Esophageal doppler monitoring during colorectal resection offers cost-effective improvement of hemodynamic control
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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

CRD summary
The study assessed the cost-effectiveness of using oesophageal Doppler monitoring to improve haemodynamic control during colorectal surgery. The authors concluded that strategies that incorporated oesophageal Doppler monitoring were likely to be cost-effective as they improved health outcomes and reduced health care costs. Valid cost-effectiveness methods were used that considered key areas of uncertainty. The authors’ conclusions appear valid.

Type of economic evaluation
Cost-effectiveness analysis, cost-utility analysis

Study objective
The study assessed the cost-effectiveness of using oesophageal Doppler monitoring to improve haemodynamic control during colorectal resection.

Interventions
Four strategies were compared: conventional clinical assessment plus central venous pressure plus oesophageal Doppler monitoring; conventional clinical assessment plus oesophageal Doppler monitoring; conventional clinical assessment plus central venous pressure; and conventional clinical assessment alone.

Oesophageal Doppler monitoring involved cardiac output monitoring with an oesophageal ultrasound system and the calculation of blood flow through the descending aortic artery.

Conventional clinical assessment involved the monitoring of cardiac output via the measurement of clinical variables such as the heart rate, blood pressure, and urine volume.

Location/setting
Spain/hospital.

Methods
Analytical approach:
A decision analytic model with a short-term time horizon (until hospital discharge) was used. A lifetime horizon was considered in the sensitivity analysis. The authors stated that the analysis was carried out from the perspective of the Spanish public health system.

Effectiveness data:
Clinical inputs were derived from randomised clinical trials (RCTs) included in published systematic reviews that assessed the efficacy of oesophageal Doppler monitoring. Specifically, four RCTs involving 343 patients were included. Clinical inputs were synthesised using a meta-analysis based on a fixed-effect method. Heterogeneity among the trials was investigated. The total numbers of complications and major complications were the key inputs of the model, which were obtained by meta-analysis.

Monetary benefit and utility valuations:
Utility valuations were used in a sensitivity analysis and were based on a published source.

Measure of benefit:
Avoided mortality and avoided complications plus avoided mortality were used as the summary benefit measures. Quality-adjusted life-years (QALYs) were considered in a long-term sensitivity analysis.

Cost data:
The included costs were oesophageal Doppler monitoring probes (disposable probe and monitoring equipment), hospital stay, stay in high-dependence unit, operating theatre time, and central venous catheters. The cost of an oesophageal Doppler monitoring probe was provided by the manufacturers. Other costs were derived from a hospital finance department and regional accounting system. Resource quantities were mainly derived from the RCTs. Costs were in Euros (EUR). The price year was 2007.

Analysis of uncertainty:
One-way sensitivity analyses were carried out to investigate the impact of individual inputs on model outcomes using published and assumed ranges of values. A probabilistic sensitivity analysis was performed to consider the joint impact of all variables using conventional probability distributions. A Monte-Carlo simulation was used; the results were shown as cost-effectiveness acceptability curves. A cost-utility analysis was performed as part of a sensitivity analysis in a long-term model.

Results
With conventional clinical assessment, the expected survival rate was 0.900, the proportion of patients free from major complications was 0.750, and the projected cost was EUR 9,540.94.

With conventional clinical assessment plus oesophageal Doppler monitoring, the expected survival rate was 0.902, the proportion free from major complications was 0.830, and the projected cost was EUR 8,955.34.

With conventional clinical assessment plus central venous pressure, the expected survival rate was 0.979, the proportion free from major complications was 0.867, and the projected cost was EUR 9,490.33.

With conventional clinical assessment plus central venous pressure plus oesophageal Doppler monitoring, the expected survival rate was 0.993, the proportion free from major complications was 0.982, and the projected cost was EUR 8,579.21.

The conventional clinical assessment plus central venous pressure plus oesophageal Doppler monitoring was the dominant strategy as it was more effective (for both outcomes) and less expensive than the comparators.

The two most influential inputs were the relative risk of mortality and the assumed length of hospital stay.

The probabilistic sensitivity analysis showed that conventional clinical assessment plus oesophageal Doppler monitoring and conventional clinical assessment alone were unlikely to be cost-effective unless willingness to pay was close to zero. The probabilities of being cost-effective for conventional clinical assessment plus central venous pressure and conventional clinical assessment plus central venous pressure plus oesophageal Doppler monitoring were quite similar, although slightly favouring the latter strategy, especially for higher willingness to pay thresholds.

In the long-term analysis (with QALYs as benefit measure), oesophageal Doppler monitoring dominated non-oesophageal Doppler monitoring strategies. The incremental cost per QALY of conventional clinical assessment plus central venous pressure plus oesophageal Doppler monitoring over conventional clinical assessment plus oesophageal Doppler monitoring was EUR 118.65.

Authors' conclusions
The authors concluded that strategies that incorporated oesophageal Doppler monitoring were likely to be cost-effective as they improved health outcomes and reduced health care costs. Further studies should investigate the cost-effectiveness of other forms of monitoring.

CRD commentary
Interventions:
The rationale for comparator selection was clear; the most commonly used monitoring strategies in clinical settings and
in the published literature were considered.

**Effectiveness/benefits:**
Clinical evidence was obtained from systematic reviews of the literature that included only RCTs. Data were pooled using a meta-analysis that was appropriately described. Heterogeneity among RCTs was considered. These represent valid approaches. The authors stated that three RCTs that reported evidence on the efficacy of monitoring were included in the Agency for Healthcare Research and Quality (AHRQ) review and were considered to be of high quality. The authors stated that clinical trials including oesophageal Doppler monitoring were generally non-blinded, with the potential bias associated with overestimation of oesophageal Doppler monitoring benefits. Extensive sensitivity analyses were conducted on all clinical parameters. The main benefit measures were relevant for the disease under analysis and the interventions considered. In a sensitivity analysis, QALYs were considered with the assumption of equal utility weights for survivors after hospitalisation. These values were taken from a published study which was not described.

**Costs:**
The cost categories included in the analysis and the sources of unit costs reflected the perspective of the third party payer. Resource quantities and unit costs were generally presented separately, which enhanced the transparency of the analysis. Resource use was taken from the RCTs used for clinical effectiveness; it was unclear whether these estimates were representative of the usual practice in the authors’ setting. The use of RCTs should have ensured a detailed collection of data. Costs were treated stochastically and were varied in the sensitivity analysis. The price year was reported.

**Analysis and results:**
The expected costs and benefits were synthesised using an incremental approach, which allowed the identification of the optimal strategy. Valid approaches were used to investigate uncertainty, with extensive results presented. Limited information was given on the long-term model and its assumptions. The authors acknowledged some potential limitations of their analysis, although these were mainly addressed in the sensitivity analyses. The study results were clearly reported. The transferability of the results was not explicitly addressed; it was unclear whether these findings would be relevant to other settings as all cost data were specific to the authors’ region.

**Concluding remarks:**
Valid cost-effectiveness methods were used that considered key areas of uncertainty. The authors’ conclusions appear valid.

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