

# Comment on profitability analysis of a femtosecond laser system for cataract surgery using a fuzzy logic approach

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## Dear Editor,

We read with interest the recently published study by Trigueros *et al*<sup>[1]</sup>, highlighting the financial and management conditions of femtosecond laser-assisted cataract surgery (FLACS). The authors derived a simulation to estimate the profitability of FLACS and tested this with a sensitivity analysis and a fuzzy logic approach.

Their sensitivity analysis suggested that their clinic should do 1400 operations per year and charge each patient an additional \$500 per procedure. This seemed to be nothing more than an amortization of the cost of a VICTUS (Bausch & Lomb, Germany) femtosecond laser over 5y. The details of the amortization were sparse and it was difficult to determine how the authors thought the laser would cost \$3.3 million over 5y.

When the fuzzy logic approach was applied, the authors revised the additional cost to each patient to be between \$661.8 and \$667.4. Fuzzy logic is an approach to uncertainty which uses a number between 0 and 1 to quantify the "degree of truth" rather than either 1 or 0 used in Boolean logic. Trigueros *et al*<sup>[1]</sup> used 6 experts to create a fuzzy estimate of the increase in cost: minimum and maximum values were \$500 and \$750. This was reevaluated by a further 5 independent experts who graded the likelihood of truth of the original estimates. How

the experts came to make their estimates was not discussed. Who the experts were or how they were recruited was not explicit in the paper. The final confidence interval between \$661.8 and \$667.4 seemed overwhelmingly narrow for such a difficult estimation with many uncertain or unknown variables. In this study, there was no mention of the change in productivity which occurs upon the implementation of FLACS. If the same surgeon is performing both the laser and the surgery then productivity may fall and this was not accounted for<sup>[2-4]</sup>. We have recently conducted our own sensitivity and threshold analyses (currently accepted for publication) which estimated the cost of FLACS when a so-called "hub-and-spoke" model is used with one laser feeding patients into 2 theatres. Above all else, the cost of the patient interfaces (PIs) had the greatest effect on our simulation and, by their nature, were unaffected by the number of operations performed. After the cost of the PI, the number of phacoemulsification operations possible per theatre list before and after the implementation of the laser became the next most important factors.

The femtosecond laser may cause a paradigm shift in the way ophthalmic theatres are designed to maximize efficiency around a two-stage procedure. Improvements in productivity from the design and evolution of femtosecond laser-centric services remains to be seen.

## ACKNOWLEDGEMENTS

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## REFERENCES

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## Author Reply to the Editor

Dear Editor,

Thank you very much for the interest in our work. Our study is based on the use of the fuzzy logic to obtain an estimation of the requirements for the profitability of a femtosecond laser system for cataract surgery. For performing our study, we needed some baseline data, including the cost of the laser and the information from experts providing the additional cost that supposes for them the use of a femtosecond laser platform. Concerning the cost of the laser system, as described in the paper, this information was provided by the manufacturer. This was not a personal point of view or estimation, as suggested in your comment. Regarding the selection of experts, we contacted with several Spanish clinics performing femto-cataract and they provided to us their point of view about costs. With this information and the appropriate mathematical analysis, we obtained the additional cost that would be necessary and the number of surgeries per year to avoid a loss of money. Our sensitivity analysis estimated that a clinic should do 1400 operations per year and charge each patient an additional \$500 per procedure to avoid losing money. Please read carefully the paper, we are not stating that the cost of the surgery will be \$500. We are stating that this is the additional cost that should be add to the cost of the intraocular lens and other additional costs, assuming that all procedures of the clinic are femto-cataract. If you combine femto-cataract and traditional phacoemulsification, you would need more surgeries per year and possibly a higher additional cost. We are now conducting more simulation analyses including some of those variables that you mention and the conditions to obtain profitability become harder.

We agree with you that the introduction of a femtosecond laser system for cataract surgery in a clinic is something that must be considered with care and a profitability analysis must be done. For this reason, we have begun this research line.

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## Further Response

Dear Editor,

Thank you for responding to our comments. In our letter, we did not suggest that the cost of surgery was US\$500. We are discussing with the additional costs of femtosecond laser assisted cataract surgery (FLACS) over conventional phacoemulsification surgery (CPS). Your paper references the cost-effectiveness analysis by Abell and Vote<sup>[1]</sup>. In their hypothetical model they derive that their use of the FL resulted in reducing their theatre efficiency by 2 cases per list, and subsequently they estimated the additional cost of FL to be AUS\$1065 per case (US\$810 approx.), AUS\$750 (US\$570 approx.) of which were the direct costs from the FL and AUS\$315 (US\$270 approx.) from lost productivity. Your model did not appear to take any change of productivity into account when considering profitability of FLACS.

If you plan to charge patients extra for FLACS then invariably you will have a mix of FLACS and CPS. As you state yourselves, this may require more operations in order to break even, yet this factor was not featured in your original model.

The VICTUS femtosecond laser (Bausch & Lomb, Germany) has one of the biggest footprints of all femtosecond lasers and is not portable, therefore requires careful planning as to where to site the laser. If located in an operating room it will either reduce productivity or capacity depending on whether the room is big enough to accommodate the laser in addition to the usual equipment. Alternatively, if not located in an operating theatre, it needs to be close enough to the operating suite that the patient can be easily transferred, and there may also be other costs in developing this room so that it is suitable. Where the laser is sited will dictate your patient flow through theatres and is a crucial factor in overall productivity.

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1 Abell RG, Vote BJ. Cost-effectiveness of femtosecond laser-assisted cataract surgery versus phacoemulsification cataract surgery. *Ophthalmology* 2014;121(1):10-16.