Options for possible changes to the blood donation service: health economics modelling

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Scientific summary

The HEMO study

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Scientific summary

The NHS Blood and Transplant (NHSBT) service is an essential part of the health service in England and North Wales, and in 2015–16 it issued 1.594 million units of red cells at a production cost of approximately £160M. The demand for the universal blood type [O negative (O–)], as well as A negative (A–), B negative (B–) and other rare blood types that are more common in black and Asian minority ethnic (BAME) donors is increasing. A major concern is ensuring that there is a sufficient supply of those blood types that are in relatively high demand. The 2013–17 NHSBT Blood Donation Strategy recognised that, to encourage existing donors to donate whole blood at the requisite frequency, changes to the blood collection service were needed to improve the donor experience. To inform future blood service strategies and research priorities, evidence is therefore required about the likely effects of changes to the blood service on the frequency and costs of whole-blood donation. The INTERVAL trial [Di Angelantonio E, Thompson SG, Kaptoge S, Moore C, Walker M, Armitage J, *et al.* Efficiency and safety of varying the frequency of whole blood donation (INTERVAL):a randomised trial of 45 000 donors. *Lancet* 2017;**390**:2360–71] will provide evidence on whether or not reducing the minimum interval between whole-blood donations is safe and efficacious, but will not provide information on relative cost-effectiveness.

The aim of our study [the Health Economics MOdelling of blood donation (HEMO) study] was to evaluate the cost-effectiveness of alternative future changes to the blood collection service.

Objectives

The objectives of the study were to:

1. estimate the cost-effectiveness of alternative minimum interdonation intervals between whole-blood donations
2. investigate the frequency with which donors are willing to donate whole blood according to alternative future changes to the blood collection service
3. estimate the cost-effectiveness of alternative strategies for maintaining the supply of whole blood to the NHS.

Methods

The HEMO study consisted of three interlinked components: a within-trial cost-effectiveness analysis (CEA) of the INTERVAL trial strategies, stated preference (SP) surveys that elicited donor preferences and a CEA of different strategies for changing the blood collection service. The strategies of interest included changes to opening times and appointment availability at blood collection venues, the introduction of a donor health report and reduced minimum intervals between whole-blood donations. The overall target population was existing whole-blood donors in England, of whom approximately 85% currently donate whole blood at mobile (temporary) blood collection venues, with the remainder donating at static (permanent) blood collection centres. The study took a Health and Personal Social Services perspective to cost measurement. The costs measured were those anticipated to differ according to strategy, and included additional collection and staff costs, but not processing, marketing or fixed costs. The results were reported overall and according to subgroups, in particular donors whose blood type was defined as 'high' (O–, A– and B–) versus 'standard' demand, ethnicity and age group. The NHSBT and blood donors helped define the strategies of interest, design the SP surveys and interpret the findings.

Trial-based cost-effectiveness analysis of reduced minimum intervals using the INTERVAL trial

The CEA used data from the INTERVAL trial to report the cost-effectiveness of reducing the minimum interval between whole-blood donations. The INTERVAL trial included 45,263 whole-blood donors (22,466 men and 22,797 women). Male participants were randomly assigned to 12- versus 10- versus 8-week interdonation intervals, and female participants to 16- versus 14- versus 12-week interdonation intervals. The CEA excluded donors who withdrew consent for use of their data ($n = 221$), died during or after the trial follow-up period ($n = 142$), or who did not have requisite PULSE (the NHSBT national blood supply database) data available ($n = 37$), leaving an overall sample of 44,863 donors.

The CEA used information on the number of whole-blood donations, deferrals (temporary suspension from donating blood), including those caused by low haemoglobin (Hb), and donors' health-related quality of life (QoL) assessed by the Short-Form 6D utility score, all measured over 2 years. The cost analysis combined resource use measures, such as the number of deferrals and donations, with unit costs, mainly taken from NHSBT financial records. We report the incremental cost-effectiveness of the reduced interval strategies, according to the incremental (difference in means) cost per additional unit of whole blood donated.

Stated preference surveys to predict frequency of whole-blood donation

The HEMO study undertook two SP surveys designed to elicit donor preferences for alternative future changes to the blood collection service and to predict the effects of these future changes on the annual frequency of whole-blood donation. The choice of policy-relevant attributes for the surveys was informed by a rapid literature review, qualitative research with blood donors, input from NHSBT policy-makers and a pilot study (5016 invitees, 25% response rate). The chosen attributes were travel time to the venue, blood collection venue opening hours, appointment availability, provision of a health report and the maximum number of annual whole-blood donations. Donors were asked to state the frequency with which they would be willing to donate blood according to the alternative attributes and levels in the survey.

The survey had a full factorial design, and 100,000 donors not included in the INTERVAL trial were invited to take part (non-INTERVAL survey). Donors were considered for inclusion according to the following criteria: 17–70 years old, donation of at least one unit of whole blood in the past 12 months, e-mail address held by the NHSBT and resident in mainland England. We repeated the same SP survey with the eligible ex-INTERVAL participants, as these donors had experienced donation at a static centre during the trial ($n = 28,732$). The HEMO study also compared the donation frequencies predicted from the survey responses with those observed in the PULSE database.

Cost-effectiveness analysis of alternative strategies

The CEA used estimates from the SP surveys on the relative frequency with which donors were predicted to donate according to proposed changes to the blood service. The CEA also used information from the PULSE donor database on the absolute levels of donation frequency for the target population of interest, and according to the characteristics of the blood service experienced by the target population at their previous donation visit. The CEA incorporated evidence from the INTERVAL trial on the rates of deferral per attendance to predict the annual frequency of successful donation for each strategy. We calculated the effects of the alternative strategies on the number of whole-blood donations and the relevant costs of blood collection over 1 year. The CEA reported the additional costs per extra unit of whole blood donated. The sensitivity analysis considered whether or not the results were robust to alternative assumptions, including whether or not additional staff time was required in static donor centres for collecting additional units of blood.

Results

The CEA of the INTERVAL trial strategies found that the average Hb deferral rate was higher following the introduction of shorter minimum donation interval strategies; for men the rate was 5.7% per session attended in the 8-week arm compared with 2.6% in the 12-week arm, and for women the corresponding rates were 7.9% (12-week arm) and 5.1% (16-week arm). For men, the average number of whole-blood donations increased by 1.71 [95% confidence interval (CI) 1.60 to 1.80] for the 8- versus the 12-week interval arm, and by 0.79 (95% CI 0.70 to 0.88) for the 10- versus the 12-week interval arm (over 2 years). For women, the corresponding increase in the average number of donations was 0.85 (95% CI 0.78 to 0.92) for the 12- versus the 16-week interval. Donors' QoL was similar across arms for all time points. The shorter interval strategies led to an increase in the average number of donations, at a small additional average cost, compared with current practice. For example, the incremental cost-effectiveness ratios (ICERs) were £9.51 (95% CI £9.33 to £9.69) and £10.17 (95% CI £9.80 to £10.54) for the 8- versus the 12-week interval arm for men, and the 12- versus the 16-week interval arm for women, respectively. These findings were similar across donor subgroups, including for donors with high-demand blood types.

A total of 25,187 (25%) donors in the non-INTERVAL sample and 9318 (32.4%) in the ex-INTERVAL sample responded to the SP survey. The analysis of the survey responses provided plausible estimates of the effects of alternative future changes to the blood collection service on the stated frequency of whole-blood donation. The results were generally similar for the non-INTERVAL and ex-INTERVAL surveys, and by donor subgroups. The results showed that, for static donor centres, extending appointment availability to weekday evenings or weekends, or reducing the minimum interval between whole-blood donations, would increase the stated frequency of blood donation by on average 0.5 donations per year. The introduction of the donor health report had a relatively small effect on the predicted frequency of donation (about 0.2 extra donations per year). Switching mobile sessions from weekdays to weekends, while maintaining current levels of appointment availability, led to a small average increase in the predicted donation frequency (about 0.1 extra donations per year).

The survey found that, if travel time was increased by 30 minutes, the proportion of donors who said that they would 'probably not donate' was between 23% and 86% (according to donor subgroup). This effect was greater for those subgroups of donors who were younger or less experienced (1–4 donations in the last 5 years) or who donated less frequently in the 12 months prior to the survey, or BAME donors who responded to the ex-INTERVAL survey.

For men, the average annual frequency of donations predicted from the survey responses was moderately higher (+20%) than their observed donation frequency recorded on the PULSE register. For women, the corresponding discrepancy was minimal, and, for both sexes, this discrepancy was similar across subgroups.

The CEA found that the strategies of extending opening times to weekday evenings or weekends in all static donor centres would provide additional units of whole blood at a cost per additional unit of £23 or £29, respectively. This finding was similar for the subgroup of donors whose blood type is in high demand. The introduction of a health report was less cost-effective [£130–140 per additional unit collected (across all subgroups)]. Reducing the minimum interval between donations to the shortest minimum interval considered in the INTERVAL trial had a relatively low cost per additional unit of whole blood collected [£10–20 per unit of blood donated (across all subgroups)]. These findings were robust to alternative assumptions, in particular the choice of data for predicting donation frequency (either survey or INTERVAL trial) and assumptions about the level of unit costs implied by different capacity constraints.

Limitations

The time horizon for the main CEA was 1 year, and so the long-term effects of the alternative strategies on the rate and costs of donors leaving the donation register were not considered. The study excluded any additional costs to donors, for example from time off work or increased travel time. The study did not evaluate all the strategies of potential interest to the NHSBT, such as expanding the number of static donor collection centres or closing/merging mobile sessions.

Conclusions

The HEMO study found that donors are willing to donate whole blood more often than they do currently, but the magnitude of the predicted increase differs according to the proposed change to the blood collection service. Those donors attending static donor centres would strongly prefer more opportunities to donate during weekday evenings or at weekends. Extending opening hours for blood donation to weekday evenings or to the weekends for all static donor centres is a relatively cost-effective way of increasing the blood supply for donors whose blood type is in high demand. Reducing the minimum interdonation interval could also provide additional whole blood at a small additional cost in the short term, but, as the INTERVAL trial showed, this would increase rates of Hb-related deferrals over 2 years. As increasing deferrals may lead to reduced donor retention, which implies higher future costs beyond those considered, it is unclear whether or not reducing the minimum interval between donations will be cost-effective in the long term.

The HEMO study found that neither moving mobile sessions to the weekends nor providing a donor health report at each donation visit led to sufficient increases in the frequency of whole-blood donations to justify the additional costs. Our surveys also found that requiring donors to travel further to donate whole blood discouraged donors from donating, particularly younger, less experienced and BAME donors, who are among those subgroups most important to retain. Hence, if the NHSBT continues to close mobile sessions and increase travel time for donors, it may be important to adopt strategies that lead to other improvements in the donation experience for these particular donor subgroups.

Future work

1. If any of these strategies are implemented, it will be important to monitor the preferences and donation frequency for different donor subgroups, and in alternative settings. Such an evaluation could build on the research framework presented here, and consider the costs and consequences of scaling up the strategy, in real time, by using large-scale surveys of preferences, calibrated to actual donation behaviour as recorded in the PULSE registry.
2. Further research is required to investigate the clinical effectiveness and cost-effectiveness of tailoring opportunities to donate blood according to the preferences of particular donor subgroups. There is a particular requirement to understand the preferences of BAME donors, as their blood is in high demand and only a relatively small sample of these donors were surveyed in the HEMO study.
3. Improved understanding of how to predict which donors are likely to have Hb-related deferrals would allow the stratification of the donor population by likelihood of deferral. This could allow increased blood collection using shorter interdonation intervals for a defined subpopulation of donors whose blood type is in high demand.
4. Further research is warranted on evaluating novel marketing strategies to encourage the recruitment of particular subgroups of new donors (blood type O–, BAME, younger donors), to ensure the required mix of blood donors to sustain the future blood supply.

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