Reasonable worst-case planning scenario – 21 May 2020

Purpose: To help government departments plan for the impact of COVID-19, this document sets out the reasonable worst-case planning scenario as agreed by SAGE (Scientific Advisory Group for Emergencies) on 21 May 2020. This reasonable worst-case scenario (RWCS) is available for the whole of the UK, for devolved nations, and the seven NHS regions of England. Annex A presents two further scenarios, offering a sensitivity analysis. The differences between the scenarios lie in the assumptions made about rate of epidemic growth as a result of relaxing and re-implementing behavioural and social interventions (BSIs).

It should be noted that **these are scenarios, not predictions**. The precise timings of peaks in infection and, in particular, demand on healthcare are subject to **significant uncertainty**. The scenarios are sensitive to initial conditions and any increase in the starting estimates of numbers of infections, hospitalisations, or deaths could lead to a larger peak.

These assumptions will be kept under review and amended as the scientific and medical advice develops, and implications of the current measures are further understood.

For the RWCS, deaths, ICU occupancy, hospital admissions and new infections are modelled for a 16-week period from 18 May to 6 September 2020 inclusive.

The RWCS models an easing of BSIs from 1 June that leads to an increase in R to 1.7, for four weeks, on the assumption this rise is not detected quickly. At this point, it is assumed that the resulting increase in hospitalisations and deaths leads to a reversal of easing BSIs. R then reduces to 0.7 until incidence levels are comparable to those as at 1 June. At this point, BSIs are relaxed again until R returns to approximately 1 for the rest of the time period.

It is possible that a lower R, still greater than 1 such as 1.1-1.2, would be harder to detect and be reacted against more slowly. Over longer periods than this RWCS covers, this lower R situation could have a larger impact overall than a peak that is brought under control.

SAGE provides scientific advice to government. It does not make decisions on what scenario government should be planning for. The Cabinet Office Civil Contingencies Secretariat currently advises that HMG should plan based on the RWC scenario below.

SAGE RWCS planning assumptions – 21 May 2020

The data that have contributed to tables 1 and 2 were provided by multiple modelling groups 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 the RWCS but illustrate the range of current estimates used by SPI-M modellers.**

Table 1: Severity estimates for stages of COVID-19

Risk	Proportion
Proportion of infections which have symptoms	Unknown[1]
Infected people hospitalised	1.2 – 2.7%
Hospitalised (non-ICU) patients transferring to ICU (HDU/ITU)	14 – 20%
Hospitalised (non-ICU) patients dying *without* an ICU (HDU/ITU) admission	30 – 39%
ICU (HDU/ITU) patients dying	40 – 68%
All hospitalised patients dying	37 – 42%
Overall infection fatality rate	0.5% – 1.0%

1) The proportion of infections that do not present with symptoms is highly uncertain with estimates varying from 10-80%. Best estimates of some SPI-M-O members is that asymptomatic or very mild infections account for a large proportion of disease, including the group whose results are used in this scenario.

The model from which the RWCS is derived makes various assumptions based on the data available about the how long it takes to progress from one stage of time in hospital e.g. ICU admission to another e.g. discharge.

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 *without* an ICU (HDU/ITU) admission	9.8 – 11.0
Hospital (non-ICU) admission to discharge *without* 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†	9.7 – 15.7

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

Table 3 gives the severity parameters used in the model that forms the RWCS. It is not valid to take the most pessimistic value for each parameter value when modelling one scenario, as **this would give outputs that are entirely implausible**. As the reproduction numbers used in the RWCS were chosen to reflect an unlikely but plausible scenario, it is appropriate to use the best estimates of the group from whose model the RWCS was taken. Extensive comparisons between different academic groups' models were used to show that this model and its input parameters were appropriate.

Table 3: Severity parameters by five-year age group for the RWCS model

Age band	Proportion of infected people who are hospitalised	Proportion of hospitalised cases need ICU	Proportion of infected people who die
0 to 4	0.4%	1.1%	0.0%
5 to 9	0.1%	0.0%	0.0%
10 to 14	0.0%	0.0%	0.0%
15 to 19	0.1%	16.6%	0.0%
20 to 24	0.1%	9.6%	0.0%
25 to 29	0.1%	26.8%	0.0%
30 to 34	0.2%	23.9%	0.0%
35 to 39	0.3%	19.1%	0.0%
40 to 44	0.4%	23.6%	0.0%
45 to 49	0.7%	18.8%	0.1%
50 to 54	1.1%	25.1%	0.2%

Age band	Proportion of infected people who are hospitalised	Proportion of hospitalised cases need ICU	Proportion of infected people who die
55 to 59	1.5%	31.7%	0.4%
60 to 64	2.1%	26.0%	0.6%
65 to 69	5.1%	19.7%	1.9%
70 to 74	5.8%	15.7%	3.2%
75 to 79	4.9%	7.1%	3.1%
80 to 84	7.2%	2.6%	4.8%
85 to 89	8.6%	0.6%	6.4%
90 to 94	7.9%	0.2%	7.0%
95 to 99	5.4%	0.2%	7.2%
100+	6.6%	0.0%	8.2%
Average	**1.2%**	**14.2%**	**0.6%**

Table 4: Key RWCS headline data based on epidemiological modelling, to support HMG planning decisions.

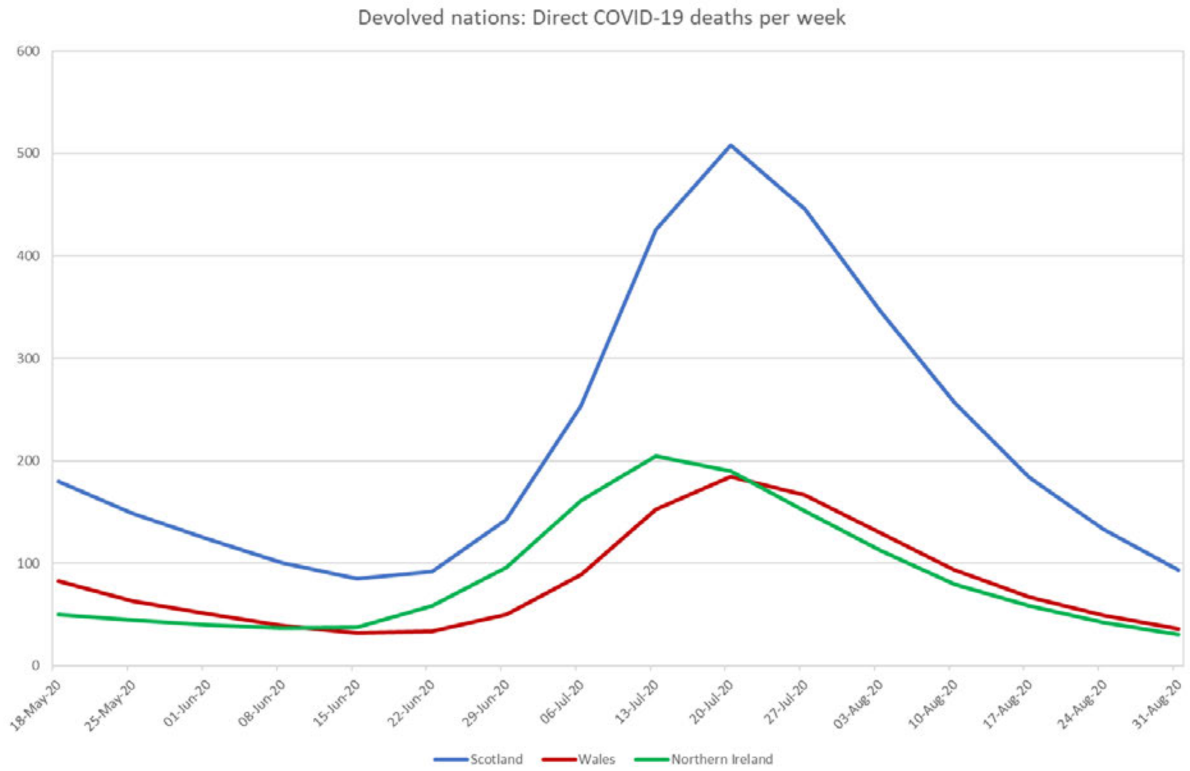
Number of direct COVID-19 deaths This is the number of **confirmed** COVID-19 deaths per the PHE line list (and equivalent for DAs), for hospitals, care homes and the community. It does not include deaths which are not captured in those headline data, additional COVID-19 deaths that could occur due to lack of NHS capacity, or other excess deaths	**59,000** (to the nearest 1,000, 18 May to 6 September 2020) **Weekly direct covid-19 deaths over 3,000** for 7 weeks (**Peak 8,500** - nearest 100 - in mid-July 2020) **The peak weeks are from end of-June until mid-August, with a slower decline than increase** in the RWCS.
Number of cases requiring hospitalisation	**130,000** (to the nearest 10,000, 18 May to 6 September 2020)
Number of cases requiring ICU admission	**19,000** (nearest 1,000, 18 May to 6 September 2020), peaking at 3,000 admissions per week

For the first time, regional and devolved nation breakdowns are available for all RWC scenarios.

Table 5: Key RWCS headline data based on epidemiological modelling for each devolved nation, to support planning decisions.

	England	Scotland	Wales	Northern Ireland
Number of direct COVID-19 deaths This is the number of **confirmed** COVID-19 deaths per the PHE line list (and equivalent for DAs), for hospitals, care homes and the community. It does not include deaths which are not captured in those headline data, additional COVID-19 deaths that could occur due to lack of NHS capacity, or other excess deaths	53,000	3,500	1,300	1,400
Number of cases requiring hospitalisation	110,000	11,000	4,000	12,000
Number of cases requiring ICU admission	17,000	1,100	500	500

Figure 1: RWCS weekly direct COVID-19 deaths for Scotland, Wales and Northern Ireland, 18 May to 6 September 2020



Assumptions

The RWCS is based on a mitigated epidemic, however the changes in the rate of growth of the disease have been modelled in policy-neutral way, i.e. they do not reflect any specific assumptions about how contact patterns change in specific settings in the future, other than R changes.

The values for R chosen after the easement BSIs have been agreed, both amongst SPI-M-O epidemiological modelling experts and in collaboration with SAGE and the Cabinet Office Civil Contingencies Secretariat.

SPI-M members agreed that several different combinations of factors as part of relaxation of BSIs could easily lead to an R of approximately 1.5-1.7. This could be any mix of non-essential retail and more people returning to work, or minimal school reopening with extensive increase in leisure contacts.

Estimates of R in the community may have been as low as 0.5-0.6. Under the assumption that a second lockdown would have lower adherence than the first, a higher R of 0.7 after reimplementation of BSIs was chosen. An R of below 1 is required after a peak in infections to induce a decrease in the incidence of infections and relieve pressure on the health and care system before any further relaxation of measures might allow a plateauing of cases and R returning to approximately 1.

NOTE 1: The modelling here is appropriate for short-term planning and is based on mitigations designed to suppress the immediate wave. **As ever, there will need to be further detailed discussions around planning beyond the short-term.**

NOTE 2: This modelling has been performed at the national and English region level and does not necessarily reflect the variability that might be observed at a more local level. Care must be taken when applying this scenario and its data to smaller geographies as **there will be significantly more variability at a more local scale**.

Annex A: Sensitivity analyses

In order to observe the impacts of R, modellers performed sensitivity analyses across multiple R values. These scenarios followed similar patterns as the RWCS with slight differences.

In the first of these, **R increased to 2** after BSIs were eased, showing a more pessimistic situation. This might reflect particularly poor adherence from a large proportion of the population to social distancing measures in place at the time. This was thought to be unlikely to happen but could not be ruled out.

Modellers also predicted what would happen if **R increased to 2.4** after social distancing measures were eased. The contact patterns in the models that were necessary to achieve this scenario with some proportion of the population having been exposed to the virus and with some mitigations in place meant this was **not a plausible scenario**.

For these increases in R scenarios, as well as the RWCS, the time **period between the increase in rate of transmission and imposing social distancing measures was four weeks**. This is an estimate of the length of time it takes to see a definitive signal in the epidemiological data, such as hospitalisations and deaths, and to take action to reverse the trend. It is possible that measures could be re-imposed more quickly than this, particularly where such metrics are deteriorating rapidly or other, as yet unavailable, leading indicators could give an earlier signal.

The relaxing and reimplementation of social distancing measures scenario was also run for **R increasing to 1.2**. As this is only a small increase compared to the other sensitivity analyses, **eight weeks** were left for R to run at this level to represent the need for more time to observe the change. This a slight increase over time leads to quite a large increase in the spread of disease and associated hospitalisations, ICU bed occupancy and deaths.

Another scenario where **R increased to 1.7 from 1st July**, rather than 1st June, with the same timescales for relaxation and reimplementation of social distancing measures led to significantly smaller peaks than the RWCS. This is mostly due to the assumed decrease in incidence over the month of June. This means that, as restrictions are lifted, there are assumed to be almost three times fewer infections in the population compared to the same easing a month earlier.

In choosing a RWCS, multiple modelling groups submitted various scenarios. One group appeared to have significantly higher volumes for hospitalisations and deaths compared to the others. This resulted, almost entirely, from their more pessimistic assumptions about the level of incidence at the start of the scenario. Combined with the evidence from R increasing from 1st July, this shows that it is critical to drive incidence as low as possible before relaxing lockdown.

Annex B: RWC Scenario Graphs UK

Figure 1: Number of deaths directly from COVID-19 under RWC planning scenario

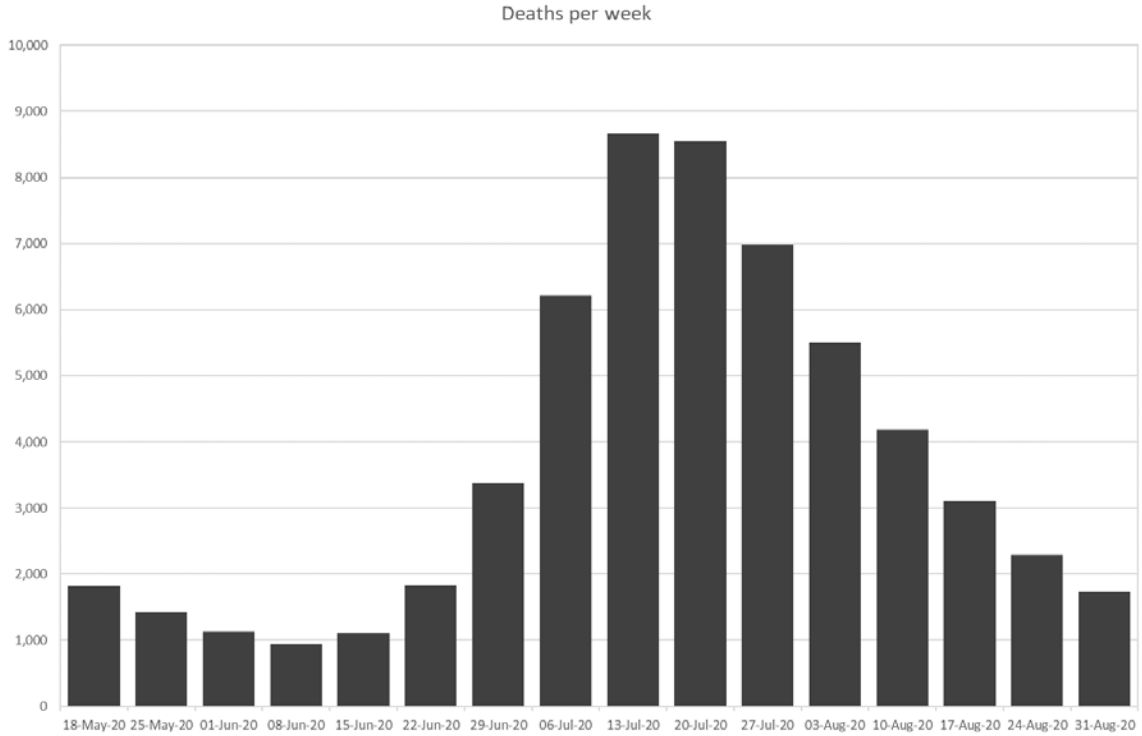


Figure 2: ICU occupancy under RWC planning scenario

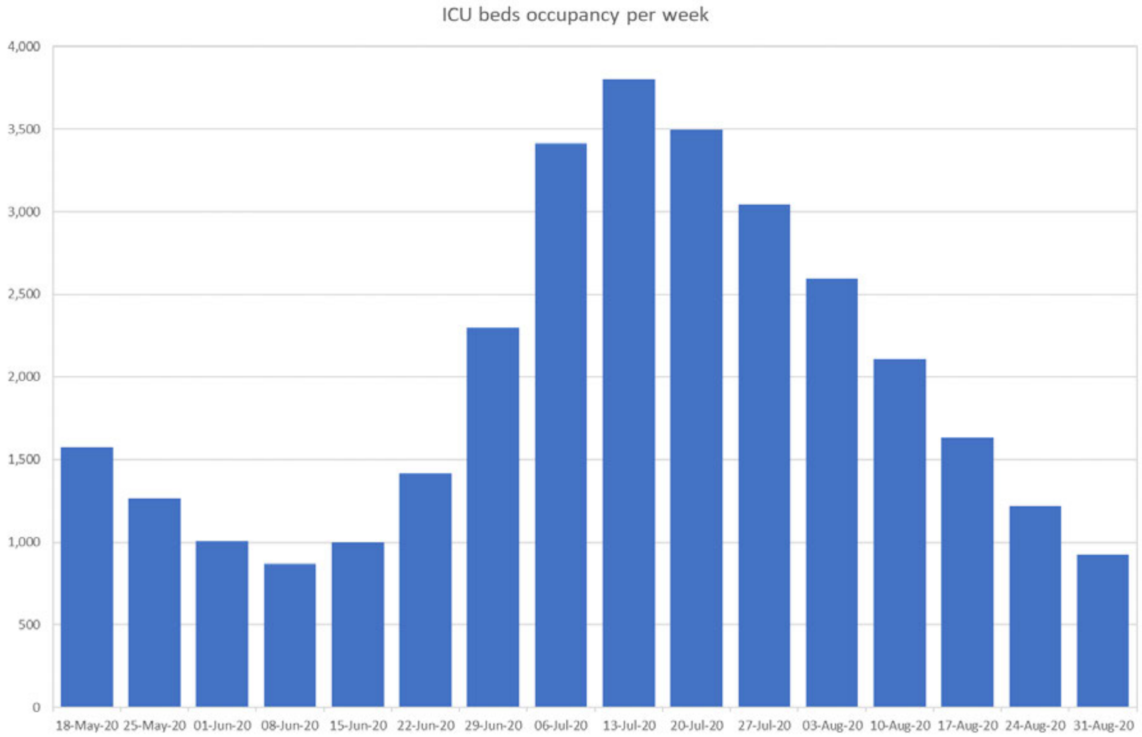


Figure 3: Number of hospital admissions per week under RWC planning scenario

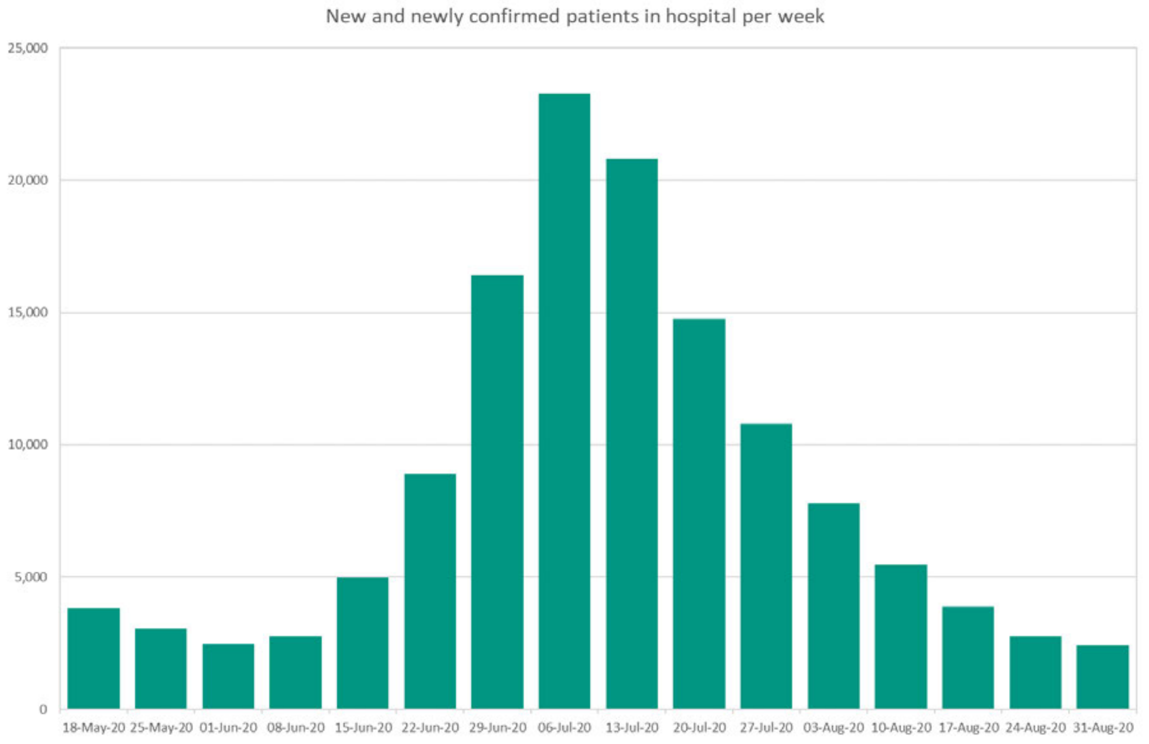
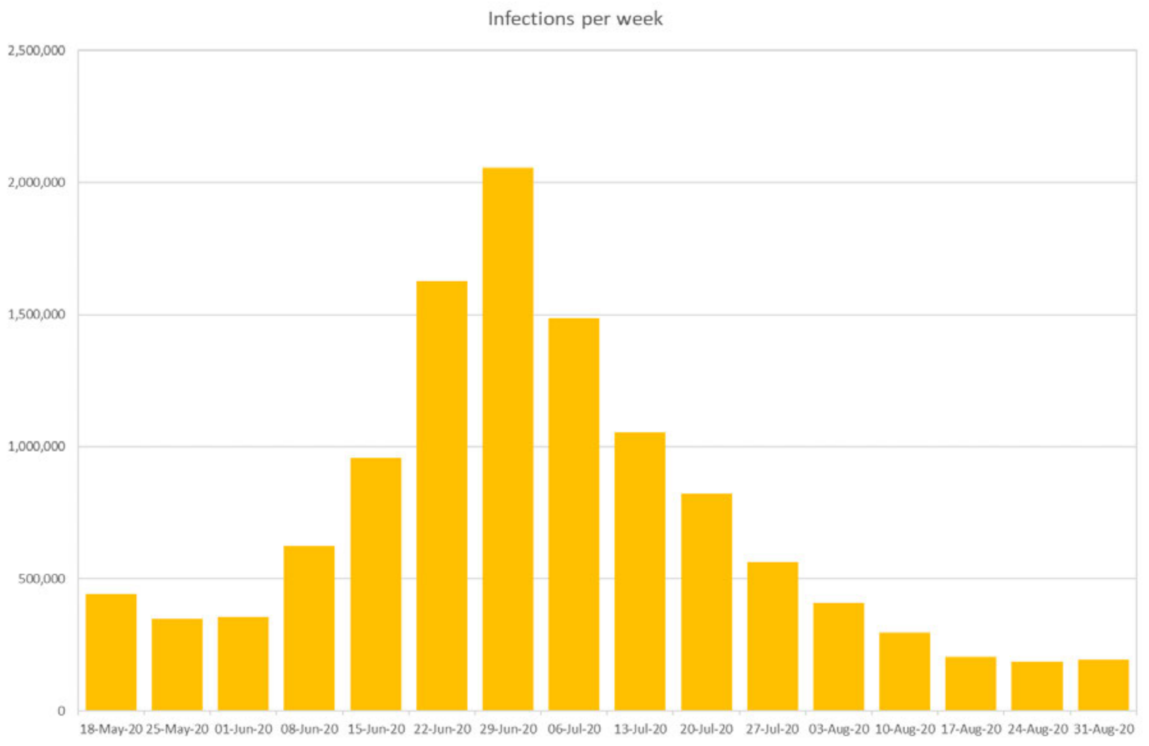


Figure 4: Number of new infections per week under RWC planning scenario



Annex C: RWCS Data Tables – UK

Dates	Deaths	Infections	Hospitalisations	ICU Admissions	ICU Occupancy	Deaths (per 100k)	Infections (per 100k)	Hospitalisations (per 100k)
18 May 20	1.8k	443.2k	3.8k	0.7k	1.6k	3	667.0	5.7
25 May 20	1.4k	349.7k	3.1k	0.5k	1.3k	2	526.4	4.6
01 Jun 20	1.1k	357.6k	2.5k	0.4k	1.0k	2	538.2	3.7
08 Jun 20	0.9k	625.2k	2.8k	0.5k	0.9k	1	941.1	4.2
15 Jun 20	1.1k	955.5k	5.0k	0.8k	1.0k	2	1,438.2	7.5
22 Jun 20	1.8k	1,627.9k	8.9k	1.5k	1.4k	3	2,450.3	13.4
29 Jun 20	3.4k	2,055.2k	16.4k	2.6k	2.3k	5	3,093.5	24.7
06 Jul 20	6.2k	1,487.2k	23.3k	3.1k	3.4k	9	2,238.5	35.1
13 Jul 20	8.7k	1,053.2k	20.8k	2.7k	3.8k	13	1,585.3	31.3
20 Jul 20	8.5k	821.1k	14.8k	2.0k	3.5k	13	1,235.9	22.2
27 Jul 20	7.0k	564.1k	10.8k	1.5k	3.0k	11	849.1	16.3
03 Aug 20	5.5k	407.2k	7.8k	1.1k	2.6k	8	612.9	11.7
10 Aug 20	4.2k	295.5k	5.5k	0.8k	2.1k	6	444.9	8.2
17 Aug 20	3.1k	206.2k	3.9k	0.5k	1.6k	5	310.4	5.8
24 Aug 20	2.3k	186.9k	2.8k	0.4k	1.2k	3	281.3	4.2
31 Aug 20	1.7k	192.5k	2.4k	0.4k	0.9k	3	289.7	3.6

Further data is available for regions and nations in the accompanying spreadsheet