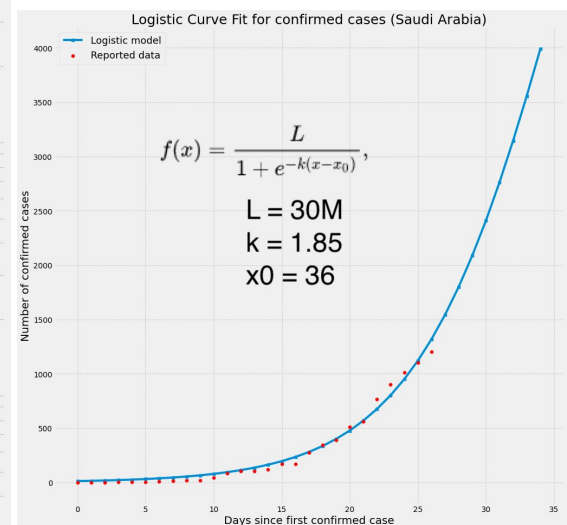
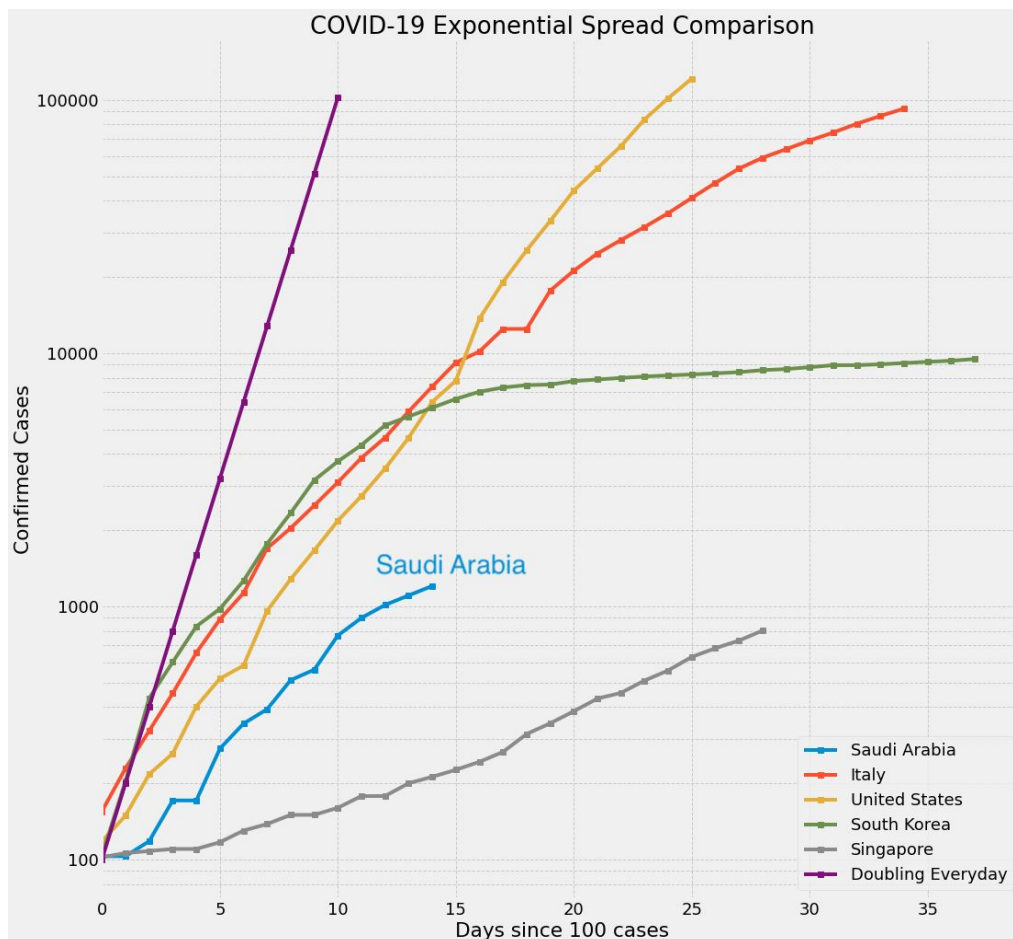


Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and was first identified in late 2019 in Wuhan, China. The disease is known to be highly contagious while still being asymptomatic [1]. Incubation period ranges between 1 and 12 days [2]. Total confirmed cases globally exceeded 680k with 31k deaths at the time of writing this [1]

Report Goals:

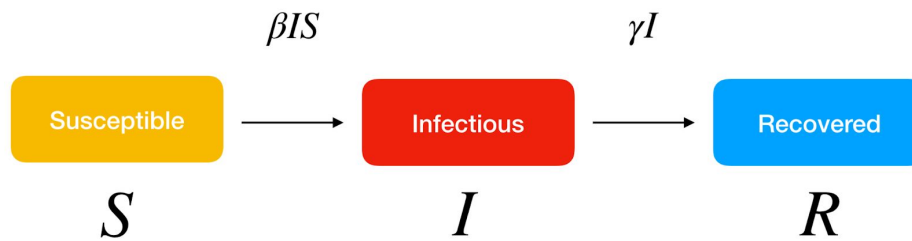
1. Compare confirmed cases trends between Saudi and other relevant countries.
2. Model disease progression in Saudi using the SIR model.
3. Simulate the disease progression with government's interventions with different scenarios.



Source: author. Data: Johns Hopkins CSSE; Updated: 03/28/2020

SIR Epidemic Model

The SIR model takes into account reductions in the susceptible population as they either gain immunity or die, which makes it useful for long term predictions.



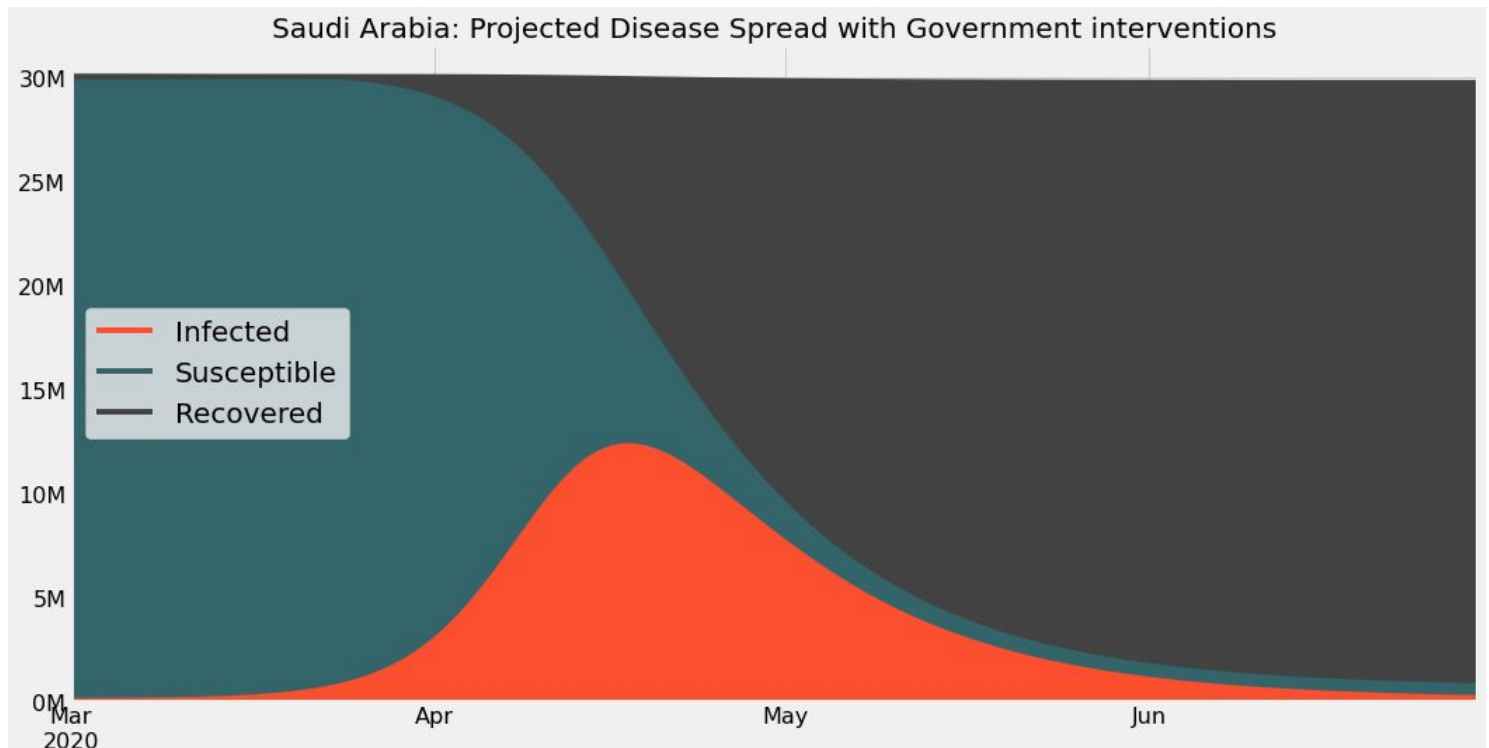
Source: <https://www.lewuathe.com/covid-19-dynamics-with-sir-model.html>

- **S(t)** refers to the susceptible population that has not yet been infected.
- **I(t)** is the number of infected individuals (also contagious) .
- **R(t)** individuals who have recovered from the disease and have become immune.

Model Parameters for Saudi's case:

- Total population: **30 Million**
- R (basic reproduction number) : **2.5** *based on Saudi CDC note[3]*
- Recovery period: **14 days** *source[2]*
- Mean incubation period: **5 days** *source[2]*

Initial conditions: # infected population = 1299 and # recovered individuals = 66 [1]



Source: author. deaths and severe cases are not modelled for simplicity

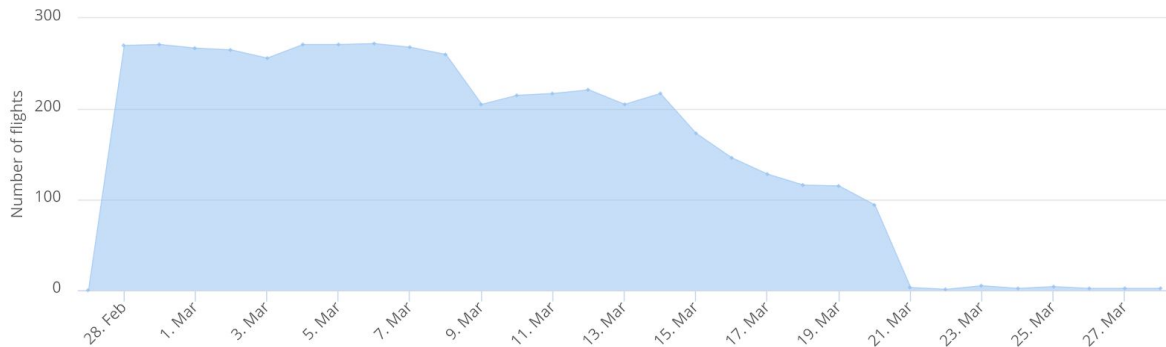
The chart shows disease spread over time without government interventions. Peak infected population reaches ~12M by late April! Long tail subsides by late Summer 2020. Overall, this scenario is very disastrous.

SIR Epidemic Model: *with government intervention*

Interventions:

- Social distancing + personal hygiene awareness
- Contact tracing
- Close large gathering venues (i.e. schools) and limit travel and flights.

Example of a government intervention: suspending flights to limit travelers from further spreading the disease.

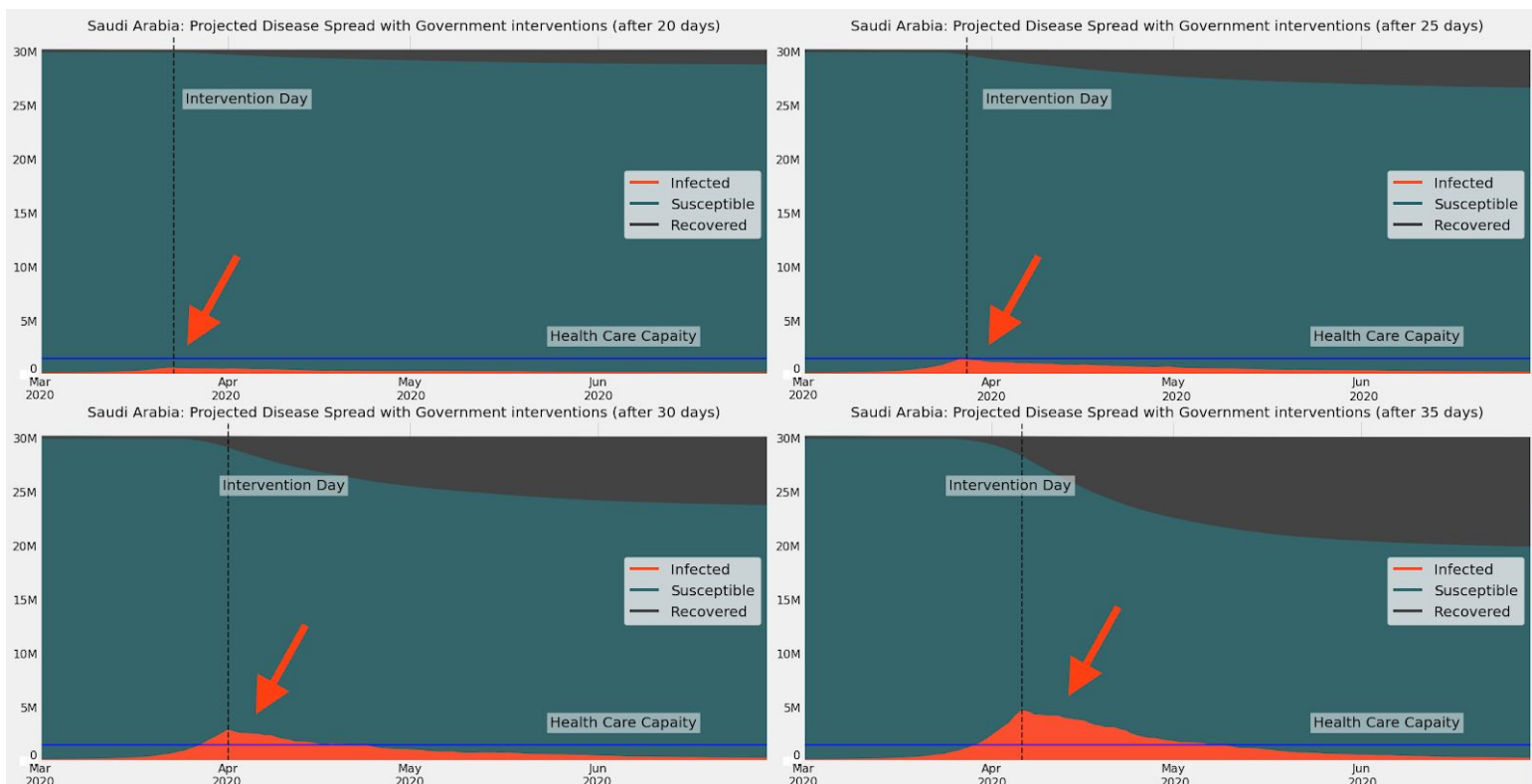


Number of daily flights into Riyadh's airport (RUH) during March 2020. Source: flightradar24.com

Effective **R** (basic reproduction number) with government intervention: **1.25**

Saudi CDC note[3]

This value varies widely based on the measures enforced and their effectiveness. For more, [refer to this note](#)



4 simulated scenarios based on Saudi's government interventions on different dates (at 20, 25, 30 and 35 days) since 100 confirmed cases. Source: author

Observation: enforcing containment measures early on **significantly** helps in reducing the size of the infected population (and therefore deaths, severe cases and health-care pressure)

Conclusion: a mere 10-day delay in enforcing social measures would've likely led to a high growth in new cases that would overwhelm the local healthcare system eventually. Thankfully it looks like that while measures last, COVID-19 in Saudi will be under control.

References:

1. [Johns Hopkins CSSE](#)
2. https://en.wikipedia.org/wiki/Coronavirus_disease_2019
3. Saudi CDC: <https://twitter.com/SaudiCDC/status/1243521250141577217?s=20>
4. <https://www.lewuathe.com/covid-19-dynamics-with-sir-model.html>
- 5.