Viral Load model

Each agent will have a viral load of 0 to 100

Viral load affects:

1. Transference to agent contact with lower VL
2. Effect on duration of state
3. Effect on susceptibility (total measure of intrinsic risk)
4. Effect on infectivity (size)
5. Effect on viral growth rate

Set two thresholds: EFFECT THRESHOLD (ET) and TRANSITION THRESHOLD (TT)

GREEN (susceptible) VL 0 to 24

YELLOW (incubating) VL 25 to 50

BLUE (infective) VL 50 to 74

RED (clinical symptomatic) VL 75 to 100

Transference between two agents with different VLs

For any two agents m and n,

VL(m)-VL(n) is the difference = dV

VL(m)+VL(n) total of the two together = sV

And dV/sV is the delta of transference, of the larger to the smaller

So the new level of the smaller, say agent n is

n + m(dV/sV) where m has the larger VL

and the higher agent does not lose VL

However, there is also the degree of contact, or overlap….so this will affect the viral load transference. We proceed this way:

* If r1 and r2 are the radii of the two agents, their maximal separation for contact is r1+r2. If they overlap, the distance between their centers is found by the sqrt(dx^2 + dy^2) = delta(d) and the overlap is (r1+r2) – delta(d).

The extent of overlap is the degree to which the viral transference will apply – ie the factor of

[(r1+r2)-delta(d)]/(r1+r2) is the extent to which the Viral Transference will be applied……

Growth Rate

For any agent with VL(a) where a is the agent,

If VL(a) < 25 (green, susceptible), growth is deemed to be negative at 0.9 daily

If VL(a) >24 (yellow, blue, red), growth is deemed to be positive at

1.05 per day for yellow (VL(a) >24 and <50)

1.1 per day for blue (VL >50 and < 75)

1.15 per day for red (VL >75)

Duration of State

The global settings for duration of incubation, period of asymptomatic infectivity, and undetected symptomatic periods, can be modified by viral load in the aggressive direction.

We take the following approach:

* If 50 is the lower bound of the VL for blue agents (infective) and the stated duration is D days, then we state that the upper bound (74) will be reached as the VL grows and as the blue agent is affected by other contacts….

So for now we will not incur additional reductions of duration based on VL as the growth factor will reduce duration.

Suceptibility and Size

The proxy for susceptibility and infectivity is size, as this determines the likelihood of contact with another agent…and the greater the size, the greater the infectivity and the greater the susceptibility.

Susceptibility is determined by the intrinsic risk calculations, as seen in a separate section.

Infectivity is then the extent to which the base size is affected by the viral load, as an increase in base size.

Since the Effect Threshold is a VL of 25 to 49 for agents who are designated YELLOW, their size is correspondingly increased by the factor:

* If VL(y) it the Viral Load for the agent who is in the Yellow State, the size if increased by a factor of

Log(dm)

Using the unfounded assumption as the viral load grows logarithmically, the size increases as the log of the number, then

40 is the agent VL and 25 to 49 is the Yellow VL range, the increase in size is

Log(1+(40-25)/25) = log(1.6) = 0.2 of VL…

Note: the maximum increase is log(2) = 0.3….

So the increase in size (radius) is 1,2 X existing radius….

WE PUT THIS IN PLACE AND WAIT FOR A STATISTICIAN PROFESSIONAL TO PUT BETTER ESTIMATES HERE

INTRINSIC RISK

Age is said by most to be an intrinsic risk. What we have is P(A|D) in other words, we know for persons with Covid what the age distributions are.

The age distribution for BC Covid-19 cases is:

Age Numbers Case% Population

<10 26/2502 1% 9.25%

10-19 47/2502 2% 10.29%

40-49 381/2502 15.23% 12.75%

50-59 482/2502 19.26% 14.27%

The approach we take here is simplistic….if the risk in the 40-49 age group is the same as the population demographics, the case % would have been 12.75%. Instead, it was 15.23%.

Therefore we assign the raw relative risk as 15.23/12.75, so 1275 persons in the population would have generated 1,523 cases. The raw relative risk is 1.19….but 1.19 of what? Well, it would be P(D|population) which is around 2,502/5,110,523 is 0.0489% or 4.89 per 10,000.

Now, the way to combine two risk factors might be as follows:

If P(A) is the probability of A and P(B) is the probability of B then

(1-P(A)) is the probability of NOT(A) and (1-P(B)) of NOT(B)

So the probability of both NOT(A) AND NOT(B) is their product, and the

Probability of either A or B is (1-the product) and so this can be extended to multiple factors..

These risk factor cumulatives will be used to affect the radius of an agent through the susceptibility value.

Since the relative risk can be less than 1, it is possible for the susceptibility to decrease through the risk factors, and we will combine them at present by simply multiplying them.

So, susceptibility is changed by the Viral Load, which is affected by contact with more heavily infected and by the degree of overlap, as well as the viral growth rate.

Intrinsic risks then are applied to susceptibility, to generate a final size, viral load, growth rate, and duration is affected through growth rate and viral load.

Extrinsic factors are to do with mingling, which can be agent-specific based on roles, and in addition, site specific such as in enclosed spaces with high density of persons as in bars.

Density can be applied by introducing a higher base size for all agents.