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A first estimation of the impact of public health actions against COVID-19 in Veneto (Italy)

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The Veneto region, a plot of land that goes from Adriatic Sea to the Alps in North-Eastern part of Italy, has been one of the first areas in the country where COVID-19 has been spreading. The number of positive cases as of today (14th of March) is 1775, with 55 deaths and 366 hospitalizations (one third in the Intensive Care Units). Veneto has been also one of the first to react to the epidemic, by adopting severe actions in line with recommendations based on previous experiences ^{1,2}, like the adoption of community-based containment strategies, starting from quarantining the city of Vo' and further implementing such strategies with the spreading of the outbreak (Supplementary Material for the timeline of such interventions).

We looked for an early indication of the modification in the epidemic growth after the first actions were implemented: i.e.: after February 23rd. A specific changepoint in the epidemic growth has been identified on the 2nd of March, where the epidemic changed speed as compared to what was to be expected.

Based on the analysis before and after the changepoint, our estimates indicate that, as of today, about 348 (95% C.I. 322 – 373) infected cases were avoided, thanks to a slowing down in the evolution of the epidemic compared to what was expected as per what was observed 'till the 2nd of March. Such figures represent a reduction of XX% as compared to the foreseen cases Indeed, the outbreak slowed down to 12.91 cases per day as of March 12 (95% C.I. 11.99 – 19.82), peaking on March 6 by 40 fewer cases per day than the previous days. More important for the management of the health care system, such slow-down allowed to “earn” about 2.4 days (95% C.I. 2.05 -2.74) before reaching the same levels of infected cases as predicted by the model.

Communication to the public is important to convince the citizens to continue to stay at home for a prolonged time period ³. Nevertheless, the main communication strategies have been focusing only on forecasts regarding the probable inflection point in the epidemic growth. Little to nothing has been done to inform people on the actual effect of the actions being implemented.

We believe that such information is essential to: (i) understand the actions taken by the public authorities, in particular when the results are lagged forward and (ii) help people have a rebound of their efforts in remaining home. Thus, we implemented such estimations as a daily updated WEB-based application to

continuously monitor effectiveness of the actions. The application, publicly available at <https://r-ubesp.dctv.unipd.it/shiny/covid19ita/> follows out a four step approach based on (i) identifying a changepoint in the epidemic curve after the initial days of spreading, (ii) fitting a smoothing quadratic model to the first data-point up to the changepoint (iii) and predicting future behavior of the epidemic beyond the estimated changepoint and (iv) comparing such figure with the actual data ...

Given the importance of monitoring the actions implemented to fight COVID-19 infection, we plan to continue hosting and managing our monitoring tools throughout the entirety of the COVID-19 outbreak and to expand its capabilities to other regions and countries. We believe our efforts are crucial to help inform about the effectiveness of public health efforts and to motivate people to continue adopting recommended behaviors.

No conflict of interest to disclose

Supplementary material

PDF for the Veneto region con grafici (anche timeline degli interventi) and technical details (including discussion on the quadratic model)

Technical details

A Bayesian changepoint detection method was employed to understand whether ill-behaved data, i.e. the growth of the epidemic does not follow common nonlinear models, was the case of COVID-19 epidemic. In the analysis of Veneto unfolding of positive cases, we found a first highly probable changepoint on March 2nd. A piece-wise polynomial model was used to fit data divided into two intervals at the identified changepoint. On the first interval, i.e. the week from February 24th to March 2nd, a quadratic growth was identified by a GAM model with local polynomial.

References

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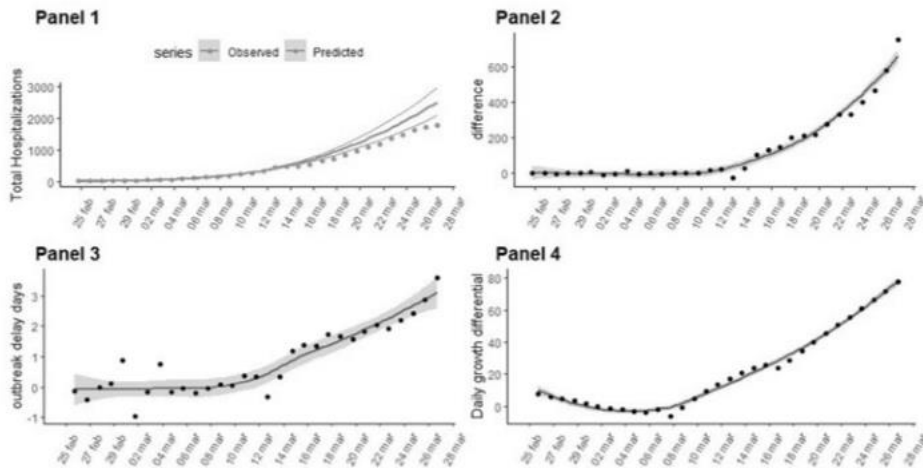


Figure 1. Time series for the indicators related to the COVID-19 epidemic outbreak in Italy reported and estimated from 24 February to 27 March. For the estimated measures, the grey areas indicate the 95% confidence bounds. Panel 1 Estimated total hospitalisations (bold curve with 95% confidence bounds) based on the outbreak trend until 12 March (changepoint day). The observed trend of COVID-19 cases is represented with a dotted line. Panel 2 The number of avoided COVID-19 hospitalised cases in the Veneto region compared with the trend expected as of 12 March. Panel 3 Days of delay estimated by

taking the difference between the days needed to achieve an equal level of hospitalisations between the estimated total hospitalisations and the observed data. Panel 4 The difference in daily growth (number of daily hospitalisations) between the estimated and observed epidemic curves.