

# SPI-M-O: Planning scenarios and current estimates of severity and length of stay

*Date: 11<sup>th</sup> May 2020*

## Planning Scenarios

1. HM Government requires estimates of the future epidemic that allow for short, medium, and longer-term planning for a range of operational considerations, including NHS capacity. It is challenging to model this with any degree of precision as it will be highly dependent on the timing and nature of policy decisions that are taken and the behaviour of individuals over the time range considered. It will also be affected by fluctuations due to probability, which will become more significant as incidence falls. To reflect these fundamental uncertainties, it is important to consider a range of scenarios covering a reasonable set of assumptions.
2. **It is important to note that these scenarios are not forecasts. They do not represent the full range of possible outcomes and no likelihood is attached to any of these scenarios at this stage.**
3. Planning scenarios are designed to be policy-neutral in terms of specific changes but reflect the overall aim of gradually relaxing behavioural and social interventions while attempting to maintain R at or below 1. Scenarios under consideration will model forward incidence based on the current R until:
  - i. Change of messages in May pushed R to 1 and remains at R=1 for the rest of 2020
  - ii. BSI easing at 1 June pushes R to 1 and remains at R=1 for the rest of 2020
4. Both scenarios represent situations where incidence remains stable, with neither growth or decline in infections, once R=1.
5. Additional scenarios, including where R returns above 1, resulting in an increase in infections (either because of behavioural changes, or because the impact of a policy change leads to more transmission than anticipated) will be considered in a future update of this document. One of these scenarios will be a revised reasonable worst-case planning scenario (RWCS).
6. The scenarios presented should **not** be considered a reasonable worst case. It is possible that future incidence and demand could be considerably higher or lower than this.

SPI-M-O: Planning scenarios and current estimates of severity and length of stay, 11<sup>th</sup> May 2020

7. To produce scenarios i and ii, the SPI-M-O consensus short-term forecasts are used to project forward from today to 18<sup>th</sup> May and 31<sup>st</sup> May respectively. After these dates, the assumption that R=1 and remains constant will lead to an approximate flat line epidemic curve and thus similar to the levels predicted by the short-term forecasts.
8. The values in Table 1 below represent SPI-M-O's consensus view on 11<sup>th</sup> May 2020, with 90% confidence bounds presented in brackets.

**Table 1:** Forecast for hospitalisations (new and newly confirmed cases in hospital) by nation of the UK and region of England

Nation of the UK	Numbers of new hospitalisations when R=1	
	18 <sup>th</sup> May	31 <sup>st</sup> May
England	662 (431 – 979)	428 (222 – 938)
Scotland	73 (26 – 113)	55 (4 – 90)
Wales	47 (25 – 69)	38 (20 – 56)
Northern Ireland	51 (5 – 108)	43 (2 – 105)
<b>Region of England</b>		
East of England	81 (38 – 138)	60 (16 – 136)
London	101 (49 – 191)	59 (16 – 188)
Midlands	121 (58 – 199)	86 (26 – 195)
North East and Yorkshire	126 (70 – 226)	89 (30 – 228)
North West	142 (77 – 220)	107 (39 – 206)
South East	84 (43 – 144)	55 (16 – 136)
South West	37 (11 – 74)	29 (2 – 88)

9. It is recommended that any operational modelling conducted using these scenarios for planning is based on these new hospitalisation forecasts.
10. By combining these data with mean length of stay and severity estimates (see Annexes A and B), it is possible to calculate a range of metrics for the time period in each of these scenarios, such as predicted numbers of infections and hospital mortality rate.

11. Figures in these subsequent annexes are provided by each modelling group and will differ as they are fitted to various underlying data and the models use different methodologies. Values presented here are the range of parameter estimates based on all returns. They do not represent the parameters for a RWCS but illustrate the range of current estimates used by SPI-M modellers.

### Annex A: Length of stay

12. Estimates for the length of stay were produced by several groups independently, based on different models and using different data sources. Data sources included COVID-19 Hospitalisation in England Surveillance System (CHESS), COVID-19 Clinical Information Network (CO-CIN), NHS situation reports, and data sourced directly from a specific hospital site.

13. While average numbers are presented here, there is a broad distribution with total stays potentially extending to many weeks.

**Table 2:** Average length of stay for COVID-19 hospitalisation phases

Period	Mean length of stay (days)
Hospital (non-ICU) admission to transfer to ICU (HDU/ITU)	1.7 – 2.6
Hospital (non-ICU) admission to death <i>without</i> an ICU (HDU/ITU) admission	9.8 – 11.0
Hospital (non-ICU) admission to discharge <i>without</i> an ICU (HDU/ITU) admission	7.6 – 12.8
ICU (HDU/ITU) admission to death	7.6 – 12.8
ICU (HDU/ITU) admission to discharge <sup>†</sup>	9.7 – 15.7

<sup>†</sup> Does not include any step-down care in hospital (non-ICU) following ICU stay but prior to discharge.

## Annex B: Severity estimates

14. While there is a wide range in the estimated proportion of patients dying in different settings within the hospital the overall risk of death is more consistent between the groups in the range 37 – 42%.

**Table 3:** Severity estimates for stages of COVID-19

Risk	Proportion
Infected with symptoms	XX – XX% <sup>a</sup>
Infected hospitalised	1.9 – 2.7%
Hospitalised (non-ICU) patients transferring to ICU (HDU/ITU)	17 – 20%
Hospitalised (non-ICU) patients dying <i>without</i> an ICU (HDU/ITU) admission	30 – 39%
ICU (HDU/ITU) patients dying	40 – 68%
All hospitalised patients dying	37 – 42%
Overall infection fatality rate	0.6% – 1.0%

a) An update to the symptomatic infection rate will be provided in the next iteration of this document.

15. Severity estimates by five-year age group have been produced by three separate SPI-M-O groups independently based on their models. Table 4 shows the similarities and differences between the groups for the infection hospitalisation rates, rates of ICU if a patient is hospitalised, and infection mortality rates in hospital.

16. These rates can be used with the new and newly confirmed cases in hospital data (Table 1) to calculate metrics, such as numbers of patients from a particular age group in ICU, or the number of likely infections. To do this, **only one group's set of severity estimates should be used** to maintain the relevant model's internal logic.

**Table 4:** Severity parameters for each SPI-M-O modelling group by five-year age group

Age group	Group 1			Group 2			Group 3		
	Proportion of infections hospitalised	Proportions of hospitalisations requiring ICU	Proportions of infections hospitalised and then dying	Proportion of infections hospitalised	Proportions of hospitalisations requiring ICU	Proportions of infections hospitalised and then dying	Proportion of infections hospitalised	Proportions of hospitalisations requiring ICU	Proportions of infections hospitalised and then dying
0-4	0.1%	28.4%	0.0%	2.1%	1.7%	0.0%	0.1%		0.1%
5-9	0.0%	13.5%	0.0%	0.9%	0.6%	0.0%	0.1%		0.1%
10-14	0.1%	8.7%	0.0%	0.6%	1.0%	0.0%	0.1%		0.0%
15-19	0.1%	7.1%	0.0%	0.6%	20.2%	0.0%	0.1%		0.0%
20-24	0.1%	7.2%	0.0%	0.7%	12.6%	0.0%	0.2%		0.1%
25-29	0.2%	8.6%	0.0%	0.6%	33.8%	0.0%	0.2%		0.1%
30-34	0.3%	11.3%	0.0%	1.0%	30.1%	0.1%	0.2%		0.1%
35-39	0.5%	16.0%	0.0%	1.3%	24.2%	0.1%	0.2%		0.1%
40-44	0.8%	23.0%	0.0%	1.8%	30.0%	0.1%	0.5%		0.2%
45-49	1.2%	32.2%	0.1%	2.7%	24.0%	0.2%	0.5%		0.2%
50-54	1.8%	41.8%	0.2%	3.4%	32.0%	0.4%	1.7%		0.7%
55-59	2.7%	47.9%	0.6%	3.9%	40.4%	0.8%	1.7%		0.7%
60-64	4.0%	46.5%	1.2%	5.3%	33.1%	1.1%	5.8%		2.3%
65-69	6.0%	36.4%	2.2%	9.1%	24.9%	2.4%	5.8%		2.3%
70-74	8.9%	21.9%	3.7%	9.6%	19.9%	3.8%	18.0%		7.2%
75-79	13.1%	9.7%	5.9%	9.0%	9.1%	4.1%	18.0%		7.2%
80+	26.6%	1.4%	13.9%	11.6%	2.0%	6.1%	18.0%		7.2%
<b>Average</b>	<b>2.7%</b>	<b>19.2%</b>	<b>1.0%</b>	<b>1.9%</b>	<b>a</b>	<b>0.6%</b>	<b>2.4%</b>	<b>17.0%<sup>b</sup></b>	<b>0.9%</b>

Proportion of hospitalisations requiring ICU: a) Group 2 average value to be confirmed b) Group 3 do not use an age breakdown so only an average has been provided.

## Annex C: SPI-M-O short-term forecasts

17. These short-term forecasts are produced specifically for planning purposes and provide the SPI-M-O's consensus forecast of how the epidemic will develop over the near future (i.e. within the next month). They have been informed by the available data and **implicitly assume that the current suite of social distancing measures remains in place for the next three weeks.**
18. Each of the SPI-M-O modelling groups produce their own set of forecasts for the four metrics below. These are combined by fitting a normal distribution to each prediction and aggregating with equal weights to produce a consensus forecast.
19. SPI-M-O forecast the following key metrics and indicators of pressure on the health service:
  - a. **ICU occupancy:** The number of individuals in ICU each day that have confirmed COVID-19.
  - b. **Hospital bed occupancy:** The number of individuals in hospital beds, including in ICU, that have confirmed COVID-19.
  - c. **Hospital and community deaths, by date of death:** The number of deaths in hospital and the community due to COVID-19 by date of death. Note the coverage of deaths in the short-term forecasts differs from the figures quoted in Table 3 above, which relate to the proportion of hospitalised cases which go on to die.
  - d. **New and newly confirmed patients in hospital:** The number of new admissions that tested positive, new admissions that were tested positive prior to admission, and existing patients that tested positive for COVID-19.
20. SPI-M-O does not produce consensus forecasts for the number of daily infections due to the amount of uncertainty around the proportion of asymptomatic infections and a lack data to compare the accuracy of forecasts to. In some cases, it would be possible to infer the number of infections using the forecasts for the number of new and newly confirmed patients in hospital and the proportion of infections which are asymptomatic, proportion of symptomatic individuals requiring hospital treatment, and the time lags noted above.
21. The ICU occupancy forecasts for Northern Ireland include confirmed and suspected COVID-19 cases. Data limitations mean the other forecasts for Northern Ireland have not been informed by data. As a result, these forecasts need to be treated with caution and represent SPI-M-O's best assessment using the available data from other parts of the UK.

22. The bed occupancy forecasts depend on the distribution of lengths of stay, which are estimated separately for the different models from different data sources.

23. Different data definitions across the four nations mean that it isn't possible to sum across England, Wales, Scotland and Northern Ireland to obtain a UK forecast.

**Table 5:** Forecasts for the four nations of the UK for general and ICU bed occupancy, new hospitalisations, and deaths by date of death at 18<sup>th</sup> and 31<sup>st</sup> May.

		Day when R=1	
		18 <sup>th</sup> May	31 <sup>st</sup> May
	Metrics		
England	Total beds occupied	6,692 (5,442 – 8,384)	4,235 (3,141 – 5,972)
	Total ICU beds occupied	1,291 (879 – 1,654)	836 (436 – 1,148)
	New and newly confirmed patients in hospital	662 (431 – 979)	428 (222 – 938)
	Hospital and community deaths, by date of death	263 (143 – 390)	158 (60 – 274)
Scotland	Total beds occupied	908 (555 – 1,088)	676 (428 – 854)
	Total ICU beds occupied	91 (49 – 146)	68 (37 – 116)
	New and newly confirmed patients in hospital	73 (26 – 113)	55 (4 – 90)
	Hospital and community deaths, by date of death	34 (6 – 94)	25 (0 – 182)
Wales	Total beds occupied	553 (318 – 728)	437 (246 – 643)
	Total ICU beds occupied	74 (44 – 137)	60 (37 – 123)
	New and newly confirmed patients in hospital	47 (25 – 69)	38 (20 - 56)
	Hospital and community deaths, by date of death	23 (5 – 74)	20 (0 – 279)
Northern Ireland	Total beds occupied	253 (93 – 722)	210 (60 – 630)
	Total ICU beds occupied	28 (11 – 50)	24 (5 – 47)
	New and newly confirmed patients in hospital	51 (5 – 108)	43 (2 – 105)
	Hospital and community deaths, by date of death	8 (0 – 40)	7 (0 – 38)

**Table 6:** Forecasts for the regions of England for general and ICU bed occupancy, new hospitalisations, and deaths by date of death at 18<sup>th</sup> and 31<sup>st</sup> May.

	Metrics	Day when R=1	
		18 <sup>th</sup> May	31 <sup>st</sup> May
East of England	Total beds occupied	752 (604 – 1,093)	541 (397 – 1,052)
	Total ICU beds occupied	152 (73 – 222)	107 (32 – 206)
	New and newly confirmed patients in hospital	81 (38 – 138)	60 (16 – 136)
	Hospital and community deaths, by date of death	35 (10 – 70)	25 (2 – 70)
London	Total beds occupied	1,160 (692 – 1,447)	652 (419 – 836)
	Total ICU beds occupied	344 (217 – 464)	192 (106 – 275)
	New and newly confirmed patients in hospital	101 (49 – 191)	59 (16 – 188)
	Hospital and community deaths, by date of death	25 (4 – 64)	14 (0 – 56)
Midlands	Total beds occupied	1,067 (758 – 1,407)	666 (479 – 996)
	Total ICU beds occupied	176 (107 – 258)	110 (54 – 179)
	New and newly confirmed patients in hospital	121 (58 – 199)	86 (26 – 195)
	Hospital and community deaths, by date of death	45 (16 – 88)	28 (4 – 70)
North East and Yorkshire	Total beds occupied	1,216 (988 – 1,781)	856 (669 – 1,687)
	Total ICU beds occupied	176 (96 – 260)	123 (54 – 261)
	New and newly confirmed patients in hospital	126 (70 – 226)	89 (30 – 228)
	Hospital and community deaths, by date of death	55 (21 – 102)	38 (8 – 101)
North West	Total beds occupied	1,414 (1,097 – 1,934)	982 (753 – 1,671)
	Total ICU beds occupied	182 (113 – 258)	126 (61 – 225)
	New and newly confirmed patients in hospital	142 (77 – 220)	107 (39 – 206)



		<b>Day when R=1</b>	
<b>Metrics</b>		<b>18<sup>th</sup> May</b>	<b>31<sup>st</sup> May</b>
	Hospital and community deaths, by date of death	52 (19 – 94)	36 (5 – 85)
<b>South East</b>	Total beds occupied	850 (667 – 1,175)	560 (430 – 939)
	Total ICU beds occupied	162 (109 – 222)	108 (53 – 177)
	New and newly confirmed patients in hospital	84 (43 – 144)	55 (16 – 136)
	Hospital and community deaths, by date of death	34 (10 – 64)	22 (1 – 56)
<b>South West</b>	Total beds occupied	313 (235 – 447)	202 (134 – 367)
	Total ICU beds occupied	48 (28 – 79)	31 (15 – 63)
	New and newly confirmed patients in hospital	37 (11 – 74)	29 (2 – 88)
	Hospital and community deaths, by date of death	13 (1 – 45)	8 (0 – 83)

## Annex D: Data sources used to inform the short-term forecasts

**Table 7:** Data sources used to inform the short-term forecasts

<b>Metric</b>	<b>Nation</b>	<b>Source</b>
<b>ICU bed occupancy</b>	England	NHSE SitRep (all NHS trusts), field "Number of confirmed COVID-19 patients in HDU/ITU at 0800 (Total)".
	Scotland	NHS Scotland SitRep, field "Total number of confirmed COVID-19 inpatients in ICU at midnight"
	Wales	NHS Wales SitRep (all hospitals), field "Total number of confirmed COVID-19 patients in invasive ventilated beds".
	Northern Ireland	NI SitRep, field "ICU Occupancy". Note these are confirmed and suspected cases.
<b>Hospital bed occupancy (including ICU beds)</b>	England	NHSE SitRep (all NHS trusts), field "Total number of beds occupied with confirmed COVID patients at 08:00 (Total)"
	Scotland	<a href="#">NHS Scotland trends in daily COVID-19 data</a> , field "COVID-19 patients in Hospital (including those in ICU) – confirmed".
	Wales	NHS Wales SitRep (all hospitals), field "Total number of confirmed COVID-19 patients in hospital beds".
	Northern Ireland	N/A
<b>Deaths by date of death</b>	England	PHE CHES line list of deaths ( <i>death_type</i> is "confirmed").
	Scotland	NHS Scotland deaths line list, file is circulated alongside the Sitrep and called "Scottish COVID-19 deaths".
	Wales	<a href="#">Public Health Wales dashboard</a> . "Suspected COVID-19 deaths in lab confirmed cases" field.
	Northern Ireland	N/A

<b>Metric</b>	<b>Nation</b>	<b>Source</b>
<b>New and newly confirmed cases in hospital</b>	England	NHSE SitRep (all NHS trusts), sum of fields "Number of inpatients diagnosed with COVID-19 in last 24 hours (Total)" and "Number of patients admitted with COVID-19 in last 24 hours (Total)".
	Scotland	"Scotland Tested Positive in Hospitals" file, sum of fields "N.Positive.In.Hospital" and "N.Positive.On.Admission".
	Wales	"SPI-M Wales Hospital Data" file. Hospital admissions with confirmed COVID-19, "All admissions" sheet.
	Northern Ireland	N/A