

The evidence of Bayesian A/B testing in the contrast of clinical events by COVID-19

La estimación de la evidencia de la prueba A/B bayesiana en el contraste de eventos clínicos por COVID-19

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The clinical investigations reported in this journal employ the standard framework of frequentist statistics based on significance assumptions ($p < 0.05$). This method leads to a dichotomization of the results as “significant” or “non-significant” requiring the evaluation of statistical hypotheses¹. Therefore, the use of the Bayesian approach is important as an improved way of drawing statistical conclusions from clinical data since it facilitates the answer to the question, what is the probability that the effect is conclusive based on the data, which provides greater validity to the significant conclusions. One of the best known methods is the Bayes factor (BF), which estimates the probability of one hypothesis relative to the other given the data (e.g., null hypothesis vs alternate hypothesis)^{1,2}, this allows estimation of the weight of evidence (10 times the decimal logarithm value of the BF)^{3,4}, useful for decision making of significant findings, where results with evidence values greater than 20 are optimal for clinical decision making.

Replication of clinical results is recommended to validate the practical credibility of such findings by Bayesian inference, useful in various statistical tests^{1,2}, because such estimates are convertible to an effect size (ES), for example, the odd ratios (OR) measure or the area under the curve ROC (AUROC)⁵ using an online calculator as referred to by Ramos-Vera².

Another Bayesian model of interest is the Bayesian A/B test to contrast two similar clinical events considering the assignment of prior distributions and the control of such sample data according to the logarithmic odds ratio scale ($\log OR < 0$, $\log OR > 0$)⁶, more suitable for simultaneous evaluation with a

normal distribution⁷. The contrast of variation between both proportional groups is represented by the BF, this is useful for various studies that include participants with and without the clinical event of interest, of greater interest to the current pandemic context given the comorbidity or mortality due to COVID-19. The application of this Bayesian model favors greater precision of difference rates in national and international data between two composite proportional groups, where more realistic probabilities are reported given the data by transforming the Bayesian TE obtained: OR to probability = $OR/(OR+1)$ and their respective intervals. Such estimates allow us to determine how likely it really is that participants with the clinical outcome of interest will have such an occurrence, which has been recommended by Bayesian Neurology Group-Texas (BNG-TX)⁶.

For the present letter we considered data reported from a study of the present journal, which included adult patients with serological and molecular tests for COVID-19 from three hospitals in the Peruvian highlands (Ancash and Apurímac) included with clinical suspicion between April and June 2020⁸. The objective was to determine how likely is actually the most frequent comorbidity clinical events at positive diagnosis of COVID-19 ($\log OR > 0$), compared to negative diagnosis ($\log OR < 0$).

Table 1 indicates that the clinical outcome of having AT and positive COVID-19 diagnosis was of higher occurrence with a substantial weight of evidence (7.36) with a 66% probability of risk in contrast to the other event. Having a diagnosis of DMT2 with COVID-19 presented a decisive evidence value of

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Table 1. Bayesian A/B test values

Condition	(n total = 184)		Quantitative weight of the evidence 10log (FB)	Posterior Probability (Posterior probability intervals)
	Negative	Positive		
	(n = 170)	(n = 14)		
AT	13	2	7,36	0,66 (0,38-0,86)
DMT2	4	2	22,67	0,79 (0,52-0,93)

AT: arterial hypertension, DMT2: Diabetes mellitus type 2; *1-5: minimal, 5-10: substantial, 10-15: good, 15-20: very good, 20 to more: decisive³.

22.67 and a 79% probability of occurrence versus the other event. Such Bayesian findings refer to wide intervals given the small sample sizes, therefore, future studies with larger sample sizes are recommended to pinpoint more stable probability distributions.

Statistical application using Bayesian A/B testing may be very useful in other COVID-19 related research^{5,6,9}. Therefore, we recommend the articles by Rosenfeld and Orson¹⁰, and Kelter¹ that can serve as tutorial guides for a better understanding to the investigators of the present journal on various statistical techniques of major clinical use using the Bayesian method.

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