Assessing reliable COVID-19 infected number: the Italian case

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COVID-19 (SARS-CoV-2) is a pandemic disease the world is currently managing. A lot of infected people, as we show in this article, is not detected. Furthermore, among the infected population, a subset of patients are detected at very late stages of the infection. It is important to track real numbers for the evolution of the pandemic disease [3, 4]. Starting from mortality rates of diseases caused by viruses in the same family (e.g. MERS, SARS, H1N1), we study the relationship between the (real) number of COVID-19 infections and the number of deaths, through Italian regions. We provide a method to assess reliable Italian COVID-19 infection numbers, also at regional scale. The method can be used by other countries in similar contexts in the next future [1]. In all countries the critic part is related to ICU resources [5].

The percentage of deaths, i.e. Case Fatality Rates (CFR), measured for other viruses in the Coronaviridæ family are the following: (i) virus subtype H5N1 = 60.0%; (ii) Middle Eastern Respiratory Syndrome (MERS) = 35.0%; (iii) Severe acute respiratory syndrome (SARS) = 11.0%; (iv) Coronavirus disease 2019 (COVID-19) = $\sim$ 4.3%; (v) Spanish (1918) flu = $\sim$ 2.5%. We observe that CFR values measured in Italy during the COVID-19 emergency are much higher than what virologists agree on [6]. Hence, starting from acceptable CFR values scenarios (i.e. 1%, 2% and 3%), we derive more realistic number of infections by exploiting the only real variable measurable (i.e. number of deaths) for those CFR percentage levels.

By using Italian infection data at April 2020[1], we report a total of 132, 547 cases (from 721, 732 swab tests), of which 93, 187 positives, 16, 523 deaths and 22, 837 recovered patients. By analysing the CFRs, we observe a value starting from low figures and increasing towards levels near 18%. We simulate three scenarios for CFR (1%, 2% and 3%), as reported in Figure 1 in which we give an idea of the difference between measured data versus more realistic one. We estimate the real total infections, e.g. in the 1% scenario, by considering the total positive COVID-19 cases measured (i.e. 93, 187) and the number of deaths (i.e. 16, 523). For these two values, the resulting CFR would be $CFR = 17.7\%$, which is heavily affected by the above mentioned bias. Hence, we consider the number of deaths (7, 503) as being true and, for each scenario, we calculate the total infections (e.g. $CFR = 1\%$, we obtain 1, 652, 300 infections, see Figure 1).

[1] http://www.salute.gov.it/nuovocoronavirus

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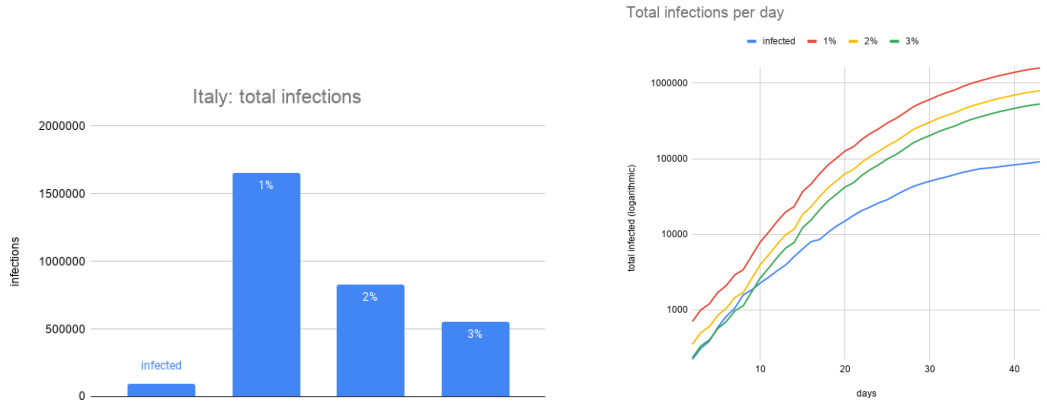

Fig. 1. Data reprojections with respect to three Case Fatality Rates (CFR) scenarios (1%, 2% and 3%) for Coronaviridiae virus. Left figure represents current total infections in Italy calculated for each CFR scenario. Right figure reprojects infection curves in the interval February 24^{th} - April 6^{th} 2020.

Finally, in right part of Figure 1 we show the measured total infections (Y axis) per day (X axis) in the official dataset (blue line) and in the projected CFR scenarios (red yellow and green lines) resulting in this study. Reported values are the trends of the total infections for each day (on the x axis) of the emergency. Please note that the y axis, which reports the number of infections, is logarithmic. These trends show how the number of infected has been heavily underestimated over time. The calculated scenarios are in fact higher than the measured ones by an order of magnitude from the early days towards the end of the time window (~ 40 days later). In [2] we report the whole information about how our method is applied at regional scale.

REFERENCES

[1] Yaseen M Arabi, Robert Fowler, and Frederick G Hayden. 2020. Critical care management of adults with community-acquired severe respiratory viral infection. *Intensive Care Medicine* (2020), 1–14.

[2] Pierangelo Veltri Giuseppe Tradigo, Pietro Hiram Guzzi. 2020. On the assessment of more reliable COVID-19 infected number: the italian case.

[3] Weijie Guan, Zheng-yi Ni, Yu Hu, Wenhua Liang, Chun-quan Ou, Jian-xing He, Lei Liu, Hong Shan, Chun-liang Lei, David SC Hui, et al. 2020. Clinical characteristics of coronavirus disease 2019 in China. *New England Journal of Medicine* (2020).

[4] Chaolin Huang, Yeming Wang, Xingwang Li, Lili Ren, Jianping Zhao, Yi Hu, Li Zhang, Guohui Fan, Jiuyang Xu, Xiaoying Gu, et al. 2020. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet* 395, 10223 (2020), 497–506.

[5] P Veltri P Guzzi, G. Tradigo. 2020. Spatio-Temporal Resource Mapping for Intensive Care Units at Regional Level for COVID-19 Emergency in Italy. *Int Journal of Env research and public health* (2020).

[6] Joseph T Wu, Kathy Leung, Mary Bushman, Nishant Kishore, Rene Niehus, Pablo M de Salazar, Benjamin J Cowling, Marc Lipsitch, and Gabriel M Leung. 2020. Estimating clinical severity of COVID-19 from the transmission dynamics in Wuhan, China. *Nature Medicine* (2020), 1–5.