

Can Mathematical Modeling  
Guide Pandemic Response,

or is the Prescription Given in  
Leviticus as Good as It Gets

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## Modeling To Guide Policy

How Many Infections?

How Serious ?

How Many Hospital Beds?

ICU ?

Non Pharmaceutical Interventions    NPI

Masks

Social Distancing

Isolation

# COVID

## Epidemic Modeling

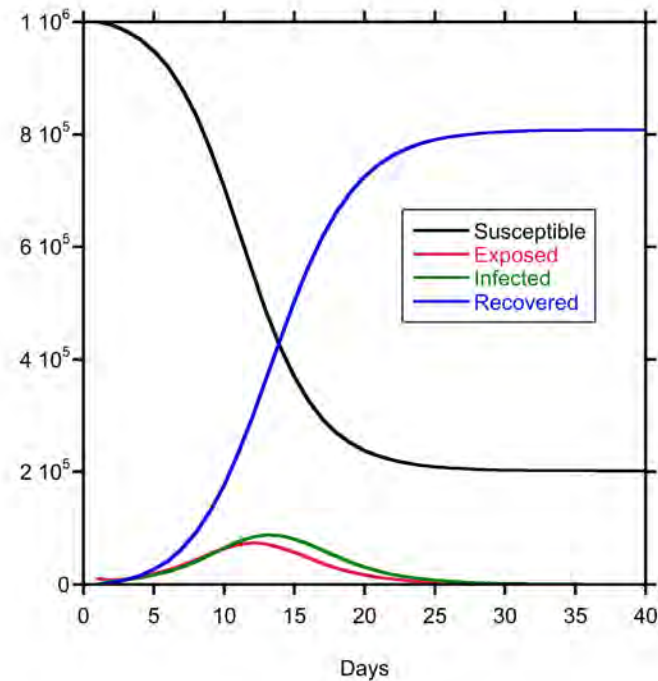
S Susceptible    I Infected    R Recovered    (Sometimes add E Exposed)

$$\frac{dS}{dt} = -\beta I \frac{S}{N}$$

$$\frac{dI}{dt} = \beta I \frac{S}{N} - \gamma I$$

$$\frac{dR}{dt} = \gamma I$$

$$R_0 = \frac{\beta}{\gamma}$$



# Bayesian Approach

Ferguson

Probability of Data Given Model

$$P(\Theta|D) = P(D|\Theta)P(\Theta)$$

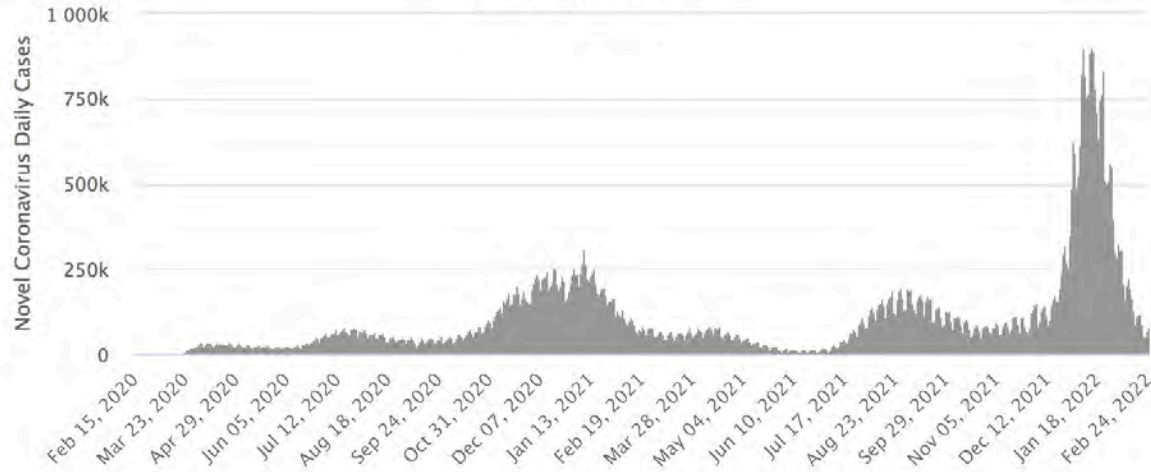
Probability of Model Given Data

Prior Probability of Model Parameters

Relies on assumptions on distributions

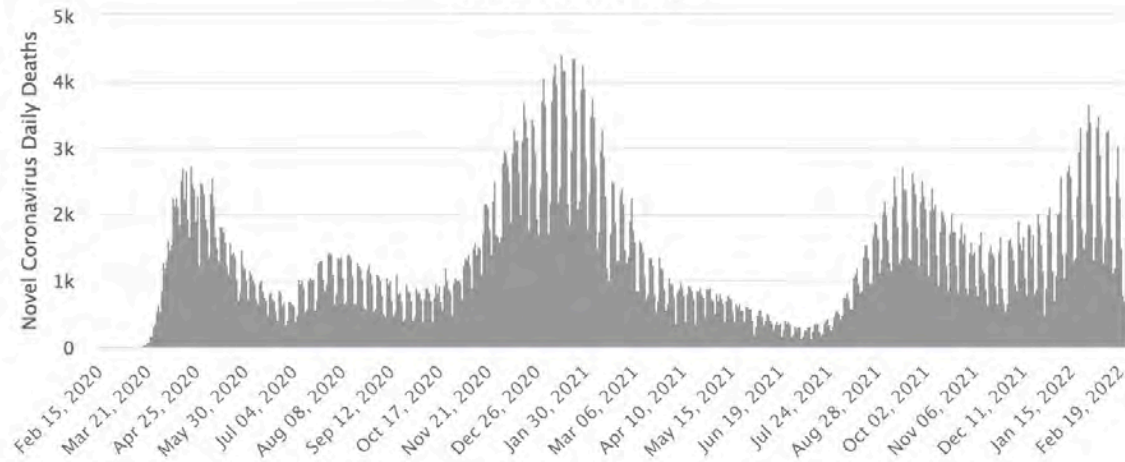
## Daily New Cases

Cases per Day  
Data as of 0:00 GMT+0



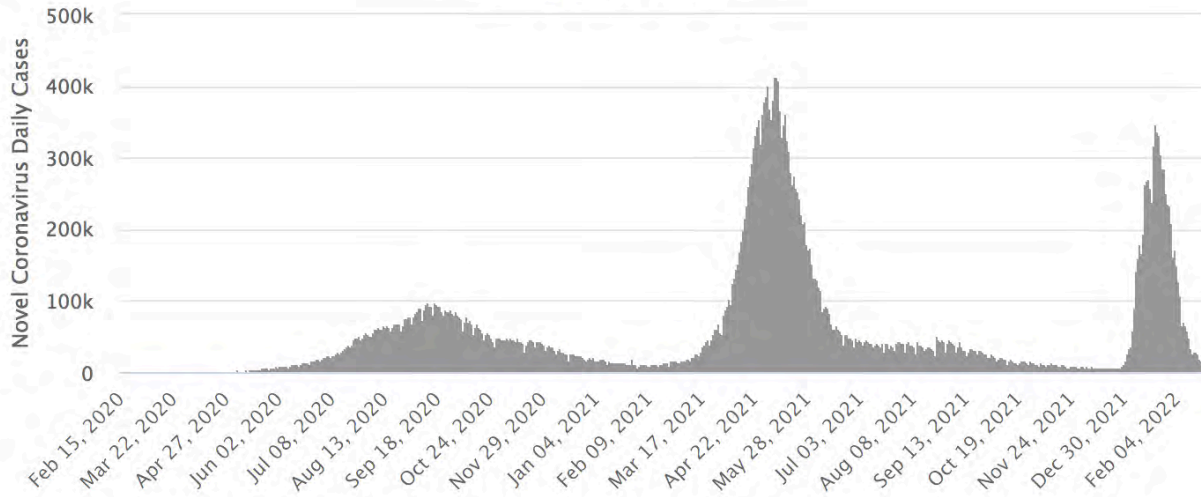
## Daily Deaths

Deaths per Day  
Data as of 0:00 GMT+8



## Daily New Cases

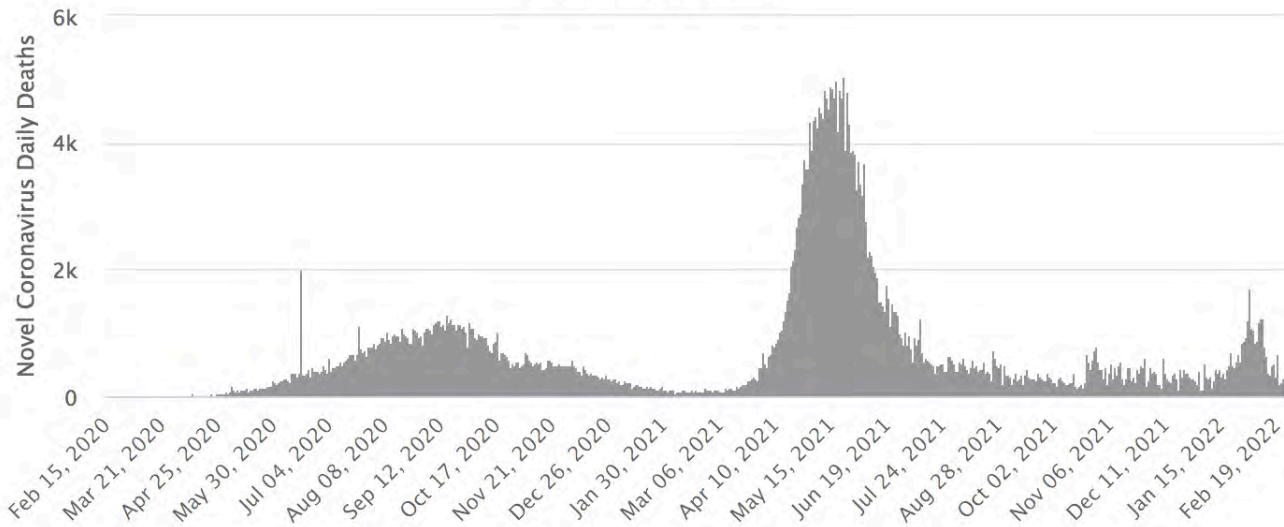
Cases per Day  
Data as of 0:00 GMT+0



India

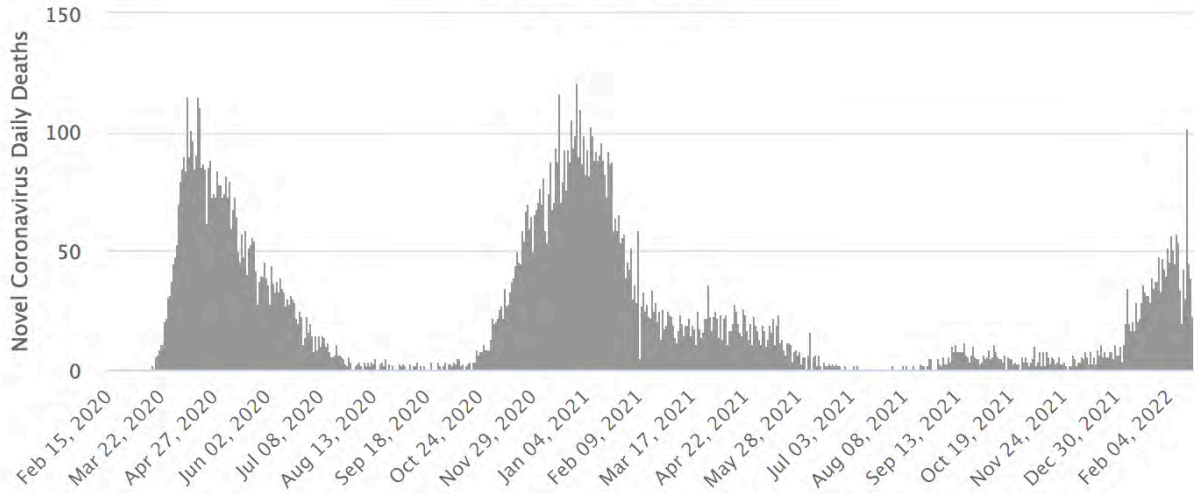
## Daily Deaths

Deaths per Day  
Data as of 0:00 GMT+8



### Daily Deaths

Deaths per Day  
Data as of 0:00 GMT+8

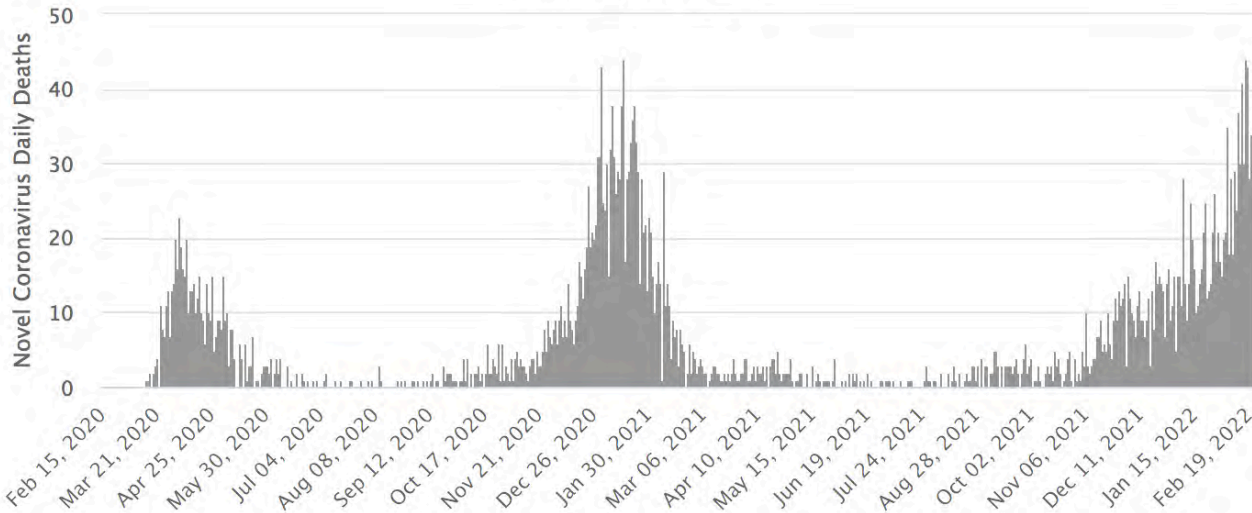


Sweden

Anders Tegnell

### Daily Deaths

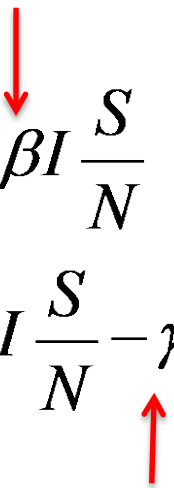
Deaths per Day  
Data as of 0:00 GMT+8



Denmark

“What I quickly found out is that the simulation results depend *entirely* on the input parameters, none of which are known with any accuracy, and those parameters are almost randomly time dependent”

S. Das Sharma, Physics Today February 2022

$$\begin{aligned}\frac{dS}{dt} &= -\beta I \frac{S}{N} \\ \frac{dI}{dt} &= \beta I \frac{S}{N} - \gamma I \\ \frac{dR}{dt} &= \gamma I\end{aligned}$$




# Plagues in Biblical Times

Endemic

Zoonotic Transfer

# Pandemics The Biblical Way !

Parshat Tazria Lev 13 45,46

וְעַל־שָׁפָם יַעֲטֶה וְטָמֵא | טָמֵא יִקְרָא:

כָּל־יְמֵי אִשְׁרֵי הַנִּגַּע בּוֹ יִטָּמֵא טָמֵא הוּא בְּדָד יֵשֵׁב מִחוּץ לַמַּחֲנֶה מִוֹשְׁבָיו:

1. Wear a Mask over the Mouth
2. Announce “Infected” (Unclean)
- 3 Isolate !

Minimise contact

2 Missing

**THIS IS AN EMERGENCY**

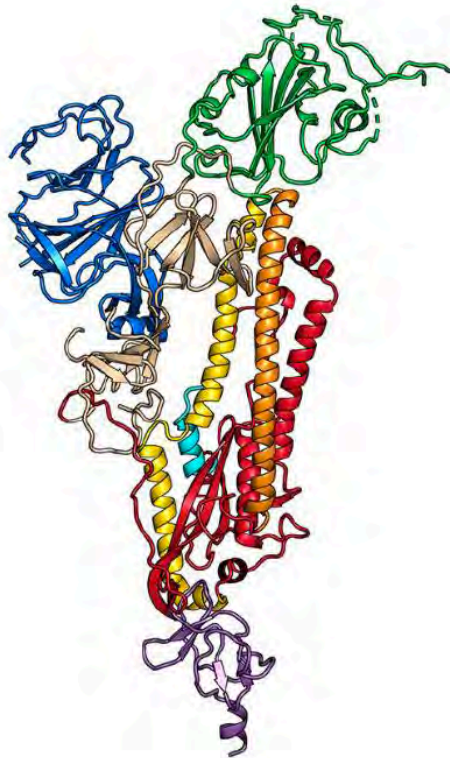
Forget about HIPPA

TSA Groping

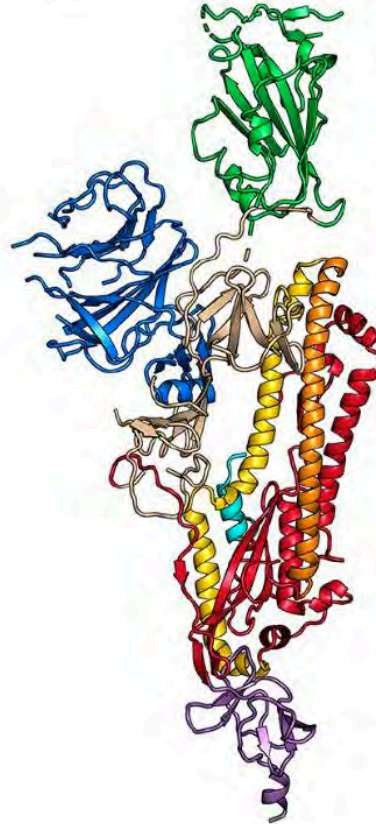
What wasn't available in biblical times  
Vaccination mRNA Vaccines  
Why what we do is important

**A**

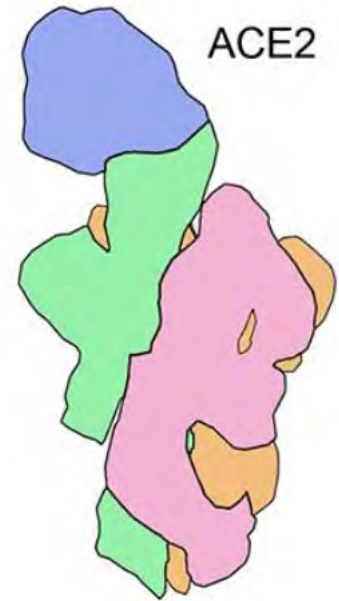
2019-nCoV S RBD down protomer



2019-nCoV S RBD up protomer



ACE2



SARS COVID 2019 at 3.5 Angs + Binding to ACE2  
Wrapp et al, Science 367, 1260 (2020) (March)

## Deut 18, 22 Shofetim

אָשֶׁר יִדְבַר הַנְּבִיא בְּשֵׁם יְהוָה וְלֹא יֵהְיֶה הַדְּבָר וְלֹא יָבֹא הוּא הַדְּבָר  
אָשֶׁר לֹא־דִבְּרוּ יְהוָה בְּזָדוֹן דִּבְרוּ הַנְּבִיא לֹא תִגֹּר מִמֶּנּוּ:

If what the prophet says in the name of the Lord  
doesn't happen then he spoke presumptuously and  
shall not live with you

Torah Our DNA not all of it expressed !