# Adjusting the Flu Complications model to Corona

## General

We are considering the potential of a variant to our Flu complications model to be used in the battles against Covid-19. The idea is that if we get a model predicting who is more likely tocomplicate in case of having Covid-19, then this could maybe be used in the following use cases:

* Help decide who should be in heavier quarantine (currently almost all the population in Israel, but may not be like that for a long time).
* Help decide who gets some relief from the quarantine (may happen soon)
* Help decide who gets to get vaccinated first in case of a vaccine in short supply (expected within a few months – up to a year).

We have developed a similar model for Flu, which is a related disease: viral spread, and respiratory, similar complications to Covid-19 (albeit less probably to complicate). There are however major differences, one of the main ones is that young patients don’t seem to complicate in Covid-19, while they do with the Flu, and in general the prior for complications given age is different between the 2 diseases.

Another issue is the lack of available Covid-19 datasets big enough to repeat the training.

Hence, we are considering using the Flu model with some adjustments.

## Suggested adjustment for Age

Given the known different prior of Age with the two diseases, we suggest the following directions:

### Bayesian Fix along the old CRC lines

We learn a model for flu complications on an age-matched training set, and evaluate the following probabilities - and ;

We then use the following Bayesian argument –

Using , and applying the same argument to we end with:

### A direct aposteriori probability fix

We learn a model for flu complications on an age-matched training set and calibrate it on a similar set. This gives us , the probability for complications given the sample data.

We also take from current known numbers the prior for Covid-19 complications given Age:

We then combine those probabilities together using aposteriori probability:

And report this as our adjusted risk.

### Unifying the approaches

Note that

So, looking at the direct approach, we get –

Which means that replacing the direct approach with -

Gives the Bayesian fix using only the overall case to control ratio, ***without need to build the inverse probability tables*** !

## Validating the adjustment model

Several tests can be done:

* Verify that repeating the same process given a flu prior gives predictions that are good for the flu problem, on which we have data.
* Verify that the average prediction for an age group gives the expected prior.
* Manual clinical verification of high and low scores. Explainanility graphs

## Additional adjustments

If there’s data on the distribution of the disease complications given additional factors (such as some background disease, etc), we can measure if the prior is very different from the flu one, and if so, consider adding it to the prior fix methodology.

## Action Item

* Finish this document, circulate and decide.
* Train age matched flu model(s).
  + Full model
  + Regularized based on fewer signals model.
* Get the most accurate tables to calculate the prior from.
* Combine and check.