

Article

A Cost–Benefit Analysis of COVID-19 Vaccination in Catalonia

Francesc López ^{1,2,3,*} , Martí Català ⁴ , Clara Prats ^{4,5} , Oriol Estrada ¹, Irene Oliva ^{1,2}, Núria Prat ⁶ , Mar Isnard ⁶, Roser Vallès ⁶, Marc Vilar ⁶, Bonaventura Clotet ^{3,7}, Josep Maria Argimon ⁸, Anna Aran ⁹ and Jordi Ara ¹

- ¹ Directorate for Innovation and Interdisciplinary Cooperation, North Metropolitan Territorial Authority, Catalan Institute of Health, 08006 Barcelona, Spain; innovacio.mn.ics@gencat.cat (O.E.); irene.olr.12@gmail.com (I.O.); gterritorial.mn.ics@gencat.cat (J.A.)
- ² Centre for Research in Health and Economics, Pompeu Fabra University, 08002 Barcelona, Spain
- ³ Fight AIDS and Infectious Diseases Foundation, 08916 Barcelona, Spain; bclotet@irsicaixa.es
- ⁴ Comparative Medicine and Bioimage Centre of Catalonia (CMCiB), Fundació Institut d'Investigació en Ciències de la Salut Germans Trias i Pujol, 08916 Barcelona, Spain; mcatala@igtp.cat (M.C.); clara.prats@upc.edu (C.P.)
- ⁵ BIOCOM-SC, Physics Department, Universitat Politècnica de Catalunya, 08034 Barcelona, Spain
- ⁶ North Metropolitan Primary Care Directorate, Catalan Institute of Health, 08006 Barcelona, Spain; nprat@gencat.cat (N.P.); misnard.bnm.ics@gencat.cat (M.I.); rvallesf@gencat.cat (R.V.); mvilar@gencat.cat (M.V.)
- ⁷ IrsiCaixa AIDS Research Institute, University Hospital Germans Trias i Pujol, 08916 Barcelona, Spain
- ⁸ Ministry of Health, 08007 Barcelona, Spain; jmargimon@gencat.cat
- ⁹ Catalan Health Service, Ministry of Health, 08007 Barcelona, Spain; dacrsb@catsalut.cat
- * Correspondence: flopezse.germanstrias@gencat.cat

Abstract: (1) Background: In epidemiological terms, it has been possible to calculate the savings in health resources and the reduction in the health effects of COVID vaccines. Conducting an economic evaluation, some studies have estimated its cost-effectiveness; the vaccination shows highly favorable results, cost-saving in some cases. (2) Methods: Cost–benefit analysis of the vaccination campaign in the North Metropolitan Health Region (Catalonia). An epidemiological model based on observational data and before and after comparison is used. The information on the doses used and the assigned resources (conventional hospital beds, ICU, number of tests) was extracted from administrative data from the largest primary care provider in the region (Catalan Institute of Health). A distinction was made between the social perspective and the health system. (3) Results: the costs of vaccination are estimated at 137 million euros (€48.05/dose administered). This figure is significantly lower than the positive impacts of the vaccination campaign, which are estimated at 470 million euros (€164/dose administered). Of these, 18% corresponds to the reduction in ICU discharges, 16% to the reduction in conventional hospital discharges, 5% to the reduction in PCR tests and 1% to the reduction in RAT tests. The monetization of deaths and cases that avoid sequelae account for 53% and 5% of total savings, respectively. The benefit/cost ratio is estimated at 3.4 from a social perspective and 1.4 from a health system perspective. The social benefits of vaccination are estimated at €116.67 per vaccine dose (€19.93 from the perspective of the health system). (4) Conclusions: The mass vaccination campaign against COVID is cost-saving. From a social perspective, most of these savings come from the monetization of the reduction in mortality and cases with sequelae, although the intervention is equally widely cost-effective from the health system perspective thanks to the reduction in the use of resources. It is concluded that, from an economic perspective, the vaccination campaign has high social returns.

Keywords: cost–benefit analysis; vaccination; COVID-19; health economics; economic appraisal; pharmacoeconomics



Citation: López, F.; Català, M.; Prats, C.; Estrada, O.; Oliva, I.; Prat, N.; Isnard, M.; Vallès, R.; Vilar, M.; Clotet, B.; et al. A Cost–Benefit Analysis of COVID-19 Vaccination in Catalonia. *Vaccines* **2022**, *10*, 59. <https://doi.org/10.3390/vaccines10010059>

Academic Editor: Yee-Joo Tan

Received: 22 November 2021

Accepted: 29 December 2021

Published: 31 December 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

In relation to the economic model, the study also has several limitations. First, macroeconomic impacts such as the savings derived by avoiding the closure of the territory's economy are not considered. It is likely that in a non-vaccination scenario, limitations in some sectors or limitations regarding mobility would have had to be imposed, which would have entailed an economic loss that should be considered. Second, there is no official source regarding the costs per vaccine dose: the figure used corresponds to a consensus among the authors, based on a literature review. In this sense, the work highlights the lack of transparency of institutions in providing official data. Third, it would be reasonable to adjust the cost for doses that will expire without being administered: in the absence of better approximations, it is observed that 5.6% of purchased doses have not yet been administered [27]. Fourth, the cost to the healthcare system caused by the underdiagnoses arising from mandatory closures has yet to be assessed, which, according to recent studies performed in Catalonia, could be substantial [30,31].

On the other hand, it should be noted that the analysed period has moments of high and low efficiency, depending on the size and type of the vaccination infrastructure and demand. In this interim analysis, it should also be noted that vaccination kinetics were strongly conditioned until early spring according to dose availability. Future research ought to try to identify the vaccination campaign that has had the highest social return.

5. Conclusions

The analysis concludes that the mass vaccination campaign against COVID is cost-saving. From a social perspective, most of these savings come from the monetization of the reduction in mortality and cases with sequelae (B/C ratio = 3.4), although the intervention is equally widely cost-effective from the perspective of the health system thanks to the reduction in hospital beds and ICU and number of laboratory tests (B/C ratio = 1.4). These results are robust with respect to different assumptions regarding vaccine effectiveness. It is concluded that, from an economic perspective, the vaccination campaign has high social returns.

Author Contributions: Conceptualization, F.L., O.E., J.M.A. and J.A.; Data curation, F.L., M.C., C.P., I.O. and A.A.; Formal analysis, F.L., M.C., C.P. and M.V.; Funding acquisition, I.O.; Investigation, F.L., O.E. and R.V.; Methodology, F.L., M.C., C.P. and O.E.; Project administration, F.L., O.E. and N.P.; Re-sources, F.L. and N.P.; Software, F.L.; Supervision, O.E., M.I., B.C. and J.A.; Validation, F.L., C.P., R.V., M.V., B.C. and J.A.; Visualization, M.C., N.P., M.I., M.V., B.C. and J.A.; Writing—original draft, F.L., M.C. and I.O.; Writing—review & editing, F.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. McGill; COVID-19 Vaccine Tracker Team. "COVID-19 Vaccine Tracker". Available online: <https://covid19.trackvaccines.org/> (accessed on 8 November 2021).
2. Català, M. On Short-Term Scenarios of COVID-19 in Europe. Comparison of the Epidemic Dynamics between High and Very High Vaccinated Countries. In *Analysis and Prediction of COVID-19 for EU-EFTA-UK and Other Countries*; Research Report; Universitat Politècnica de Catalunya: Barcelona, Spain, 2020; pp. 9–15. Available online: https://biocomsc.upc.edu/en/shared/20211022_report_299.pdf (accessed on 22 October 2021).
3. Kohli, M.; Maschio, M.; Becker, D.; Weinstein, M.C. The potential public health and economic value of a hypothetical COVID-19 vaccine in the United States: Use of cost-effectiveness modeling to inform vaccination prioritization. *Vaccine* **2021**, *39*, 1157–1164. [CrossRef]
4. Siedner, M.J.; Alba, C.; Fitzmaurice, K.P.; Gilbert, R.F.; Scott, J.A.; Shebl, F.M.; Ciaranello, A.; Reddy, K.P.; Freedberg, K.A. Cost-effectiveness of COVID-19 vaccination in low-and middle-income countries. *medRxiv* **2021**. [CrossRef]