

## Comment on “Predicting the mortality due to covid-19 by the next month for Italy, Iran and South Korea; a simulation study”

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(Please cite as: **Mirmomeni G, Bayat A. Predicting the mortality due to covid-19 by the next month for Italy, Iran and South Korea; a simulation study. Gastroenterol Hepatol Bed Bench 2020;13(4):421-422.**)

### To The Editor

We have read with great interest the study by Shojaee et al. (1) entitled “predicting the mortality due to COVID-19 by the next month for Italy, Iran and South Korea; a simulation study.” During this study, the authors precisely estimated the number of laboratory-confirmed COVID-19 patients and the rate of death among three countries in the next month using a “Poisson” distribution.

Poisson distribution is the common discrete probability distribution for the modeling of counts data. This type of distribution assumes an equi-dispersion of data (2). The equi-dispersion results when the variance and the mean are equal.

However, in real life, the populations are usually non-uniform (heterogeneous) and for several count data, the mean is not necessarily equal to that variance. This phenomenon is called as a problem of over-dispersion (3). Endo et al. (4) findings also indicated that the distribution of COVID-19 infection is highly over-dispersed.

It has been suggested that the most appropriate approach to deal with the problem of over-dispersion is using the “negative binomial” (NB) distribution. The NB distribution can be utilized for over-dispersed count data when the conditional variance is higher than the conditional mean (2). If the distribution of the outcome variable is over-dispersed, then the confidence intervals (CIs) for the negative binomial distribution are probably to be narrower than those derived from a Poisson distribution.

In conclusion, we suggest simulating the mortality rate in COVID-19 studies using the “negative binomial” distribution. This distribution could provide more flexible functional forms than Poisson distribution to accommodate over-dispersion.

### Conflict of interests

The authors declare that they have no conflict of interest.

### References

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## Authors' responses to letter

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### To The Editor

We are appreciate to Golshan Mirmomeni and Arash Bayat for reading our paper (1) with interest.

As they mentioned in their letter, in the real life count data are usually non-uniform (heterogeneous) and in most cases the mean is not necessarily equal to that variance, which over-dispersion. We agree that negative binomial could be an appropriate approach to deal with the problem of over-dispersion. However, in our simulation, we believe the accuracy of model, despite of the problem of over-dispersion, is in a good level. In our study, main goal was to predict the number of confirmed and death cases in just short period of one month. In addition, we consider the items as an input data in a queue system by day-to-day, and according to a study of Bhat (2), the input distribution in the queue system has a Poisson distribution. We used this default and predicted new cases and mortality in the coming days. Now, it is worth mentioning that we have passed

the forecast date mentioned in the study, after checking and verifying the predictions with the reality that happened in the surveyed countries (and reported as the official statistics of COVID-19 infection and mortality), the accuracy of our results will be confirmed. By the way, using the negative binomial approach could be useful for feature studies to predict the future behavior of COVID-19.

Sincerely.

### References

1. Shojaee S, Pourhoseingholi MA, Ashtari S, Vahedian-Azimi A, Asadzadeh-Aghdai H, Zali MR. Predicting the mortality due to Covid-19 by the next month for Italy, Iran and South Korea; a simulation study. *Gastroenterol Hepatol Bed Bench* 2020;13:177-79.
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