USC Schaeffer

Leonard D. Schaeffer Center
for Health Policy & Economics

TECHNICAL APPENDIX:
THE VALUE OF TREATMENT FOR COVID-19

Table A1 provides the main population results (corresponds to Figure 2 in manuscript), and Table A2 shows the cost savings for both treatment scenarios (relative to no treatment) stratified by the under- and over-65 populations.

Table A1. Population Outcomes with Treatment, Q3.2020-2021

Mortality Parameters	Scenario	Total Cases [Symptomatic]	Hospitalizations	Deaths
Mid Mortality	No Treatment	48,685,836 [31,645,793]	1,140,894	170,814
	Scenario 1		855,671	128,111
	Scenario 2		1,140,894	119,570
High Mortality	No Treatment	48,685,836 [31,645,793]	1,140,894	283,946
	Scenario 1		855,671	212,960
	Scenario 2		1,140,894	198,762

Notes: Assumes 35% of cases are asymptomatic, 5% attack rate by July 1, 2020 and 20% attack rate for 2020-2021. Scenario 1 assumes 50% of non-hospitalized symptomatic patients receive a treatment which reduces the probability of hospitalization by 50%. Scenario 2 assumes all hospitalized patients receive a treatment which results in 30% length of stay reduction and 30% reduction in the probability of death.

Table A2. Cost Savings ($, Billions) Relative to No Treatment, Stratified by Age

Mortality	Scenario	Cost Outcome	Main Results	<65 Years Old	65+ Years Old
Mid	Scenario 1	Hospitalization	10.9	7.1	3.8
		Mortality	46.1	14.5	31.5
		Total	56.9	21.6	35.3
	Scenario 2	Hospitalization	13.1	8.5	4.5
		Mortality	55.3	17.5	37.8
		Total	68.4	26.0	42.4
High	Scenario 1	Hospitalization	10.9	7.1	3.8
		Mortality	77.1	25.4	51.8
		Total	87.9	32.4	55.5
	Scenario 2	Hospitalization	13.1	8.5	4.5
		Mortality	92.5	30.4	62.1
		Total	105.6	39.0	66.6

Notes: Assumes 35% of cases are asymptomatic, 5% attack rate by July 1, 2020 and 20% attack rate for 2020-2021. Scenario 1 assumes 50% of non-hospitalized symptomatic patients receive a treatment that reduces the probability of hospitalization by 50%. Scenario 2 assumes all hospitalized patients receive a treatment that results in 30% length of stay reduction and 30% reduction in the probability of death.

Sensitivity Analyses

We conduct one-way sensitivities for the attack rate and asymptomatic share parameters. As expected, total cases are increasing in attack rate (see A3). Total symptomatic cases, hospitalizations, and number of deaths are increasing in attack rate (see Table A3), and decreasing in asymptomatic share (see Table A4).

Table A3. Population Outcomes Without Treatment (2020-2021), Attack Rate Sensitivity

Attack Rate	Total Cases [Symptomatic]	Hospitalizations	Mortality Parameters	Deaths
20%	64,871,200 [42,166,280]	1,520,179	Low	151,725
			Mid	227,600
			High	378,343
30%	97,306,800 [63,249,420]	2,280,269	Low	227,587
			Mid	341,401
			High	567,514
40%	129,742,400 [84,332,560]	3,040,357	Low	303,499
			Mid	455,201
			High	756,685

Notes: Assumes 35% of cases are asymptomatic.

Table A4. Population Outcomes Without Treatment (2020-2021), Asymptomatic Share Sensitivity

Asymptomatic Share	Total Cases [Symptomatic]	Hospitalizations	Mortality Parameters	Deaths
50%	64,871,200 [32,435,600]	1,169,368	Low	116,711
			Mid	175,077
			High	291,033
35%	64,871,200 [42,166,280]	1,520,179	Low	151,725
			Mid	227,600
			High	378,343
18.5%	64,871,200 [52,870,028]	1,906,070	Low	190,239
			Mid	285,376
			High	474,383

Notes: Assumes 20% attack rate for 2020-2021.

We also conduct a two-way sensitivity for attack rate in the pre-treatment period (Q1-Q2 2020) and the overall attack rate (2020-2021) to demonstrate the impact on the number of cases in the no treatment scenario (Table A5).

Table A5. Number Infected (Q3.2020-2021) Without Treatment, Attack Rate Sensitivity

Attack Rate by Q3.2020	Attack Rate (2020-2021)	Susceptible as of July 1, 2020	Total Cases (Q3.2020-2021)	Symptomatic Cases (Q3.2020-2021)
3%	20%	314,625,320	55,059,431	35,788,630
3%	30%		87,465,839	56,852,795
3%	40%		119,872,247	77,916,960
5%	20%	308,138,200	48,685,836	31,645,793
5%	30%		81,040,347	52,676,225
5%	40%		113,394,858	73,706,657

Notes: Assumes 35% of cases are asymptomatic.

We estimate full treatment scenario results for three sets of attack rates: 5% by Q3.2020 and 30% overall; 5% by Q3.2020 and 40% overall; and 3% by Q3.2020 and 20% overall (Table A6).

Increasing the overall attack rate has a larger effect on the number of hospitalizations, deaths, and cost savings (Tables A6-A8) from treatment compared with a decrease in the attack rate by Q3.2020. This result makes sense because a higher overall attack rate results in more cases overall and in the post-treatment period, whereas a lower attack rate by Q3.2020 (holding overall attack rate fixed at 20%) shifts more patients to the post-treatment period. For both scenarios, cost savings relative to no treatment more than double if we increase the attack rate from 20% to 40% (Table A8).

Table A6. Number of Hospitalizations (Q3.2020-2021), Attack Rate Sensitivity

Mortality	Scenario	Main Results	Attack Rate 2020-2021*		Attack Rate by Q3.2020**
			30%	40%	3%
Mid	No Treatment	1,140,894	1,899,083	2,657,272	1,290,252
	Scenario 1	855,671	1,424,312	1,992,954	967,689
	Scenario 2	1,140,894	1,899,083	2,657,272	1,290,252
High	No Treatment	1,140,894	1,899,083	2,657,272	1,290,252
	Scenario 1	855,671	1,424,312	1,992,954	967,689
	Scenario 2	1,140,894	1,899,083	2,657,272	1,290,252

Notes: Scenario 1 assumes 50% of non-hospitalized, symptomatic patients receive a treatment that reduces the probability of hospitalization by 50%. Scenario 2 assumes all hospitalized patients receive a treatment that results in 30% length of stay reduction and 30% reduction in the probability of death. Main results assume 5% attack rate by Q3.2020 and 20% attack rate between 2020-2021. *Assumes 5% attack rate by Q3.2020. **Assumes 20% attack rate between 2020-2021.

Table A7. Number of Deaths (Q3.2020-2021), Attack Rate Sensitivity

Mortality	Scenario	Main Results	Attack rate 2020-2021*		Attack rate by Q3.2020**
			30%	40%	3%
Mid	No Treatment	170,814	284,330	397,846	193,176
	Scenario 1	128,111	213,247	298,384	144,882
	Scenario 2	119,570	199,031	278,492	135,223
High	No Treatment	283,946	472,645	661,343	321,118
	Scenario 1	212,960	354,483	496,007	240,839
	Scenario 2	198,762	330,851	462,940	224,783

Notes: Scenario 1 assumes 50% of non-hospitalized, symptomatic patients receive a treatment that reduces the probability of hospitalization by 50%. Scenario 2 assumes all hospitalized patients receive a treatment that results in 30% length of stay reduction and 30% reduction in the probability of death. Main results assume 5% seroprevalence by Q3.2020 and 20% attack rate between 2020-2021. *Assumes 5% attack rate by Q3.2020. **Assumes 20% attack rate between 2020-2021.

Table A8. Cost Savings ($, Billions) Relative to No Treatment, Attack Rate Sensitivity

Mortality	Scenario	Cost Outcome	Main Results	Attack Rate 2020-2021*		Attack Rate by Q3.2020**
				30%	40%	3%
Mid	Scenario 1	Hospitalization	10.9	18.1	25.3	12.3
		Mortality	46.1	76.7	107.3	52.1
		Total	56.9	94.7	132.5	64.3
	Scenario 2	Hospitalization	13.1	21.7	30.4	14.8
		Mortality	55.3	92.0	128.8	62.5
		Total	68.4	113.8	159.2	77.3
High	Scenario 1	Hospitalization	10.9	18.1	25.3	12.3
		Mortality	77.1	128.3	179.6	87.2
		Total	87.9	146.4	204.8	99.4
	Scenario 2	Hospitalization	13.1	21.7	30.4	14.8
		Mortality	92.5	154.0	215.5	104.6
		Total	105.6	175.8	245.9	119.4

Notes: QALY value = $150K. Outpatient cost savings (not shown) equal total costs minus hospitalization and mortality costs. Scenario 1 assumes 50% of non-hospitalized, symptomatic patients receive a treatment which reduces the probability of hospitalization by 50%. Scenario 2 assumes all hospitalized patients receive a treatment which results in 30% length of stay reduction and 30% reduction in the probability of death. Main results assume 5% attack rate by Q3.2020 and 20% attack rate between 2020-2021. *Assumes 5% attack rate by Q3.2020. **Assumes 20% attack rate between 2020-2021.

Next, we consider sensitivities that impact the value of a QALY and the mortality costs associated with C-19. These sensitivities only affect mortality cost savings and do not impact hospitalization or outpatient costs. First, we present results for QALYs valued at 100K (compared with $150K in the main analysis). Next, we consider two sensitivities that reduce the mortality costs (i.e., QALY gains for patients that recover) associated with C-19. The first sensitivity ("high risk") adjusts QALY gains downward using a standardized mortality ratio (SMR) equal to 3, which corresponds to a population with more comorbidities compared with the main results (SMR=1). The second sensitivity ("nursing home adjustment") is based on the fact that approximately 44% of C-19 deaths in Q1-Q2 2020 occurred in the nursing home population and we expect them to have shorter life expectancy compared with the non-institutionalized population.

Table A9 compares the mortality cost (QALYs) parameters for the "high risk" and "nursing home adjustment" sensitivities. We assume no one under age 65 reside in a nursing home and 44% of deaths for those aged 65+ occur in the nursing home population. Therefore, the mortality cost in the two older age groups (65-74 and 75+) is calculated as the weighted average between the main analysis parameters and 1 QALY (the assumed mortality cost if someone in the nursing home population survives C-19).

Table A9. Mortality Cost (Discounted Quality-Adjusted Life Years) Sensitivity Parameters

Mortality Cost (Discounted QALY)	Main Analysis	High Risk	Nursing Home Adjustment
0-17 years	26.61	16.48	26.61
18-64 years	18.48	9.12	18.48
65-74 years	9.72	2.76	5.87
75+ years	5.89	1.2	3.74

Notes: Discounted QALYs were calculated using a discount rate of 3%. The main analysis used an SMR=1; high risk used an SMR=3. Nursing home adjustment assumed 44% of deaths for patients 65+ occurred in the nursing home population, and these individuals gain 1 QALY if they survive C-19.

The cost savings from treatment for the QALY value and mortality cost sensitivities are shown in Table A10. The high risk sensitivity indicates that the value of treatment is lower if the majority of C-19 patients tend to have more comorbidities. Nursing home residents accounted for a relatively large share of (44%) deaths in the first six months of the pandemic. Since we have improved managing high risk environments, it is not clear whether nursing home residents will continue to account for a similarly high share of deaths going forward. However, even if the 44% share persists, the value of treatment is only moderately impacted since younger populations are not impacted by the nursing home adjustment, and they contribute substantially to mortality costs from C-19.

Table A10. Cost Savings ($, Billions) Relative to No Treatment, QALY Value and Mortality Cost Sensitivities

Mortality	Scenario	Cost Outcome	Main Results	QALY: $100K	Mortality Cost Sensitivity	
					High Risk	Nursing Home Adjustment
Mid	Scenario 1	Hospitalization	10.9	10.9	10.9	10.9
		Mortality	46.1	30.7	18.9	35.9
		Total	56.9	41.5	29.7	46.7
	Scenario 2	Hospitalization	13.1	13.1	13.1	13.1
		Mortality	55.3	36.9	22.7	43.1
		Total	68.4	49.9	35.8	56.2
High	Scenario 1	Hospitalization	10.9	10.9	10.9	10.9
		Mortality	77.1	51.4	32.0	60.4
		Total	87.9	62.2	42.8	71.3
	Scenario 2	Hospitalization	13.1	13.1	13.1	13.1
		Mortality	92.5	61.7	38.4	72.5
		Total	105.6	74.7	51.5	85.6

Notes: Outpatient cost savings (not shown) equal total costs minus hospitalization and mortality costs. Scenario 1 assumes 50% of non-hospitalized, symptomatic patients receive a treatment which reduces the probability of hospitalization by 50%. Scenario 2 assumes all hospitalized patients receive a treatment which results in 30% length of stay reduction and 30% reduction in the probability of death. Main results assume 5% attack rate by Q3.2020 and 20% attack rate between 2020-2021. Discounted QALYs were calculated using a discount rate of 3%. The main analysis used an SMR=1; high risk used an SMR=3. Nursing home adjustment assumed 44% of deaths for patients 65+ occurred in the nursing home population, and these individuals gain 1 QALY if they survive C-19. The value of a QALY for the mortality cost sensitivities equals $150K

Our final set of sensitivities considers the possibility that treatment in Scenario 2 will not be widely available, perhaps due to manufacturing and supply constraints (Table A11). First, we limit treatment to 50% of the population rather than 100%. Our second two sensitivities

are based on the projection that approximately 1 million courses of treatment will be available by the end of 2020. In the "Treat 88%" sensitivity, we distribute the treatment uniformly across all age groups to approximate 1 million courses, and in the "Prioritize older population" sensitivity, we treat 100% of all patients aged 65+, and are able to treat 80% of patients aged 18-64 before exhausting the 1 million doses. Consequently, the population aged 0-17 does not receive treatment in this sensitivity.

Table A11. Scenario 2 Cost Savings ($, Billions) Relative to No Treatment, Treatment Availability Sensitivity

Mortality	Cost Outcome	Main Results	Treat 50%	Treat 88%	Prioritize Older Population
Mid	Hospitalization	13.1	6.5	11.5	11.1
	Mortality	55.3	27.6	48.7	51.4
	Total	68.4	34.2	60.2	62.5
High	Hospitalization	13.1	6.5	11.5	11.1
	Mortality	92.5	46.3	81.4	85.9
	Total	105.6	52.8	92.9	97.0

Notes: Outpatient cost savings (not shown) equal total costs minus hospitalization and mortality costs. Scenario 1 assumes 50% of non-hospitalized, symptomatic patients receive a treatment which reduces the probability of hospitalization by 50%. Scenario 2 assumes all hospitalized patients receive a treatment which results in 30% length of stay reduction and 30% reduction in the probability of death. Main results assume 5% attack rate by Q3.2020 and 20% attack rate between 2020-2021.