



## Letter to the Editor

**Preliminary estimation of the novel coronavirus disease (COVID-19) cases in Iran: A reply to Sharifi**


## To the editor

The worldwide outbreak of the novel coronavirus (SARS-Cov-2) pneumonia remains a major public health concern. We thank Sharifi *et al.*'s comments to our recent study (Zhuang *et al.*, 2020). In that paper we adopted the similar method as Imai's (Imai *et al.*, 2020), which was used to estimate the number of COVID-19 cases in the early stages of the COVID-19 outbreak in Wuhan, Hubei, China. The model provided a rough range estimation about the epidemic size and has been recognized by peers as a valid method in the early stage of an epidemic (Kucharski *et al.*, 2020; Boldog *et al.*, 2020; Ng *et al.*, 2020). The accumulated evidence coincides with early estimation in scales.

The estimation of the total infected cases could be improved if more evidence is available. We had discussed alternative scenarios (Zhuang *et al.*, 2020) including smaller catchment population (e.g., 75% of the population), shorter detection window (e.g. different generation interval), different load factors of planes. A lower estimation of total infected cases is possible under the scenario in which a smaller catchment population is linked to those airports. Nevertheless, there are no solid evidence which specific scenario would be the reality now. Thus, we listed results under all scenarios.

It is a weak argument that international flight travelers have a more extensive local social network, as they might have a smaller local social network due to losing connections while living overseas. Some social studies may be helpful to determine which is more reasonable. The report from Statistical center of Iran (Statistical center of Iran, 2018) supports that over 25% of the whole population live in rural area. However, according to the same reference (Statistical center of Iran, 2018), population size of the age group 1-14 is around 4% larger in rural areas, compared to the urban areas. This situation is likely to be a factor in reducing the onset of infection symptoms among rural population, since most of COVID-19 patients were aged from 30 to 79 (87%) (Wu and McGoogan, 2020). Rural areas may be less dense compared to urban areas which is likely to result in decreased average number of effective contacts. Also, it is likely that there are not as many tests available for the rural population. Hence, overall, lower prevalence of infection in rural areas does not strongly reject the assumption that flight passengers are distributed homogeneously among rural and urban population.

If individuals are infected in other countries, then fly to Iran and finally arrive in a third country, they need to go through multiple temperature screenings without being noticed since many airports

have implemented boarding temperature screening. Thus, the probability is low. Meanwhile, according to the WHO Situation Report, the likely places of exposure for these 5 cases are outside reporting country and outside China (World Health Organization, 2020a; World Health Organization, 2020b; World Health Organization, 2020c). It was difficult for Chinese passengers to use Iran as the connection for their international flights after 31 January 2020 since Iran suspended all flights to and from China (Tasnim News Agency, 2020). In addition, Qom is a significant destination of pilgrimage. Given the epidemic situation in Qom at the early stage of outbreak, it is likely that some COVID-19 cases were exported to other counties and regions. Based on the current information (World Health Organization, 2020a; World Health Organization, 2020b; World Health Organization, 2020c; Tasnim News Agency, 2020; Republic of Lebanon Ministry of Public Health, 2020; Ministry of Health Sultanate of Oman, 2020; Gulf News, 2020) and research (Tuite *et al.*, 2020), it is reasonable to presume these cases exported from Iran were infected in Iran. If more laboratory evidence provided that these cases are infected outside Iran, results will be change.

We did not consider other international flight since other countries did not disclose the number of COVID-19 cases imported from Iran and it is unreasonable to assume this number to be 0. In our model, numbers of passengers were determined for each country separately. Inputting additional information from other countries and corresponding passengers to our model can improve the estimation accuracy and narrow the confidence interval. As for those countries sharing borders with Iran, we did not include them as we could not find population flow data on land and maritime travel between those countries and Iran.

The model we used is a simple model with a few parameters. We have provided the assumption, parameter values (effective catchment population, detection window, listed in Table 2) and reference in the methods part. Basic reproductive number ( $R_0$ ) and the date of the epidemic onset were not involved in the model. The use of news did not affect the setting of our parameters. We mentioned the news in order to explain the reason why we conduct such research.

An early estimation of epidemic is aimed to raise the public and government awareness. It gives a rough estimate of the total cases. Before a large-scale serological study is available, we already tried to consider as many scenarios as possible to prevent the result from being misinterpreted. As for the factors (governments measures) mentioned by Sharifi *et al.*, we agree that it is important and it should be considered carefully when researchers try to forecast future development of epidemic situation. We appreciate great efforts made by Iranians in fighting against the epidemic and we thank Sharifi *et al.*'s comments to our study. As we explained, our method and estimate are robust and in line with (Tuite *et al.*, 2020), but we also agree with (Tuite *et al.*, 2020) on the estimate of couple

thousands in a less likely scenario. Our estimates in Table 2 included cases of several thousands.

## Declaration

### Ethical Approval and Consent to participate

Not applicable.

## Competing interests

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## Authors' contributions

All authors conceived and conducted the research and wrote the draft. All authors approved the submission.

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