

Examination of the Quantitative and Temporal Features of COVID-19

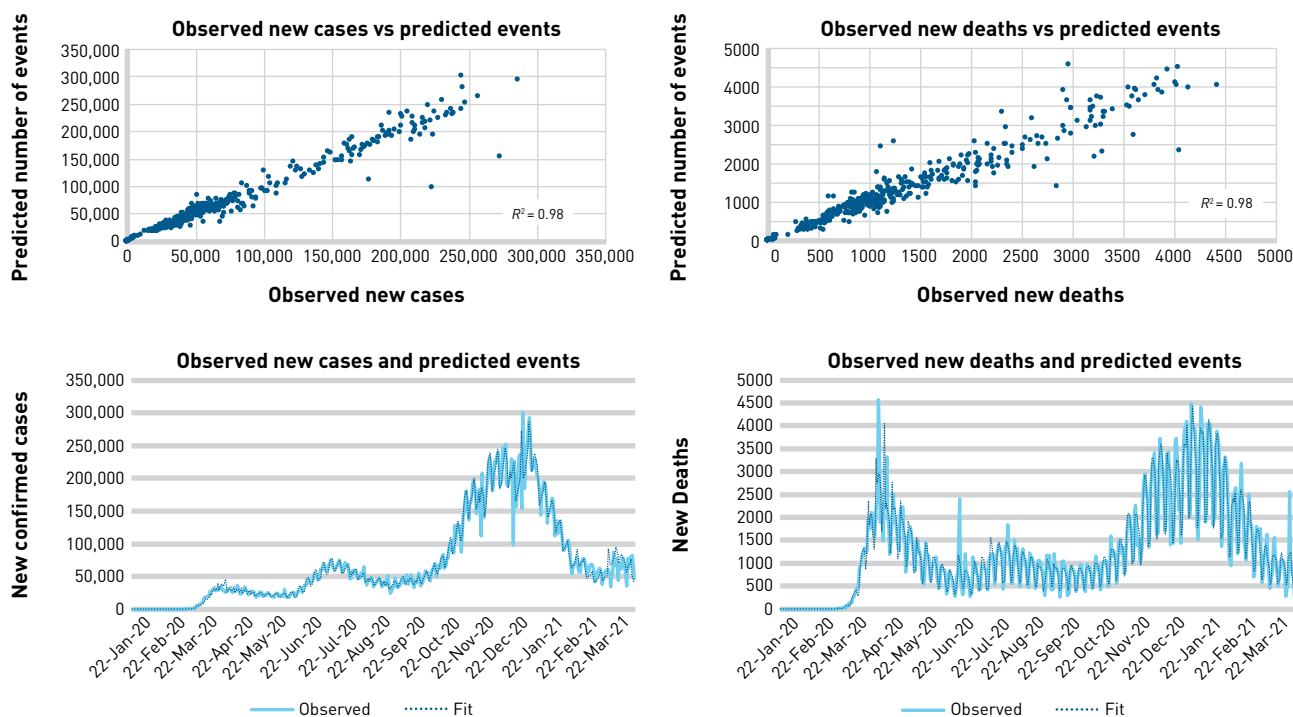
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Examination of the quantitative and temporal features of COVID-19 infections and deaths through appropriate model fitting provides the benefit of sensitivity analysis in which different values of the independent variables can be applied in a formula to estimate the impact on the outcome variable¹ among other sensitivities. The model fitting process identifies the independent variables that are available for sensitivity analysis.

Both COVID-19 infections and deaths can be fit by standard count models that are used for discrete outcomes such as infections. A negative binomial model that adjusts for overdispersion

in count models is employed. R^2 estimation in count models has been described by Cameron and Trivedi.² The results are shown in the **Figure**, in which the upper panels show the x-y plot of observed and fit and the lower panels show observed and fit/estimated over time. The independent variables used to achieve the fits shown for both new cases and deaths are day of the week, week of the year, and the polynomial terms required by the observed pattern type (eg, quadratic, cubic). Day of the week describes the weekly cycle, where new cases are highest on Fridays and lowest on Sundays and deaths are highest on Wednesdays and lowest on Sundays. Week of

FIGURE. Comparison of the Observed and the Regression Fit/Estimate of New COVID-19 Cases and Deaths



the year accounts for differences in exposure and transmission during the 4 seasons. The regression output includes the incident rate ratios and their CIs, estimated by week from daily new cases and deaths shown in [eAppendix Figure 1](#) (eAppendix available at [ajmc.com](#)), emphasizing the seasonality of both. [eAppendix Figure 2](#) shows a comparison of the reproduction rate (R_0) for COVID-19 estimated at the national level using EpiEstim³ and the daily new infection count. When the new infection count is rising, resulting in a positive slope, R_0 is greater than 1; when declining, R_0 is less than 1. Stata version 17 (StataCorp) was used for regression analyses. The COVID-19 data acquisition method has been previously described.⁴

Late spring and fall are when the variation in infection and death is lowest; middle to late winter and summer is when variation in both is greatest, as revealed by the regression model results. The large variations in new cases and new deaths are potentially opportunities for improvement. A convenient rule of thumb is implied by the comparison of R_0 and the daily infection count. ■

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TAKEAWAY POINTS

- COVID-19 infections and deaths vary by the 4 seasons annually and cycle by the day of the week.
- ▶ Deaths are greatest on Wednesdays and lowest on Sundays.
 - ▶ Cases are greatest on Fridays and lowest on Sundays.
 - ▶ Deaths and cases are greatest and show the greatest variation in middle to late summer and winter, and they are lowest and show the least variation in late spring and late fall.
 - ▶ Large variations are potentially opportunities for improvement.

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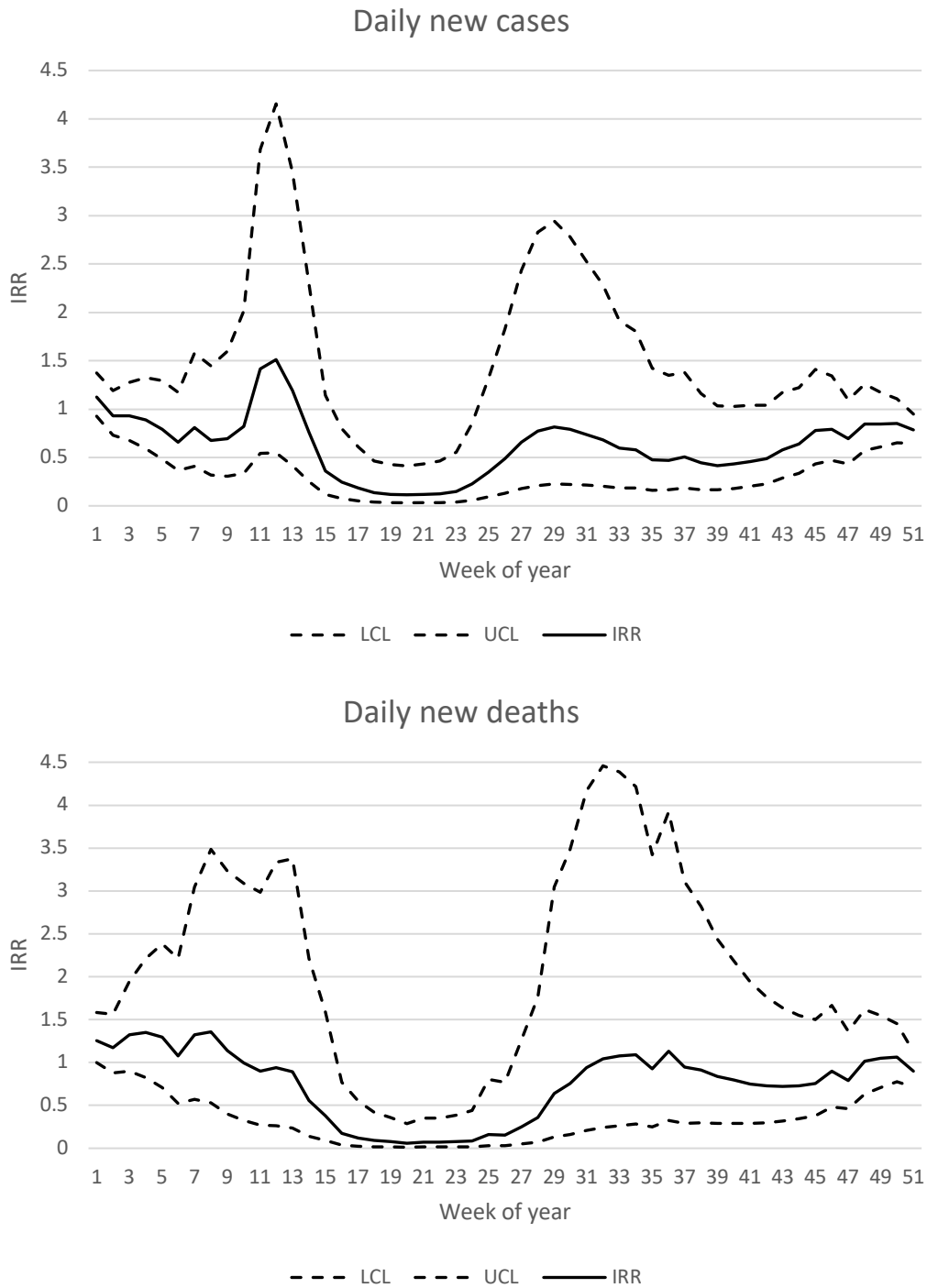
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eAppendix Figure 1. Seasonal Variation in Magnitude and Confidence Interval of New COVID-19 Cases and Deaths



IRR, incidence rate ratio; LCL, lower confidence limit; UCL, upper confidence limit.

eAppendix Figure 2. Comparison of COVID-19 R_0 and the Slope of New Cases

