

The budget impact of introducing intraoperative imaging system with navigation for spinal fusion procedures in Spain.

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Objective

In recent years, the importance of intraoperative navigation in spinal surgery has been increasing, with multiple studies proving the advantages and safety of computer-assisted procedures.<sup>1</sup>

We aimed to estimate the economic impact of navigated spine surgery in combination with a multidimensional imaging system, from the perspective of a Spanish tertiary hospital, over 10-years period.

Methods

- A cost analysis was developed based on previously published evidence to assess the budget impact of replacing conventional fluoroscopy with image-guided navigation for spinal fusion procedures, on a 1:1 basis, regardless of the indication.<sup>2-5</sup>
- Unit costs, sourced from various Spanish references and expressed in €2024, were applied to health resource consumption, which included equipment, consumables, maintenance, surgical procedure, postoperative hospitalization and computed tomography (CT) scans, postoperative screw revisions and surgical site infections (SSI).<sup>6-9</sup>

- To assess the reliability of the results, a deterministic sensitivity analysis was conducted, adjusting the unit cost accordingly.
- A clinical expert validated the model inputs to ensure accuracy.

Results

- For each treatment group, 150 procedures were considered annually over 10 years.
- Estimated mean total costs per patient for image-guided surgery and fluoroscopy-assisted surgery were €10,002 and €10,326, respectively, resulting in an average cost saving of €324 per patient. (Figure 1)
- The acquisition cost of image-guided navigation system was offset primarily by the cost savings associated with potential reduced need for revision procedures and shorter length of stay, leading to cost reductions of €858 and €575 per patient, respectively. (Figure 2)
- These allowed for a return on the capital investment within six years of acquisition.
- Considering the total population, the results projected savings of €485,574 in 10 years. (Figure 3)

- The model's reliability was confirmed through sensitivity analysis, in which unit costs were varied by ±10%. (Figure 4)

Table 1: Health resources and unit costs.

| Health resource               | Fluoroscopy-assisted surgery | Image-guided surgery | Unit cost (€ 2024)       |
|-------------------------------|------------------------------|----------------------|--------------------------|
| Surgical procedure            |                              |                      |                          |
| Operating room (hours)        | 2.1 <sup>2</sup>             | 2.0 <sup>2</sup>     | €829.8 <sup>6</sup>      |
| Surgeon                       | 2                            | 2                    | €25.7 <sup>7</sup>       |
| Anaesthesiologist             | 1                            | 1                    | €25.7 <sup>7</sup>       |
| Nurse                         | 2                            | 2                    | €14.9 <sup>7</sup>       |
| Nurse assistant               | 1                            | 1                    | €10.5 <sup>7</sup>       |
| Diagnostic Tests              |                              |                      |                          |
| Postoperative CT scan (%)     | 21.7 <sup>3</sup>            | 16.6 <sup>3</sup>    | €196.7 <sup>8</sup>      |
| Postoperative hospitalization |                              |                      |                          |
| Length of stay (days)         | 5.8 <sup>2</sup>             | 5.3 <sup>2</sup>     | €1,249.8 <sup>8</sup>    |
| Complications                 |                              |                      |                          |
| Revision surgery (%)          | 6.0 <sup>4</sup>             | 1.0 <sup>4</sup>     | €17,160.5 <sup>8-9</sup> |
| SSI (%)                       | 2.1 <sup>5</sup>             | 0.8 <sup>5</sup>     | €3,866.8 <sup>8</sup>    |

Figure 1: Estimated mean total costs per patient undergoing image-guided or fluoroscopy-assisted surgery.

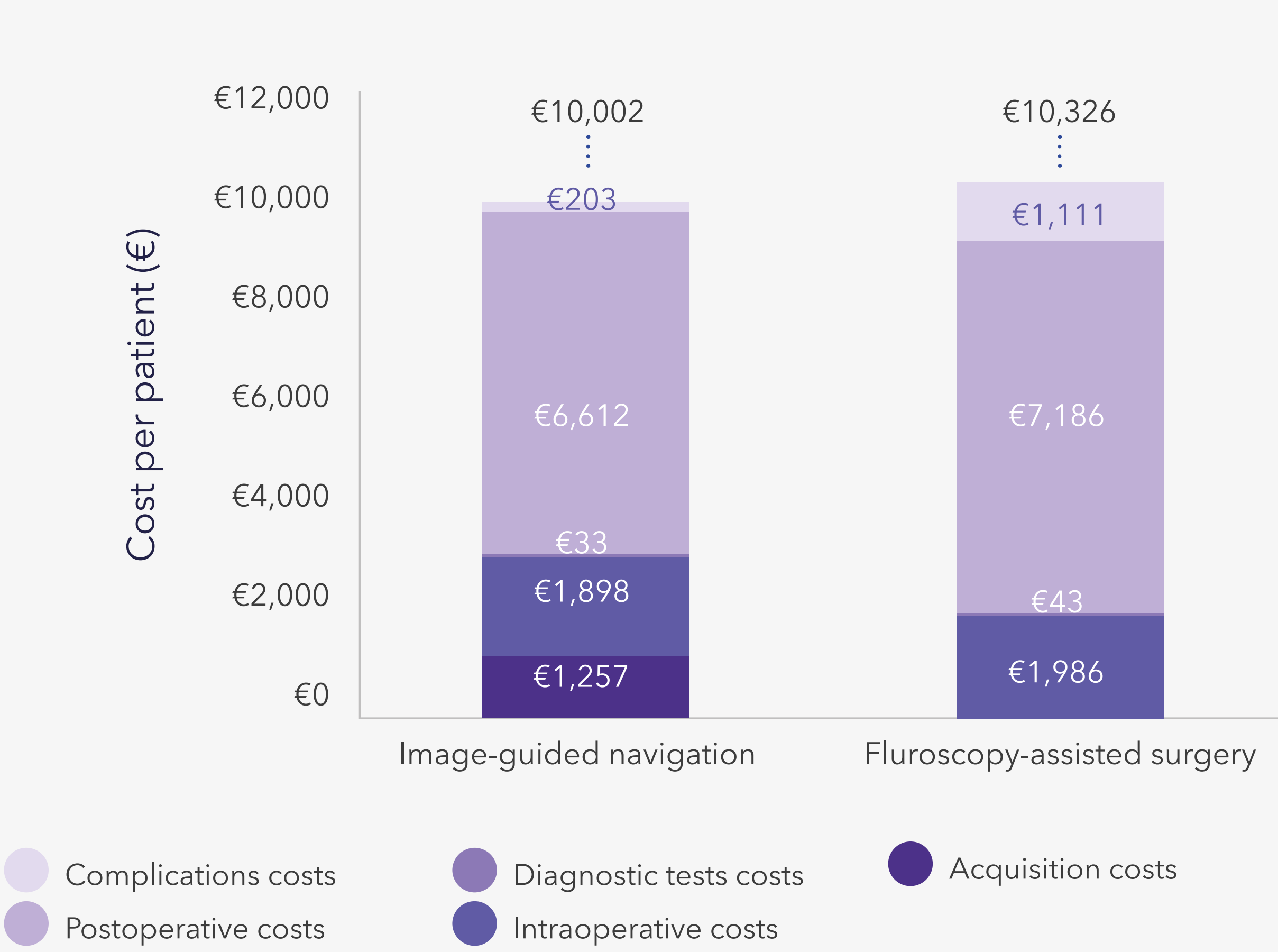


Figure 2: Cost increase/decrease per patient treated with image-guided surgery compared to fluoroscopy-assisted surgery.

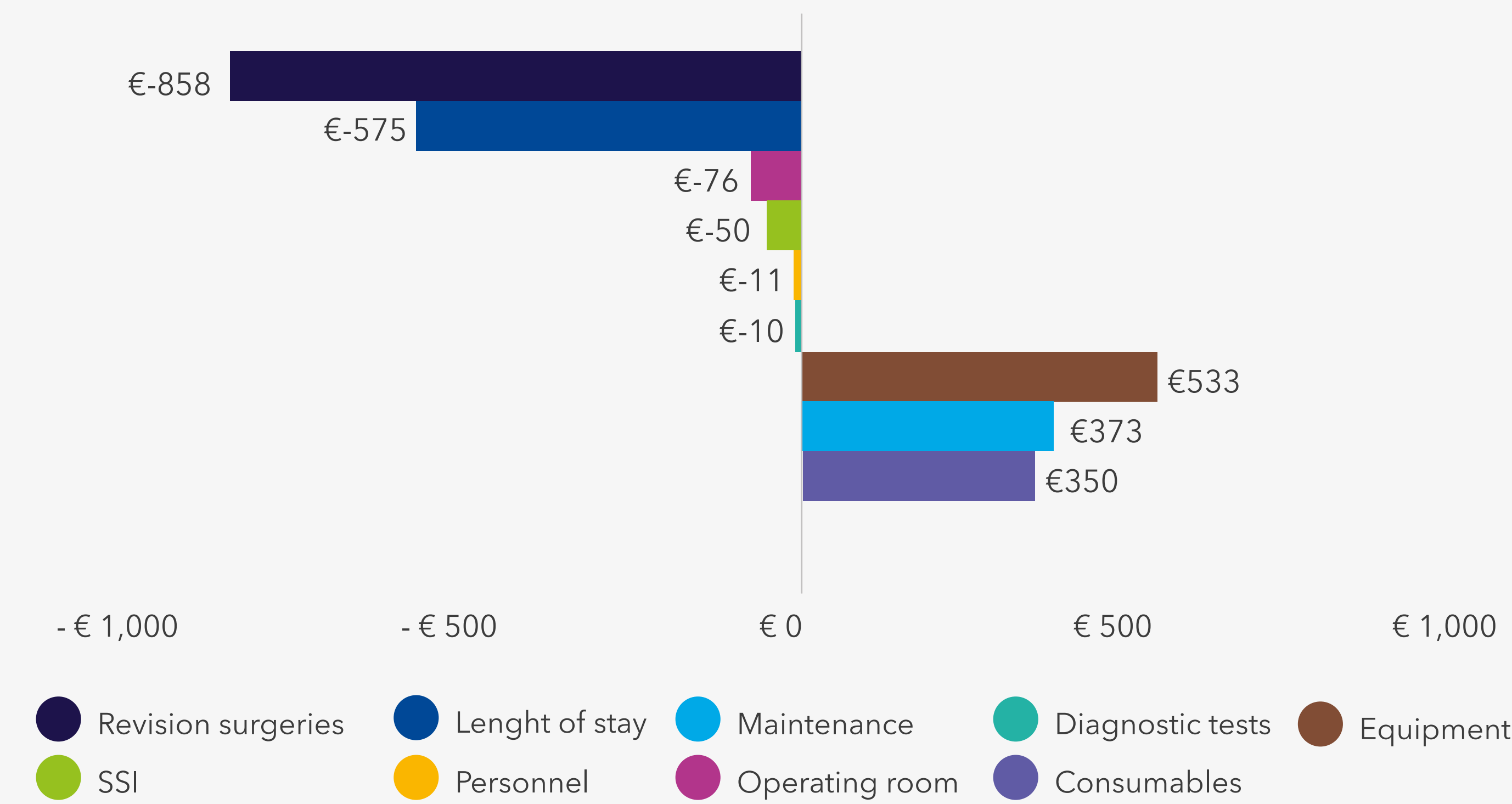


Figure 3: Budget impact analysis of the use of image-guided surgery considering the total cohort of patients after 10 years.

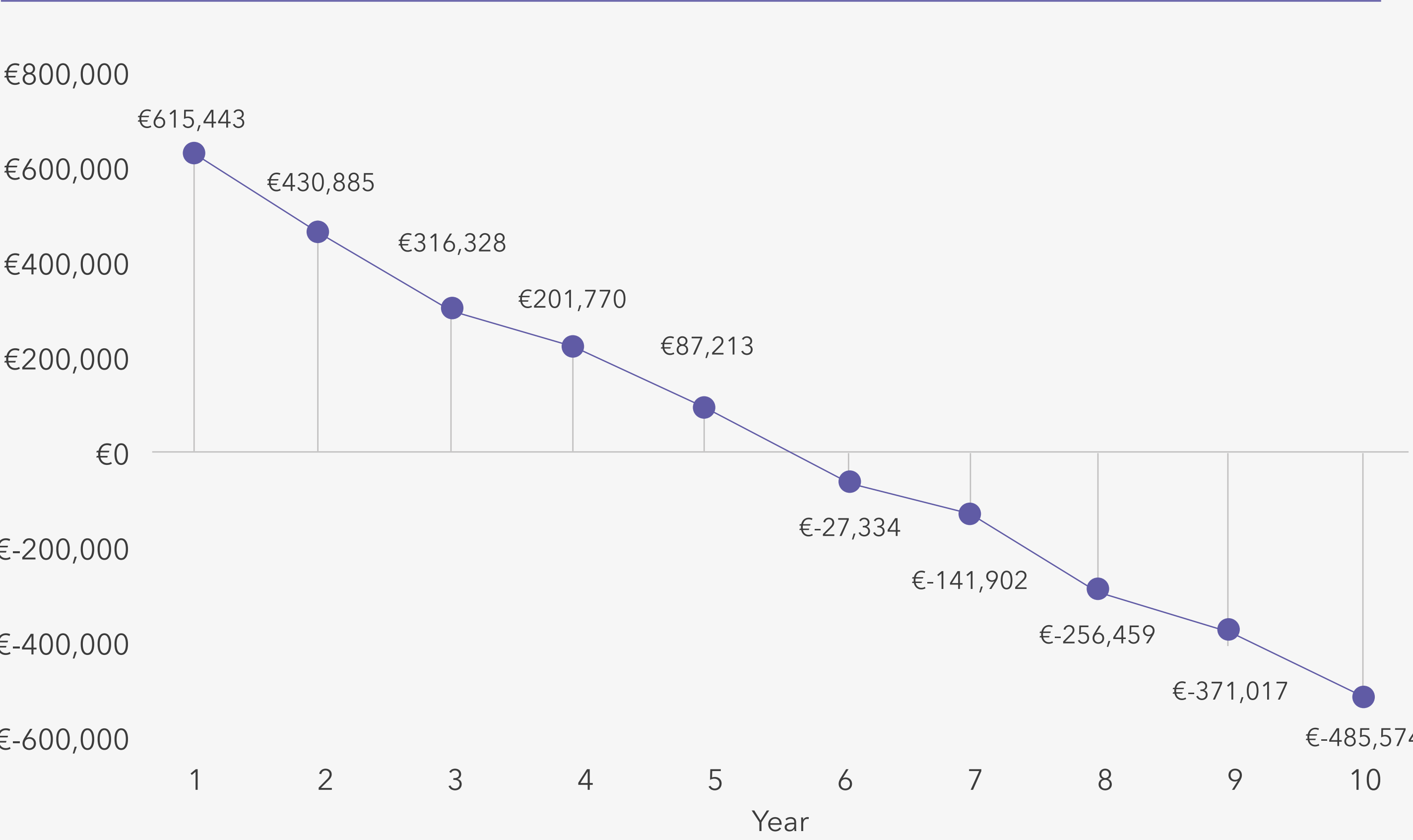
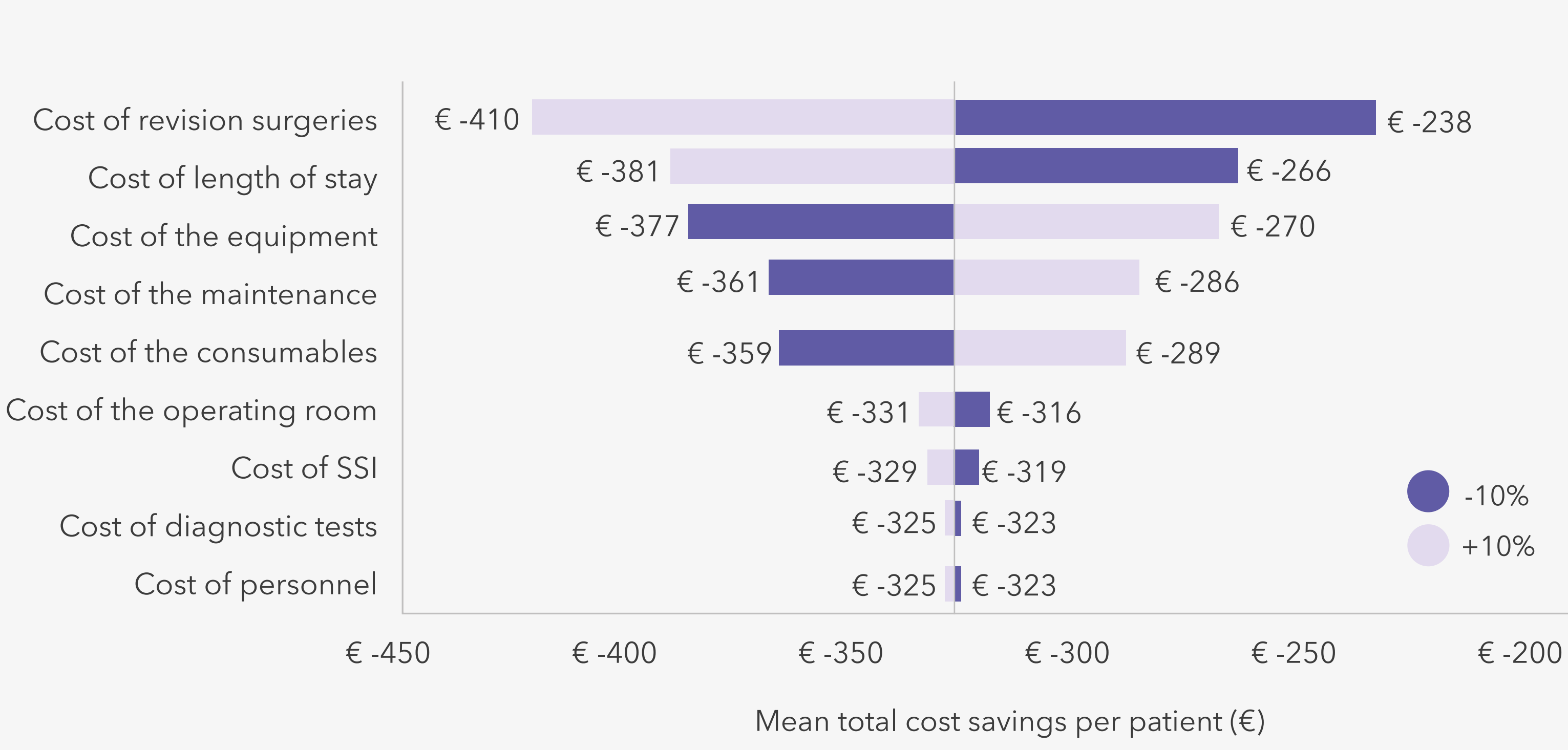


Figure 4: Tornado diagram of the univariate sensitivity analysis.



Conclusion

From a Spanish hospital perspective, upfront costs of image-guided navigated spinal fusion procedures regardless of the indication were estimated to be totally offset before the sixth year of investment in comparison with conventional fluoroscopy.

References

1. Wilson JP Jr, Fontenot L, Stewart C, Kumbhare D, Guthikonda B, Hoang S. Image-Guided Navigation in Spine Surgery: From Historical Developments to Future Perspectives. J Clin Med. 2024 Apr 1;13(7):2036.  
2. Restelli U, Anania CD, Porazzi E, Banfi G, Croce D, Fornari M, Costa F. An observational analysis of costs and effectiveness of an intraoperative compared with a preoperative image-guided system in spine surgery fixation: analysis of 10 years of experience. J Neurosurg Sci. 2022 Aug;66(4):350-355.  
3. Dea N, Fisher CG, Batke J, Strelzow J, Mendelsohn D, Paquette SJ, Kwon BK, Boyd MD, Dvorak MF, Street JT. Economic evaluation comparing intraoperative cone beam CT-based navigation and conventional fluoroscopy for the placement of spinal pedicle screws: a patient-level data cost-effectiveness analysis. Spine J. 2016 Jan 1;16(1):23-31.  
4. Rohe S, Strube P, Hölzl A, Böhle S, Zippelius T, Lindemann C. Cone-Beam Navigation Can Reduce the Radiation Exposure and Save Fusion Length-Dependent Operation Time in Comparison to Conventional Fluoroscopy in Pedicle-Screw-Based Lumbar Interbody Fusion. J Pers Med. 2022 May 1;12(5):736.  
5. Xiao R, Miller JA, Sahbharwal NC, Lubelski D, Alentado YJ, Healy AT, Mroz TE, Benzel EC. Clinical outcomes following spinal fusion using an intraoperative computed tomographic 3D imaging system. J Neurosurg Spine. 2017 May;26(5):628-637.  
6. Díez del Val, I. Bypass gástrico abierto o laparoscópico: comparación de costes. Cir Esp 2004;75(5):299-300.  
7. ORDEN de 18 de enero de 2023, de la Consejería de Economía, Hacienda y Empleo, por la que se dictan Instrucciones para la Gestión de las Nóminas del Personal de la Comunidad de Madrid para 2023. B.O.C.M. Núm. 23. Viernes 27 de Enero de 2023. Available at: [https://www.comunidad.madrid/transparencia/sites/default/files/open-data/downloads/orden\\_gestion\\_nominas.pdf](https://www.comunidad.madrid/transparencia/sites/default/files/open-data/downloads/orden_gestion_nominas.pdf) [accessed June 2024].  
8. Oblitue Consulting. Base de datos de costes sanitarios eSalud [Internet]. Barcelona: Oblitue Consulting; 2015. Available at: <http://www.oblitue.com/bddcostes/> [accessed June 2024].  
9. Ministerio de Sanidad. Subdirección General de Información Sanitaria. Registro de Actividad de Atención Especializada - RAE-CMBD. Available at: <https://pestadistico.inteligenciadegestion.sanidad.gob.es/publicoSNS/C/rae-cmbd/rae-cmbd/grupos-relacionados-por-el-diagnostico-grd/grd-estadisticos-por-comunidad-autonoma-grupo-de-hospitales-servicios> [accessed June 2024].