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Letter to the Editor

Modeling Occurrence of Dengue Cases in Malaysia

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Dear Editor-in-Chief

Dengue fever (DF) is the single most important vector-borne viral disease in tropical and subtropical areas worldwide. Globally, estimated 390 million dengue virus infection cases and 100 million incidences of DF occur each year (1). According to the WHO (2), southeast and western Pacific areas carry approximately 75% of global DF infections. This is a serious issue because the severity resulting from DF is considerably larger than that of other infectious diseases. In Malaysia, DF infection rates have continually increased from 376 infections in 1985 to 49355 infections in 2008 (3). Over 131 fold growth in incidence this period. In fact, the prevalence of DF is increasing at an alarming pace and has caused significant health, economic, and social burdens on communities and their occupants. The increase in DF incidence from 2011 to 2012 was 10.14% (4). In 2014, there was a 17.118% increase in DF cases in comparison with 1981 cases and 3.640% compared with 1991 cases. Current dengue prevention approaches in Malaysia are largely inadequate or underdeveloped and provide little assistance in preventing the transmission and regulation of DF. Timely, forecasts for possible DF outbreaks would be useful for the prevention and control of DF.

Time series methods process have been increasingly used in surveys to forecast communicable diseases, including DF (5). The objective of this study was to develop a model that can predict DF for the period from 2016 to 2025 in Malaysia based on a 34-yr time series data for the period from1981 to 2014. Such forecasting would be useful in improving outbreak preparation and growing public health interventions to address dengue incidence.

The yearly data on DF cases in Malaysia from 1981 to 2014 were collected from the Malaysian Health Ministry's published reports other documents. An ARIMA model was fitted using a training dataset from 1981 to 1999, and the fitted model was used to predict values for a validation period from 2000 to 2014 to evaluate the fitted model. Overall, the data showed a tendency toward increasing DF incidence. The smallest incidence was 376 (1985), and the largest incidence was 108698 (2014). Over these 34 yr, 69669 cases were reported with a mean incidence of 20473 (median =12201) and a standard deviation of 22850 cases, reflecting a positive skew in the data. The time sequence plot of reported DF incidences exhibited an upward trend assumed nonstationary. We considered a first-lag difference span in the ARIMA model structure (d=1). Plots of the ACF and PACF difference series support these deductions. Therefore, an ARIMA (p, 1, q) was selected the best of the models considered.

Several models had different fitted values of p and q, and ARIMA (1, 1, 1) was selected as the best model with a RMSE of 6950.65 a BIC of 671.3, an AIC of 667.7 and a MAPE of 46.24. Model adequacy was established using the Ljung-Box test (Q statistic=12.11, *P*-value=0.92), which showed no significant residual correlation at different lag times. The residuals appeared as white noise, as supported by the plots of ACF and PACF. After testing its validity, the best model was used to predict the prevalence of DF cases from 2016 to 2025. The fitted value of the Malaysian dengue fever incidence from 2000 to 2015 has an increasing trend up to 2011 then there is a slow decline up from 2012 to 2013, then a sharp increase in 2014. The trend in the spread of DF cases was forecast, it reveals from the results that there is a gradual decrease of the forecasted case from 2016 to 2025.

ARIMA models are advantageous for modeling the time-based dependent configuration of a time series and can be used as adequate tools for epidemiological surveillance (6). An ARIMA (2, 1, 3) model presented the best fit to dengue prevalence in Brazil (5). Additionally, ARIMA (1, 0, 0) was an appropriate model to predict dengue prevalence in Bangladesh (7). To our knowledge, this study is the first to describe the presentation of an ARIMA model for forecasting the incidence of DF cases in Malaysia. The number of DF cases generally increased from 1981 to 2014. The forecasted values revealed that DF incidence will reach maximum in 2014 and that the incidence will subsequently decline slowly until 2025. Nevertheless, these forecasts might not reliably project the number of DF cases in endemic years because an epidemic might result from a deficiency of protection in residents unprotected from first time exposure to a given dengue virus-related stereotype. More decisively, weather-related phenomena, such as temperature, humidity, and precipitation have substantial influences on dengue spread; thus, introducing environmental variations into these models may increase their predictive power.

The forecasting models were based on reported data, which represent the most serious cases of DF admitted to hospitals and confirmed by laboratory testing. Nevertheless, the ARIMA modeling is a utilitarian instrument for analyzing surveillance data and for forecasting cases and helps to guide timely prevention and control standards.

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