Epidemic Calculator

Day
218

Susceptible
Population not immune to disease. ∑ *6,138,597 (87.69%)* ∆ *-76 / day*

✓ Exposed
Population currently in incubation. ∑ *528 (0.01%)* ∆ *-26 / day*

✓ Infected
Number of infections *actively* circulating. ∑ *342 (0.00%)* ∆ *-17 / day*

Removed
Population no longer infectious due to isolation or immunity. ∑ *860,534 (12.29%)* ∆ *-196 / day*

Recovered
Full recoveries. ∑ *832,702 (11.90%)*

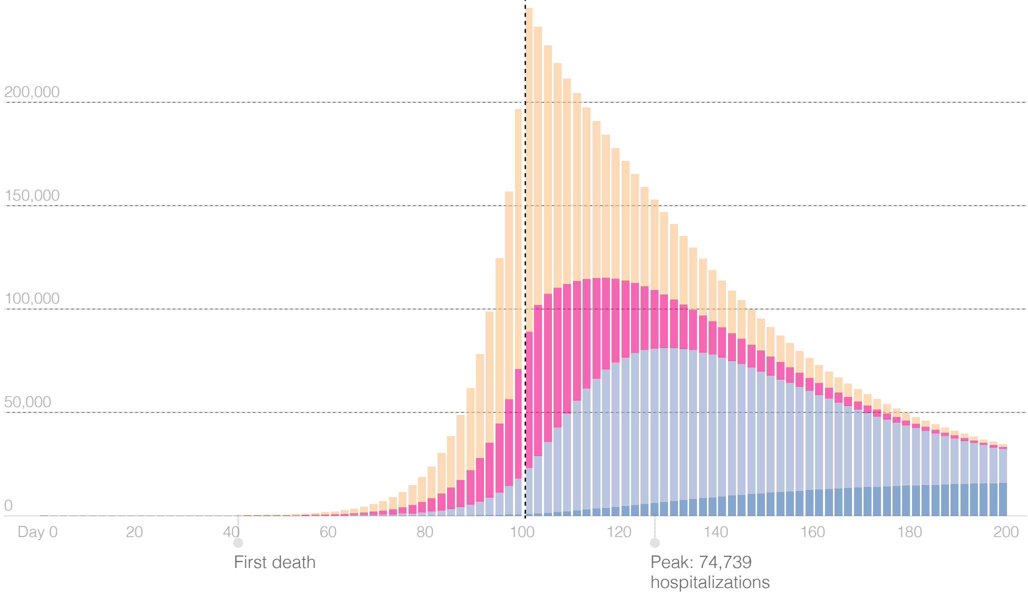
✓ Hospitalized
Active hospitalizations. ∑ *9,007 (0.13%)* ∆ *-281 / day*

✓ Fatalities
Deaths. ∑ *16,479 (0.24%)* ∆ *25 / day*

✓ linear scale

Intervention on day 100 (drag me) to decrease transmission by 66.67%

$\longleftarrow \mathcal{R}_0 = 2.20$ $\mathcal{R}_t = 0.73 \longrightarrow$



Transmission Dynamics

Population Inputs
Size of population. 7,000,000
Number of initial infections. 1

Basic Reproduction Number $\mathcal{R}_0$
Measure of contagiousness: the number of secondary infections each infected individual produces. 2.2

Transmission Times
Length of incubation period, T_{inc}. 5.20 days
Duration patient is infectious, T_{inf}. 2.9 Days

Clinical Dynamics

Morbidity Statistics
Case fatality rate. 2.00 %
Time from end of incubation to death. 32 Days

Recovery Times
Length of hospital stay 28.6 Days
Recovery time for mild cases 11.1 Days

Care statistics
Hospitalization rate. 20.00 %
Time to hospitalization. 5 Days

At the time of writing, the coronavirus disease of 2019 remains a global health crisis of grave and uncertain magnitude. To the non-expert (such as myself), contextualizing the numbers, forecasts and epidemiological parameters described in the media and literature can be challenging. I created this calculator as an attempt to address this gap in understanding.

This calculator implements a classical infectious disease model — **SEIR** (**S**usceptible → **E**xposed → **I**nfected → **R**emoved), an idealized model of spread still used in frontlines of research e.g. [Wu, et. al, Kucharski et. al]. The dynamics of this model are characterized by a set of four ordinary differential equations that correspond to the stages of the disease's progression:

$$\frac{dS}{dt} = -\frac{\mathcal{R}_t}{T_{\text{inf}}} \cdot IS, \qquad \frac{dE}{dt} = \frac{\mathcal{R}_t}{T_{\text{inf}}} \cdot IS - T_{\text{inc}}^{-1} E, \qquad \frac{dI}{dt} = T_{\text{inc}}^{-1} E - T_{\text{inf}}^{-1} I, \qquad \frac{dR}{dt} = T_{\text{inf}}^{-1} I$$

In addition to the transmission dynamics, this model allows the use of supplemental timing information to model the death rate and healthcare burden.

Note that one can use this calculator to measure one's risk exposure to the disease for any given day of the epidemic: the probability of getting infected on day 218 given close contact with 40 individuals is 0.00088% given an attack rate of 0.45% [Burke et. al].

A sampling of the estimates for epidemic parameters are presented below:

	Location	Reproduction Number $\mathcal{R}_0$	Incubation Period T_{inc} (in days)	Infectious Period T_{inf} (in days)
Kucharski et. al	Wuhan	3.0 (1.5 — 4.5)	5.2	2.9
Li, Leung and Leung	Wuhan	2.2 (1.4 — 3.9)	5.2 (4.1 — 7.0)	2.3 (0.0 — 14.9)
Wu et. al	Greater Wuhan	2.68 (2.47 — 2.86)	6.1	2.3

WHO Initial Estimate	Hubei	1.95 (1.4 — 2.5)		
WHO-China Joint Mission	Hubei	2.25 (2.0 — 2.5)	5.5 (5.0 - 6.0)	
Liu et. al	Guangdong	4.5 (4.4 — 4.6)	4.8 (2.2 — 7.4)	2.9 (0 — 5.9)
Rocklöv, Sjödin and Wilder-Smith	Princess Diamond	14.8	5.0	10.0
Backer, Klinkenberg, Wallinga	Wuhan		6.5 (5.6 — 7.9)	
Read et. al	Wuhan	3.11 (2.39 — 4.13)		
Bi et. al	Shenzhen		4.8 (4.2 — 5.4)	1.5 (0 — 3.4)
Tang et. al	China	6.47 (5.71 — 7.23)		

See [Liu et. al] detailed survey of current estimates of the reproduction number. Parameters for the diseases' clinical characteristics are taken from the following WHO Report.

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Model Details

The clinical dynamics in this model are an elaboration on SEIR that simulates the disease's progression at a higher resolution, subdividing I, R into *mild* (patients who recover without the need for hospitalization), *moderate* (patients who require hospitalization but survive) and *fatal* (patients who require hospitalization and do not survive). Each of these variables follows its own trajectory to the final outcome, and the sum of these compartments add up to the values predicted by SEIR. Please refer to the source code for details. Note that we assume, for simplicity, that all fatalities come from hospitals, and that all fatal cases are admitted to hospitals immediately after the infectious period.

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Export parameters:

http://gabgoh.github.io/COVID/?CFR=0.02&D_hospital_lag=5&D_incbation=5.2&D_infectious=2.9&D_recovery_mild=11.1&D_recovery_severe=28.6&I0=1&InterventionAmt=0.3333