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Point prevalence of surgical checklist use in Europe: relationship with hospital mortality

I. Jammer[1,2], T. Ahmad[3], C. Aldecoa[4], D. Koulenti[5,6], T. Goranović[7], I. Grigoras[8], B. Mazul-Sunko[7,9], R. Matos[10], R. Moreno[10], G. H. Sigurdsson[11], P. Toft[12], B. Walder[13], A. Rhodes[14] and R. M. Pearse[3]* for the European Surgical Outcomes Study (EuSOS) group[†]

[1] Department of Clinical Medicine, University of Bergen, Bergen 5021, Norway
[2] Department of Anaesthesia and Intensive Care, Haukeland University Hospital, Bergen 5021, Norway
[3] Queen Mary University of London, London E1 4NS, UK
[4] Department of Anesthesia and Surgical Critical Care, Hospital Universitario Rio Hortega, Valladolid 47012, Spain
[5] 2nd Critical Care Department, Attikon University Hospital, Athens 12462, Greece
[6] Burns, Trauma and Critical Care Research Centre, University of Queensland, Brisbane, QLD 4006, Australia
[7] Department of Anaesthesiology and Intensive Care Medicine, University Hospital Sveti Duh, Zagreb 10000, Croatia
[8] Anesthesia and Intensive Care Department, Regional Institute of Oncology, University of Medicine and Pharmacy 'Gr. T. Popa', Iasi 700483, Romania
[9] Medical School of J.J. Strossmayer University, Osijek 31000, Croatia
[10] UCINC, Hospital de São José, Centro Hospitalar de Lisboa Central, EPE, Lisboa 1150-199, Portugal
[11] Landspitali Unversity Hospital, University of Iceland, 101 Reykjavik, Iceland
[12] Anaesthesia and Intensive Care, Odense University Hospital, Odense 5000, Denmark
[13] Postanaesthesia and Intermediate Care Unit, University Hospitals of Geneva, Geneva 1211, Switzerland
[14] Critical Care, St George's Healthcare NHS Trust and St George's University of London, London SW17 0QT, UK

* Corresponding author. Adult Critical Care Unit, Royal London Hospital, London E1 1BB, UK. E-mail: r.pearse@qmul.ac.uk

Editor's key points

- Checklists promote recollection of recommended steps or actions, overcoming lapses in memory and attention.
- Clinical team participation in a checklist procedure should enhance communication.
- Checklists are a tool, not a replacement for adequate training and supervision, vigilance, and teamwork.
- The consistent relationship between checklist use and better outcomes probably indicates direct (causal) and indirect beneficial effects.

Background. The prevalence of use of the World Health Organization surgical checklist is unknown. The clinical effectiveness of this intervention in improving postoperative outcomes is debated.

Methods. We undertook a retrospective analysis of data describing surgical checklist use from a 7 day cohort study of surgical outcomes in 28 European nations (European Surgical Outcomes Study, EuSOS). The analysis included hospitals recruiting >10 patients and excluding outlier hospitals above the 95th centile for mortality. Multivariate logistic regression and three-level hierarchical generalized mixed models were constructed to explore the relationship between surgical checklist use and hospital mortality. Findings are presented as crude and adjusted odds ratios (ORs) with 95% confidence intervals (CIs).

Results. A total of 45 591 patients from 426 hospitals were included in the analysis. A surgical checklist was used in 67.5% patients, with marked variation across countries (0–99.6% of patients). Surgical checklist exposure was associated with lower crude hospital mortality (OR 0.84, CI 0.75–0.94; $P=0.002$). This effect remained after adjustment for baseline risk factors in a multivariate model (adjusted OR 0.81, CI 0.70–0.94; $P<0.005$) and strengthened after adjusting for variations within countries and hospitals in a three-level generalized mixed model (adjusted OR 0.71, CI 0.58–0.85; $P<0.001$).

Conclusions. The use of surgical checklists varies across European nations. Reported use of a checklist was associated with lower mortality. This observation may represent a protective effect of the surgical checklist itself, or alternatively, may be an indirect indicator of the quality of perioperative care.

Clinical trial registration. The European Surgical Outcomes Study is registered with ClinicalTrials.gov, number NCT01203605.

Keywords: checklist; hospital mortality; outcome assessment (health care)

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[†] See Supplementary file.

It is estimated that more than 230 million patients undergo surgery worldwide each year, with mortality rates reported to be between 1 and 4%.[1–3] Variations in mortality between hospitals suggest both the potential and the need to improve outcomes resulting from preventable adverse events.[3–9] Consequently, there is increasing focus on improving the quality of perioperative care to minimize adverse events, and hence postoperative mortality. The World Health Organization (WHO) surgical checklist is a simple intervention designed to reduce error rates during surgery and anaesthesia.[10] By improving communication within the surgical team, checklist use may improve hazard detection, leading to meaningful improvements in patient safety.[11 12]

The first report of the use of the WHO surgical checklist was a cohort study, in which implementation was associated with a decrease in adverse event rates from 11 to 7% and a reduction in mortality from 1.5 to 0.8%.[10] These preliminary findings were consistent with subsequent studies, with reports of reductions in adverse event rates[13 14] and mortality.[13–15] Checklists improve teamwork and communication in the operating theatre, which may be one explanation for improved patient outcomes.[16] These improvements in outcomes may also result in economic benefits.[17] Despite the strong arguments in support of surgical checklist implementation, there is anecdotal evidence of wide variation in use between hospitals and nations. However, there have been no international epidemiological studies of surgical checklist use, or associated mortality, to confirm or refute this proposition. The aim of our study was to describe the prevalence of surgical checklist use in patients recruited to the European Surgical Outcome Study (EuSOS),[3] and to establish whether there is any relationship between reported use of a surgical checklist and subsequent hospital mortality.

Methods

Data collection

This was a secondary analysis of the European Surgical Outcome Study (EuSOS) data set.[3] The EuSOS was an observational study including all patients aged 16 years and over undergoing non-cardiac surgery in participating hospitals during the 7 day cohort week between April 4 and April 11, 2011. Patients undergoing planned day-case surgery, cardiac surgery, neurosurgery, radiological, or obstetric procedures were excluded. A paper case record form was completed for consecutive eligible patients. This was then anonymized before data entry onto a secure Internet-based electronic case record form. Patients were followed up until hospital discharge for data describing hospital mortality, censored at 60 days after surgery. We assessed data for completeness and then checked for plausibility and consistency with prospectively defined ranges. As part of the prospective data set, investigators were asked to record whether a surgical checklist was used in the care of each individual patient. No other details were requested regarding how the checklist was used. Ethical requirements differed by country. In Denmark, centres were exempt from ethical approval because the study was deemed to be a clinical audit. In all other nations, formal ethical approval was obtained. Informed consent was obtained from patients where required by local research ethics committees. A list of participating hospitals and full details of the methodology of the study can be found in the original publication.[3] To improve data quality, the primary analysis was performed on a data set that excludes sites with $\leq$10 patients and sites above the 95th centile for mortality. A sensitivity analysis was conducted on the entire data set.

Statistical analysis

The mortality outcome was defined as death in hospital within 60 days of surgery. Patients were categorized according to baseline demographics, including age, gender, smoking status, ASA physical status score, urgency of surgery, grade of surgery, surgical procedure category, and co-morbid disease. A single-level binary logistic regression model was used to conduct univariate analysis of the effect of surgical checklist use on hospital mortality. We then constructed a multivariate logistic regression model to compare the use of surgical checklist across these categories. Factors were entered into the multivariate logistic regression model according to their association with mortality in the univariate logistic regression analysis ($P<0.05$). To adjust for likely variations within countries and hospitals, a hierarchical three-level generalized mixed model was developed, with patients as the first level, hospital as the second level, and countries as the third level. The model was constructed with and without the surgical checklist as a variable in order to compare the effect on hospital mortality. Categorical variables are presented as *n* (%) and continuous variables as mean (SD). Findings are presented as odds ratios (ORs) with 95% confidence intervals (CIs). Adjusted ORs are presented with crude ORs for comparison. All data analysis was conducted using SPSS version 21 for Windows (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.). Statistical significance was set at $P<0.05$.

Results

The EuSOS database consists of 46 539 patients from 498 hospitals. Of these, 45 591 patients from 426 sites were included in the primary analysis, with an overall hospital mortality of 3.0%. Baseline data are presented in Table 1 along with the likelihood of exposure to a surgical checklist according to these factors. There was wide variation in exposure to a surgical checklist according to baseline characteristics. The overall prevalence of surgical checklist use in this population was 67.5%, but there was marked variation between countries from 0 to 99.6%. There was no clear relationship between patterns of checklist use and mortality rates in individual countries (Fig. 1 and Supplementary Table 1).

The use of a surgical checklist was associated with a lower crude hospital mortality (OR 0.84, CI 0.75–0.94; $P=0.002$). This effect was strengthened after adjustment for baseline risk factors in a multivariate regression model (adjusted OR 0.81, CI 0.70–0.94; $P<0.005$). To account for the effect of variation within countries and hospitals, we then