

Cost-Utility Analysis of a Preoperative Diabetes Optimization Program in Posterior Spinal Fusion Surgery

Guillermo A. Martinez¹, Elyette M. Lugo², Rachel Bronheim², Amit Jain²

¹San Juan Bautista School of Medicine, Caguas, PR, ²The Johns Hopkins University School of Medicine, Baltimore, MD

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INTRODUCTION: Diabetes mellitus (DM) has been identified as an independent risk factor for a variety of post-operative complications following spine surgery, most notably surgical site infection (SSI). SSI is a major contributor to increased health-care costs, as it can lead to unplanned hospital re-admission, prolonged treatment course, and in some cases, reoperation. Many studies have evaluated the optimal threshold for preoperative HbA1c level associated with reduced risk for SSI. The cost-effectiveness of a preoperative diabetes optimization program in patients planned to undergo elective PSF has not been previously reported. This study aimed to perform a cost-effectiveness analysis of using a preoperative diabetes optimization program in patients planned to undergo elective posterior spinal fusion (PSF).

METHODS: A decision-analysis model was built for a hypothetical adult patient with DM planned to undergo elective PSF. A comprehensive review of the literature was performed to obtain event probabilities, costs, and health utilities at each node. Health utilities were utilized to calculate Quality-Adjusted Life Years (QALYs). A base-case analysis was carried out to obtain the incremental cost and effectiveness (QALYs) of the diabetes optimization program. Probabilistic sensitivity analysis was performed to evaluate uncertainty in the model and to obtain mean incremental costs, effectiveness, and net monetary benefits. One-way sensitivity analyses were also performed to identify the variables with the greatest impact on the model.

RESULTS SECTION: Utilization of a preoperative diabetes optimization program was favored as a strategy in 89% of the iterations. The mean incremental utility ratio for using a preoperative diabetes optimization program demonstrated higher benefit and lower cost, while being lower than the willingness-to-pay threshold of \$100,000 per quality adjusted life years. Use of a preoperative diabetes optimization program was associated with a mean incremental net monetary benefit (INMB) of \$3,623 + 3,065. One-way sensitivity analysis reported QALY of uncomplicated patients and QALY of patients that develop infection to be the main determinant factors.

DISCUSSION: This cost-effectiveness analysis demonstrates that implementing a preoperative diabetes self-management education (DSME) program for patients undergoing elective posterior spinal fusion (PSF) is a cost-effective strategy to reduce postoperative surgical site infection (SSI) risk. The model found that DSME resulted in lower average costs per QALY gained and was the favored strategy in 89% of simulations. These findings align with existing literature supporting DSME's utility in glycemic control and cost reduction across medical and select surgical populations.

Prior studies have largely focused on surgical techniques or device comparisons, with limited investigation into preoperative optimization strategies. This study fills that gap by being the first, to our knowledge, to evaluate the cost-utility of preoperative diabetes optimization in spine surgery. Results showed a mean cost savings of \$2,769 per patient and supported the broader implementation of DSME as part of surgical optimization pathways.

Sensitivity analyses indicated that the cost of index surgery and QALYs associated with revision procedures most influenced outcomes, emphasizing the economic burden of complications. Revisions, especially for infection, are known to substantially increase healthcare costs and impact patient quality of life.

This study is limited by its reliance on previously published inputs, absence of DM type/severity stratification, and exclusion of non-revision postoperative infection outcomes. Nonetheless, the findings support the integration of DSME into preoperative protocols for diabetic patients undergoing PSF as a cost-effective, value-based intervention.

SIGNIFICANCE/CLINICAL RELEVANCE: This study addresses a critical gap in preoperative care for spine surgery patients by demonstrating that diabetes self-management education (DSME) programs are a cost-effective strategy to reduce surgical site infections. These findings support the integration of DSME into standard preoperative optimization pathways, potentially improving outcomes and lowering costs in a high-risk, high-cost surgical population.

Table 1. Input Parameter Estimates for Decision-analysis Model

Parameter	Distribution	Estimate	±
Cost of Multilevel PSF (2022 USD)	Normal	45,732.36	4,573.236
Cost of preoperative 12-month diabetes optimization program (2022 USD)	Normal	435	43.5
Cost of Revision Multilevel PSF due to SSI (2022 USD)	Normal	52,865.38	5,286.538
Probability (%) of achieving DM control (HbA1c<7.0%) after program	Beta	0.28	0.028
Probability (%) of SSI in controlled DM patient	Beta	0.01	0.001
Probability (%) of SSI in uncontrolled DM patient	Beta	0.353	0.0353
5-year QALY for patient with SSI	Normal	3.07	0.307
5-year QALY for patient without SSI	Normal	3.07	0.307

USD, United States Dollars; QALY, Quality Adjusted Life Years
 Controlled DM = HbA1c less than 7%
 Uncontrolled DM = HbA1c higher or equal to 7%

This table includes cost, probabilities and 5-year quality-adjusted life years (QALY) findings reflected by their distribution, estimates and standard deviations.

Figure 1. Decision-analysis model for hypothetical diabetic patient undergoing elective posterior spinal fusion surgery. PSF, Posterior Spinal Fusion; DM, Diabetes Mellitus; SSI, Surgical site infection; QALY, Quality adjusted life years. Prefix "p" indicate event probability.

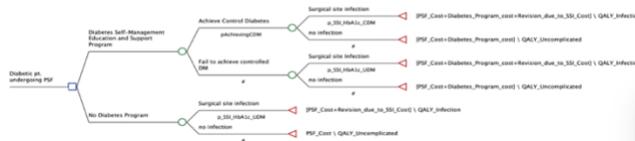


Figure 2. Scatterplot graph presenting incremental cost and incremental effectiveness benefits for Diabetic optimization program vs No Diabetic optimization program in diabetic patients undergoing elective PSF surgery. WTP Threshold at \$100,000 per QALY. QALY, Quality adjusted life years; WTP, Willingness to pay.

