

Forecasting the Trends and Probable Impact of COVID-19 on Low and Middle Income Countries based on the publicly available data

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Abstract

The COVID-19 pandemic becomes a public-health threat globally exerting a devastating impact on patients, healthcare providers, systems, and financing. Both developed and developing countries are struggling to control the pandemic, though situation is alarming in Low-and-Middle-Income-Countries (LMICs). Lack of social-distancing, higher population, health-inequalities, adequate health infrastructure is placing tremendous challenge to control COVID-19. Present study was undertaken to forecast the trends in outbreak of COVID-19 in LMICs (40 countries) based on the publicly-available-case-data drawn from the <https://ourworldindata.org/coronavirus-source-data>. An auto-regressive-integrated-moving-averages (ARIMA) model was used to predict the trends in total confirmed and death-cases caused by COVID19. Findings reveal the highest point-forecast of confirmed-case rate for Zambia (2.13%) and lower death rate(0.48%) in Morocco across LMICs. Keeping in view the limited healthcare resources in LMICs, accurate forecasting and detection, stronger disease-surveillance, and avoidance of acute-care for infected-cases is indispensable.

Keywords: COVID-19, Low-and-Middle-Income-Countries, ARIMA, Forecasting, Healthcare

I. Introduction

Worldwide, over the past two decades, a larger number of individuals and animals have been affected with three epidemics caused by the family of coronavirus (Severe-Acute-Respiratory-Syndrome (SARS)-2003, Middle-East-Respiratory-Syndrome (MERS)-2012, and Coronavirus-Disease (COVID-19) [1]. However, significant genetic dissimilarities have been documented between pathogens of these three epidemics, particularly amid MERS and COVID-19. Initially, the hotspots for these epidemics were the Middle-East, Saudi-Arabia, and China. They transmitted from animal to human, and later transmissions of pathogens were reported from humans to humans in other countries as well. Epidemiological evidence of the COVID-19 outbreak began from Wuhan, China from December 12, 2019 [2].

The World Health Organization (WHO) declared COVID-19 a pandemic on March 11, 2020 as more than 118,000 cases had been reported in 110 countries with a sustained worldwide risk of further spread [3, 4]. As of May 05, 2020, the spread of COVID-19 since the first case in December 2019, has reached 3,582,469 confirmed-cases including 2, 51,365 deaths globally [5, 6]. It is argued that developed countries have greater expertise in the investigation and management of such cases than low-and-middle-income-countries (LMICs). Controlling the spread in these countries would be critical as these LMICs are accommodating about 6.3 billion people [7, 8]. The COVID-19 pandemic continues to create an acute shortage of essential supplies, personal protective equipment, diagnostics, and medical supplies among the LMICs [9].

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According to real-time data, confirmed-cases of COVID-19 are growing exponentially. Therefore to contain the spread of coronavirus, it is important to forecast the precise increase in the expected number of cases to comprehend what is required to control the perturbing trends in COVID-19 [9-11]. The accuracy in the predictions will play a critical role in managing the health emergency and preparedness of the respective governments of these LMICs to tackle the COVID situation. In this paper, we aimed to assess the spread of coronavirus (COVID-19) in the LMICs from publicly available data and to assess the quality of official case records trend by using the ARIMA method.

II. Research Methodology

The data were collected from the publicly available sources i.e. Our World in Data (<https://ourworldindata.org/coronavirus-source-data>) on COVID-19 total confirmed and death cases [12]. The data were collected and analyzed from December 31, 2019, to June 9, 2020. We used the Auto-Regressive-Integrated-Moving-Average (ARIMA) forecasting model, a popular statistical method for univariate-time-series forecasting [13]. In this method, we use weighted-averages of past observations to forecast new values. Here, the idea is to give more importance to recent values in the series. Thus, as observations get older (in time), the importance of these values get exponentially smaller. ARIMA model has been used to forecast the COVID-19 daily confirmed and death cases in LMICs. The information was available for only 40 LMICs, which has been used in the present study. The regressive forecast-curves were consistent with the pattern of actual values. ARIMA methodology does have its limitations. The parameters for the tentative model from the identification step were estimated using the ARIMA module in R Software [14].

III. Results and Conclusion

The study estimates show the highest point-forecast for confirmed-cases rate of COVID-19 in Zambia across the LMICs. The confirmed-cases in Zambia could be around 1339 (95% CI: 980, 1699) as on June 9, 2020. As a result, the confirmed-case rate of disease for Zambia as a whole will increase approximately at the rate of 2.13% for confirmed cases daily. The base data has been taken from December 31, 2019, to May 30, 2020, for daily confirmed and death cases. Based on this data, these confirmed and death cases have been predicted from May 31, 2020 to June 9, 2020, and presented in Table 1. Among these 40 LMICs, the lowest number of death cases rate has been estimated in Morocco was 0.48(207 with 95% CI 173, 240), mentioned in Table 2. Figure 1(a) and 1(b) shows the highest and lowest rate of confirmed and death cases for COVID-19. The figure shows a trend line depicted in red and blue colors, where the red color curve indicates the number of confirmed and death cases from December 31, 2019, to May 30, 2020, based on the actual data. The blue colour curve indicates the predicted values for both confirmed and death cases. The Y-axis represents the number of confirmed-cases and the X-axis represents days. It is predicting the number of confirmed (Zambia)and death (Morocco) cases rate from May 31, 2020 to June 9, 2020.

Table 1

Higher and lower forecasting rate of confirmed and death cases across the LMICs by using Auto ARIMA method

Date	Confirmed (Zambia)			Deaths (Morocco)		
	Point Estimate	95% confidence intervals		Point Estimate	95% confidence intervals	
31-May-20	1099.19	1031.01	1167.37	202.51	197.98	207.03
01-Jun-20	1111.08	1018.83	1203.32	203.01	195.71	210.31
02-Jun-20	1139.69	1012.07	1267.30	203.52	193.44	213.59

03-Jun-20	1168.30	1007.68	1328.92	204.02	191.06	216.99
04-Jun-20	1196.91	1003.97	1389.84	204.53	188.54	220.52
05-Jun-20	1225.52	1000.27	1450.76	205.04	185.86	224.21
06-Jun-20	1254.13	996.23	1512.02	205.54	183.04	228.05
07-Jun-20	1282.74	991.67	1573.80	206.05	180.06	232.04
08-Jun-20	1311.35	986.48	1636.21	206.55	176.93	236.18
09-Jun-20	1339.96	980.59	1699.33	207.06	173.67	240.45

Table 2

Highest in number of confirmed and death cases in India across the LMICs by using ARIMA method

Date	Total cases			Total deaths		
	Point Estimate	95% confidence intervals		Point Estimate	95% confidence intervals	
31-May-20	182085.73	181625.1	182546.4	5189.78	5159.35	5220.21
01-Jun-20	190570.77	189637.6	191504	5408.55	5354.08	5463.03
02-Jun-20	198808.63	197155	200462.3	5627.33	5546.34	5708.32
03-Jun-20	207029.56	204495.9	209563.3	5846.11	5735.94	5956.27
04-Jun-20	215392.71	211929.2	218856.2	6064.88	5922.99	6206.78
05-Jun-20	223723.16	219246.7	228199.6	6283.66	6107.62	6459.69
06-Jun-20	231984.34	226385.1	237583.6	6502.43	6289.99	6714.88
07-Jun-20	240284.18	233485	247083.3	6721.21	6470.20	6972.22
08-Jun-20	248611.03	240549.5	256672.6	6939.99	6648.38	7231.60
09-Jun-20	256908.42	247510.6	266306.2	7158.76	6824.60	7492.93

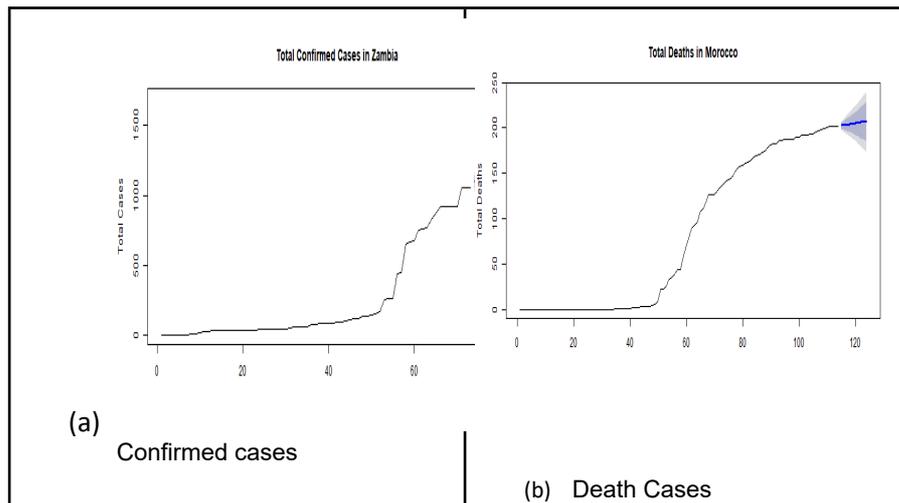


Figure 1: Higher and lower rate of forecasting confirmed and death cases through ARIMA method among LMICs

Based on the size of the population, India has the highest number of confirmed-cases when compared to other LMICs. The total number of confirmed cases in India by June 9, 2020 will be 256908 (95% CI: 247510, 266306). India followed by Pakistan, Ukraine, Bangladesh, Indonesia, Philippines, and other remaining LMICs as of June9, 2020. Similarly, it was estimated that India had the highest number of deaths which will be 7158 (95% CI: 6824, 7492). India is followed by Indonesia, Philippines, Pakistan, Egypt, Ukraine, Bangladesh, Moldova, and other remaining LMICs respectively by June9, 2020.

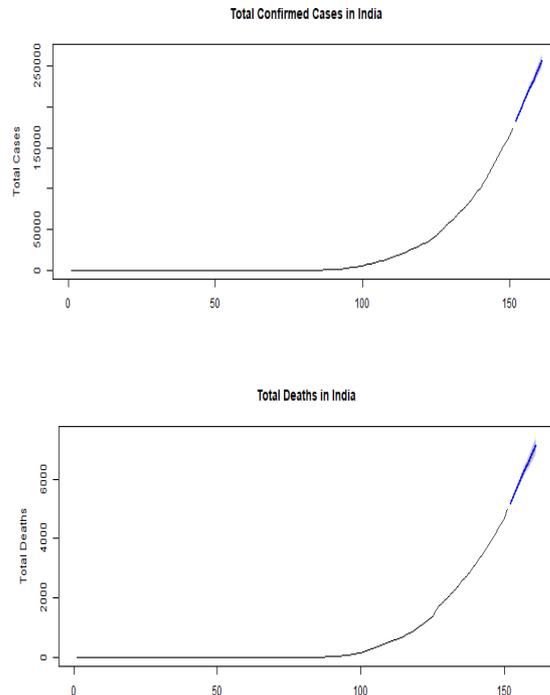


Figure 2: Highest in number of confirmed and death cases through ARIMA method in India among LMICS

IV. Discussion

Having the highest share of the population, who are struggling for daily sustenance and living in the poor socio-economic environment, the spread of the disease is far easier in LMICs than that of the developed countries [15]. The present paper forecasts the spread of COVID-19 among the 40 LMICs in terms of confirmed and death cases by June 9, 2020. Though the data was not available on the death-cases among 9 out of 40 LMICs, predictions were not possible for them in terms of deaths. The study highlights that if we go by the highest rate of point-forecasts for confirmed-cases, Zambia will outnumber other LMICs till June 9, 2020 [16]. What makes this pandemic particularly difficult for countries like Zambia are; the structural constraints that already exist in their economies; notable socio-economic inequalities, and highest labour force in the informal sector, the country may face severe challenges to handle

the pandemic [16]. In terms of the highest rate of point-forecast for death-cases, Senegal may be at the top of the list of all 40 LMICs. The country is already facing concerns about basic hygiene needs, health infrastructure, and people living in unfavourable conditions [17].

However, if we go by the numbers and in terms of the size of the population, then India will outnumber other countries in terms of both confirmed and death cases. The country is accommodating the second-largest share of the population, having varied socio-economic and demographic conditions, facing tremendous challenges in terms of the COVID-19 outbreak [18].

Lowest confirmed cases will be recorded in Tunisia, and the lowest deaths have been forecasted in Morocco. It is time for the LMICs to get ahead of the curve and respond to the emergency. The insufficient healthcare resources, inadequate financing mechanisms, and constrained health infrastructure in LMICs have resulted in the escalated rate of infections followed by a higher incidence of mortality. It needs to be recognized that prevention and overall management of such health crises may be more difficult in LMICs than in developed countries.

References

- Yang, Y., Peng, F., Wang, R., Guan, K., Jiang, T., Xu, G. & Chang, C. (2020). The deadly coronaviruses: The 2003 SARS pandemic and the 2020 novel coronavirus epidemic in China. *Journal of autoimmunity*, 102434.
- Kolifarhood, G., Aghaali, M., Saadati, H. M., Taherpour, N., Rahimi, S., Izadi, N., & Nazari, S. S. H. (2020). Epidemiological and clinical aspects of COVID-19; a narrative review. *Archives of academic emergency medicine*, 8(1).
- Cascella, M., Rajnik, M., Cuomo, A., Dulebohn, S. C., & Di Napoli, R. (2020). Features, evaluation and treatment coronavirus (COVID-19). In *Statpearls* [internet]. StatPearls Publishing.
- Lauer, S. A., Grantz, K. H., Bi, Q., Jones, F. K., Zheng, Q., Meredith, H. R., ... & Lessler, J. (2020). The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: estimation and application. *Annals of internal medicine*, 172(9), 577-582.
- Benvenuto, D., Giovanetti, M., Ciccozzi, A., Spoto, S., Angeletti, S., & Ciccozzi, M. (2020). The 2019-new coronavirus epidemic: evidence for virus evolution. *Journal of medical virology*, 92(4), 455-459.
- World Health Organization. Coronavirus; 2020. https://www.who.int/health-topics/coronavirus#tab=tab_3. Accessed 26 Mar 2020.
- World Health Organization. Novel coronavirus (COVID-2019) situation; 2020. <https://experience.arcgis.com/experience/685d0ace521648f8a5beeeee1b9125cd>. Accessed 26 Mar 2020.
- World Health Organization. Coronavirus disease 2019 (COVID19) situation report – 56. 2020. https://www.who.int/docs/default-source/coronavirus/situation-reports/20200316-sitrep-56-covid-19.pdf?sfvrsn=9fda7db2_6. Accessed 26 Mar 2020.
- Hopman, J., Allegranzi, B., & Mehtar, S. (2020). Managing COVID-19 in low-and middle-income countries. *Jama*, 323(16), 1549-1550.
- Van Doremalen, N., Bushmaker, T., Morris, D. H., Holbrook, M. G., Gamble, A., Williamson, B. N., ... & Lloyd-

- Smith, J. O. (2020). Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *New England Journal of Medicine*, 382(16), 1564-1567.
- World Health Organization. Coronavirus; 2020. https://www.who.int/health-topics/coronavirus#tab=tab_2. Accessed 26 Mar 2020. <https://ourworldindata.org/coronavirus-source-data>
- Montgomery, D. C., Jennings, C. L., & Kulahci, M. (2015). Introduction to time series analysis and forecasting. John Wiley & Sons.
- Hyndman, R. J., & Khandakar, Y. (2007). Automatic time series for forecasting: the forecast package for R (No. 6/07). Clayton VIC, Australia: Monash University, Department of Econometrics and Business Statistics.
- Bong, C. L., Brasher, C., Chikumba, E., McDougall, R., Mellin-Olsen, J., & Enright, A. (2020). The COVID-19 Pandemic: Effects on Low-and Middle-Income Countries. *Anesthesia and analgesia*.
- World Health Organization. Coronavirus disease (COVID-19) advice for the public: myth busters; 2020. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters>. Accessed 26 Mar 2020.
- Zhao, Z., Li, X., Liu, F., Zhu, G., Ma, C., & Wang, L. (2020). Prediction of the COVID-19 spread in African countries and implications for prevention and controls: A case study in South Africa, Egypt, Algeria, Nigeria, Senegal and Kenya. *Science of the Total Environment*, 138959.
- Singh, A. K., Singh, A., Shaikh, A., Singh, R., & Misra, A. (2020). Chloroquine and hydroxychloroquine in the treatment of COVID-19 with or without diabetes: A systematic search and a narrative review with a special reference to India and other developing countries. *Diabetes & metabolic syndrome*, 14(3), 241–246. <https://doi.org/10.1016/j.dsx.2020.03.011>