COVID-19 in Italy: characterizing the shapes of epidemic waves through Functional Data Analysis

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Abstract

Italy was among the western nations hit hardest by COVID-19, with distinct epidemic. The epidemic unfolded very heterogeneously across the country. We gathered and analyzed publicly available data for the 20 Italian regions during the first wave of the epidemic. Notwithstanding limitations in accuracy and resolution of the data available from public sources, we pinpoint significant trends exploiting information in curves and shapes with Functional Data Analysis techniques. These depict two starkly different epidemics; an "exponential" one unfolding in Lombardia and the worst hit areas of the north, and a milder, "flat(tened)" one in the rest of the country – including Veneto, where cases appeared concurrently with Lombardia but aggressive testing was implemented early on. We find that mobility and positivity can predict COVID-19 mortality, also when controlling for relevant covariates. Among the latter, primary care appears to mitigate mortality, and contacts in hospitals, schools and workplaces to aggravate it. This work was recently published in the article Boschi et al. (2021) Functional data analysis characterizes the shapes of the first COVID-19 epidemic wave in Italy. Scientific Reports 11, 17054.

In an effort to validate and refine our analyses, we are now assembling data at higher spatial resolution (107 Italian provinces) as it becomes available and contrasting the two waves of the epidemic. Preliminary results at the level of provinces suggest the existence of three (as opposed to two) distinct epidemic patterns and document a clear reversal in the severity of the epidemic between the two waves for some areas within Lombardia and Veneto. Also, a role for mobility as a lagged predictor of mortality is confirmed, but can be better nuanced at higher resolution and between the two waves, which saw different types of restrictions and degrees of compliance across the country.