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ANALYSIS OF QUARANTINE STRATEGIES USING A MICROSIMULATION MODEL

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Objectives and background of the model

In this report we present simulation results of different pandemic containment strategies for the Santiago Metropolitan Region. We used a microsimulation model based on the work of the Imperial College Covid-19 Response Team (Ferguson et. Al). The model simulates the behavior of individuals and their social interactions in the home, at work, at school and their connections in the community, using for this purpose **detailed and objective information on the movement of people in the city**:

1. School Admission System: indicates the flow patterns of children from the home to the school.
2. Validation of Transantiago 'BIP' smartcards: indicates the travel patterns of people on public transport during work hours.
3. Source-Destination Transport Survey: indicates private transport travel patterns.

Scenarios analyzed: social distancing, total and intermittent quarantine

Scenario 1: Social distancing + school and university closure

- Community connection between individuals are reduced to 25% of the original, in line with the call for social distancing and the suspension of group events.
- All connections associated with college and university are removed. Community connections around the home are added.

Scenario 2: Total quarantine in the Santiago Metropolitan Region

- Al of the restrictions in Scenario 1.
- All work-related connections are eliminated for 90% of the region.

Scenario 3: Intermittent quarantines

- The region's boroughs are grouped into six zones defined according to the Metropolitan Health Services, in order to illustrate the use of the model. It is possible to analyze other types of zoning.
- A threshold policy is used to activate quarantine on a zone level: quarantine is activated in an area when the number of active infected persons exceeds 5 for every 10,000 inhabitants. Quarantine is deactivated in a zone when the number of infected people falls below the same threshold.

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- During the periods without quarantine, social distancing and school closures are maintained (similar to Scenario 1).

Results

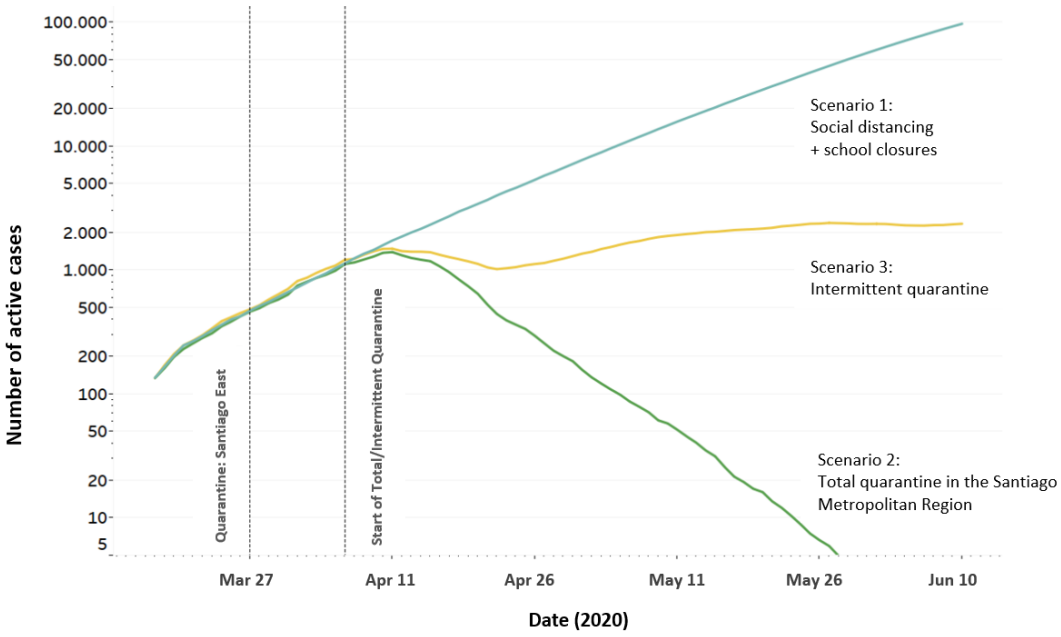

Figure 1: Forecast of active cases for three containment scenarios (vertical axis in log scale).

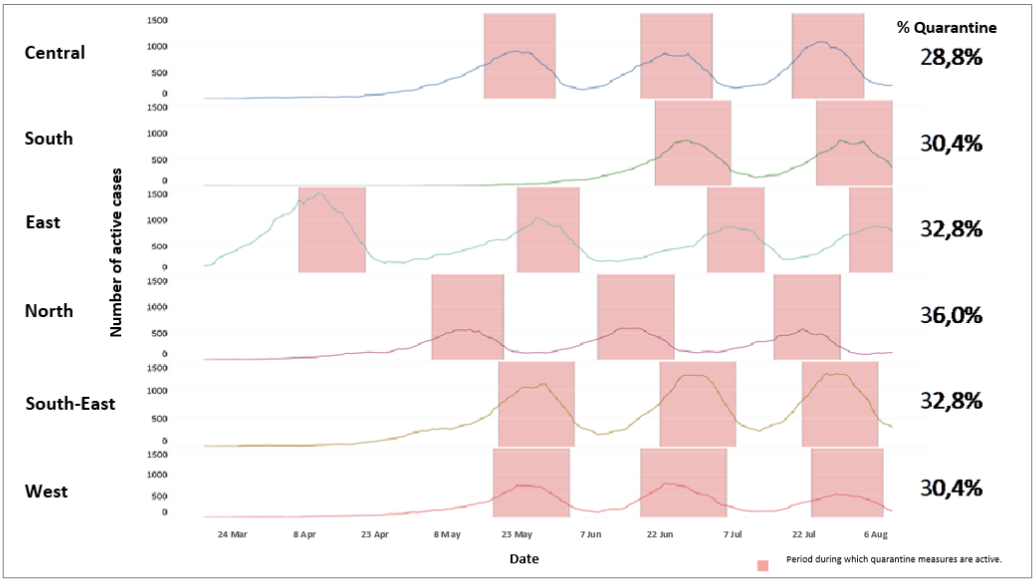

Figure 2: Time evolution of intermittent quarantine strategies according to the Santiago Metropolitan Region Health Service.

Conclusions

- Early measures aimed at inducing social distancing through the closure of schools and the prohibition of group events (Scenario 1) generated a contained growth in the number of active cases. In epidemiological terms, these measures were effective in reducing the number of reproduction (R0) to 1.6 (compared to R0 = 2.5 reported in other countries).

- However, the closure of schools and social distancing (Scenario 1) by itself shows to be insufficient in containing the exponential spread of infection.

- Scenario 2 (total quarantine for Metropolitan Region) would rapidly reduce the number of active cases over a short time. During quarantine, the reproduction number R0 drops to 0.6, however, this does not mean the end of the pandemic if the removal of the total quarantine (not graphed) is not followed by other measures such as: mass testing, monitoring of new cases of infection, confinement and/or intermittent quarantine strategies according to a defined threshold. Indeed, if the total quarantine is followed only by social distancing and the closure of educational establishments, a situation similar to that of Scenario 1 is quickly triggered, which is not sustainable.

- Intermittent quarantine (Scenario 3) appears to be a viable alternative, keeping the number of active cases of infection in the Metropolitan Region relatively stable, ranging between 2,000 and 4,000. Figure 2 illustrates a representative scenario of how this operates over time. The zones remain closed for around a third of the time, with the periods of closure generally alternating between the zones, so that the city can continue operating (always factoring in closed schools and social distancing). The intermittent quarantine scenario can be analyzed in combination with, for example, mass testing and confinement, which would affect activation times and quarantine durations in each zone. Of course, other zoning or other activation thresholds can be analyzed.

- **We advise against reopening educational establishments for now**. Given that in Chile schools were closed early, we do not have objective evidence to measure the impact of reopening schools. If we use the contagion parameters in schools used in the model for the United Kingdom, the reproduction number R0 increases to 2.5, strongly accelerating the spread of the virus in periods without quarantine. Since there is more migration between boroughs to attend school in the Metropolitan Region, the effect could be greater. The good performance of intermittent quarantines rests in part on the moderate growth (R0 = 1.6) that was observed in the Metropolitan Region during the period of school closures. **It is advisable to wait for more data before making decisions on this matter**.