**BACKGROUND**

Coronavirus disease 2019 (COVID-19) is a disease caused by severe acute respiratory syndrome coronavirus 2 (SARS CoV-2). It

was declared on March 11, 2020, by the World Health Organization as pandemic disease. The disease has neither approved

medicine nor vaccine and has made governments and scholars search for drastic measures in combating the pandemic.

Regrettably, the spread of the virus and mortality due to COVID-19 has continued to increase daily. Hence, it is imperative to

control the spread of the disease particularly using nonpharmacological strategies such as quarantine, isolation, and public

health education. This work studied the effect of these different control strategies as time-dependent interventions using

mathematical modeling and optimal control approach to ascertain their contributions in the dynamic transmission of COVID-

19. The model was proven to have an invariant region and was well-posed. The basic reproduction number and effective

reproduction numbers were computed with and without interventions, respectively, and were used to carry out the sensitivity

analysis that identified the critical parameters contributing to the spread of COVID-19. The optimal control analysis was carried

out using the Pontryagin’s maximum principle to figure out the optimal strategy necessary to curtail the disease. The findings of

the optimal control analysis and numerical simulations revealed that time-dependent interventions reduced the number of

exposed and infected individuals compared to time-independent interventions. These interventions were time-bound and best

implemented within the first 100 days of the outbreak. Again, the combined implementation of only two of these interventions

produced a good result in reducing infection in the population. While, the combined implementation of all three interventions

performed better, even though zero infection was not achieved in the population. This implied that multiple interventions need

to be deployed early in order to reduce the virus to the barest minimum.

* Chiedere alla prof se si possono usare altri metodi per il calcolo del controllo ottimo oppure va bene il principio usato dagli altri

**MOTIVATIONS**

Motivazioni per cui serve il controllo ottimo:

Necessario controllo ottimo per minimizzare il carico del controllo usato minimizzando allo stesso tempo il numero di persone infette. Infatti, un problema che tuttora è presente è la difficoltà di gestire i pazienti ospedalizzati (fare un controllo ottimo su infetti in terapia intensiva e non, quindi I1 e I2 e allo stesso tempo minimizzare il controllo sulle cure)

* Chiedere alla professoressa il significato dei pesi imposti sul controllo delle cure (teoricamente il peso aumenta se aumenta la conoscenza della malattia, ossia si sa come trattarla