Reasonable Worst-Case Planning Scenario – 29/03/2020

Purpose: To help government departments plan for Covid-19, this document sets out two planning scenarios as agreed by SAGE (Scientific Advisory Group for Emergencies) on 29 March 2020**.** They are a reasonable worst case (RWC) and an optimistic case, both for the whole of the UK. The differences between the scenarios lie in the assumptions made about public compliance with behavioural and social interventions.

It should be noted that **these are scenarios, not predictions**. The precise timings of peaks in infection and demand on healthcare in particular are subject to significant uncertainty.

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 both RWC and optimistic scenarios, deaths, ICU occupancy, hospital admissions and new infections are modelled for a 6-month period. **The modelling assumes that all current mitigations are maintained throughout this time**: the impacts of the lifting of interventions and the nature and timing of any consequent second peak in transmission has not been modelled by SAGE.

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 RWC planning assumptions - 29 March 2020

The table below set out epidemic parameters, based on observed data. These are used to develop planning assumptions for the UK reasonable worst-case scenario (table 2).

Table 1 – Covid-19 RWCS estimates for key epidemic parameters

Epidemic parameters	COVID-19 RWCS estimates
Reproduction number, when unmitigated (the reproduction numbers under each scenario, including mitigations, are given below)	2.8
Doubling time (Time required for the number of infections to double, pre-mitigations. The actual doubling time for each scenario is given below)	3.3 days
Infection fatality rate (the proportion of infected people, including those without symptoms, who would die without mitigations)	1%
Proportion of infected people hospitalised	5%
Fatality rate of hospitalised people	12%
Proportion of hospitalised patients requiring ventilation	30%
Fatality rate for people requiring invasive ventilation	50%
Proportion of cases asymptomatic	33%
Average length of stay in ICU	9.5 days

Table 2 - Key RWCS headlines, based on modelling, to support HMG planning decisions. Please note, these figures would vary in the optimistic scenario.

Number of Direct Covid-19 deaths in a first wave (This does not take into account the number of deaths that could occur due to lack of NHS capacity)	**Wave 1:** 50,000 (to the nearest 1,000, 30th March - Sept 2020) **Weekly direct covid-19 deaths over 2000** for 14 weeks (**Peak 2,700** - nearest 100) **The peak weeks are from start of April with a very slow decline** in the RWC scenario.
Number of cases requiring hospitalisation in a first wave	Wave 1: 260,000 (to the nearest 10,000, 30th March - Sept 2020)
Number of cases requiring ICU admission in a first wave	Wave 1: 66,000 (nearest 1000, 30th March - Sept 2020), peaking at 3,700 admissions per week

Timing

The RWC and optimistic scenarios are based on a mitigated epidemic. The mitigations modelled reflect those in place at the time of writing which are:

- Case isolation
- Voluntary home quarantine
- Closure of schools and universities
- Social distancing for the entire population, including shielding of vulnerable groups.

These policies were enacted on 17th March, barring school closures which began effective from the 23rd March, and social distancing for the entire population is assumed to be concurrent with this. As noted above, for modelling purposes, it is assumed that all **current mitigations are maintained throughout this 6-month period covered by the scenarios.**

Assumptions

The scenarios below make different assumptions about compliance with interventions (i.e. the reduction in the number of contacts between individuals). The values chosen are informed by the full range of observational and survey data now available although there is significant uncertainty as to how this translates into actual number of contacts and therefore transmission.

The **Reasonable Worst-Case Scenario** assumes a poor compliance. The specific assumptions in the modelling are detailed below:

- School closures lead to an increase in contacts within the home by 100%
- Social distancing reduces workplace contacts by 25% and other contacts outside the home by 66%
- 50% of households adhere to household quarantine and 70% of symptomatic cases adhere to case isolation.
- Quarantined households and isolated individual cases reduce contacts outside the household by 75%.
- In combination, these interventions reduce the reproduction number to just below 1.

Also included below is a second **scenario based on good compliance**. This is not the Reasonable Worst-Case Scenario used as the basis for planning but provides a second set of data for context. The “good compliance" scenario assumes:

- School closures lead to an increase in contacts within the home by 50%.
- Social distancing reduces workplace contacts by 50% and other contacts outside the household by 90%
- 75% of households adhere to household quarantine and 70% of symptomatic cases adhere to case isolation.
- Quarantined households and isolated individual cases reduce contacts outside the household by 75%.

In combination, these interventions reduce the reproduction number to approximately 0.6.

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

NOTE 2: One might ask why UK interventions are expected to make our epidemic plateau relatively soon, compared to events in Spain and Italy. There is tentative, emerging evidence that cases have

started to plateau in Spain in recent days. The epidemic in Italy is behaving as multiple epidemics. Some are declining slowly now (e.g. in Lombardy), but others are taking off. There has not been the same uniformity of interventions as modelled here.

RWC Scenario Graphs (Poor Compliance with Behavioural and Social Interventions, BSIs) UK

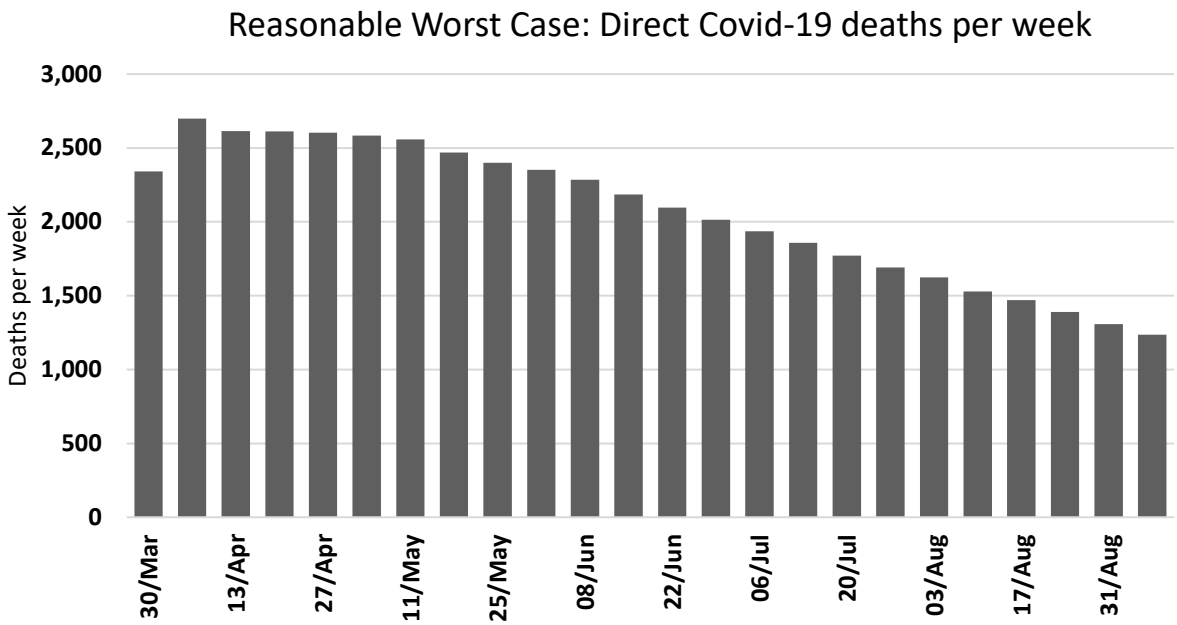

Figure 1 - Number of deaths directly from Covid-19 under RWC planning scenario – (Poor compliance with BSIs)

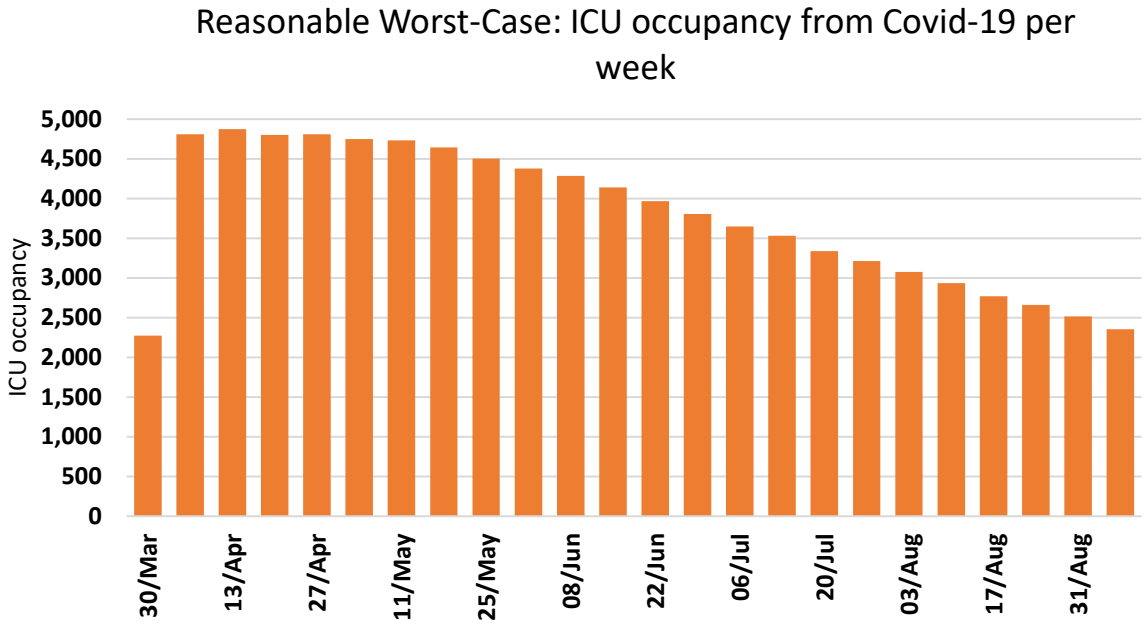

Figure 2 – ICU occupancy by age group under RWC planning scenario – (Poor compliance with BSIs)

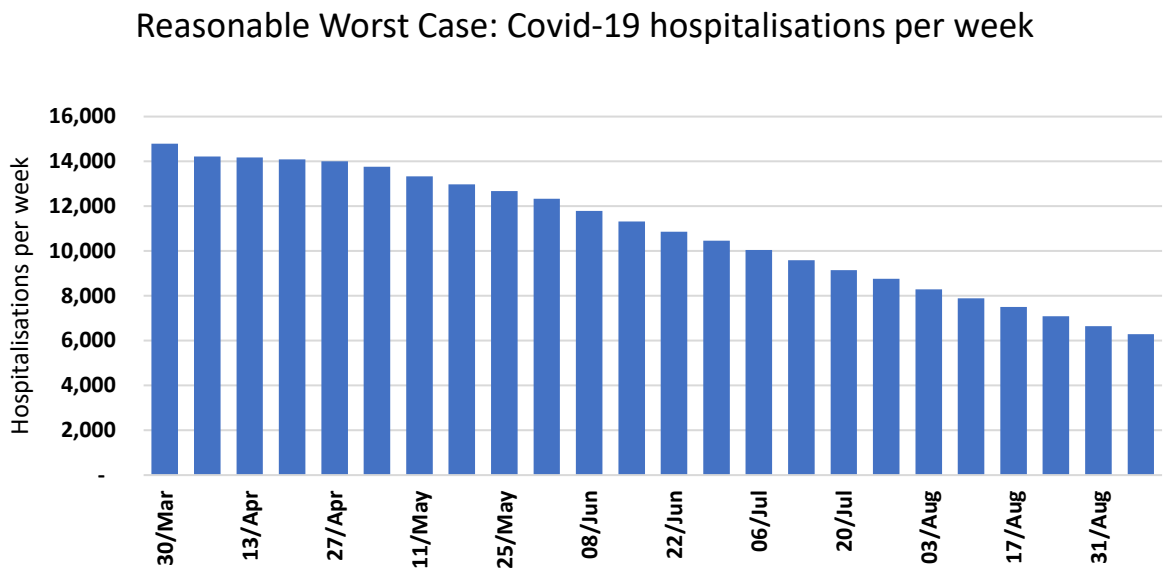

Figure 3 - Number of hospital admissions per week under RWC planning scenario – (Poor compliance with BSIs)

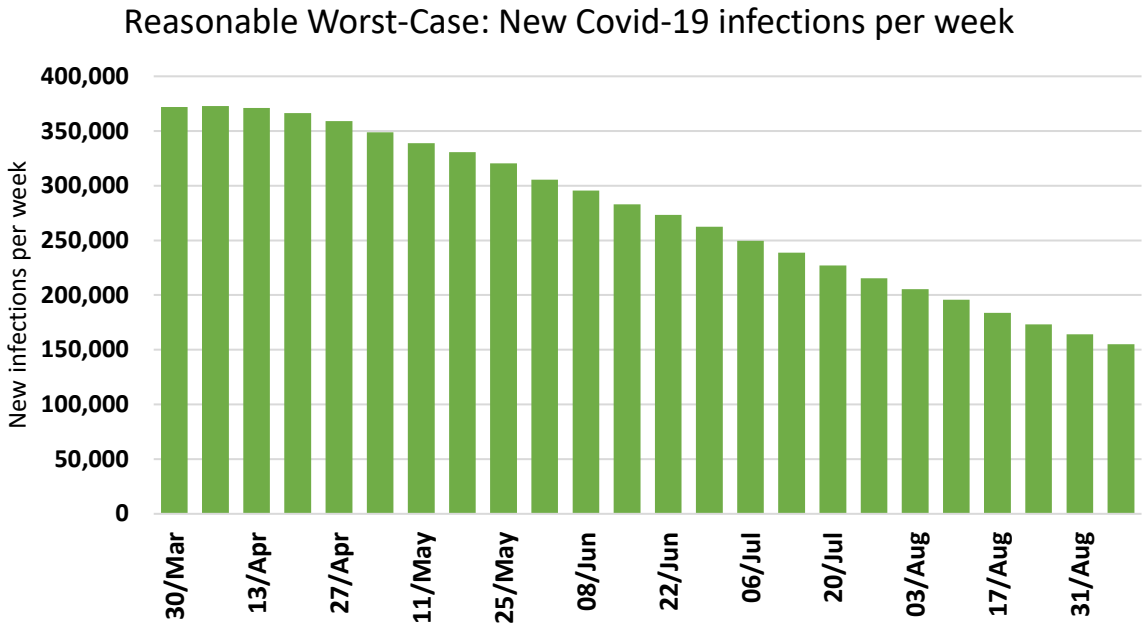

Figure 4 - Number of new infections per week by age group under RWC planning scenario – (Poor compliance with BSIs). ***Note that because behavioural and social interventions reduce the proportion of infected people who are in older age groups, the number of deaths is less than 1% of the number of infections***

RWC Scenario Charts (Good Compliance with BSIs) – UK

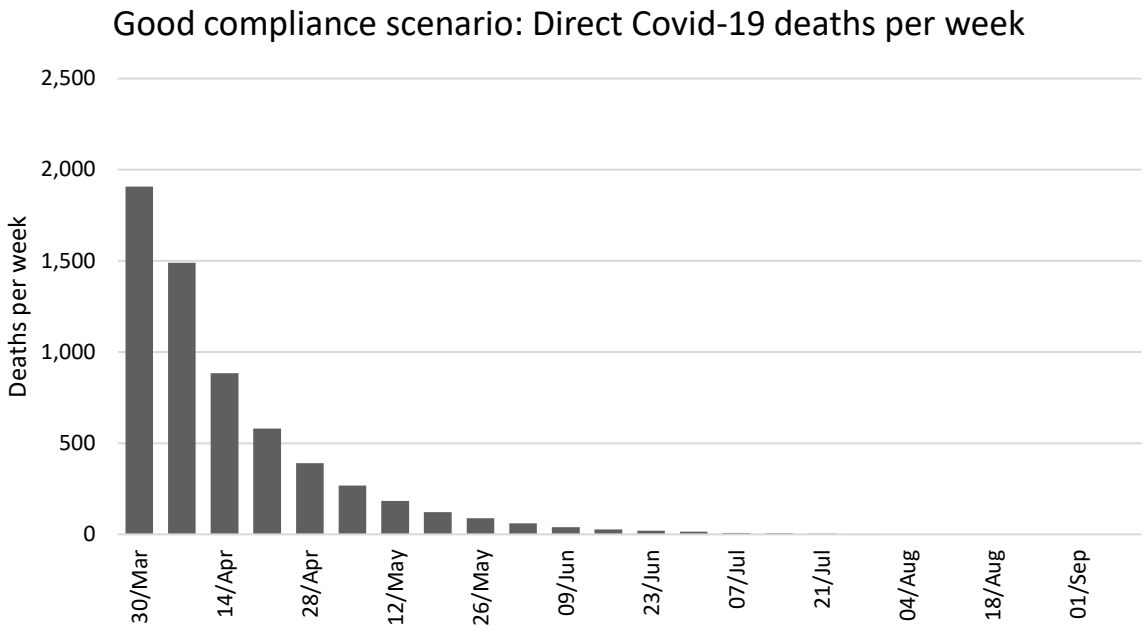

Figure 5 - Number of deaths directly from Covid-19 under good compliance scenario

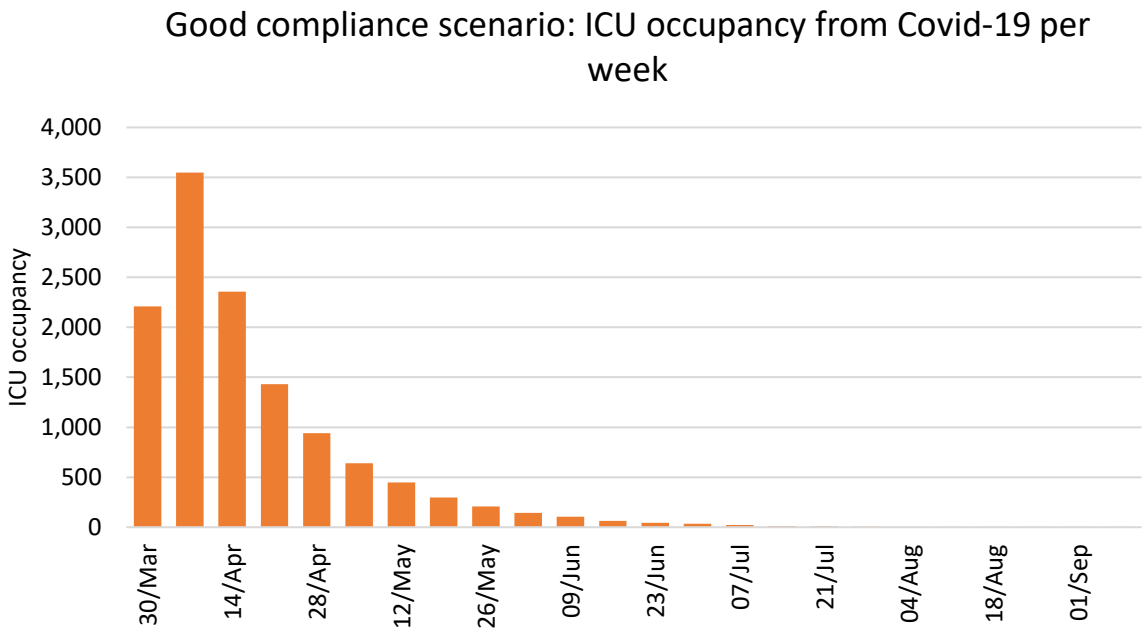

Figure 6- ICU occupancy from Covid-19 under good compliance scenario

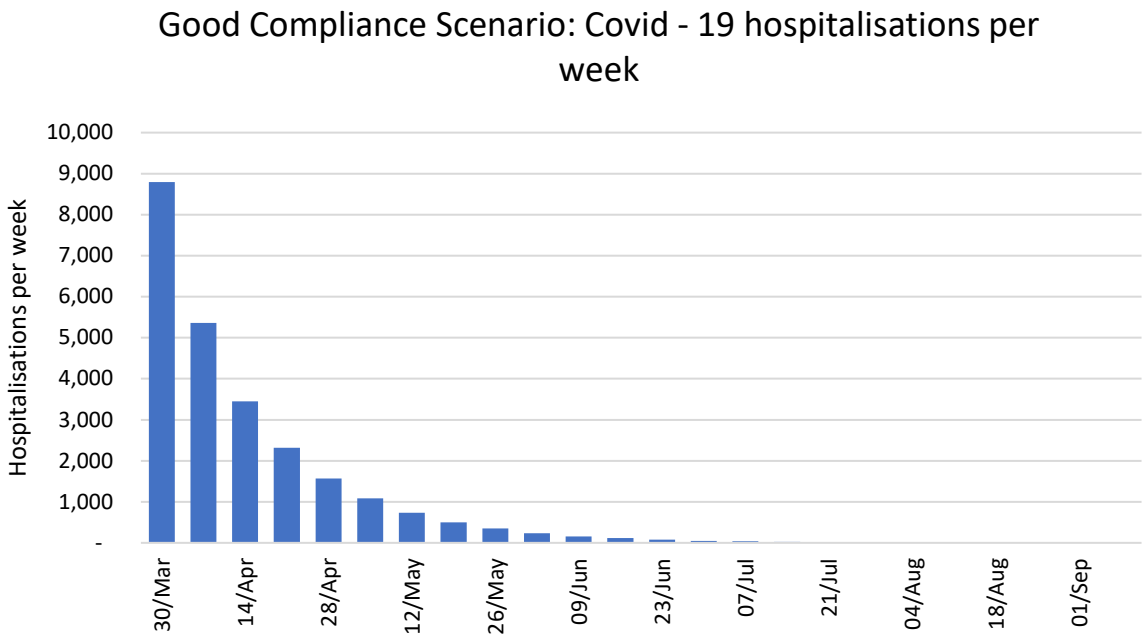

Figure 7- Hospital admissions per week under good compliance scenario

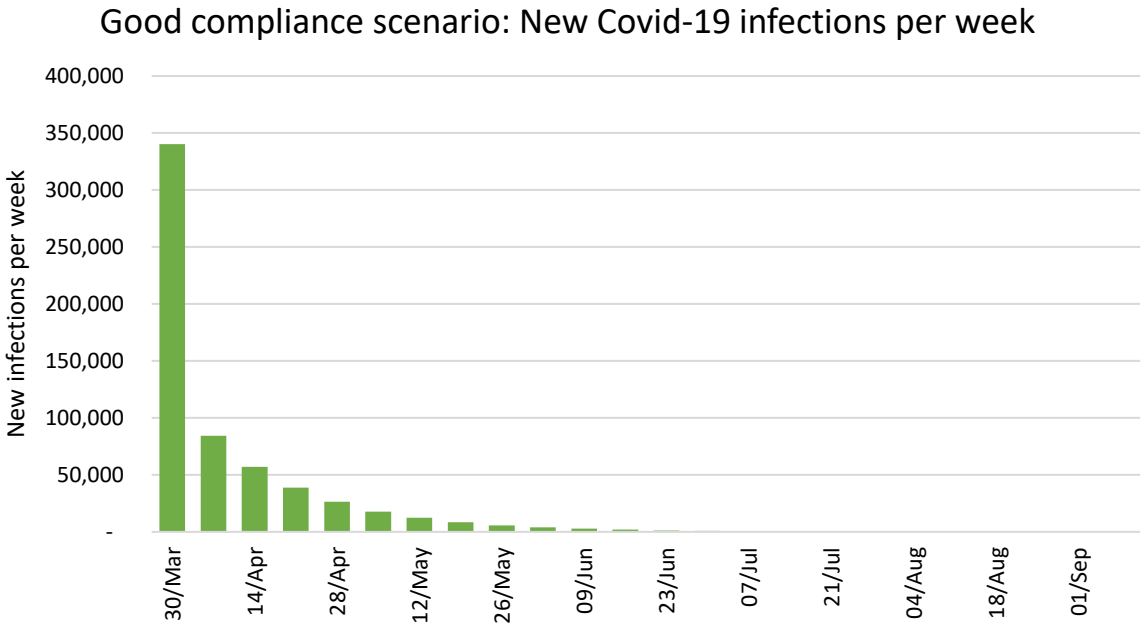

Figure 8 - Number of new infections per week under good compliance scenario. ***Note that because behavioural and social interventions reduce the proportion of infected people who are in older age groups, the number of deaths is less than 1% of the number of infections***

RWC Scenario Data Tables (Poor Compliance with BSIs) – UK

Note that because behavioural and social interventions reduce the proportion of infected people who are in older age groups, the number of deaths is less than 1% of the number of infections.

Dates	Deaths	Infections	Hospitalisations	ICU Admissions	ICU Occupancy	Deaths (per 100k)	Infections (per 100k)	Hospitalisations (per 100k)
30/03/2020	2.3k	371.8k	14.8k	3.7k	2.3k	3.6	551.6	22.2
06/04/2020	2.7k	372.7k	14.2k	3.5k	4.8k	4.1	552.8	21.3
13/04/2020	2.6k	371.0k	14.2k	3.5k	4.9k	4.0	550.3	21.2
20/04/2020	2.6k	366.4k	14.1k	3.5k	4.8k	4.0	543.4	21.1
27/04/2020	2.6k	359.1k	14.0k	3.5k	4.8k	4.0	532.7	21.0
04/05/2020	2.6k	348.7k	13.8k	3.5k	4.8k	3.9	517.3	20.6
11/05/2020	2.6k	338.9k	13.3k	3.4k	4.7k	3.9	502.8	20.0
18/05/2020	2.5k	330.7k	13.0k	3.3k	4.6k	3.7	490.6	19.4
25/05/2020	2.4k	320.6k	12.7k	3.2k	4.5k	3.6	475.5	19.0
01/06/2020	2.4k	305.5k	12.3k	3.1k	4.4k	3.6	453.2	18.5
08/06/2020	2.3k	295.5k	11.8k	3.0k	4.3k	3.5	438.3	17.7
15/06/2020	2.2k	282.9k	11.3k	2.9k	4.1k	3.3	419.7	17.0
22/06/2020	2.1k	273.4k	10.9k	2.7k	4.0k	3.2	405.5	16.3
29/06/2020	2.0k	262.5k	10.5k	2.6k	3.8k	3.1	389.4	15.7
06/07/2020	1.9k	249.5k	10.1k	2.6k	3.6k	2.9	370.1	15.1
13/07/2020	1.9k	238.6k	9.6k	2.4k	3.5k	2.8	354.0	14.4
20/07/2020	1.8k	227.0k	9.1k	2.3k	3.3k	2.7	336.7	13.7
27/07/2020	1.7k	215.3k	8.8k	2.2k	3.2k	2.6	319.3	13.1
03/08/2020	1.6k	205.4k	8.3k	2.1k	3.1k	2.5	304.7	12.4
10/08/2020	1.5k	195.6k	7.9k	2.0k	2.9k	2.3	290.2	11.8
17/08/2020	1.5k	183.8k	7.5k	1.9k	2.8k	2.2	272.7	11.3
24/08/2020	1.4k	173.1k	7.1k	1.8k	2.7k	2.1	256.8	10.6
31/08/2020	1.3k	164.0k	6.7k	1.7k	2.5k	2.0	243.3	10.0

Scenario Data under Good Compliance with BSIs – UK

Note that because behavioural and social interventions reduce the proportion of infected people who are in older age groups, the number of deaths is less than 1% of the number of infections.

Dates	Deaths	Infections	Hospitalisations	ICU Admissions	ICU Occupancy	Deaths (per 100k)	Infections (per 100k)	Hospitalisations (per 100k)
30/03/2020	1.9k	340.1k	8.8k	2.2k	2.2k	2.9	552	13
06/04/2020	1.5k	84.3k	5.4k	1.4k	3.5k	2.3	125	8.0
13/04/2020	0.9k	57.0k	3.4k	0.9k	2.4k	1.3	85	5.2
20/04/2020	0.6k	38.8k	2.3k	0.6k	1.4k	0.9	58	3.5
27/04/2020	0.4k	26.4k	1.6k	0.4k	0.9k	0.6	39	2.4
04/05/2020	0.3k	17.9k	1.1k	0.3k	0.6k	0.4	27	1.6
11/05/2020	0.2k	12.3k	0.7k	0.2k	0.4k	0.3	18	1.1
18/05/2020	0.1k	8.6k	0.5k	0.1k	0.3k	0.2	13	0.7
25/05/2020	0.1k	5.7k	0.4k	0.1k	0.2k	0.1	8	0.5
01/06/2020	0.1k	4.0k	0.2k	0.1k	0.1k	0.1	6	0.3
08/06/2020	0.0k	2.8k	0.2k	0.0k	0.1k	0.1	4	0.2
15/06/2020	0.0k	1.9k	0.1k	0.0k	0.1k	0.0	3	0.2
22/06/2020	0.0k	1.3k	0.1k	0.0k	0.0k	0.0	2	0.1
29/06/2020	0.0k	0.9k	0.0k	0.0k	0.0k	0.0	1	0.1
06/07/2020	0.0k	0.6k	0.0k	0.0k	0.0k	0.0	1	0.1
13/07/2020	0.0k	0.4k	0.0k	0.0k	0.0k	0.0	1	0.0
20/07/2020	0.0k	0.2k	0.0k	0.0k	0.0k	0.0	0	0.0
27/07/2020	0.0k	0.2k	0.0k	0.0k	0.0k	0.0	0	0.0
03/08/2020	0.0k	0.1k	0.0k	0.0k	0.0k	0.0	0	0.0
10/08/2020	0.0k	0.1k	0.0k	0.0k	0.0k	0.0	0	0.0
17/08/2020	0.0k	0.1k	0.0k	0.0k	0.0k	0.0	0	0.0
24/08/2020	0.0k	0.1k	0.0k	0.0k	0.0k	0.0	0	0.0
31/08/2020	0.0k	0.0k	0.0k	0.0k	0.0k	0.0	0	0.0

Annex: Reasonable Worst-Case age dependent severity assumptions

Age band	Proportion of infected people who are hospitalised	Proportion of infected people who die	Proportion of hospitalised people who die
0 to 4	0.1%	0.00%	3.8%
5 to 9	0.1%	0.00%	3.8%
10 to 14	0.1%	0.00%	3.8%
15 to 19	0.2%	0.01%	3.8%
20 to 24	0.5%	0.02%	3.8%
25 to 29	1.0%	0.04%	3.8%
30 to 34	1.6%	0.06%	3.8%
35 to 39	2.3%	0.1%	4.0%
40 to 44	2.9%	0.1%	4.5%
45 to 49	3.9%	0.2%	5.6%
50 to 54	5.8%	0.5%	7.8%
55 to 59	7.2%	0.8%	11.3%
60 to 64	10.2%	1.7%	16.9%
65 to 69	11.7%	2.7%	23.2%
70 to 74	14.6%	4.3%	29.1%
75 to 79	17.7%	6.2%	34.8%
80+	18%	9.6%	53.5%