**Parameters – Comments and NZ specific data**

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| **#** | **Current Model Assumptions** | **Comment / NZ refinement from Nick** | **TB generic comments (i.e. not necessarily country-specific** |
|  | 85% of people start out social distancing, 85% of the time | It depends when the model run starts. Might be good to use this: Google has published [mobility data](https://www.google.com/covid19/mobility/) across March and April 2020. For NZ for the 29 March report the average reduction in all the categories (excluding residential) was 73% reduction. For Australia it was 38%. The more recent 10 April report gives additional data. Perhaps we could assume that these average value applies to all settings (including the home – eg, via improved hygiene as another contact reduction measure). | Jason – Nick and co have just published this a Public Health Expert Blog |
|  | Social policy restrictions are implemented at day 65 after January 15th - around March 21 in Australia - Same for NZ? | The lock-down in NZ started late at night on 25 March – so operational from 26 March. But from the Google data you can see behaviour change in NZ started around 15 March:  A screenshot of a cell phone  Description automatically generated |  |
|  | Incubation period is mean of 5 days sd 1 day before being symptomatic | Fine – if you have a reference for this | Ln transform. Below. S.e. of 0.2 would give 95% UI:  3.379 7.400 |
|  | Illness duration is set at a mean of 15 days, SD 2 days | Presumably this is based on: The WHO-China Joint Mission report stated that “the median time from onset to clinical recovery for mild cases is approximately 2 weeks and is 3-6 weeks for patients with severe or critical disease” [1]. | SD 2 days is too little, me thinks.  I would also use a ln transformation. S.e. on ln scale might be something like 0.1625 (i.e. something like s.e. = 0.15, which with 15 as expected=median, gives 95% UI of:  11.179147 to 20.1268  Essentially, tweak s.e. on ln scale to fit observed data. |
|  | Identified COVID-19 cases are isolated after the incubation period has lapsed | What % does this apply to? A minority of people may not adhere to home isolation (eg, could assume that 5% don’t adhere with SD=2%). |  |
|  | New cases are officially reported at a mean of 10 days after initial infection | Seems reasonable | Maybe a bit less? Also, it should be a separate var for days post infection (i.e. after event in 3) above. Ln normal again, etc… |
|  | 90% diagnosed cases comply with isolation orders | I might guess a bit higher at 95% - as per item “5” above | Put Uncertainty around this with something like beta 28,2. Gives mean 0.933, sd 0.045, median 0.942. Harder to get wider distribution than this in beta with high median – if looking for more uncertainty width, switch to logistic.    Beta 27, 3 gives mean 0.9, sd 0.054, median 0.909: |
|  | Age-ranges for the population are in deciles and current to Australian census data - Is NZ data readily available? | See attached Excel file. |  |
|  | The reinfection rate is 0 | Ok | Agreed |
|  | Early stage R0 is around 3.0 - it is not predetermined but calculated dynamically as the population infection evolves | Fine – I back-calculated Rt for NZ at 3.1 (using the CovidSIM model and an assumed start date of 1 March).  But good to perhaps use Ro=2.5 for a scenario analysis.  Of note is the basic reproduction number (R0) reported on 6 March by the WHO as in the range of 2.0 to 2.5 [2]. Of note is that an earlier review of 12 studies [3], suggested estimates that ranged from 1.4 to 6.49, with a mean of 3.28, a median of 2.79 and interquartile range of 1.16. Recent UK modelling used an estimate of 2.4 (range: 2.0 to 2.6) [4]. | Agreed |
|  | Superspreaders exist prior to travel restrictions being implemented - around 1 in 100 people moving to a random location | Superspreading seems to have been common in NZ given the various clusters reported here: <https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-current-situation/covid-19-current-cases/covid-19-clusters> | I wonder if the true prev of super-spreaders is less, simply because (I hypothesize) we are grossly underestimating incidence/prevalence of infection (more so at younger ages) currently. I suspect in the next week we will see seroprevalence surveys which suggest true infection double that in Verity et al, etc.  Aside here – but important for calibration. And for specifying consequences such as mortality. |
|  | People have an average number of close contacts per day of around 0.75 pre policy implementation and 0.25 post policy | I would favour u.15sing the Google data – as per item “1” above | What defines close contact? Isn’t it going to be more of a stochastic distribution, perhaps gamma, for each individual.  Moreover, it will be a dual type function:   * X contacts at Y level of closeness * Y contacts at Z level of closeness * Etc…..   That is, each individual would have a (daily, correlated) random draw of an entire CDF distribution of number of contacts by some measure of closeness. Yes? |
|  | The disease transmission rate is 50% per close contact | Not sure about this. Is it not better for this to be driven by the Rt and the reduction in contact via the interventions. | Entirely depends on above! I.e. definition of closeness. And far from binary.  Nick’s suggestion merits pursuing. So each individual would simply draw from a range of Rt (ln normal), with some predictor function. That draw would occur each day, and be correlated (quite highly) over time within individuals. Yes?  The next trick is to allow for some people to cut across (i.e. those essential service people who contact many). Can the population be split into average citizens, and essential workers? These two populations then sample from their own Rt curves by day?  The more I think about this, the trickier it is. Happy to dicuss in person. I am assuming, though, there is a standard way in ABM to do this. It is essential, though, for the question of “can we eliminate?” |
|  | People are potentially infectious through the period of their illness | Yes. But you could break the symptomatic period into two periods. In the second period, it might be reasonable to assume half the infectivity of the 1st period as may be broadly consistent with one study on changing viral load [5]. | Or, ideally, drawn from stochastic distribution.  So now we have multiple dimensions effecting transmission rate:   * Stochastic variation between individuals in how infective they are, all other vars held constant (i.e. non-contagious through to super spreader). May vary in predictable way between people by sex, age [again, all other vars held constant below – esp number of contacts per day that will vary by age] * **Variability in number of contacts per day outside household** * [assume all contacts within household contacted] * **Duration or closeness of each contact outside household** * Susceptibility of each contact.   The two items in bold will have perhaps a bimodal distribution by normal citizen versus essential worker. This is a critical variable to vary in scenario analyses to see if elimination is viable. |
|  | If hospital beds are available (max 65,000 Australia), patients can be quarantined | In our published modelling work for the Ministry of Health [6], we had the following:  “For isolation capacity in NZ hospitals we assumed that 10% of hospital beds could be converted for this use during the pandemic, with NZ having 2.61 hospital beds per 1000 population in 2018 [7]. If 10% of these were used for isolation purposes, then this is 2.6 per 10,000 (rounded to 3 per 10,000 for use in CovidSIM, or 1,500 beds in total).”  Using the current NZ population as 5.0 million – would indicate a total of 13,100 beds in NZ. |  |
|  | If ICU beds are available, they are allocated (max 7000 beds in Australia, ??? New Zealand??) | In our report [6], we had:  “ICU bed capacity: We used the reported number of ICU ventilated beds in NZ at 221 and an estimate from an ICU expert that these could be doubled (ie, to 442) in “extreme circumstances” [8].”  But a lot has happened in recent weeks so might be reasonable to use the 442 bed figure. In a scenario analysis a 3-fold increase could be used (ie, 663 beds). | There were 2,200 odd ICU beds. It is safe to assume tripling to quadrupling by May if we elect to relax social distancing.  Other key things, though, include:   * Length of stay – if it can be shortened on average from 10 to 5 days, we have doubled capacity.   That all said, I do not think this is an important var (at all?) for this paper focusing on chance of elimination. |
|  | 5% of people who become infected require ICU | **First in our most recent work we have used 1% of symptomatic cases being hospitalised:**  At the time of writing on 7 April 2020, 12 people were currently hospitalised in NZ with COVID-19 (out of a cumulative total 943 laboratory-confirmed cases [9]). But NZ does not publish the cumulative total of hospitalisations and the cases may represent a relatively healthy group of travellers with the most common age-group being 20-29 years. So we used data from Iceland where testing has been much more extensive and the age-distribution of cases appears more representative of the community [10]. In this setting on 7 April there were 39 hospitalisations out of a cumulative total of 1,586 infections [10], and where approximately half of infections were reported to be asymptomatic [11]. This gave a hospitalisation risk for symptomatic cases of 5%.  Of note is that modellers in the United Kingdom (UK) have used 4.4% (of all infected cases) [4], and for modelling in the United States 3%, 5% and 12% have been proposed [12]. The length of hospitalisation was assumed to be 10 days which is similar to other modelling work eg, 10.4 days for the UK [4].  **For the proportion of hospitalised cases needing ICU – we can use current NZ data 5/15 = 30%** <https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-current-situation/covid-19-current-cases>  **So combining the above gives 1.5% (5% x 30%) of symptomatic cases needing ICU.** (And we assume 50% of cases are asymptomatic – so 0.75% of infected cases needing ICU). | **I did this this differently again, using Verity and Fergusson data, but CRITICALLY the percentage of cases symptomatic by age makes a huger difference. I assumed a log-odds linear association by age, calibrated to crude data for <20 yr olds and >20 yr olds.**  **I will b updating this for our paper with latest evidence in next 48 hours – as it drives everything else.**  **Happy to share rough version now, or better version in 48 hours.** |
|  | **Others? Weather effects?** | In our report [6], we used in the base case a 25% variation in Ro:  Winter conditions are known to accelerate transmission of influenza and also the other coronaviruses which cause common cold like symptoms [13]. Enveloped viruses show strong seasonality with winter peaks [14], and SARS-Cov-2 is an enveloped virus. Even though there are many uncertainties relating to seasonality and this novel coronavirus [15], it seems prudent to assume some seasonal fluctuation so we increased the average by 25% in winter and reduced it by 25% in summer (with a sinusoidal variation throughout the simulated year), using a mid-winter peak for NZ of 15 July (ie, day 106 of the simulation). |  |
|  | **Case Fatality rates** | What is the source? The best source I have seen for the IFR & CFR is Verity et al [16] |  |
|  | if agerange = 0-9 [ set riskofDeath 0 ] |  |  |
|  | if agerange = 10-19 [ set riskofDeath .002 ] |  |  |
|  | if agerange = 20-29 [ set riskofDeath .002 ] |  |  |
|  | if agerange = 30-39 [ set riskofDeath .002 ] |  |  |
|  | if agerange = 40-49 [ set riskofDeath .004 ] |  |  |
|  | if agerange = 50-59 [ set riskofDeath .013 ] |  |  |
|  | if agerange = 60-69 [ set riskofDeath .036 ] |  |  |
|  | if agerange = 70-79 [ set riskofDeath .08 ] |  |  |
|  | if agerange = 80-89 [ set riskofDeath .148 ] |  |  |
|  | if agerange = 90-99 [ set riskofDeath .148 ] |  |  |

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