

Clinical and Economic Impact of Non-Pharmacological Interventions on the Covid-19 Pandemic: A Predictive Model Based on the Spanish Case

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BACKGROUND

- The COVID-19 pandemic has overwhelmed health systems forcing governments to implement non-pharmacological interventions (NPI) to control the spread of the disease^{1,2}
- Spain was one of the first and most severely impacted countries by the COVID-19 pandemic. Despite its health system being among the world's best performing, the rapid spread of the first COVID-19 wave overwhelmed the health system, resulting in the government declaring the State of Emergency on March 14th, 2020, and imposing one of the strictest lockdowns in Europe³
- These restrictions, managed to reduce the spread of COVID-19, but led to a 17.8% drop in Gross Domestic Product (GDP) vs. Q1 2020, placing Spain in the top three OECD countries with the steepest GDP decline during Q2 2020⁴

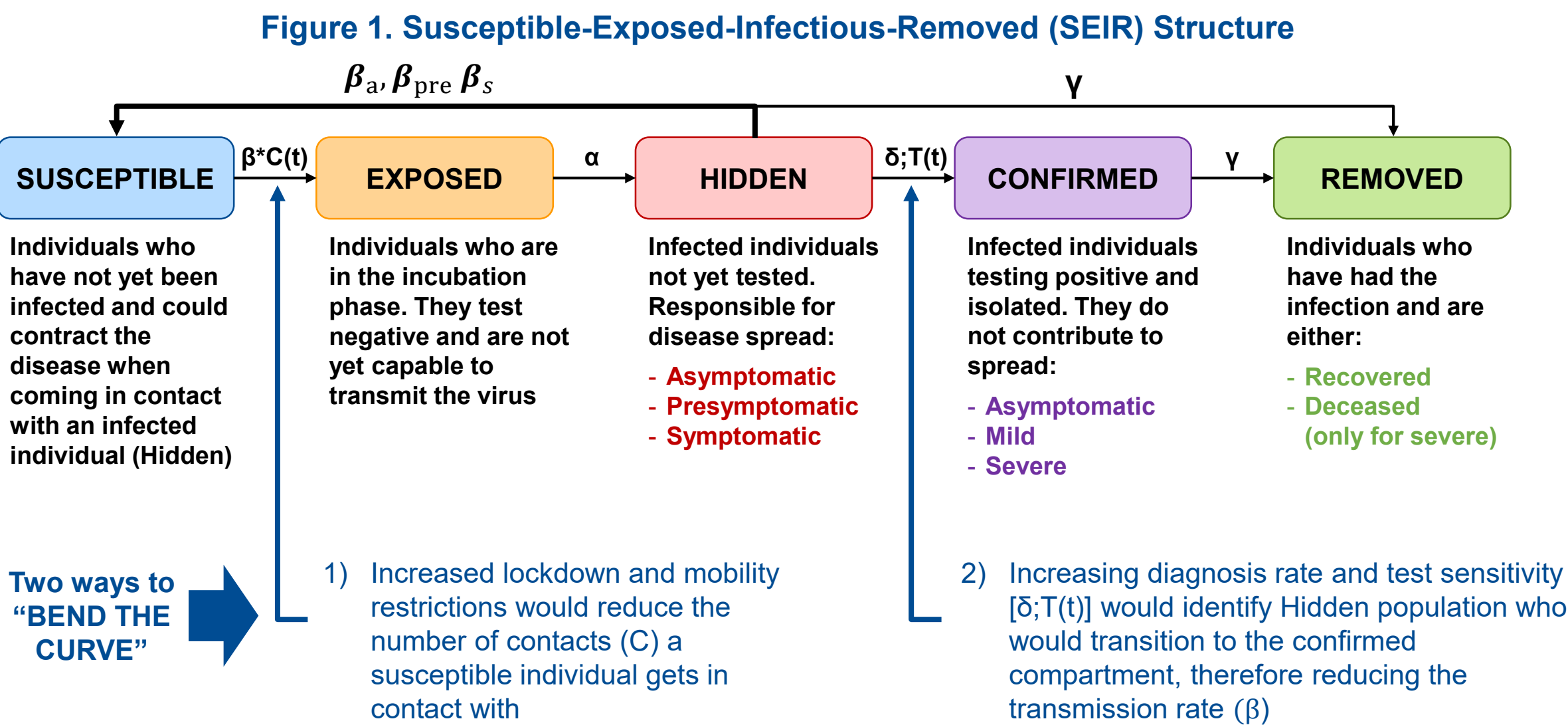
OBJECTIVES

- This project aimed to assess the epidemiological, direct healthcare costs, and GDP impacts of different social restrictions and testing strategies to control the COVID-19 pandemic based on the particular Spanish case⁵

METHODS

- Two separate models were developed to assess the epidemiological and economic impacts of different NPI (i.e., social restrictions and testing) on the COVID-19 pandemic:
 - A dynamic, modified, Susceptible-Exposed-Infectious-Removed (SEIR) model was developed. The Spanish population was distributed into the following compartments based on their infection status: Susceptible (S), Exposed (E), Hidden infectious (H), Confirmed infectious (C) and Removed (R). The model was populated and calibrated by adjusting the number of estimated confirmed patients to the number of actual confirmed patients as reported by Spanish Authorities, up to September 11th, 2020 (Figure 1)⁶
 - Then, the output from the SEIR model was used in the second model to estimate direct healthcare costs and GDP changes using a regression model which correlated different NPI and GDP changes observed across 42 countries
- Overall, 13 scenarios combining different NPI based on social restrictions and testing rates were simulated through both models (Figure 2). The epidemiological and economic impact of the following variables was assessed:
 - Level of restrictions/lockdown (stringency)⁷
 - Number of molecular tests per case⁸
 - Test sensitivity⁹⁻¹¹

METHODS (cont.)



RESULTS

- Based on the results from the SEIR simulation both increased social restrictions (scenarios 7-to-13) and increased testing rates (scenario4-to-6) would manage to control the COVID-19 spread (Figure 3). However, notable differences are observed in terms of direct healthcare costs (Table 1) and GDP impact (Figure 4)
- Policies entailing increased testing rates (scenarios 2-to-6) translated into higher healthcare costs and lower GDP decline (vs. same quarter from previous year), whereas increased social restrictions (scenarios 7-to-13) are correlated with greater GDP declines, with differences of up to 4.4% points among scenarios (Table 1 and Figure 4)
- Increased test sensitivity (scenario 4 vs. scenario 5 and 6) also leads to higher reductions on cases, hospitalizations and deaths (Figure 3) and lower direct healthcare costs (Table 1)

Table 1. Direct Costs by Type of Cost for Each Scenario

Scenario*	Stringency Increase	Testing Rate Increase	Hospitalization (M€)	ICU (M€)	Primary Care (M€)	Individual Testing (M€)	Total (M€)
1 Base Case	SI=62	10.6 tests/case*	504.3	347.6	140.7	791.2	1,783.7
2	None SI=62	Mild (x3)*	373.0	257.1	101.6	1,563.3	2,295.1
3	None SI=62	Moderate (x6)*	264.9	182.6	67.6	1,908.5	2,423.6
4	None SI=62	High (x10)*	191.9	132.3	45.2	1,940.9	2,310.3
5	None SI=62	High (x10)**	201.7	139.0	48.2	2,100.3	2,489.3
6	None SI=62	High (x10)***	228.7	157.6	56.4	2,550.1	2,992.8
7	Moderate SI=73	None*	199.2	137.3	47.5	201.6	585.6
8	Moderate SI=73	Mild (x2)*	183.4	126.4	43.9	353.5	707.2
9	Moderate SI=73	Moderate (x3)*	171.0	117.9	40.6	473.6	803.2
10	Moderate SI=73	High (x10)*	125.3	86.4	27.1	1,064.4	1,303.3
11	High SI=85	None*	121.0	83.4	26.1	84.6	315.2
12	High SI=85	Mild (x2)*	117.3	80.8	25.6	158.9	382.7
13	High SI=85	Moderate (x3)*	114.1	78.7	24.9	225.5	443.2

ICU: Intensive Care Unit; SI: Stringency Index
*All scenarios except 5 and 6 consider a level of sensitivity of 96%; **89% sensitivity; *** 73.3% sensitivity

Figure 2. Scenarios Considered

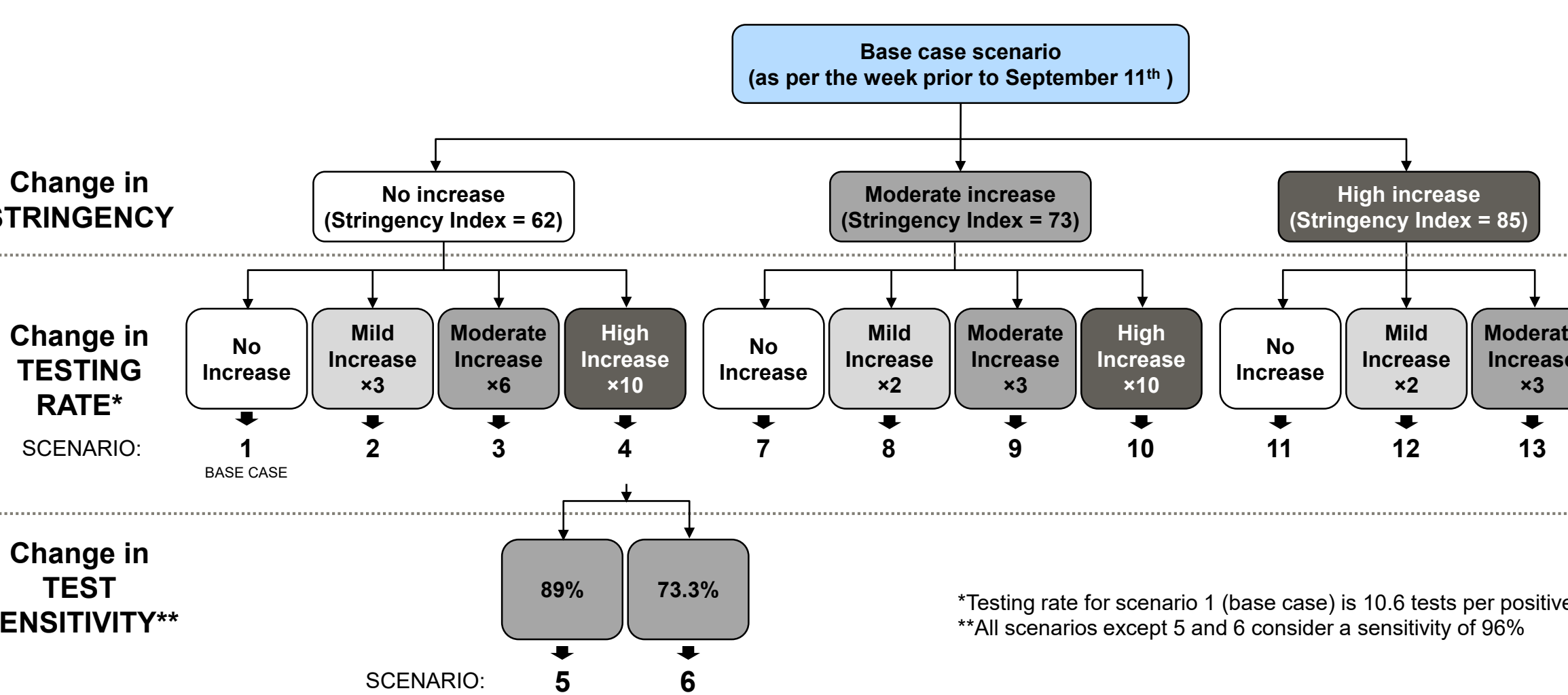


Figure 3. Exposed cases by 30-day period and scenario

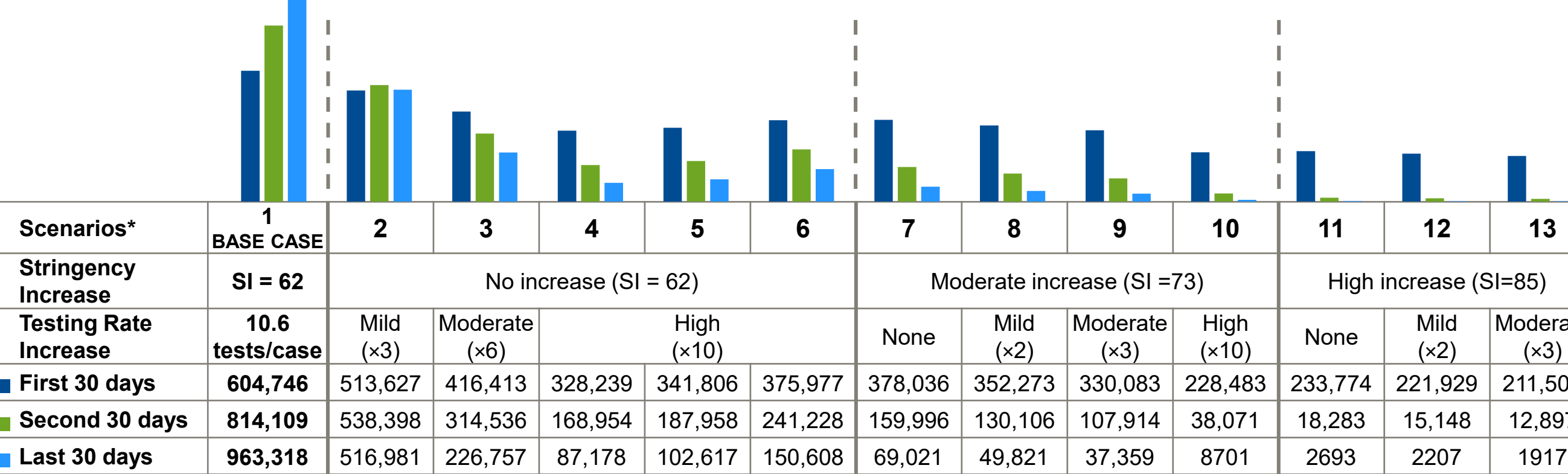
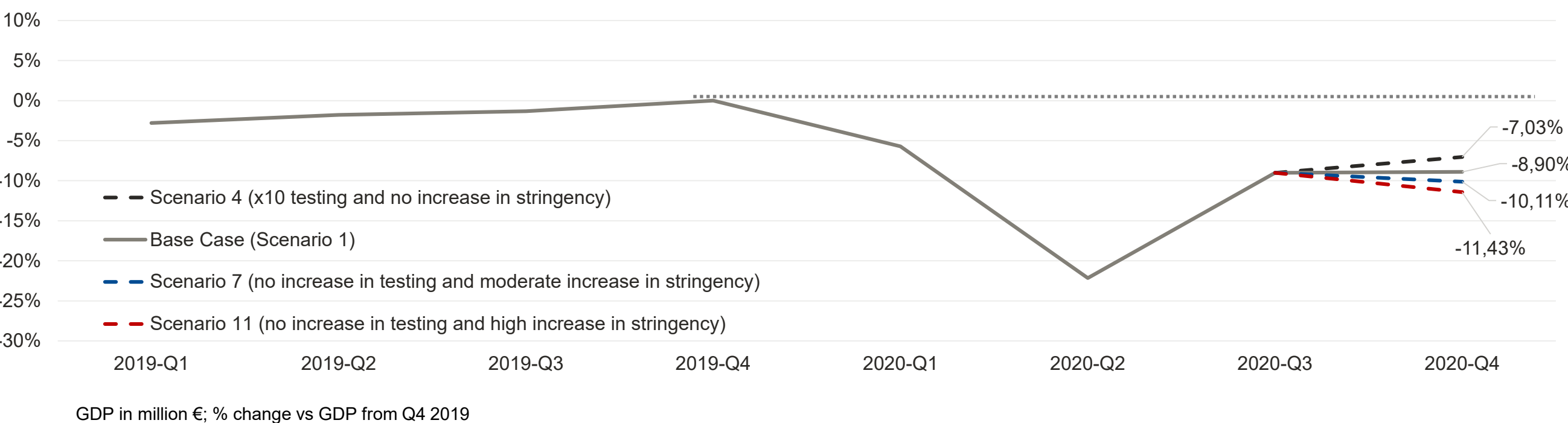


Figure 4. Potential Q4 GDP 2020 evolution for different scenarios of testing and stringency



CONCLUSION

Increased testing may have controlled the COVID-19 pandemic while minimizing the GDP impact

These models may provide evidence for decision makers during future pandemics and in countries where vaccination rates are still low – helping to better balance health and socio-economic concerns

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