

# An estimate of total active cases of COVID-19 based on number of announced deaths in a given region

March 23, 2020

*Sony Fermino dos Santos*  
Independent Researcher  
[sony.fermino@gmail.com](mailto:sony.fermino@gmail.com)

## Abstract

Considering the exponential nature of the spread of COVID-19, the Infected Fatality Rate, and the mean time to death, it is possible to estimate a more realist number of total active cases – in contrast to the reported confirmed cases – based on the number of deaths announced on a given day in a region. In an example we have the number of active cases estimated in 1600 times the number of new deaths in that day. This can be useful to provide better resource allocations.

## Definitions

$D$	Mean number of days since infection to death
$t_0$	Initial date of infection of a group of $n_0$ people
$t_D$	Date after $D$ days have passed after $t_0$ ( $t_D = t_0 + D$ )
$I_{FR}$	Infected Fatality Rate, percentage of infected people who die
$m$	Total number of new deaths announced on day $t_D$
$T$	Time to double the number of cases, in days
$n_0$	Total number of infected people on day $t_0$
$n_D$	Total number of infected people on day $t_D$

## Development

Since  $m$  is the number  $n_0$  of infected people who die after  $D$  days, we have:

$$m = n_0 \frac{I_{FR}}{100} \quad (1)$$

or

$$n_0 = \frac{100 m}{I_{FR}} \quad (2)$$

Let  $p$  be the number of doubling periods  $T$  in  $D$  days, that is:

$$p = \frac{D}{T} \quad (3)$$

So, after  $D$  days, the total number of active cases is multiplied by  $2^p$ , that is:

$$n_D = n_0 2^p \quad (4)$$

Therefore, the total number of active cases in day  $t_D$  is:

$$n_D = \frac{100 m}{I_{FR}} 2^{D/T} \quad (5)$$

## Example

For this example we will take some common parameters, but they vary widely according to region<sup>1</sup>:

$$D = 20 \text{ days} \quad (6)$$

$$I_{FR} = 1\% \quad (7)$$

$$T = 5 \text{ days} \quad (8)$$

which lead us to

$$n_D = 100 m 2^{20/5} = 1600 m \quad (9)$$

## Conclusion

This approximation shows that the real number of total active cases can be much higher than the reported confirmed cases in a day, based on the number of new deaths of that day. This can be useful to provide better demand previsions to allocate healthcare resources according to region.

## Reference

1. Max Roser, Hannah Ritchie and Esteban Ortiz-Ospina (2020). Coronavirus Disease (COVID-19) – Statistics and Research. <https://ourworldindata.org/coronavirus>.