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# A BRIEF APPRAISAL OF THE COVID-19 PANDEMIC IN PORTUGAL

## (*Discussion on the paper by Nunes, Caetano, Antunes and Dias*)

Author: M. Gabriela M. Gomes
– University of Strathclyde, Glasgow, United Kingdom,
and University of Porto, Porto, Portugal
gabriela.gomes@strath.ac.uk

In this issue, Nunes *et al.* ([4]) review the prominent role embraced by statistical and epidemiological researchers in conducting societies through the COVID-19 pandemic. Basic epidemiological concepts, such as infection-fatality ratios (IFR), temporal infection reproduction numbers ($R_t$) and herd immunity thresholds (HIT), became part of every person vocabulary. Daily new cases, recoveries and deaths, have been diligently tracked and featured at the opening of prime-time news since the first case was confirmed in each country (February–March in most of Europe). Besides reviewing research conducted by themselves and others, Nunes *et al.* ([4]) provide a frank account of the challenges associated with conducting scientific research under such spotlight. Their paper should interest a very wide readership.

Comparing COVID-19 trajectories across countries and regions and appraising control strategies became topical in most social encounters, whether physical or virtual. Europe was the first major epicentre outside the source in China, and European countries quickly started to be classified into those with high death toll (such as Italy, UK, Belgium and Sweden) or low death toll (most prominently, Czech Republic) during the first wave in the spring 2020. Due to combinations of non-pharmaceutical interventions based on social distancing measures and naturally acquired immunity in populations, epidemics curbed throughout Europe and cases were brough to very low levels during the summer. By the end of the summer and into the autumn, Europe started to experience a second wave. Countries who were least affected in the spring (such as Czech Republic) are seeing steeper rises now, most plausibly due to having acquired less immunity. Portugal appears in neither of these extremes. Rates of infection and death were moderate throughout and the epidemic is under control. Although a final assessment is not possible until the pandemic is over, I expect the Portuguese strategy to rank among the most balanced. This would almost certainly not have been the case without the dedicated work of statisticians and epidemiologists.

The authors touch briefly on the role of mathematical modelling of the COVID-19 pandemic. Models were developed early in the pandemic to project epidemic trajectories in various countries ([5, 3]). Initial projections for Portugal suggested that, without mitigation, up to 70% of the population would be infected before cases started to decline (HIT), 85% would be infected by the time the epidemic ended and 1% would die as a result ([5]).

These results relied on the hypothesis that populations were homogeneously susceptible, which was recently refuted ([2]). According to models constructed to account for complete heterogeneity in susceptibility or exposure to infection, and conditional on the accuracy of currently available seroprevalence results, herd immunity is expected at much lower infection levels (around 10–20%) which I estimate to be happening this Autumn in Portugal. Continuing monitoring will inform the accuracy of these estimates but, if confirmed, these results imply that the COVID-19 pandemic is ending in Europe. Incident cases will continue but sustained epidemic growth will not be expected more than for other seasonal respiratory viruses. Given the disease fatality observed in the spring, protection of the most vulnerable is critical until a vaccine is available but the risk of complications is considered low for the majority of the population.

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