Predictive mathematical modelling of the total number of COVID-19 cases for the United States

ABSTRACT

The current global COVID-19 pandemic is causing a lot of deaths and economic losses worldwide. The modelling of future death and cases is a very important aspect of managing the severity of the pandemic. In this paper, we demonstrated potential use of various growth models like modified Gompertz, Von Bertalanffy, Baranyi-Roberts, modified Logistics, Morgan-Mercer-Flodin (MMF), modified Richards and Huang in modeling the epidemic trend of COVID-19 in the form of total number of infection cases of SARS-CoV-2 in the United States as at 20th July 2020. The Morgan-Mercer-Flodin (MMF) model showed best fitting to the data set with least RMSE and AICc and the highest adjusted R2 values. The values for Accuracy and Bias Factors were closest to 1.0. Despite this, further statistical diagnosis of the data showed nonnormality with the residuals failing the runs and homoscedasticity tests. Interestingly, this was addressed by remodeling the data from day 132 onwards using the MMF model, which results in improving the statistical diagnosis. The fitting coefficients obtained include maximum growth rate (logmm) of 0.03 (95% CI 0.023 - 0.039), curve constant (d) that affects the inflection point of 1.42 (95% CI 1.304 - 1.540), lower asymptote value (b) of 6.454 (95% CI 6.451 - 6.456) and maximal total number of cases (ymax) of 7,906,786 (95% CI 6,652,732 - 10,839,269). The MMF model predicted that by 20th of August 2020 the total number of cases in the United States will be 5,560,168 (95% CI of 5,295,337 - 5,838,243), while the Fig. will rise to 6,366,506 (95% CI of 5,791,751 - 6,998,298) by 20th of September 2020. The predictive potential of the utilized model makes it a powerful tool for epidemiologist monitoring the severity of SARS-CoV-2 (COVID-19) in the United States in the near future. Although, predictions from this model as with any other model, need to be taken with caution due to unpredictable nature of COVID-19 situation locally and globally.

Keyword: Total infection; COVID-19; Pandemic; MMF; Mathematical model