

THE MONTE CARLO MODEL AS A TOOL FOR ESTIMATING THE ECONOMIC BURDEN OF ECTOPIC PREGNANCY BY PREDICTING FUTURE CASES

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Introduction

Ectopic pregnancy is a potentially life-threatening gynecological complication that requires urgent medical intervention. In Mexico, its prevalence has increased, posing a challenge for both healthcare systems and the financial resources allocated for its treatment. To optimize resource allocation and predict future costs associated with this condition, it is crucial to have tools that can accurately forecast healthcare expenditures. In this context, the Monte Carlo simulation model has proven to be an effective methodology for predicting healthcare costs.

Objectives

To assess the accuracy of the Monte Carlo model in predicting healthcare costs by comparing observed and calculated expenses in the treatment of patients diagnosed with ectopic pregnancy at a Mexican public health institution.

Methods

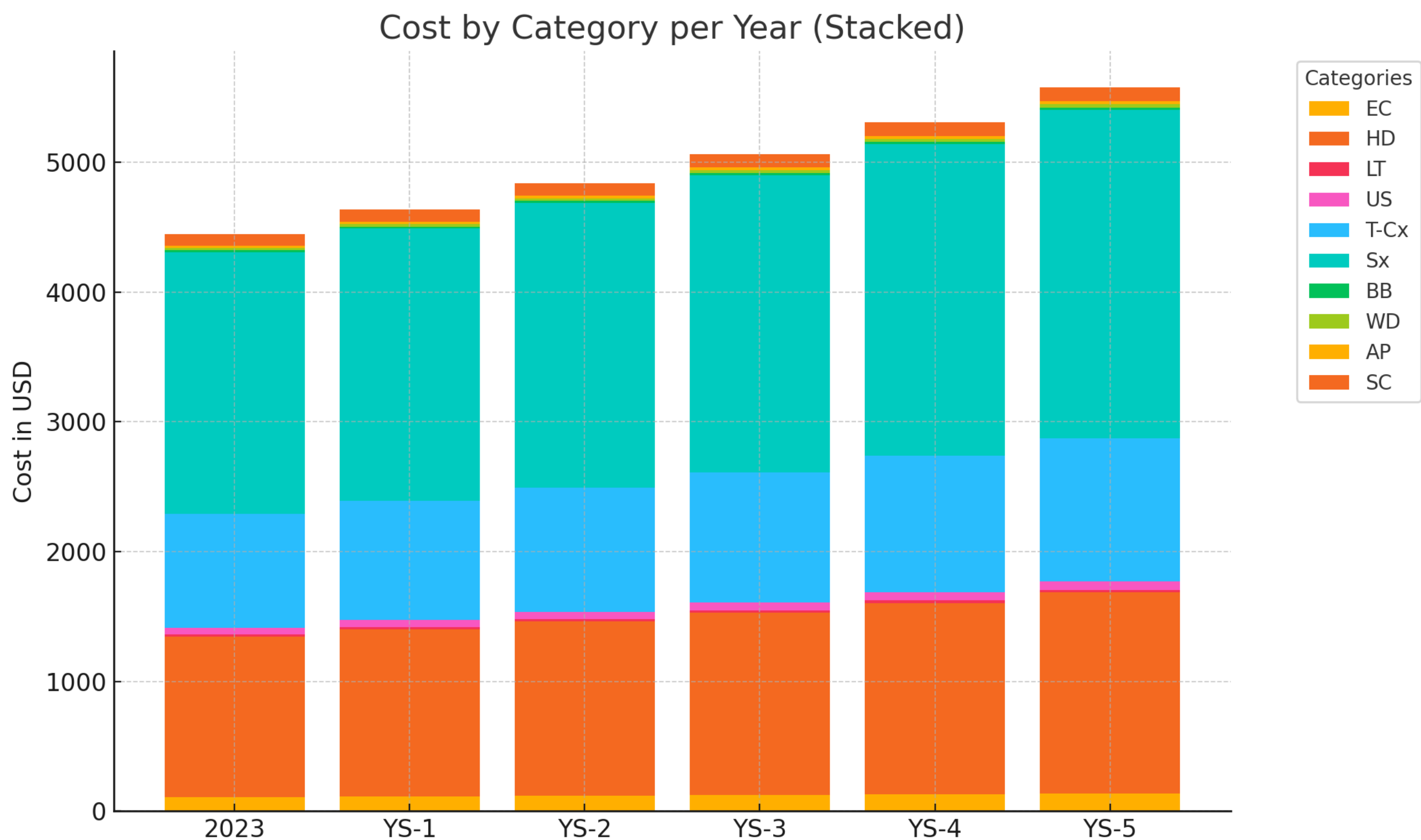
The medical records of 42 women diagnosed with ectopic pregnancy were reviewed to calculate the total healthcare expenditure during their treatment. Subsequently, the Monte Carlo predictive mathematical model was developed to estimate expenditures, considering inflation for each period, over a 5-year projection. This model accounts for the same clinical characteristics, including emergency care, hospitalization days, use of ultrasonography, intervention in tocosurgery, surgical interventions, blood bank services, dressings, pathological anatomy studies, and specialty consultations. The sample consisted of cases reported at a Mexican public health institution.

Category	2023	Sim YS-1	Sim YS-2	Sim YS-3	Sim YS-4	Sim YS-5
EC	\$107.99	\$112.58	\$117.52	\$122.91	\$128.93	\$135.38
HD	\$1,236.55	\$1,288.99	\$1,345.56	\$1,407.22	\$1,476.16	\$1,550.20
LT	\$15.77	\$16.44	\$17.16	\$17.95	\$18.83	\$19.75
US	\$51.82	\$54.02	\$56.39	\$58.97	\$61.86	\$64.95
T-Cx	\$880.85	\$918.22	\$958.51	\$1,002.43	\$1,051.55	\$1,105.00
Sx	\$2,014.22	\$2,099.66	\$2,191.80	\$2,292.24	\$2,404.54	\$2,529.41
BB	\$14.94	\$15.57	\$16.26	\$17.00	\$17.83	\$18.72
WD	\$18.57	\$19.36	\$20.21	\$21.13	\$22.17	\$23.31
AP	\$18.88	\$19.68	\$20.55	\$21.49	\$22.54	\$23.66
SC	\$87.77	\$91.49	\$95.51	\$99.88	\$104.78	\$110.10
Cost per Patient	\$4,447.37	\$4,636.02	\$4,839.46	\$5,061.23	\$5,309.19	\$5,585.13

**Table 1:** Projected cost comparison per patient for the treatment of ectopic pregnancy, expressed in USD, using the Monte Carlo model. The costs are broken down by healthcare categories, including emergency care (EC), hospitalization days (HD), laboratory tests (LT), ultrasound (US), tocosurgical intervention (T-Cx), surgical intervention (Sx), blood bank (BB), wound dressing (WD), anatomical pathology (AP), and specialty consultation (SC). Values are presented for the base year 2023 and cost simulations for the next 5 years (Sim YS-1 to Sim YS-5).

	2023	Sim YS-1	Sim YS-2	Sim YS-3	Sim YS-4	Sim YS-5
Patients	21	22	22	22	22	23
Unit Cost	\$4,447.37	\$4,636.02	\$4,839.46	\$5,061.23	\$5,309.19	\$5,574.33
Total Cost	\$93,394.82	\$101,884.99	\$107,169.67	\$112,938.14	\$119,377.47	\$126,298.22

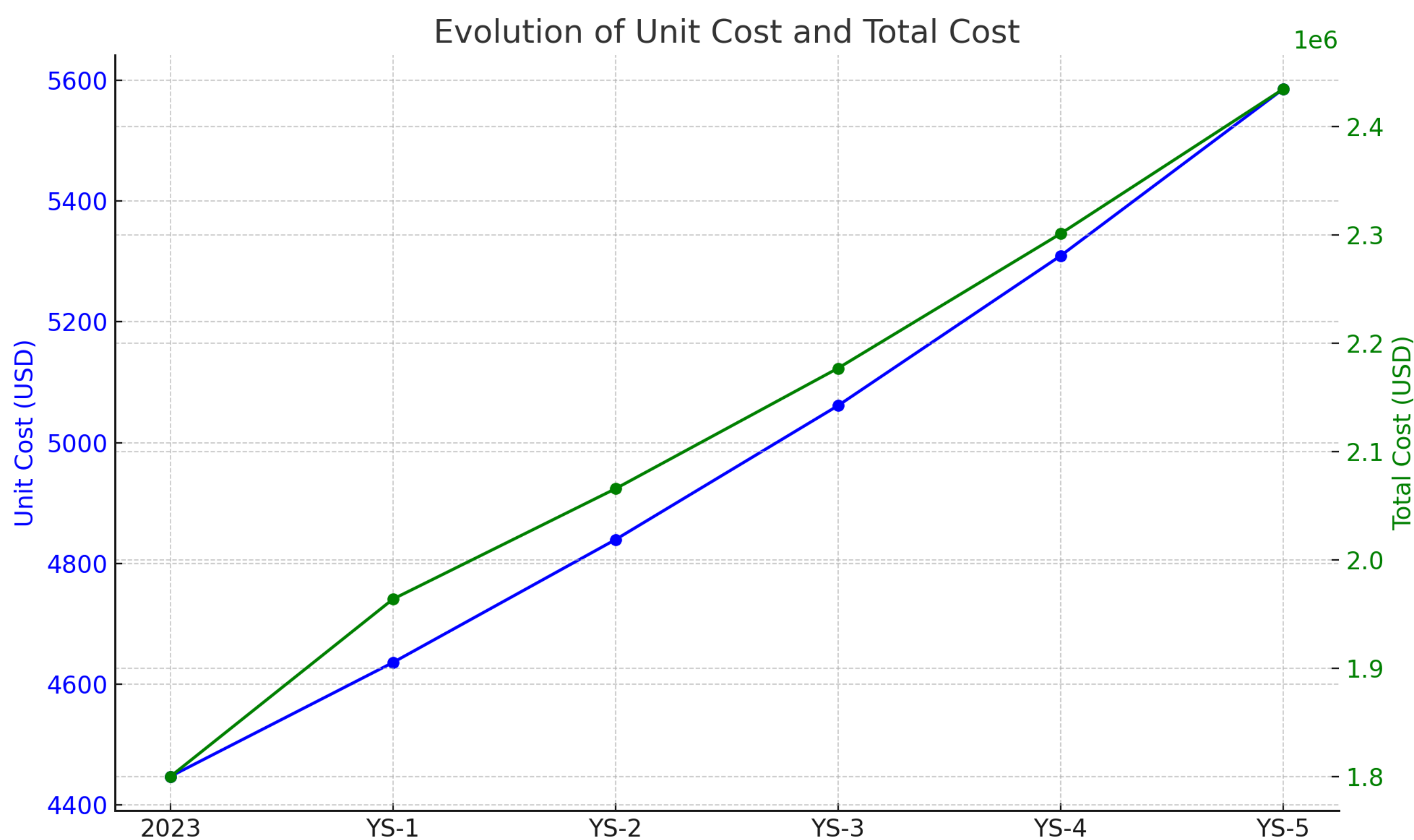
**Table 2:** Projection of the number of patients and total costs associated with ectopic pregnancy treatment using the Monte Carlo model. The table shows the number of patients treated per year (2023 and simulations AS-1 to AS-5), as well as the unit cost per patient and the total cost per year. Expressed in US Dollars.



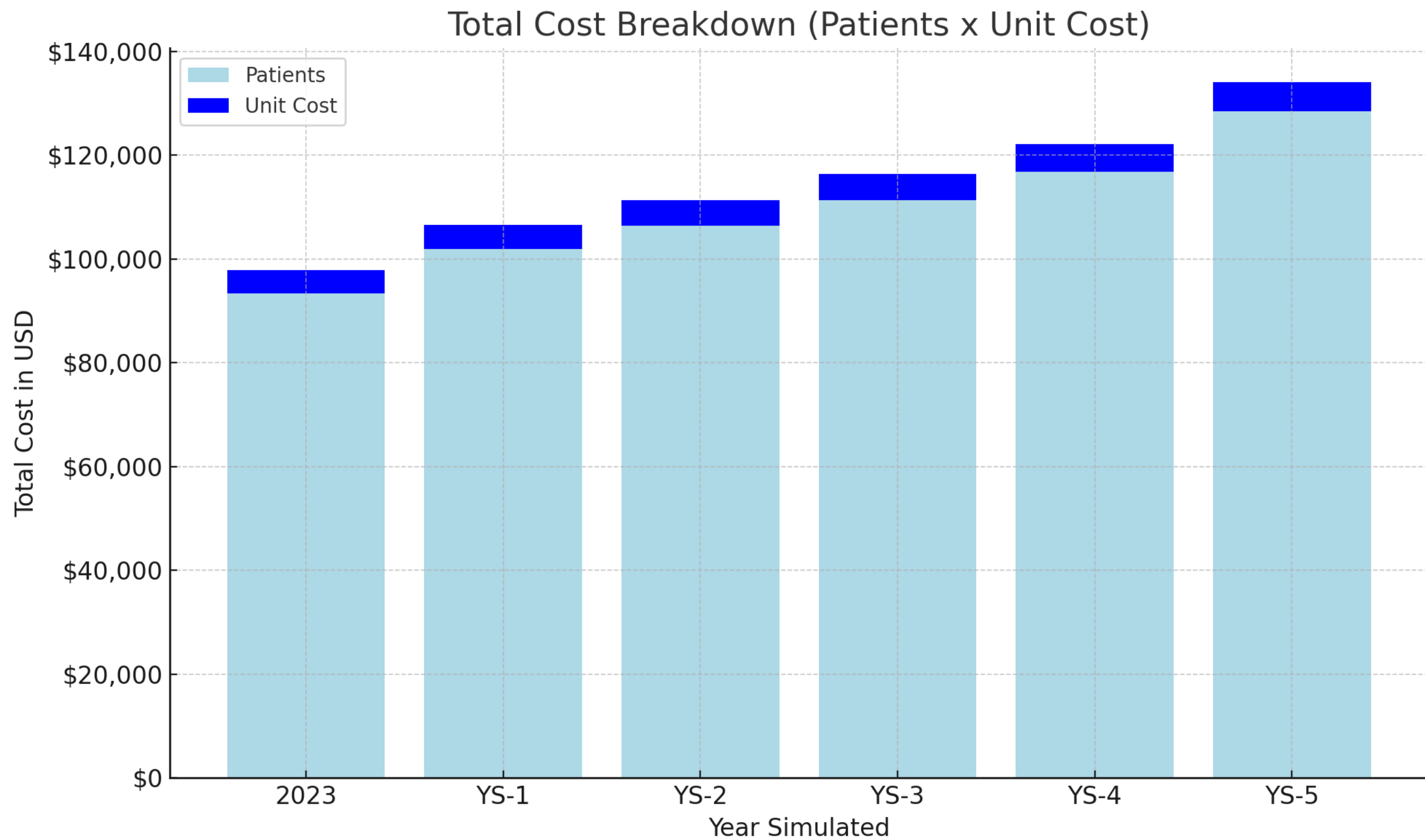
**Figure 1:** Stacked bar chart showing the costs broken down by healthcare category (EC, HD, LT, etc.) for each simulated year (2023, YS-1 to YS-5). The chart visualizes the evolution of costs in each category and how they contribute to the total cost per patient.

Results

An increase in the total number of pregnancies attended to in the medical unit was observed, in line with the population growth rates established by the National Institute of Statistics and Geography for Sinaloa, Mexico. A maximum increase of 2 new cases was noted during the last period. This controlled increase contributes to a rise in the projected expenditure for the care of patients with ectopic pregnancy. The current average cost per patient is \$85,736 MXN (USD 4,447.35), and the average cost projected for the sample in 5 years is estimated to be \$107,461.46 MXN (USD 5,574.31).



**Figure 2:** Line chart displaying the evolution of both the unit cost per patient and the total annual cost for each simulated year (2023, YS-1 to YS-5). The chart highlights the growth of both values over time, showing the relationship between the increase in unit cost and its accumulated impact on the total cost.



**Figure 3:** Stacked bar chart breaking down the total annual cost, combining the number of patients treated and the unit cost per patient for each simulated year (2023, YS-1 to YS-5). The chart illustrates how the increase in both the number of patients and the unit cost impacts the total annual cost.

Conclusions

The Monte Carlo predictive model could prove to be a useful tool in estimating healthcare service expenditures and calculating a budget that closely aligns with the actual cost.

References

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