# Wave and ceiling of care impact on COVID-19 in-hospital mortality: An inverse probability weighting analysis

Natàlia Pallarès[1], Cristian Tebé[1], Jordi Carratalà [2], Sebastià Videla [3]

[1]Biostatistics Support and Research Unit, Germans Trias i Pujol Research Institute and Hospital (IGTP), Badalona, Spain; [2]Department of Infectious Diseases, Bellvitge University Hospital, Barcelona, Spain; [3]Clinical Research Support Area, Department of Clinical Pharmacology, Germans Trias i Pujol University Hospital, Badalona, Spain

**Background and objective:** From March 2020 to July 2022, 6 waves of the COVID-19 pandemic were registered in Spain. There are several studies comparing different COVID-19 waves but, as far as we know, none of them uses a matching procedure to make patients comparable or accounts for ceiling of care. Our aim is to compare in-hospital mortality across waves in patients with and without ceiling of care at hospital admission.

**Methods**: Data come from an observational study conducted during four waves of COVID-19 (March 2020-August 2021) in 5 hospitals in Catalonia. Three models were constructed to compare in-hospital mortality by wave: 1) a raw logistic model with only wave as a covariate; 2) a fully clinical adjusted logistic regression model with wave and patient baseline information as covariates and 3) a logistic model with weights obtained from an inverse probability weighting procedure to account for differences in baseline profile between waves. Models were presented stratified by ceiling of care. All analyses were conducted using R software version 4.3.0.

**Results**: A total of 3982 patients without ceiling of care and 1831 patients with ceiling of care were included. Patients with ceiling of care were, in median, 20 years older than patients without ceiling of care and in-hospital mortality ranged from 5% to 45%. The adjusted odds ratio (OR) of in-hospital mortality in the second wave were 0.57 (95%CI 0.40 to 0.80), in the third 0.56 (95%CI 0.37 to 0.84) and in the fourth 0.34 (95%CI 0.21 to 0.56) compared with the first wave in subjects without ceiling of care. The adjusted odds ratio were significantly lower in the fourth (0.38 95%CI 0.25 to 0.58) wave compared to the first wave in subjects with ceiling of care.

**Discussion:** The likely impact of the wave on in-hospital mortality differs between patients with and without ceiling of care. In patients without ceiling of care, mortality decreased over time which may be explained by better disease knowledge and management. In ceiling of care, only fourth-wave patients were less likely to die than first-wave patients. In a future infectious disease pandemic, it will be a challenge to improve the management of patients with ceiling of care.

**Keywords**: Inverse probability weighting, Ceiling of care, COVID-19.