Provider volume and outcomes for oncological procedures
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CRD summary
This review assessed the relationship between provider volume and outcomes for oncological procedures. The authors concluded that high-volume providers significantly improve outcomes for pancreatectomy, oesophagectomy gastrectomy and rectal resection. Although this review has limitations that must be taken into consideration, the authors' conclusions are likely to be robust.

Authors' objectives
To assess the relationship between provider volume and outcomes for oncological procedures.

Searching
MEDLINE was searched from 1984 to 2004 for studies published in the English language; the search terms were reported. The Cochrane Library and reference lists of included reports were scanned. The authors stated in the abstract that EMBASE was searched, but this was not specified in the main text.

Study selection
Study designs of evaluations included in the review
Cohorts studies and community-based and population-based samples were eligible for inclusion. Studies conducted in a single institute were excluded, as were case series. The included studies used clinical and administrative data.

Specific interventions included in the review
Studies assessing the relationship between provider volume and outcomes were eligible for inclusion. The included studies used a wide range of definitions for low- and high-volume providers.

Participants included in the review
Studies of patients undergoing operations for malignant disease were eligible for inclusion. The included studies were undertaken in patients undergoing pancreatic resection, oesophagectomy and surgery for gastric cancer, lung cancer, breast cancer, colorectal cancer and miscellaneous cancers.

Outcomes assessed in the review
Studies that assessed health outcomes were eligible for inclusion if they met minimum quality criteria (see Criteria On Which The Validity (Or Quality) Of Studies Was Assessed). Studies reporting a combined outcome of death and complications using administrative databases were excluded. The included studies assessed in-hospital mortality, 30-day mortality and survival, according to the hospital and the surgeon.

How were decisions on the relevance of primary studies made?
Three reviewers selected studies, with any disagreements settled by a majority vote.

Assessment of study quality
The studies were assessed using the following criteria: representativeness of sample; number of hospitals or surgeons; sample size; number of adverse events; unit of analysis; appropriateness of patient selection; volume; adjustment for risk; measurement of clinical process of care; and outcomes. Studies were only included if they scored at least 4 points out of a possible 17. Three reviewers independently assessed validity, with any disagreements settled by a majority vote.

Data extraction
The authors did not state how the data were extracted for the review, or how many reviewers performed the data
The risk-adjusted mortality ratio (RAMR), odds ratio, or relative risk were calculated for each study.

**Methods of synthesis**

How were the studies combined?
The studies were grouped by surgical procedure and combined in a narrative. A range for the number-needed-to-treat (NNT) for each surgical procedure was calculated from the studies that reported the lowest and highest risk of mortality.

How were differences between studies investigated?
Differences between the studies were discussed in the text.

**Results of the review**

Forty-one studies (n=1,030,853) were included. Of these, 18 were based on clinical data and 24 on administrative data.

All studies showed either an inverse relationship between provider volume and mortality or no volume-outcome effect. Sixteen of the 18 clinical reports showed a statistically significant positive relationship between provider volume and outcome; no study showed a significant negative relationship.

Pancreatic resection (11 studies): the quality scores ranged from 5 to 10 (median 7). Definitions of low-volume hospitals ranged from 1 to less than 22 cases per year, and high-volume from more than 13 to more than 81 cases per year. All studies reported a statistically significant inverse relationship between hospital volume and mortality. The NNT to prevent one death was 10 to 15.

Oesophagectomy (10 studies): the quality scores ranged from 6 to 10 (median 7). Definitions of low-volume hospitals ranged from less than 2 to 32 cases per year, and high-volume from more than 6 to 83 cases per year. Nine studies reported a statistically significant inverse relationship between provider volume and mortality. The NNT to prevent one death was 7 to 9.

Surgery for gastric cancer (5 studies): the quality scores ranged from 4 to 10 (median 7). Definitions of low-volume hospitals ranged from less than 5 to 26 cases per year, and high-volume from more than 10 to 67 cases per year. Three studies reported a statistically significant inverse relationship between provider volume and mortality. One study reported a non-statistically significant reduction in RAMR for high-volume hospitals. One study reported no significant relationship. The NNT to prevent one death was 20 to 100.

Surgery for lung cancer (10 studies): the quality scores ranged from 6 to 10 (median 7). Definitions of low-volume hospitals ranged from less than 6 to less than 38 cases per year, and high-volume from 20 to 66 cases per year. Four studies found a statistically significant inverse relationship between hospital volume and mortality, with a reduction in RAMR ranging from 1.65 to 5.4%. The NNT to prevent one death was 20 to 50.

Surgery for breast cancer (4 studies): the quality scores ranged from 7 to 11 (median 9). Definitions of low-volume hospitals ranged from less than 10 to less than 25 cases per year, and high-volume from 30 to more than 149 cases per year. Three studies reported a statistically significant inverse relationship between provider volume and mortality, with the smallest study not reporting a significant relationship. The NNTs were not reported. Surgery for colorectal cancer (16 studies): the quality scores ranged from 5 to 11 (median 9). Definitions ranged from 1 to fewer than 12 cases for low-volume surgeons and from one to fewer than 84 cases per year for low-volume hospitals. Ten of 15 studies assessing hospital volume reported a statistically significant inverse relationship between volume and outcome, as did three of 7 studies assessing surgeon volume. The NNT to prevent one death was 50 to 100.

Surgery for miscellaneous cancers: the results were conflicting for cystectomy (3 studies) and nephrectomy (2 studies). High-volume providers were associated with lower mortality for radical prostatectomy (1 study), liver resection (3 studies) and intracranial tumour (1 study).
Authors' conclusions
High-volume providers had significantly improved outcomes for complex cancer surgery, particularly pancreatectomy, oesophagectomy, gastrectomy and rectal resection.

CRD commentary
The review addressed a clear question that was defined in terms of the participants, intervention, outcomes and study design. Relevant sources were searched, but limiting the search to English language reports raises the possibility of language bias. The authors did not investigate the possibility of publication bias. Methods were used to minimise error and bias during the study selection and validity assessment processes, but it was unclear whether similar steps were taken during the extraction of data. Validity was assessed using established criteria and the results were reported. Adequate details of each included study were given. The decision to combine the studies in a narrative was appropriate. Some of the limitations of the review were discussed. Although this review has limitations that must be taken into consideration, the authors' conclusions are likely to be robust.

Implications of the review for practice and research
Practice: The authors stated that results from the review support the centralisation of oncology services. However, they advised caution before advocating policy changes, owing to the limitations of current available evidence.

Research: The authors did not state any implications for further research.

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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.