trolley waits in EDs and ambulances queuing outside. This level of pressure does not usually manifest until later in the year. There is therefore a concern around how they system will deal with rising pressures over the winter period alongside increasing numbers of Covid+ patients.

There is also clear evidence that length of stay for Covid+ patients is longer than average length of stay (LOS). Recent figures from the HSCB suggest that LOS for Covid patients is 11.56 days, compared to 5.95 average. As numbers of Covid+ patients increase, this will therefore reduce capacity further.

Community Care

The position in relation to community care is also relevant. When there are outbreaks in care homes, this can impact on the ability of these sites to accept patients on discharge from hospital and increase the length of stay in hospital. With widespread community transmission and a rolling programme of testing in care homes, we are also seeing increased numbers of staff having to self-isolate across community services – which is impacting on capacity and the ability to facilitate discharge. We expect this challenge to continue to grow. In the first surge more than 21,000 hours of staff time were provided to independent sector care homes from the HSC to help maintain services. Indications from Trusts are that it will be extremely challenging to maintain this level of support to the independent sector.

Critical Care

The Department currently receives a daily update from the Critical Care Network for Northern Ireland (CCANNI) setting out the position in each unit. With the experience

of the first surge period, it is clear that the provision of critical care remains a key stress point within the system.

As a region, Northern Ireland has a funded capacity of 70 critical care beds. Critical care beds are extremely staff intensive, particularly with regard to nursing staff. To increase critical care beds by 15, requires more than 100 additional nurses. In order to open these beds, nurses therefore have to be moved from other parts of the HSC, with a severe impact on other activity, particularly on elective surgical activity. Furthermore, as the number of critical care beds being used to treat Covid+ patients increases, the capacity of the region to provide critical care support for complex surgery decreases. A small increase has a major impact.

HSC Bed Capacity Risk Levels

The impact of NPIs is expected to be between 2-3 weeks of implementation, subject to adherence by the population. With a sustained increase in the number of confirmed infections and hospitalisations, action in the form of additional NPIs is required 21 days before the HSC is overwhelmed.

Our definition of overwhelmed describes "a situation in which the rate of COVID-19 hospitalisations results in multiple NHS Trusts having to operate beyond their contingency capacity for COVID, placing a significant burden on the well-being of staff, and affecting the treatment of other acute, non-COVID patients."

While every effort will be made to maintain elective procedures, it is acknowledged that elective and non-essential procedures will likely need to be cancelled to provide the necessary bed and staffing capacity to treat COVID-19 patients within the forecasting period.

The Department has set the following risk levels in terms of overall bed capacity:

Impact of Covid demand – Risk Levels

(Expressed as percentage of General Medical Beds)

Green (<5%)	Covid and non-covid services able to be maintained.
Amber (5-15%)	Level of covid demand putting pressure on non-covid services. Some routine services de-prioritised.
Red (20%)	Covid demand having significant adverse impact on hospital services/covid contingency exceeded.

20% of beds roughly equates to 320 beds. At this point, multiple Trusts are reporting that they are at amber, with a rising numbers of Covid+ patients and an increasing impact on non-Covid services.