Allogeneic stem cell transplantation: an economic comparison of bone marrow, peripheral blood, and cord blood technologies

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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 use of bone marrow (BM) transplantation, peripheral blood cell (PB) transplantation and cord blood (CB) transplantation for stem-cell transplantation.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population consisted of recipients for stem-cell transplantation.

Setting
The setting was secondary care. The economic analysis was carried out in Canada.

Dates to which data relate
The effectiveness data were gathered from studies published between 1990 and 1999. The resource data were gathered from published (1997) and unpublished sources. The price year was 1999.

Source of effectiveness data
The effectiveness data were derived from a review of the literature.

Modelling
The economic analysis was based on models drawing on Canadian experience. A time horizon of 10 years was used.

Outcomes assessed in the review
The outcomes assessed were:

donor safety,
adverse donor events,
the time to platelet engraftment,
the time to neutrophil engraftment,

the proportion of patients who develop acute graft versus host disease (GVHD), and

survival at 100 days post transplant.

Study designs and other criteria for inclusion in the review
The literature search was conducted for studies that directly compared PB and BM technologies. There were no studies comparing either of these two with CB transplantation. Studies that reviewed the outcomes of CB transplantation were analysed separately. The studies included in the analysis were either randomised controlled trials or retrospective studies. Other criteria for inclusion in the review were not reported.

Sources searched to identify primary studies
Cancerlit was searched from 1996 to 1998. References with "bone marrow" and "stem cell transplant" in the titles were extracted. In addition, HealthSTAR was searched from 1990 to 1999. References with "bone marrow transplantation" or "haematopoietic stem cell transplantation" as subject words were extracted. The authors also searched manually for additional articles using the bibliographies of the retrieved articles.

Criteria used to ensure the validity of primary studies
Not reported.

Methods used to judge relevance and validity, and for extracting data
Not reported.

Number of primary studies included
Seven primary studies were included in the analysis of PB and BM technologies. One retrospective study was included in the analysis of CB transplantation.

Methods of combining primary studies
Not reported.

Investigation of differences between primary studies
Differences between the primary studies, in terms of pretransplantation conditioning techniques, disease indications and the number of matching antigens, were investigated. The authors provided an explanation of differences between the individual studies.

Results of the review
The authors did not report the statistical analysis of primary outcomes.

Donor safety was not significantly different between the BM and PB technologies. Donor safety for CB transplantation was negligible.

The activity of BM donors was more restricted than that of PB donors. BM donors had 3 days of restricted activity and 2 nights in hospital, while PB donors had 1 day of restricted activity and no hospitalisation.

The time to platelet engraftment was significantly more rapid for PB than BM technologies in five studies. The number of days to engraftment were 19, 20.5, 27, 15 and 17 with BM transplantation versus 14, 14, 22.5, 11 and 12,
respectively, with PB transplantation.

The time to platelet engraftment was 71 days for CB transplantation.

The time to neutrophil engraftment was significantly more rapid for PB than BM technologies in four studies. The number of days until engraftment for BM versus PB technologies were, respectively, 15 versus 11, 21.5 versus 16, 22 versus 19, and 16.5 versus 13.5. The time to neutrophil engraftment was significantly longer for PB than BM technologies in one study (10 versus 9 days).

The time to neutrophil engraftment was 28 days for CB transplantation.

The proportion of patients who developed acute GVHD was not significantly different between BM and PB technologies in any study. The data for CB transplantation were also inconclusive.

The 100-day survival was not significantly different between the BM and PB technologies.

**Measure of benefits used in the economic analysis**

No summary benefit measure was used in the economic evaluation. In effect, the study was a cost-consequences analysis.

**Direct costs**

Only direct costs of the health service were included. These were for donor maintenance and recruitment, collection, transport, processing, testing, confirmatory testing, harvesting and transplantation. It appears that the quantities have been estimated from actual data, using models drawing on Canadian experience. The authors made several assumptions to estimate the cost per recipient for each technology. The price year was 1999. The costs and the quantities were reported separately. Discounting was carried out because the costs were incurred during more than 2 years. A discount rate of 5% was used.

**Statistical analysis of costs**

No statistical analysis on the costs was performed.

**Indirect Costs**

The indirect costs were not included.

**Currency**

Canadian dollars (Can$).

**Sensitivity analysis**

One-way sensitivity analyses were conducted for key assumptions.

**Estimated benefits used in the economic analysis**

See the 'Effectiveness Results' section.

**Cost results**

The total costs were Can$270,000 for a BM recipient, Can$272,000 for a PB recipient and Can$424,000 for a CB recipient.

If only 40% of the BM and PB patients were assumed to have been tested using the more costly DNA tests, the costs of
BM and PB transplants would have been lower by about Can$30,000.

If PB and BM donors had a 5-year rather than a 10-year attribution, the BM cost per transplant would increase to Can$349,000.

Using different sizes of donor pools to achieve an 85% match, the results showed a wide range of estimates.

If PB recipients were hospitalised for 25 days rather than 50, the per-transplant cost for PB recipients would have been Can$203,000, which was considerably less than that for patients receiving BM transplantation.

Synthesis of costs and benefits
Not applicable.

Authors’ conclusions
In terms of both the costs and outcomes, peripheral blood (PB) transplantation and bone marrow (BM) transplantation appear superior. However, the current literature was inadequate for an outcomes comparison of cord blood (CB), PB and BM technologies. PB and CB are emerging technologies and, as such, the results should be viewed in light of the fact that a steep learning curve may be involved. The authors noted that their results should be considered as benchmarks against which future outcomes and costs can be compared.

CRD COMMENTARY - Selection of comparators
The reason for the choice of the comparators was clear. The comparators were chosen because they represented the most commonly used technologies for stem-cell transplantation in the authors' setting. You should consider whether these are widely used technologies in your own setting.

Validity of estimate of measure of effectiveness
The authors reported that either randomised controlled trials or retrospective studies were selected as primary studies. It appears that a systematic review of the literature has been conducted. The methods and conduct of the review were satisfactorily reported. The differences between the primary studies were investigated and an explanation of those differences was provided. However, the validity of the studies was not analysed and the statistical analysis of the primary outcomes was not reported. In addition, the estimates were not varied in the sensitivity analysis. These facts may limit the relevance of the data used.

Validity of estimate of measure of benefit
No summary benefit measure was used in the economic evaluation, which was classified as a cost-consequences analysis.

Validity of estimate of costs
The authors limited their analysis to the direct costs. The analysis did not include the costs of adverse donor events and management care of GVHD. Therefore, the total cost of the interventions may have been underestimated. The cost estimates are likely to have been specific to the Canadian setting. A sensitivity analysis on the costs was performed. The ranges used were not reported in detail, and neither were the results. Discounting was appropriately performed.

Other issues
The generalisability of the results was not addressed. The authors did not compare their findings with those from other studies. The authors highlighted some limitations of their study. They do not appear to have reported their results selectively.
Implications of the study
The authors stated that smaller countries and regional registries can benefit from low marginal registry costs by sharing such services. It would appear that economic gains may arise from focusing on international cooperation rather than self-sufficiency.

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