

UCLH bed needs modelling

Quentin Leclerc, Gwen Knight

Monday 06 April 2020

Contents

1	Model input	1
2	Model principle	2
3	Model output	2
3.1	Summary	3
3.2	Model Limitations	4
3.3	Individual scenario plots and tables	5

1 Model input

- Forecasted COVID19 hospital admissions, taking Pietro/Richard forecasts for 73% / 80% reduction in contact rates (Figure 1)
- Patient pathways
 - 1) intubated (mechanical ventilation) – mean LoS assumption: 14 days in ICU (with 50% mortality), 7 days HDU, 14 days ward bed, then discharge
 - 2) not intubated (non-invasive ventilation/CPAP) – mean LoS assumption: 7 days HDU (with 50% mortality), 10 days ward, then discharge
- Proportion of admissions going in each pathway:
 - 1) 18%
 - 2) 7.5%
- Note: 74.5% of COVID19 admissions are not critical care, and go on another pathway straight to ward beds. This is not yet accounted for in the model.
- Mortality:
 - 1) 50% in ICU, for those admitted straight to ICU. Otherwise they survive to discharge at end of pathway
 - 2) 50% in HDU, for those admitted straight to HDU. Otherwise they survive to discharge at end of pathway

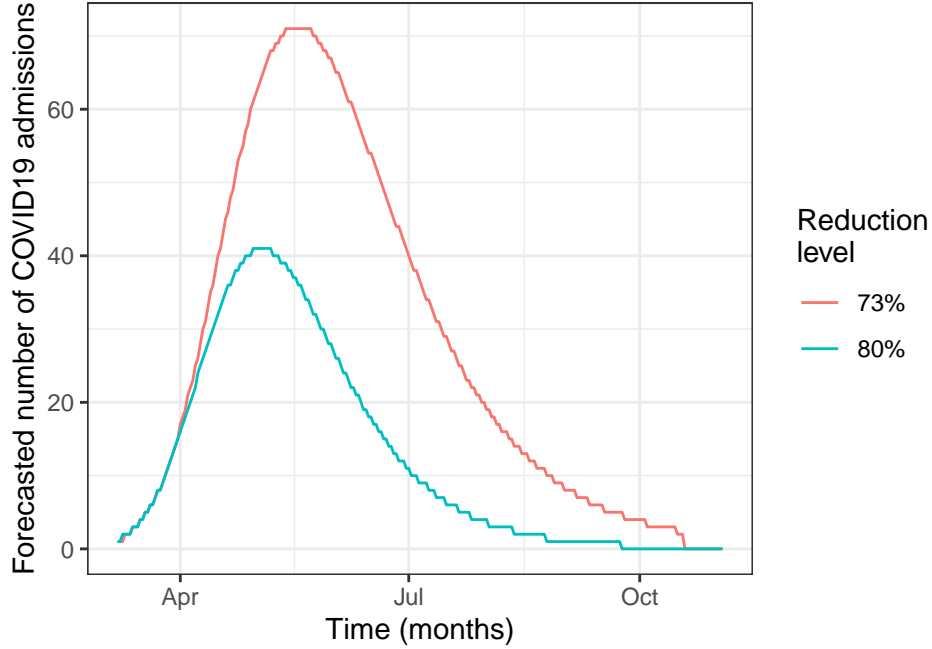


Figure 1: Forecasted daily COVID19 hospital admissions. Scenarios are: 73% reduction in contact rate, and 80% reduction in contact rates.

2 Model principle

This model simulates the next few weeks of the epidemic. Every day, we assume a fixed 25.5% of forecasted COVID19 admissions require critical care. For each admission, we randomly draw the pathway (50-50). The model then simulates the length of stay for each step in the pathway for each patient.

For example, if a patient is admitted on day 1 and goes through pathway 1, we first establish whether that patient dies, based on the mortality in ICU (here, 50%). If the patient dies, we then sample the date of death based from a Poisson distribution with mean 10, and record that a death has occurred at that time, and that an ICU bed will be needed up to that time. If the patient does not die, we randomly draw the length of stay in the ICU bed from a Poisson distribution with mean 14 days. After this duration, the patient moves on to the next step of the pathway.

We repeat the process to draw a length of stay for each remaining step (type of bed occupancy) in turn on the pathway, systematically recording the time interval when a bed will be needed. This allows us to account for the fact that beds are only needed for a limited period of time, and will eventually become available again for other patients.

3 Model output

The model outputs the number of beds that would be needed each day to accommodate all of the admitted critical care COVID19 patients. The model can be run multiple times to provide us a mean and error range for these outputs. The uncertainty presented arises from the stochastic model sampling from distributions in length of stays in each bed type, and from proportions to assign the pathways to each patient.

Results from 500 model runs for each of the 2 scenarios (73%/80% reduction) are presented below in summary Figures 2, 3 and 4, and summary Table 1. More details for each scenario are given in Figures 5 and 6, and Tables 2 and 3.

3.1 Summary

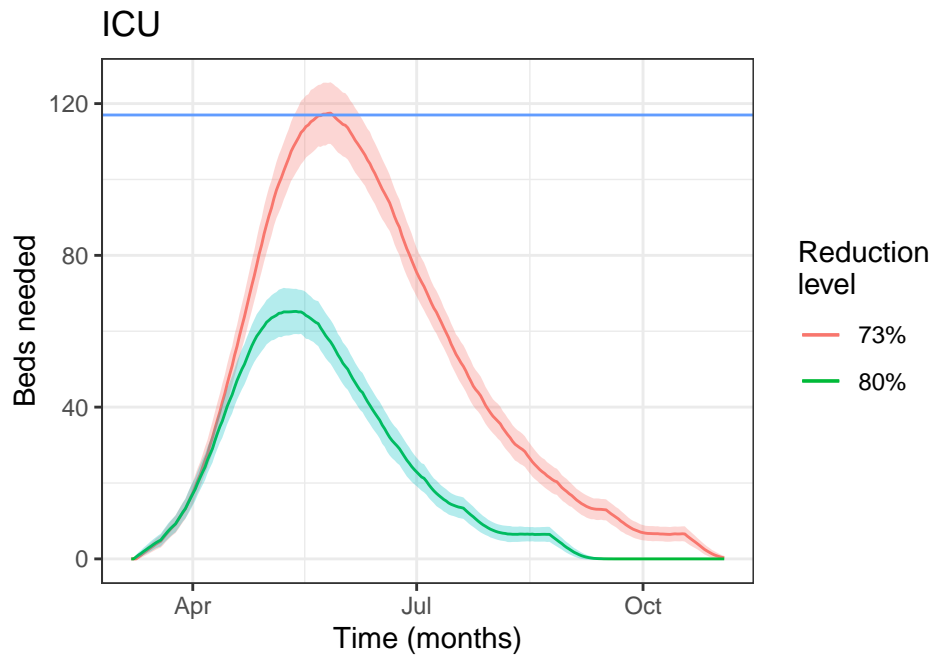


Figure 2: Output ICU bed demand from 500 model runs for the 73% and 80% reduction in contact rates. The horizontal lines represent the current maximum bed capacity. Lines are average daily requirements, shaded area represents average \pm standard deviation.

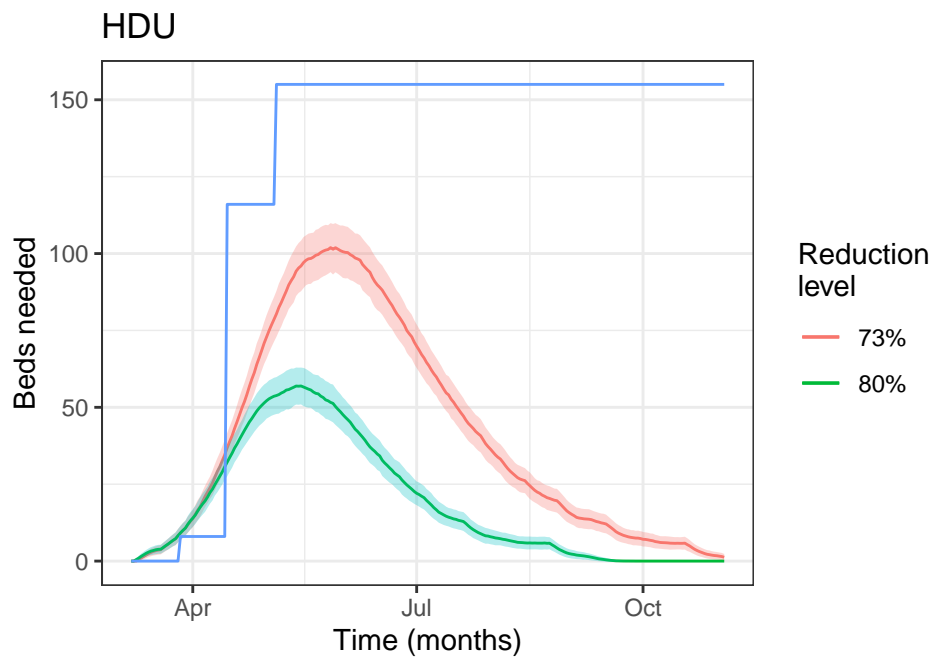


Figure 3: Output HDU bed demand from 500 model runs for the 73% and 80% reduction in contact rates. The horizontal lines represent the current maximum bed capacity. Lines are average requirements, shaded area represents average \pm standard deviation.

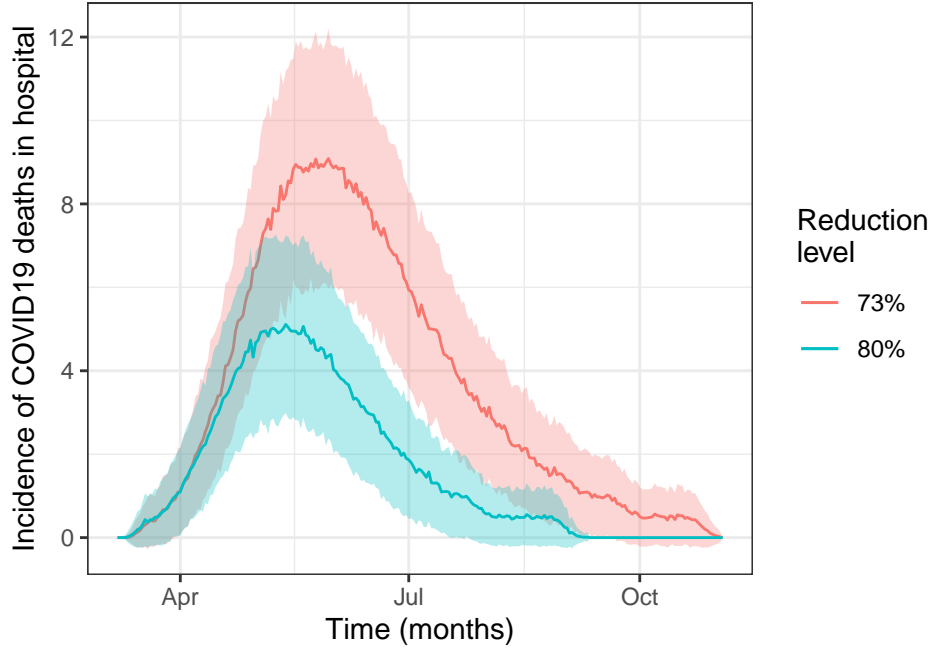


Figure 4: Estimated incidence of mortality in COVID19 hospitalised patients from 500 model runs. Scenarios are: 73% and 80% reduction in contact rates. Lines are average daily incidence, shaded area represents average \pm standard deviation.

Table 1: Summary model output from 500 model runs for all scenarios. Scenarios are: 73% and 80% reduction in contact rates SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions.

Scenario	ICU peak bed needs			HDU peak bed needs			Ward peak bed needs			Cumulative deaths	
	Peak time	Mean beds	SD	Peak time	Mean beds	SD	Peak time	Mean beds	SD	Mean deaths	SD
73% reduction	2020-05-27	117	8	2020-05-27	102	8	2020-06-12	114	10	848	389
80% reduction	2020-05-13	65	6	2020-05-15	57	6	2020-05-26	63	7	387	237

3.2 Model Limitations

- Uncertainty in inputs: using a Poisson distribution for length of stay based on single mean values
- Simple pathways: patients can only follow one of two pathways with fixed length of stay
- Mortality is assumed to be randomly assigned and to occur at the end of the length of stay (may overestimate beds needed?)
- Unlimited bed capacity: this is a prediction of bed need and does not include any competition for beds
- Uncertainty presented reflects only uncertainty in length of stay
- The population is split only by the two pathways - age / co-morbidities are not included
- Simple ward beds are only included for critical care patients, NOT for total COVID19 admissions, since we do not have an estimate of length of stay for patients admitted straight to ward beds

3.3 Individual scenario plots and tables

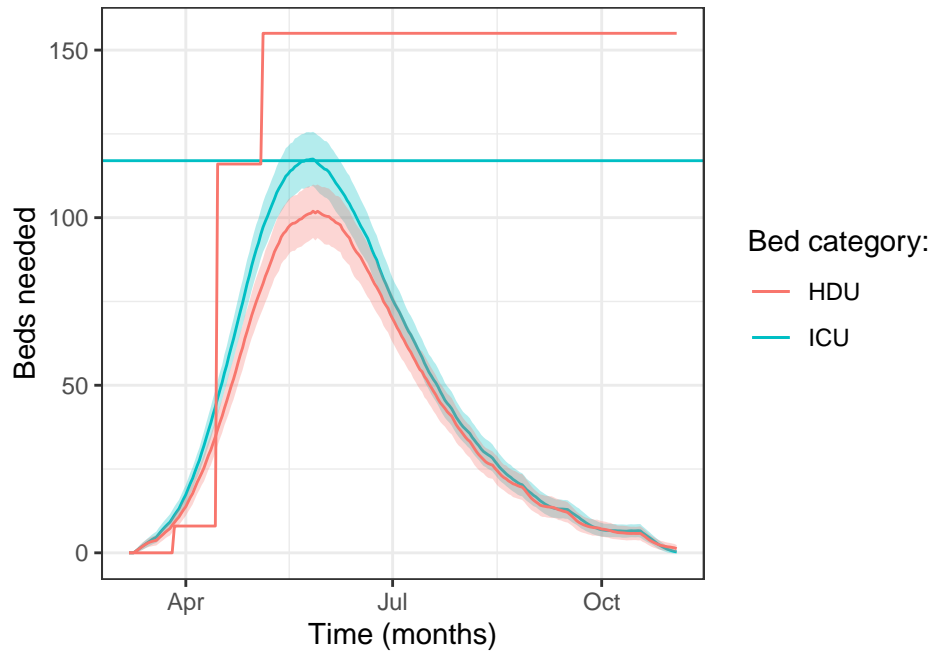


Figure 5: Output from 500 model runs for the 73% reduction scenario. The horizontal lines represent the current maximum bed capacity for the different units. Lines are average daily incidence, shaded area represents average \pm standard deviation.

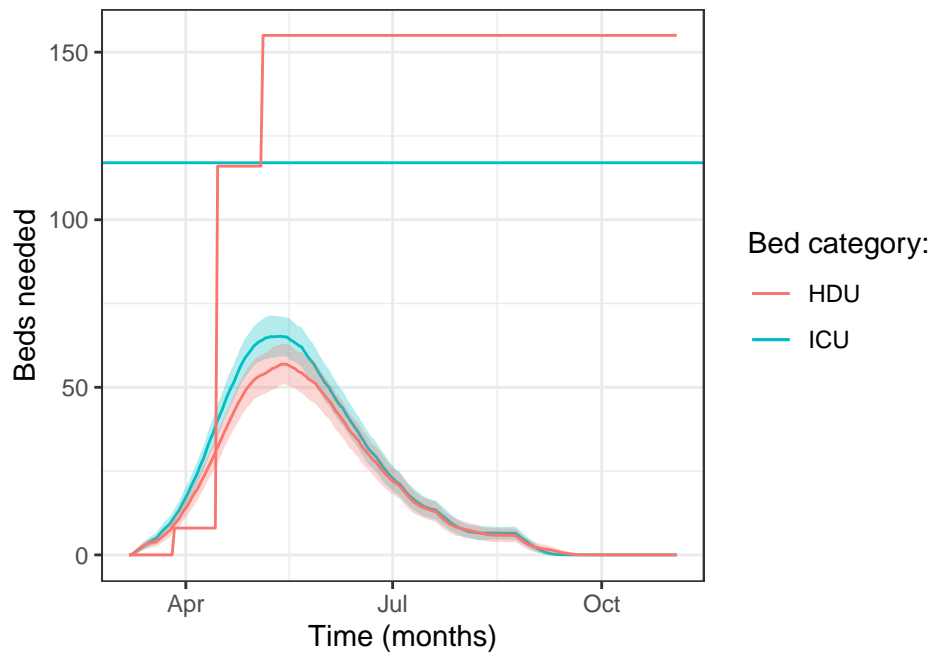


Figure 6: Output from 500 model runs for the 80% reduction scenario. The horizontal lines represent the current maximum bed capacity for the different units. Lines are average daily incidence, shaded area represents average \pm standard deviation.

Table 2: Model output from 500 model runs for the 73% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions.

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-03-07	0	0	0	0	0	0	0	0	0
2020-03-08	0	0	0	0	0	0	0	0	0
2020-03-09	0	0	0	0	0	0	0	0	0
2020-03-10	0	1	1	1	0	0	0	0	1
2020-03-11	1	1	1	1	0	0	0	0	1
2020-03-12	2	1	1	1	0	0	0	0	1
2020-03-13	2	1	2	1	0	0	0	0	1
2020-03-14	2	1	2	1	0	0	0	0	1
2020-03-15	3	1	3	1	0	0	0	0	1
2020-03-16	3	1	3	1	0	1	0	0	1
2020-03-17	4	1	3	1	0	1	0	0	1
2020-03-18	4	2	4	1	1	1	0	1	1
2020-03-19	5	2	4	2	1	1	0	1	1
2020-03-20	5	2	4	2	1	1	0	1	2
2020-03-21	6	2	5	2	1	1	0	1	2
2020-03-22	7	2	6	2	1	1	0	1	2
2020-03-23	8	2	6	2	2	1	1	1	2
2020-03-24	9	2	7	2	2	1	1	1	2
2020-03-25	9	2	7	2	2	1	1	1	2
2020-03-26	10	2	8	2	3	1	1	1	3
2020-03-27	11	3	9	2	3	2	1	1	3
2020-03-28	12	3	10	2	3	2	1	1	3
2020-03-29	13	3	11	2	4	2	1	1	3
2020-03-30	15	3	12	3	4	2	1	1	4
2020-03-31	16	3	13	3	5	2	1	1	4
2020-04-01	17	3	14	3	5	2	1	1	4
2020-04-02	19	3	15	3	6	2	1	1	5
2020-04-03	21	3	17	3	7	2	1	1	5
2020-04-04	22	3	18	3	7	2	1	1	5
2020-04-05	24	3	19	3	8	2	2	1	6
2020-04-06	26	4	21	3	9	3	2	1	6
2020-04-07	28	4	22	4	9	3	2	1	6
2020-04-08	30	4	24	4	10	3	2	1	7
2020-04-09	32	4	25	4	11	3	2	2	7
2020-04-10	34	4	27	4	12	3	2	1	8
2020-04-11	37	5	29	4	14	3	3	2	8
2020-04-12	39	5	31	5	15	4	3	2	8
2020-04-13	41	5	33	5	16	4	3	2	9
2020-04-14	44	5	35	5	17	4	3	2	9
2020-04-15	46	5	37	5	19	4	3	2	10
2020-04-16	49	5	39	5	20	4	3	2	10

Table 2: Model output from 500 model runs for the 73% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions. (*continued*)

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-04-17	51	5	41	5	22	4	3	2	10
2020-04-18	54	6	43	5	23	4	4	2	11
2020-04-19	56	6	45	5	25	5	4	2	11
2020-04-20	59	6	48	6	26	5	4	2	12
2020-04-21	61	6	50	6	28	5	4	2	12
2020-04-22	64	6	52	6	30	5	4	2	12
2020-04-23	67	6	54	6	32	5	5	2	13
2020-04-24	69	6	57	6	34	5	5	2	14
2020-04-25	72	7	59	7	36	6	5	2	14
2020-04-26	75	7	61	7	38	6	5	2	14
2020-04-27	77	7	64	7	40	6	6	2	15
2020-04-28	80	7	66	7	42	6	6	3	15
2020-04-29	83	7	68	7	45	6	6	2	15
2020-04-30	86	7	71	7	47	7	6	2	16
2020-05-01	88	7	73	7	50	7	6	2	16
2020-05-02	90	7	75	7	52	7	7	2	16
2020-05-03	92	7	77	7	54	7	7	3	16
2020-05-04	95	7	79	7	57	7	7	3	17
2020-05-05	97	7	80	7	59	7	7	3	17
2020-05-06	99	8	82	8	61	7	8	3	17
2020-05-07	100	8	84	8	64	8	7	3	17
2020-05-08	102	8	86	8	66	8	8	3	17
2020-05-09	104	8	88	8	69	8	8	3	18
2020-05-10	106	8	90	8	71	8	8	3	18
2020-05-11	107	8	91	8	74	8	8	3	18
2020-05-12	109	8	92	8	76	9	8	3	18
2020-05-13	110	8	94	8	78	9	8	3	18
2020-05-14	111	8	95	8	81	9	9	3	18
2020-05-15	112	8	96	8	83	9	9	3	18
2020-05-16	113	8	97	8	85	9	9	3	18
2020-05-17	114	8	98	8	87	9	9	3	18
2020-05-18	114	8	98	8	90	9	9	3	18
2020-05-19	115	8	98	8	92	9	9	3	18
2020-05-20	116	8	99	8	93	9	9	3	18
2020-05-21	116	8	99	8	96	9	9	3	18
2020-05-22	117	8	100	8	98	9	9	3	18
2020-05-23	117	8	100	8	99	10	9	3	18
2020-05-24	117	8	101	8	101	10	9	3	18
2020-05-25	117	8	101	8	102	9	9	3	18
2020-05-26	117	8	101	8	103	10	9	3	18
2020-05-27	117	8	102	8	105	10	9	3	18
2020-05-28	117	8	101	8	106	9	9	3	17
2020-05-29	116	8	102	8	107	9	9	3	17

Table 2: Model output from 500 model runs for the 73% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions. (*continued*)

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-05-30	116	9	101	8	108	9	9	3	17
2020-05-31	115	8	101	8	109	9	9	3	17
2020-06-01	115	8	101	9	110	9	9	3	17
2020-06-02	114	8	100	8	111	9	9	3	17
2020-06-03	114	8	100	8	112	9	9	3	17
2020-06-04	112	8	100	8	112	9	9	3	16
2020-06-05	111	9	99	8	113	9	9	3	16
2020-06-06	110	9	99	8	113	9	8	3	16
2020-06-07	109	8	98	8	113	9	9	3	16
2020-06-08	108	8	98	8	114	9	8	3	16
2020-06-09	107	8	96	8	114	9	8	3	15
2020-06-10	106	8	96	8	114	10	8	3	15
2020-06-11	105	8	95	8	114	10	8	3	15
2020-06-12	104	8	94	8	114	10	8	3	15
2020-06-13	103	8	92	8	114	10	8	3	14
2020-06-14	102	8	91	8	113	10	8	3	14
2020-06-15	100	8	90	8	113	10	8	3	14
2020-06-16	99	8	89	8	112	10	8	3	14
2020-06-17	97	8	88	8	111	10	7	3	14
2020-06-18	96	8	87	8	111	9	8	3	13
2020-06-19	95	8	86	8	110	10	7	3	13
2020-06-20	94	7	84	8	109	9	7	3	13
2020-06-21	92	7	83	8	108	10	7	2	12
2020-06-22	90	7	82	8	107	9	7	3	12
2020-06-23	89	7	80	8	107	9	7	3	12
2020-06-24	87	7	79	8	105	9	7	3	12
2020-06-25	85	7	78	7	104	9	7	3	11
2020-06-26	83	7	77	7	103	10	7	3	11
2020-06-27	82	7	75	7	102	10	7	3	11
2020-06-28	80	7	74	7	101	10	7	3	11
2020-06-29	79	7	73	7	100	9	6	2	11
2020-06-30	77	7	71	7	98	9	6	2	10
2020-07-01	76	6	70	7	97	9	6	2	10
2020-07-02	74	6	69	7	96	9	6	2	10
2020-07-03	73	6	67	7	95	9	6	2	10
2020-07-04	72	6	66	7	93	9	6	2	10
2020-07-05	70	6	65	7	92	9	5	2	9
2020-07-06	69	6	63	7	91	9	6	2	9
2020-07-07	67	6	62	6	89	9	5	2	9
2020-07-08	66	6	61	6	88	9	5	2	9
2020-07-09	65	6	60	6	86	9	5	2	9
2020-07-10	64	6	58	6	85	9	5	2	8
2020-07-11	62	6	57	6	83	8	5	2	8

Table 2: Model output from 500 model runs for the 73% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions. (*continued*)

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-07-12	61	5	56	6	82	8	5	2	8
2020-07-13	60	5	55	6	80	8	5	2	8
2020-07-14	58	5	54	6	79	8	5	2	8
2020-07-15	57	5	53	6	78	8	4	2	7
2020-07-16	55	5	52	6	76	8	4	2	7
2020-07-17	54	5	50	6	75	8	4	2	7
2020-07-18	53	6	49	6	74	8	4	2	7
2020-07-19	52	5	48	6	72	8	4	2	7
2020-07-20	51	6	47	6	71	8	4	2	7
2020-07-21	50	5	46	6	69	7	4	2	6
2020-07-22	48	5	45	6	68	7	4	2	6
2020-07-23	47	5	44	6	67	7	4	2	6
2020-07-24	46	5	43	5	65	7	4	2	6
2020-07-25	45	5	42	5	64	7	3	2	6
2020-07-26	44	5	41	6	63	7	3	2	6
2020-07-27	43	5	41	5	61	7	3	2	6
2020-07-28	42	5	39	5	60	7	3	2	5
2020-07-29	40	5	38	5	59	7	3	2	5
2020-07-30	39	5	37	5	58	7	3	2	5
2020-07-31	38	5	36	5	57	7	3	2	5
2020-08-01	38	4	35	5	56	7	3	2	5
2020-08-02	37	4	35	5	54	7	3	2	5
2020-08-03	36	5	34	5	53	6	3	2	5
2020-08-04	36	5	33	5	52	6	3	2	5
2020-08-05	34	4	32	5	51	6	3	2	4
2020-08-06	34	5	31	5	50	6	3	2	4
2020-08-07	33	4	30	5	48	6	3	2	4
2020-08-08	32	4	29	5	47	6	3	2	4
2020-08-09	31	4	29	4	46	6	3	1	4
2020-08-10	30	4	28	4	45	6	2	1	4
2020-08-11	30	4	27	4	43	6	2	1	4
2020-08-12	29	4	27	4	42	6	2	1	4
2020-08-13	29	4	26	4	41	6	2	1	4
2020-08-14	28	4	26	4	40	6	2	1	4
2020-08-15	27	4	25	4	39	6	2	1	3
2020-08-16	26	4	25	4	38	6	2	1	3
2020-08-17	26	4	24	4	37	6	2	1	3
2020-08-18	25	4	23	4	37	6	2	1	3
2020-08-19	24	4	22	4	35	6	2	1	3
2020-08-20	24	4	22	4	35	5	2	1	3
2020-08-21	23	4	21	4	34	5	2	1	3
2020-08-22	23	4	21	4	33	5	2	1	3
2020-08-23	22	4	21	4	32	5	2	1	3

Table 2: Model output from 500 model runs for the 73% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions. (*continued*)

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-08-24	21	4	20	4	32	5	2	1	3
2020-08-25	21	4	20	4	31	5	2	1	3
2020-08-26	21	4	20	4	30	5	1	1	3
2020-08-27	20	3	20	4	30	5	2	1	3
2020-08-28	20	3	19	4	29	5	2	1	2
2020-08-29	19	3	18	4	28	5	2	1	2
2020-08-30	18	3	17	4	28	5	2	1	2
2020-08-31	18	3	16	4	27	5	2	1	2
2020-09-01	17	3	16	3	26	5	1	1	2
2020-09-02	17	3	15	3	26	5	1	1	2
2020-09-03	16	3	15	3	25	5	1	1	2
2020-09-04	16	3	14	3	25	5	1	1	2
2020-09-05	15	3	14	3	24	4	1	1	2
2020-09-06	15	3	14	3	23	4	1	1	2
2020-09-07	14	3	14	3	23	4	1	1	2
2020-09-08	14	3	14	3	22	4	1	1	2
2020-09-09	14	3	14	3	21	4	1	1	2
2020-09-10	13	3	13	3	20	4	1	1	2
2020-09-11	13	3	13	3	20	4	1	1	2
2020-09-12	13	3	13	3	19	4	1	1	2
2020-09-13	13	3	13	3	19	4	1	1	2
2020-09-14	13	3	12	3	19	4	1	1	2
2020-09-15	13	3	12	3	18	4	1	1	2
2020-09-16	13	3	12	3	18	4	1	1	2
2020-09-17	12	3	11	3	17	4	1	1	1
2020-09-18	12	3	11	3	17	4	1	1	1
2020-09-19	11	3	10	3	17	4	1	1	1
2020-09-20	11	3	10	3	16	4	1	1	1
2020-09-21	11	3	9	3	16	4	1	1	1
2020-09-22	10	3	9	3	16	4	1	1	1
2020-09-23	10	3	8	2	15	4	1	1	1
2020-09-24	9	3	8	2	15	3	1	1	1
2020-09-25	9	2	8	2	14	3	1	1	1
2020-09-26	8	2	8	2	14	3	1	1	1
2020-09-27	8	2	8	2	13	3	1	1	1
2020-09-28	8	2	7	2	13	3	1	1	1
2020-09-29	7	2	7	2	13	3	1	1	1
2020-09-30	7	2	7	2	12	3	1	1	1
2020-10-01	7	2	7	2	12	3	1	1	1
2020-10-02	7	2	7	2	11	3	0	1	1
2020-10-03	7	2	7	2	11	3	0	1	1
2020-10-04	7	2	7	2	11	3	0	1	1
2020-10-05	7	2	7	2	11	3	0	1	1

Table 2: Model output from 500 model runs for the 73% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions. (*continued*)

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-10-06	7	2	6	2	10	3	0	1	1
2020-10-07	7	2	6	2	10	3	1	1	1
2020-10-08	7	2	6	2	10	3	1	1	1
2020-10-09	7	2	6	2	9	3	1	1	1
2020-10-10	7	2	6	2	9	3	0	1	1
2020-10-11	6	2	6	2	9	3	0	1	1
2020-10-12	6	2	6	2	9	3	0	1	1
2020-10-13	7	2	6	2	9	3	1	1	1
2020-10-14	7	2	6	2	8	3	1	1	1
2020-10-15	7	2	6	2	8	3	0	1	1
2020-10-16	7	2	6	2	8	3	1	1	1
2020-10-17	7	2	6	2	8	3	1	1	1
2020-10-18	7	2	6	2	8	3	1	1	1
2020-10-19	6	2	5	2	8	2	0	1	0
2020-10-20	6	2	5	2	7	2	0	1	0
2020-10-21	5	2	4	2	7	2	0	1	0
2020-10-22	5	2	4	2	7	3	0	1	0
2020-10-23	4	2	3	2	7	3	0	1	0
2020-10-24	4	1	3	2	7	2	0	1	0
2020-10-25	3	1	3	1	7	2	0	1	0
2020-10-26	2	1	2	1	6	2	0	0	0
2020-10-27	2	1	2	1	6	2	0	0	0
2020-10-28	2	1	2	1	6	2	0	0	0
2020-10-29	1	1	2	1	6	2	0	0	0
2020-10-30	1	1	2	1	6	2	0	0	0
2020-10-31	1	1	2	1	5	2	0	0	0
2020-11-01	1	1	2	1	5	2	0	0	0
2020-11-02	0	1	1	1	5	2	0	0	0
2020-11-03	0	1	1	1	4	2	0	0	0

Table 3: Model output from 500 model runs for the 80% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions.

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-03-07	0	0	0	0	0	0	0	0	0
2020-03-08	0	0	0	0	0	0	0	0	0
2020-03-09	1	0	0	0	0	0	0	0	1
2020-03-10	1	1	1	1	0	0	0	0	1

Table 3: Model output from 500 model runs for the 80% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions. (*continued*)

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-03-11	1	1	2	1	0	0	0	0	1
2020-03-12	2	1	2	1	0	0	0	0	1
2020-03-13	2	1	3	1	0	0	0	0	1
2020-03-14	3	1	3	1	0	0	0	0	1
2020-03-15	3	1	3	1	0	0	0	0	1
2020-03-16	4	1	3	1	0	1	0	0	1
2020-03-17	4	1	4	1	1	1	0	1	1
2020-03-18	5	2	4	1	1	1	0	1	1
2020-03-19	5	2	4	1	1	1	0	1	1
2020-03-20	6	2	4	2	1	1	0	1	2
2020-03-21	7	2	5	2	1	1	0	1	2
2020-03-22	7	2	6	2	2	1	0	1	2
2020-03-23	8	2	6	2	2	1	0	1	2
2020-03-24	9	2	7	2	2	1	1	1	2
2020-03-25	9	2	7	2	2	1	1	1	2
2020-03-26	10	2	8	2	3	2	1	1	3
2020-03-27	11	2	9	2	3	2	1	1	3
2020-03-28	12	2	10	2	4	2	1	1	3
2020-03-29	13	3	11	2	4	2	1	1	3
2020-03-30	15	3	12	3	4	2	1	1	4
2020-03-31	16	3	13	3	5	2	1	1	4
2020-04-01	17	3	14	3	5	2	1	1	4
2020-04-02	18	3	15	3	6	2	1	1	4
2020-04-03	20	3	16	3	6	2	1	1	5
2020-04-04	21	3	17	3	7	2	1	1	5
2020-04-05	23	3	19	3	8	2	2	1	5
2020-04-06	24	3	20	4	9	3	2	1	5
2020-04-07	26	4	21	3	9	3	2	1	6
2020-04-08	28	4	22	4	10	3	2	1	6
2020-04-09	29	4	23	4	11	3	2	1	6
2020-04-10	31	4	25	4	12	3	2	2	7
2020-04-11	33	4	26	4	13	3	2	1	7
2020-04-12	35	4	28	4	14	3	2	2	7
2020-04-13	36	4	29	4	16	4	3	2	7
2020-04-14	38	5	31	4	17	4	3	2	8
2020-04-15	40	5	32	5	18	4	3	2	8
2020-04-16	42	5	34	5	19	4	3	2	8
2020-04-17	43	5	35	5	20	4	3	2	8
2020-04-18	45	5	37	5	21	4	3	2	9
2020-04-19	47	5	38	5	23	4	3	2	9
2020-04-20	49	5	40	5	24	4	3	2	9
2020-04-21	50	5	41	5	25	5	4	2	9
2020-04-22	51	5	42	5	27	5	4	2	9

Table 3: Model output from 500 model runs for the 80% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions. (*continued*)

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-04-23	53	5	44	5	29	5	4	2	10
2020-04-24	55	5	45	6	30	5	4	2	10
2020-04-25	56	6	46	5	32	5	4	2	10
2020-04-26	57	6	48	6	33	5	4	2	10
2020-04-27	59	6	49	6	35	5	4	2	10
2020-04-28	60	6	50	6	36	5	4	2	10
2020-04-29	61	6	51	6	38	5	5	2	10
2020-04-30	61	6	51	6	40	6	4	2	10
2020-05-01	62	6	52	6	41	6	5	2	10
2020-05-02	63	6	53	6	43	6	5	2	10
2020-05-03	64	6	53	6	45	6	5	2	10
2020-05-04	64	6	54	6	46	6	5	2	10
2020-05-05	64	6	54	6	48	6	5	2	10
2020-05-06	65	6	54	6	49	6	5	2	10
2020-05-07	65	6	55	6	50	6	5	2	10
2020-05-08	65	6	55	6	51	6	5	2	10
2020-05-09	65	6	56	6	53	7	5	2	10
2020-05-10	65	6	56	6	54	7	5	2	10
2020-05-11	65	6	56	6	55	7	5	2	10
2020-05-12	65	6	57	6	55	7	5	2	10
2020-05-13	65	6	57	6	57	7	5	2	10
2020-05-14	65	6	57	6	57	7	5	2	10
2020-05-15	65	6	57	6	58	7	5	2	10
2020-05-16	65	6	57	6	59	7	5	2	9
2020-05-17	64	6	56	6	59	7	5	2	9
2020-05-18	64	6	56	6	60	7	5	2	9
2020-05-19	63	6	56	6	60	7	5	2	9
2020-05-20	63	6	55	6	61	7	5	2	9
2020-05-21	62	6	55	6	61	7	5	2	9
2020-05-22	62	6	54	6	62	7	5	2	9
2020-05-23	61	6	54	6	62	7	5	2	8
2020-05-24	60	6	53	6	63	7	5	2	8
2020-05-25	59	6	52	6	63	7	5	2	8
2020-05-26	58	6	52	6	63	7	4	2	8
2020-05-27	57	6	52	6	63	7	5	2	8
2020-05-28	56	6	51	6	63	7	5	2	8
2020-05-29	55	6	50	6	63	7	4	2	7
2020-05-30	54	6	49	6	62	7	4	2	7
2020-05-31	53	6	49	6	62	7	4	2	7
2020-06-01	52	5	48	6	62	7	4	2	7
2020-06-02	51	6	47	6	62	7	4	2	7
2020-06-03	50	5	46	5	61	7	4	2	7
2020-06-04	49	5	45	5	61	7	4	2	6

Table 3: Model output from 500 model runs for the 80% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions. (*continued*)

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-06-05	48	5	44	6	60	7	4	2	6
2020-06-06	46	5	43	5	60	7	4	2	6
2020-06-07	45	5	42	6	59	7	4	2	6
2020-06-08	44	5	41	5	58	7	4	2	6
2020-06-09	44	5	40	5	58	7	3	2	6
2020-06-10	43	5	39	5	57	6	3	2	5
2020-06-11	41	5	38	5	56	7	3	2	5
2020-06-12	40	5	37	5	55	6	3	2	5
2020-06-13	39	5	36	5	54	7	3	2	5
2020-06-14	38	5	36	5	54	7	3	2	5
2020-06-15	37	5	35	5	53	7	3	2	5
2020-06-16	37	5	34	5	52	7	3	2	5
2020-06-17	35	5	33	5	51	7	3	2	4
2020-06-18	34	5	32	5	50	7	3	2	4
2020-06-19	33	5	31	5	49	7	3	2	4
2020-06-20	32	5	30	5	47	6	2	2	4
2020-06-21	31	5	30	5	46	6	3	2	4
2020-06-22	30	5	29	4	45	6	2	2	4
2020-06-23	30	5	28	5	45	6	2	1	4
2020-06-24	29	4	27	5	44	6	2	2	4
2020-06-25	28	4	26	5	43	6	2	1	3
2020-06-26	27	4	26	5	42	6	2	1	3
2020-06-27	26	4	25	4	41	6	2	1	3
2020-06-28	25	4	24	4	40	6	2	1	3
2020-06-29	24	4	23	4	39	6	2	2	3
2020-06-30	24	4	23	4	38	6	2	1	3
2020-07-01	23	4	22	4	37	6	2	1	3
2020-07-02	22	4	22	4	36	5	2	1	3
2020-07-03	22	4	21	4	35	6	2	1	3
2020-07-04	21	4	21	4	34	5	2	1	3
2020-07-05	20	4	20	4	33	5	2	1	2
2020-07-06	20	3	19	4	32	5	2	1	2
2020-07-07	19	3	18	4	31	5	2	1	2
2020-07-08	18	3	17	4	30	5	1	1	2
2020-07-09	17	3	17	3	30	5	2	1	2
2020-07-10	17	3	16	3	29	5	1	1	2
2020-07-11	16	3	15	3	28	5	1	1	2
2020-07-12	16	3	15	3	27	5	1	1	2
2020-07-13	15	3	15	3	26	5	1	1	2
2020-07-14	15	3	14	3	25	5	1	1	2
2020-07-15	14	3	14	3	25	5	1	1	2
2020-07-16	14	3	14	3	24	4	1	1	2
2020-07-17	14	3	14	3	23	4	1	1	2

Table 3: Model output from 500 model runs for the 80% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions. (*continued*)

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-07-18	14	3	13	3	22	4	1	1	2
2020-07-19	14	3	13	3	21	4	1	1	2
2020-07-20	13	3	13	3	21	4	1	1	2
2020-07-21	13	3	12	3	20	4	1	1	1
2020-07-22	12	3	11	3	20	4	1	1	1
2020-07-23	12	3	11	3	19	4	1	1	1
2020-07-24	11	3	10	3	19	4	1	1	1
2020-07-25	11	3	10	3	18	4	1	1	1
2020-07-26	10	3	9	3	17	4	1	1	1
2020-07-27	9	2	9	3	17	4	1	1	1
2020-07-28	9	2	9	3	16	4	1	1	1
2020-07-29	9	2	8	3	16	4	1	1	1
2020-07-30	8	2	8	2	15	4	1	1	1
2020-07-31	8	2	8	2	15	4	1	1	1
2020-08-01	8	2	8	2	14	3	1	1	1
2020-08-02	7	2	8	2	14	3	1	1	1
2020-08-03	7	2	7	2	13	3	1	1	1
2020-08-04	7	2	7	2	13	3	0	1	1
2020-08-05	7	2	7	2	12	3	0	1	1
2020-08-06	7	2	7	2	12	3	1	1	1
2020-08-07	7	2	7	2	11	3	0	1	1
2020-08-08	7	2	7	2	11	3	0	1	1
2020-08-09	6	2	6	2	11	3	1	1	1
2020-08-10	6	2	6	2	11	3	1	1	1
2020-08-11	6	2	6	2	10	3	0	1	1
2020-08-12	7	2	6	2	10	3	0	1	1
2020-08-13	7	2	6	2	10	3	1	1	1
2020-08-14	6	2	6	2	9	3	0	1	1
2020-08-15	7	2	6	2	9	3	0	1	1
2020-08-16	6	2	6	2	9	3	0	1	1
2020-08-17	7	2	6	2	9	3	1	1	1
2020-08-18	6	2	6	2	9	3	1	1	1
2020-08-19	6	2	6	2	8	3	0	1	1
2020-08-20	6	2	6	2	8	3	0	1	1
2020-08-21	6	2	6	2	8	2	1	1	1
2020-08-22	6	2	6	2	8	2	0	1	1
2020-08-23	6	2	6	2	7	3	0	1	1
2020-08-24	6	2	6	2	7	3	1	1	1
2020-08-25	6	2	5	2	7	3	0	1	0
2020-08-26	5	2	5	2	7	2	0	1	0
2020-08-27	5	2	4	2	7	2	1	1	0
2020-08-28	4	2	4	2	7	2	0	1	0
2020-08-29	4	2	3	2	7	2	0	1	0

Table 3: Model output from 500 model runs for the 80% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions. (*continued*)

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-08-30	3	1	3	2	7	2	0	1	0
2020-08-31	3	1	3	1	6	2	0	1	0
2020-09-01	3	1	2	1	6	2	0	0	0
2020-09-02	2	1	2	1	6	2	0	0	0
2020-09-03	2	1	2	1	6	2	0	0	0
2020-09-04	1	1	2	1	6	2	0	0	0
2020-09-05	1	1	2	1	5	2	0	0	0
2020-09-06	1	1	2	1	5	2	0	0	0
2020-09-07	1	1	2	1	5	2	0	0	0
2020-09-08	0	1	2	1	5	2	0	0	0
2020-09-09	0	1	1	1	4	2	0	0	0
2020-09-10	0	0	1	1	4	2	0	0	0
2020-09-11	0	0	1	1	4	2	0	0	0
2020-09-12	0	0	1	1	4	2	0	0	0
2020-09-13	0	0	1	1	4	2	0	0	0
2020-09-14	0	0	1	1	3	2	0	0	0
2020-09-15	0	0	1	1	3	2	0	0	0
2020-09-16	0	0	0	1	3	2	0	0	0
2020-09-17	0	0	0	1	3	2	0	0	0
2020-09-18	0	0	0	0	3	1	0	0	0
2020-09-19	0	0	0	0	3	1	0	0	0
2020-09-20	0	0	0	0	2	1	0	0	0
2020-09-21	0	0	0	0	2	1	0	0	0
2020-09-22	0	0	0	0	2	1	0	0	0
2020-09-23	0	0	0	0	2	1	0	0	0
2020-09-24	0	0	0	0	1	1	0	0	0
2020-09-25	0	0	0	0	1	1	0	0	0
2020-09-26	0	0	0	0	1	1	0	0	0
2020-09-27	0	0	0	0	1	1	0	0	0
2020-09-28	0	0	0	0	1	1	0	0	0
2020-09-29	0	0	0	0	1	1	0	0	0
2020-09-30	0	0	0	0	1	1	0	0	0
2020-10-01	0	0	0	0	0	1	0	0	0
2020-10-02	0	0	0	0	0	1	0	0	0
2020-10-03	0	0	0	0	0	0	0	0	0
2020-10-04	0	0	0	0	0	0	0	0	0
2020-10-05	0	0	0	0	0	0	0	0	0
2020-10-06	0	0	0	0	0	0	0	0	0
2020-10-07	0	0	0	0	0	0	0	0	0
2020-10-08	0	0	0	0	0	0	0	0	0
2020-10-09	0	0	0	0	0	0	0	0	0
2020-10-10	0	0	0	0	0	0	0	0	0
2020-10-11	0	0	0	0	0	0	0	0	0

Table 3: Model output from 500 model runs for the 80% reduction scenario. SD: standard deviation. Note that ward bed needs only represent the need for critical care patients, NOT the need for total COVID19 admissions. (*continued*)

Date	ICU		HDU		Ward		Deaths		New patients (ICU+HDU)
	Bed needs	SD	Bed needs	SD	Bed needs	SD	Average	SD	
2020-10-12	0	0	0	0	0	0	0	0	0
2020-10-13	0	0	0	0	0	0	0	0	0
2020-10-14	0	0	0	0	0	0	0	0	0
2020-10-15	0	0	0	0	0	0	0	0	0
2020-10-16	0	0	0	0	0	0	0	0	0
2020-10-17	0	0	0	0	0	0	0	0	0
2020-10-18	0	0	0	0	0	0	0	0	0
2020-10-19	0	0	0	0	0	0	0	0	0
2020-10-20	0	0	0	0	0	0	0	0	0
2020-10-21	0	0	0	0	0	0	0	0	0
2020-10-22	0	0	0	0	0	0	0	0	0
2020-10-23	0	0	0	0	0	0	0	0	0
2020-10-24	0	0	0	0	0	0	0	0	0
2020-10-25	0	0	0	0	0	0	0	0	0
2020-10-26	0	0	0	0	0	0	0	0	0
2020-10-27	0	0	0	0	0	0	0	0	0
2020-10-28	0	0	0	0	0	0	0	0	0
2020-10-29	0	0	0	0	0	0	0	0	0
2020-10-30	0	0	0	0	0	0	0	0	0
2020-10-31	0	0	0	0	0	0	0	0	0
2020-11-01	0	0	0	0	0	0	0	0	0
2020-11-02	0	0	0	0	0	0	0	0	0
2020-11-03	0	0	0	0	0	0	0	0	0