Effect of a flow chart on use of blood transfusions in primary total hip and knee replacement: prospective before and after study

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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.

Health technology
The health intervention examined in the study was a flow chart on use of blood transfusion for patients undergoing primary total hip and knee replacement. A team of physicians and nurses developed an algorithm aimed at reducing the use of allogeneic blood transfusions based on guidelines published by the American Association of Anesthesiology and the American College of Physicians. Briefly, the guidelines restricted the use of transfusions in patients free from serious cardiac disease. An accurate description of the flow chart was provided.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients undergoing primary total hip and knee replacement.

Setting
The setting was tertiary care. The economic study was carried out in Switzerland.

Dates to which data relate
Effectiveness and resource use data were gathered from October 1998 to September 2000. The price year was not reported.

Source of effectiveness data
The effectiveness evidence derived from a single study.

Link between effectiveness and cost data
The costing was carried out on the same sample of patients as that used in the effectiveness analysis. It was performed retrospectively for the control group and prospectively for the intervention group.

Study sample
Power calculations were performed and suggested that a sample size of 230 operations before and 230 after the implementation of the flow chart would have detected a reduction in the incidence of patients receiving allogeneic blood transfusions from 45% to 30% with 90% power and alpha at 5%. All eligible patients who underwent surgery between October 1998 and September 1999 were included in the control group, while all eligible patients who
underwent surgery between October 1999 and September 2000 were included in the intervention group. Overall, 421 patients underwent 448 elective primary total hip or knee replacement operations. However, 4 patients had an operation before and after the implementation of the flow chart. There were 208 patients (who underwent 224 unilateral and two bilateral operations) in the control group and 217 patients (who had 218 unilateral and four bilateral operations) in the intervention group. The mean age was 69.6 years in the control period and 71.0 years in the intervention period. The proportion of women was 50.5% in the control period versus 56.7% in the intervention period.

**Study design**
This was a comparative study with historical control, and was carried out at a single institution, namely the Kantonsspital Winterthur in Switzerland. The length of follow-up was not reported, but patients were presumably followed until hospital discharge. No patient was lost to follow-up. Blinding was not performed. The authors pointed out that all operative and perioperative procedures, including surgical techniques and types of implants, remained identical.

**Analysis of effectiveness**
All patients included in the initial study sample were taken into account in the analysis of effectiveness. The primary outcome measure was the proportion of patients receiving blood transfusions (allogenic, autologous, or both). Other outcomes were proportion of allogeneic transfusions that did not fulfil the criteria for red blood cell transfusions published by the American College of Physicians; number of blood units used; number of patients donating blood preoperatively; frequency of adverse events; and length of perioperative admission. Odds ratios (ORs) were calculated using a regression model to assess the likelihood of blood transfusions in the intervention period in comparison with the control period, adjusting for age, sex, presence of risk factors, preoperative haemoglobin concentrations, type of surgery, bilateral operation, type of anaesthesia, duration of operation, estimated intraoperative blood loss, and postoperative haemoglobin concentrations. At baseline, study groups were comparable, except for preoperative haemoglobin levels (which were higher in the intervention period) and duration of surgery (which was shorter in the control period).

**Effectiveness results**
The proportion of patients receiving blood transfusions decreased from 35.0% (79 operations) to 19.8% (44 operations) for allogenic blood (difference: -15.2%; 95% confidence interval (CI): -23.3 - -7.0%); from 28.8% (65 operations) to 5.9% (13 operations) for autologous blood (difference: -22.9%; 95% CI: -29.6 - -16.2%); and from 59.7% (135 operations) to 24.8% (55 operations) for any blood transfusion (difference: -35.0%; 95% CI: -43.5 - -26.4%).

The proportion of patients receiving allogeneic transfusions significantly decreased around November 1999, which was the month after the implementation of the flow chart.

The proportion of allogeneic transfusions that did not fulfil the criteria for red blood cell transfusions published by the American College of Physicians decreased from 43.8% to 15.9% (difference: -27.9%; 95% CI: -43.2 - -12.5%).

The number of blood units used decreased from 200 to 102 for allogeneic blood (difference: -0.43 units per total joint replacement operation; 95% CI: -0.66 - -0.19) and from 127 to 25 for autologous blood (difference: -0.45 units per operation; 95% CI: -0.59 - -0.31).

The number of patients donating blood preoperatively fell from 98 patients (47.1%) donating 245 units during the control period to 53 patients (24.4%) donating 107 units during the intervention period.

The adjusted OR was 0.20 (95% CI: 0.10 - 0.39) for allogeneic transfusions, 0.14 (95% CI: 0.06 - 0.33) for autologous transfusions, and 0.07 (95% CI: 0.03 - 0.14) for any transfusion.

No serious adverse events were observed in either period. The length of perioperative admission was similar between the two groups.

The number of allogeneic transfusions was also evaluated in Switzerland and in the region of Zurich, and no clear trend
was observed.

**Clinical conclusions**
The effectiveness analysis showed that the guidelines were effective in reducing the need for blood transfusions among patients undergoing primary total hip and knee replacement.

**Measure of benefits used in the economic analysis**
Health outcomes were left disaggregated and no summary benefit measure was used in the economic evaluation. In effect, a cost-consequences analysis was performed.

**Direct costs**
The perspective taken in the study was not explicitly stated, but only costs relevant to the hospital appear to have been considered. The following items were included: blood transfusion units (both allogenic and autologous), giving sets, working hours of nurses and laboratory assistants, development and implementation of the flow chart (including working hours of physicians, nurses, laboratory assistants, and photocopies). Unit costs and quantities of resources used were reported separately. Resource use was based on data gathered alongside the effectiveness study (October 1998 to September 2000). Costs were presumably estimated from the authors’ institution. Discounting was not relevant due to the short time frame of the analysis. The price year was not reported.

**Statistical analysis of costs**
Costs were treated deterministically.

**Indirect Costs**
Indirect costs were not included in the economic evaluation.

**Currency**
UK pounds sterling (£), US dollars ($), Euros (EUR), and Swiss francs (CHF). Exchange rates were not reported.

**Sensitivity analysis**
Sensitivity analyses were not carried out.

**Estimated benefits used in the economic analysis**
Please refer to the effectiveness results reported above.

**Cost results**
The overall cost of the flow chart was CHF 2,692. The annual expenses for blood transfusion costs fell from CHF 96,787.90 to CHF 44,507.10.

The authors stated that the annual savings of about CHF 52,000 (23,000; $42,470; EUR 34,441) or 103.50 per patient undergoing total joint replacement were achieved at an extra cost of approximately CHF 2,700 (1,200).

**Synthesis of costs and benefits**
A synthesis of costs and benefits was not relevant as a cost-consequences analysis was carried out.
Authors' conclusions
The authors concluded that the implementation of a flow chart for the reduction of blood transfusions for patients undergoing primary total hip and knee replacement was effective and cost-saving. The authors noted some key elements of the programme: simplicity; wide distribution; no requirement for major changes; endorsement by local opinion leaders; and development of a sense of ownership.

CRD COMMENTARY - Selection of comparators
The selection of the comparator was appropriate as it reflected the standard treatment approach used before the introduction of the flow chart. You should decide whether this is a valid comparator in your own setting.

Validity of estimate of measure of effectiveness
The effectiveness data were estimated by means of a comparison between a prospective group and a historical control group. This design was selected because the new intervention and the comparators were implemented in two different time periods. As the two groups of patients were not assessed concurrently, factors other than the study interventions might have affected the results of the analysis. However, the authors analysed the trend of the main outcome measure outside their institution over the period covered by the study, and no significant change was observed. Furthermore, it was pointed out that operative procedures at the study institution did not change over time. Thus, the study should have captured the true intervention effect. To further enhance the robustness of the analysis, a regression analysis was also used taking into account the impact of potential confounding factors. However, study groups were not perfectly matched at baseline, and the difference in haemoglobin levels could have resulted in a decrease in the perceived need for transfusions. A further limitation of the analysis was the fact that evidence came from a single institution, and may therefore not have been representative of the general population of patients considered in the study. However, consecutive patients were enrolled. Another issue that was highlighted by the authors was that patients were not followed after hospital discharge, thus some serious adverse events could have been missed. The size of the sample was defined on the basis of statistical tests and all patients initially included were taken into account. These issues should be considered when assessing the internal validity of the analysis.

Validity of estimate of measure of benefit
No summary benefit measure was used in the analysis because a cost-consequences analysis was conducted. Please refer to the commentary reported above under 'Validity of estimate of measure of effectiveness'.

Validity of estimate of costs
The categories of costs included in the analysis suggest that a hospital perspective may have been used, although this was not clearly stated. Extensive information on unit costs and quantities of resources used was provided, which will help with replicating the analysis in other settings. The source of data was not stated but is likely to have been the hospital's accounting system. Cost estimates were specific to the study setting and the impact of using alternative economic estimates was not investigated. The price year was not given, thus limiting the possibility of reflating the costs in different time periods. Statistical analyses of costs were not performed.

Other issues
Comparisons of the current findings with those from other studies were not made. Furthermore, the authors did not address the issue of the generalisability of their results to other settings. Since sensitivity analyses were not performed, the external validity of the study was limited. However, replicating the cost analysis should be possible as details of costs and resource use were extensively reported. The study referred to patients undergoing primary total hip and knee replacement and this was reflected in the authors' conclusions. Some limitations of the study were noted and have been reported in the fields above.

Implications of the study
The study results support the implementation of a guideline for the restrictive use of blood transfusions in patients
undergoing primary total hip and knee replacement.

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None stated.

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**Other publications of related interest**


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