Mortality risks, costs, and decision making in transfusion medicine

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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 following technologies for improving blood transfusion safety were studied: use of single-donor apheresis platelets versus random platelets; solvent detergent-treated frozen plasma versus untreated fresh-frozen plasma (FFP); and leukocyte-reduced red blood cells (RBCs) versus unmodified RBCs transfusions in cardiac surgery.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients undergoing blood transfusion.

Setting
The setting was secondary/tertiary care. The economic study was carried out at the University of Rochester Medical Centre, NY, USA.

Dates to which data relate
The dates for effectiveness evidence, resource use and prices were not reported. The studies that formed the source of the effectiveness estimates were published in the period 1992-1998.

Source of effectiveness data
Effectiveness data were derived from a review of previously completed studies and from the authors’ assumptions.

Outcomes assessed in the review
The following outcomes were assessed.

For the use of single-donor apheresis platelets versus random platelets:
- the risk reduction when single-donor apheresis platelets were used; and
- the risk of contracting HIV, hepatitis B or C, and the proportion of fatal infections among infected patients when random platelets were used.

For the solvent detergent-treated versus untreated fresh frozen plasma:
- the risk reduction when solvent detergent treated plasma was used; and
the risk of contracting HIV, hepatitis B or C, and the proportion of fatal infections among infected patients (see above) when untreated fresh frozen plasma was used.

For the leukocyte-reduced versus unmodified RBCs in cardiac surgery:

mortality at 60 days after operation in recipients of unmodified RBCs and leukocyte-reduced RBCs.

**Study designs and other criteria for inclusion in the review**

The study designs for the effectiveness evidence results were mainly randomised, controlled trials although no explicit criteria for inclusion were stated.

**Sources searched to identify primary studies**

Not stated.

**Criteria used to ensure the validity of primary studies**

Not stated.

**Methods used to judge relevance and validity, and for extracting data**

Not stated.

**Number of primary studies included**

Five studies were explicitly stated as sources for the estimates of effectiveness.

**Methods of combining primary studies**

Single studies provided estimates of the parameters of interest.

**Investigation of differences between primary studies**

Not directly relevant as estimates were based on single studies.

**Results of the review**

The risk of HIV-1 infection was 1 in 493,000 donor units in random donor platelets. The risk of contracting hepatitis B was 1 in 63,000 donor units, and the risk of contracting hepatitis C was 1 in 103,000 donor units in random donor platelets, and no more than 10% of these infections would be fatal (for hepatitis B, 0.8 in 500,000, and for hepatitis C, 0.5 in 500,000, of such infections were fatal).

Current risk of fatal HIV-1 or hepatitis C and B when untreated fresh- frozen plasma was used were as in the case of the use of random donor platelets. The use of solvent detergent-treated FFP reduced the risk of transmission of hepatitis C and B and HIV-1 to zero.

Mortality at 60 days after operation in recipients of unmodified RBCs was 7.9% compared with 3.6% in recipients of leukocyte-reduced RBCs in one randomised trial. Another study showed a reduction of 2.1% (authors' unpublished data).

**Methods used to derive estimates of effectiveness**

The authors gave estimates of the numbers of procedures from their own institution and made several assumptions.
Estimates of effectiveness and key assumptions
The number of units of random donor platelets transfused annually was 27,000.

There were 700 cardiac operations per year and 10,000 units of FFP would be transfused annually.

The main assumptions were as follows:

that a standard random donor platelets is 5 units of platelets and thus, the use of single donor platelets will reduce the risk 5-fold;

the case fatality was assumed to be 100% for HIV-1 and 10% each for hepatitis B and C; and

the mortality reduction for leukocyte-reduced transfusions in cardiac surgery was assumed to be 2% (smaller than that found in the review).

The potential benefits of leukocyte-reduction in reducing post-operative complications were not considered in the analysis.

Measure of benefits used in the economic analysis
The measure of benefit used was deaths avoided.

Direct costs
The direct incremental costs of the change of technology were estimated. Quantity and cost data were based on the experience in the authors' setting. The quantities given were numbers of procedures as stated earlier. The total annual incremental costs at the authors' institution were reported. The price year was 1999. Some important cost categories may have been omitted from the analysis, such as the cost of avoided fatal complications.

Statistical analysis of costs
No statistical analysis of costs was carried out.

Indirect Costs
No indirect costs were included.

Currency
US dollars ($).

Sensitivity analysis
No sensitivity analyses were performed.

Estimated benefits used in the economic analysis
The number of deaths prevented per year was 0.10 with apheresis platelets, 0.044 with solvent detergent-treated fresh-frozen plasma, 14.0 by leukocyte-reduced transfusions, 6.0 by HIV-1 antibody testing, 2.3 by hepatitis B antibody testing, 10 by hepatitis C antibody testing and 0.033 by HIV-1 antigen testing.

Cost results
The annual incremental cost was $1,500,000 for apheresis platelets, $750,000 for solvent detergent-treated fresh-frozen plasma, $160,000 for leukocyte-reduced transfusions (cardiac surgery only), $130,000 for 65,000 components of
HIV-1 antibody testing, $130,000 for 65,000 components of Hepatitis B antibody testing, $130,000 for 65,000 components of Hepatitis C antibody testing, and $130,000 for 65,000 components of HIV-1 antigen testing.

Synthesis of costs and benefits
The cost per death prevented was $15 million with apheresis platelets, $17 million with solvent detergent-treated fresh-frozen plasma, $11,000 with leukocyte-reduced transfusions, $22,000 with HIV-1 antibody testing, $57,000 with hepatitis B antibody testing, $13,000 with hepatitis C antibody testing and $3.9 million with HIV-1 antigen testing.

Authors’ conclusions
The authors concluded that leukocyte-reduced transfusions in cardiac surgery are as cost-effective as HIV-1 antibody testing in preventing mortality in patients receiving transfusions. Solvent detergent plasma and apheresis platelets are comparatively expensive approaches to reducing mortality from transfusion complications.

CRD COMMENTARY - Selection of comparators
The choice of comparators was justified as being established alternatives to the studied interventions. Four interventions applied in practice (Hepatitis B and C, HIV-1 antibody and HIV-1 antigen testing) were studied to illustrate the comparative cost-effectiveness.

Validity of estimate of measure of effectiveness
The validity of the estimate of effectiveness is unclear. Most of the estimates were based on randomised controlled trials but, even so, insufficient information was presented to evaluate their validity. In addition, the authors made assumptions that, although conservative (see main assumptions), could have biased the estimates of effectiveness.

Validity of estimate of measure of benefit
The estimation of benefit in terms of deaths avoided was derived directly from the effectiveness evidence and the same comments apply. The choice of deaths avoided could have missed some important intervention benefits in terms of life years and/or quality of life gained through the intervention studied.

Validity of estimate of costs
The estimates of costs were based on the authors’ institution. Users of this database should consider the relevant resources and unit costs for their own settings. Quantities were given only for the procedure itself, therefore their composition in terms of, for example, materials and labour is unknown, thus reducing the generalisability of the findings.

Other issues
The authors did not compare their findings with those from other studies and did not specifically address the issue of generalisability to other settings, although the crucial parameters for the analysis were the effectiveness estimates taken from published studies and assumptions. The authors did not discuss the possible limitations of the study design and did not analyse the sensitivity of the results.

Implications of the study
The authors suggested that the use of leukocyte reduction in cardiac surgery is a cost-effective technology. The study design could have limited the internal validity and generalisability of the results and there is no sensitivity analysis to inform on the uncertainty in study results. The users of this database are advised to consider the validity of the main parameters’ estimates and assumptions and their applicability to the setting of interest.
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Other publications of related interest


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