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NOT FOR PUBLICATION

WORKING PARTY TO ADVISE ON PLASMA SUPPLIES FOR SELF-SUFFICIENCY IN BLOOD PRODUCTS

P R E L I M I N A R Y R E P O R T

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SUMMARY

1. It has been determined that 100 M i.u. Factor VIII concentrates is a reasonable estimate for clinical requirements in England and Wales by the mid-1980's. By obtaining enough plasma to satisfy FVIII needs there should be adequate source material to provide sufficient quantities of albumin products.

2. Consideration of the various types of FVIII concentrates has led to the conclusion that intermediate FVIII concentrate is the product of choice for the treatment of the majority of patients suffering from haemophilia A together with a requirement for a small proportion of high purity concentrates and frozen/freeze-dried cryoprecipitates.

3. Consideration of the yield of FVIII per kg. source plasma has led the Working Party to estimate that 500,000 kg. plasma are required to meet the requirements for FVIII concentrates.

4. It will be possible to obtain 200,000 kg. plasma from whole blood donations at a rate of blood collection which is required to provide adequate numbers of units of red cells for clinical use. Alternatives for obtaining the remaining plasma are:

   (a) Increase the collection of whole blood.

   (b) Introduce plasmapheresis.

   For ethical and economic reasons, increasing the rate of collection of whole blood donations holds disadvantages, whilst the introduction of plasmapheresis appears feasible providing that finance is available to provide the necessary facilities.

5. The Working Party considers that it will be possible to provide sufficient plasma for self-sufficiency for FVIII and albumin for England and Wales. The investigations carried out to date have only outlined the various options available to attain this goal. Much further work is required to determine how the increased supply of plasma can best be achieved.

   Thus: (a) Wide consultation is necessary to determine how and when regions could implement agreed targets for the production of fresh plasma.

   (b) Consideration of a trial of manual plasmapheresis to obtain plasma is an urgent requirement. Suggestions with respect to instituting such a trial can be put forward.

   (c) Attention has not yet been given to the production of adequate quantities of antibody-containing plasma to produce specific immunoglobulins.

6. The need for further investigations to determine the detailed procedures which will enable a phased progression to self-sufficiency in blood products in England and Wales is dependent on financial and other considerations. It is pertinent, therefore, at this stage of the investigations to ask the Advisory Committee whether it wishes the Working Party to proceed in the manner outlined above.

1. Raw material for the preparation of plasma products can be considered under two headings:

1.1 Normal human plasma for coagulation factor concentrates, normal immunoglobulins and albumin products.

1.2 Antibody-containing human plasma for specific immunoglobulins.

Since the supply of normal human plasma has the greatest impact upon the Regional Transfusion Centres (RTCs.) and the Blood Products Laboratory (BPL) it was decided that this aspect would be considered first.

2. Before the volume of plasma required for self-sufficiency in the various products can be defined it is necessary to determine the quantity of each product required for clinical use.

In essence, this is reduced to the need for two groups of products, viz., factor VIII concentrates (FVIII) and albumin preparations, since self-sufficiency has been achieved already for other coagulation factor preparations and normal immunoglobulin.

2.1 Requirement for FVIII

At present the combined capacities of BPL and the Plasma Fractionation Laboratory, Oxford (PFL) is 15 M i.u. FVIII per year. Following the interim expansion at BPL, to be completed during 1982, production of FVIII will be increased to a maximum of 30 M i.u. per year. Also, approximately 10 M i.u. FVIII per year is prepared at RTCs, in the form of frozen cryoprecipitate; it is likely that this will continue at this rate for the present, although there is the possibility that it will be reduced following the expansion at BPL. Thus by the end of 1982 a maximum of 40 M i.u. FVIII per year will be available.

Representatives of the Haemophilia Directors estimate that by the mid-1980's the annual requirement for FVIII will reach 100 M i.u. for the United Kingdom. Forecasting beyond that time could not be accurate but it was considered that by the 1990's the need for FVIII could reach 150 M i.u. per year.

2.2 Requirement for albumin products

The present production of Plasma Protein Fraction (PPF), the principal albumin preparation in use, is in the order of 55 kg. per 1 M of the population per year. Following the interim expansion at BPL, this will be increased to 80-90 kg. per M per year. There is incomplete information available with respect to the purchase of imported albumin products nor is there an accurate estimate of the clinical requirements. In certain European countries its usage reaches 350-375 kg. per M per year, but it is considered unlikely that this quantity would be required in England and Wales.

If sufficient plasma is collected to provide 100 M i.u. FVIII per year there will be sufficient raw material to provide 230 kg. PPF per M per year. This figure is consistent with the recommendations of 200 kg. PPF per M per year by the Council of Europe's Public Health Committee's Sub-committee of Specialists in Blood Problems (Report, CESP/TS(77)).

3. Basis for estimating plasma supply

The Working Party agreed that estimates for plasma supply should be based upon that required to produce 100 M I.U. FVIII per year. Whilst it was noted that this estimate was made for the U.K. it was considered that the difficulties in providing completely accurate estimates for requirements of the product were such that it was a realistic level of usage to be aimed for in England and Wales.

4. Type of FVIII preparation required

Since the yield of FVIII achieved in the preparation of the various types of concentrates has a significant bearing on the volume of starting plasma required the Working Party has examined the various products available and has considered the advantages and disadvantages of each. These are discussed in Appendix 1.

Frozen or freeze-dried cryoprecipitate derived from small pools of plasma has advantages for patients requiring infrequent treatment since exposure to a large number of donations of plasma is avoided thus lessening the risk of the transmission of hepatitis. In certain countries where this is the primary FVIII preparation there is no obligation to attain standards required by an independent agency. In the U.K. the same methods could not be used to manufacture a similar product.

Freeze-dried cryoprecipitates prepared from large pools of plasma increase the exposure of the patient but result in greater homogeneity of the product. However, intermediate FVIII concentrate, also prepared from large pools, has advantages over freeze-dried cryo-precipitate with respect to stability, the risk of reaction and potency (which results in a lower volume per dose given to the patient).

After careful consideration of the facts, the Working Party concluded that the intermediate purity concentrate was the product of choice for the treatment of the majority of patients with haemophilia A and this was also the view given by the representatives of the Haemophilia Directors. It was considered, therefore, that a minimum of 80% of the FVIII should be intermediate purity concentrate and of the remainder, up to 10% as high purity concentrate. A quantity of frozen and freeze-dried cryoprecipitate may also be necessary.

Thus, in the total of 100 M i.u. FVIII

Intermediate purity concentrate	= 80 M i.u. per year
High purity concentrate	= 10 M i.u. per year
Frozen/Freeze-dried cryoprecipitate	= 10 M i.u. per year

5. Yields of FVIII

From a consideration of the available data the Working Party has concluded that the yields given below form a realistic basis for the calculation of the volume of plasma required to obtain the 100 M i.u. FVIII

Intermediate purity concentrate	= 225 i.u. per kg.*
High purity concentrate	= 90 i.u. per kg.
Frozen/Freeze-dried cryoprecipitate	= 350 i.u. per kg.

(* 1 kg. plasma is approximately equal to 1 litre)

6. Quantity of plasma required

From the yields given in section 5, the quantity of plasma required can be calculated as follows:

80 M i.u. intermediate purity concentrate requires	350,000 kg. plasma
10 M i.u. high purity concentrate requires	110,000 kg. plasma
10 M i.u. frozen/freeze-dried cryoprecipitate requires	28,500 kg. plasma
Total	488,500 kg. plasma

It was considered that the aim should be to obtain annually, 500,000 kg. plasma, which must be separated from the red cells and frozen within 18 hours after collection.

7. Options for obtaining 500,000 kg. plasma annually

7.1 Plasma separated from donations of whole blood

During 1980, 2.032 M donations of whole blood were collected by RTCs. Enquiry of the Regional Transfusion Directors has established that an additional 125,000 donations are required to satisfy clinical needs. It is difficult to forecast the demand for red cells in the mid-1980's, but the Working Party considered that a total of 2.2 M donations per year was a reasonable estimate.

It has also been ascertained that an average of 51% of the whole blood donations could have their plasma separated within 18 hours provided that adequate staff and facilities were available. This will result in approximately 200,000 kg. plasma being available for the preparation of FVIII (and for other products after the FVIII has been removed from the plasma).

It is possible to obtain the remaining 300,000 kg. plasma by increasing the blood collection and separating the plasma from the additional whole blood donations. In the majority of RTCs. 180 g. of plasma are removed from the donation so that the red cells are still suspended in a certain volume of plasma, making them more acceptable for transfusion compared with highly

concentrated red cell preparations which may cause problems with regard to flow rate. However, once the requirement for red cells was met, it would be possible to remove more of the plasma from the whole blood donation. It is possible to separate 250 g. plasma from some donations, but if one is to avoid red cell contamination of the plasma destined for fractionation an average yield of 230 g. per donation is more realistic.

Therefore, to obtain 300,000 kg. plasma by separating 230 g. per donation it would be necessary to collect 1.3 M donations.

When considering this option the following must be borne in mind:

7.1.1 Blood collection in England and Wales would have to increase from the present 2.032 M to 3.5 M. This requires a blood collection rate of approximately 70 per 1000, which would be difficult to establish and maintain.

7.1.2 It has been estimated at one RTC that the cost of blood collection and processing is £13.00 per unit. Thus the cost of handling 3.5 M donations, on this basis, would be £45.5 M. This represents an increase of £19 M over the present costs and £16.9 M over the cost of collecting 2.2 M donations, estimated to be that required to satisfy demands for red cells (vide supra).

7.1.3 If plasma is separated from whole blood donations and the red cells are discarded, the total cost of collection and processing has to be applied to the plasma harvested. At an average of 230 g. plasma per donation there are 4.35 donations per kg. At £13 per donation the cost of obtaining 1 kg. plasma is £56.55.

7.1.4 In order to increase blood collection to this rate a large capital investment would be required. Many RTCs. would require additional space and some would require new premises. All RTCs. would require additional mobile teams.

7.1.5 Obtaining plasma by this means would, inevitably, lead to a major and unethical waste of red cells.

7.2 The introduction of plasmapheresis

Several countries use plasmapheresis, i.e. the separation of plasma from red cells of the donor with return of the red cells to the donor, as a source of plasma for the fractionation of plasma for coagulation factors.

Plasmapheresis can be conducted in two ways:

(a) Manual procedures. These have been well-tried for the collection of antibody-specific plasma. However, in order to collect 500 g. plasma the time required is 1-1½ hours. This has been put forward as a disadvantage in the recruitment of panels of such donors, although it is employed successfully in Belgium.

(b) Machine procedures. Several machines have been devised which are efficient in separating plasma from red cells. Some employ a continuous procedure and require two needles to be inserted into the veins of the donor. Other machines are discontinuous and can be used with a single venepuncture. Such machines would be those of choice for the purpose of obtaining plasma for fractionation and 500 g. plasma can be obtained in 35-45 minutes. A code of practice for the use of the latter machines has recently been compiled.

Using plasmapheresis to obtain plasma for fractionation would require the establishment of Plasmapheresis Centres in the regions and the recruitment of donor panels to service them.

7.2.1 Establishment of Plasmapheresis Centres

The Working Party found it difficult to predict whether Centres should be based upon machine or manual procedures or whether they should be established in conurbations or in smaller towns. A machine plasmapheresis centre has been established in a city in the Yorkshire region and experience gained in operating this Centre will be valuable. However, it was considered that Centres in smaller towns, using manual plasmapheresis should be retained as an option since they function successfully in Belgium. It was agreed that there was urgent need for a pilot study to evaluate this method of obtaining plasma.

From the experience gained in the Yorkshire region it seems that one could expect to obtain 1000 kg. plasma per couch per year in a machine plasmapheresis centre. If one assumes 8 couches are optimum in a centre then at 8000 kg. plasma per year approximately 35 centres would be required in England and Wales. A similar sized centre conducting manual plasmapheresis could expect to collect 4500 kg. plasma per year, so that approximately 65 centres would be required.

Combination of plasmapheresis centres and units carrying out therapeutic plasmapheresis was considered to be undesirable.

7.2.2 Donor Panels for Plasmapheresis

WHO recommendations limit the volume of plasma collected annually from a donor to 15 kg. It was agreed that this volume should not be exceeded.

From the pilot study in the Yorkshire region, the initial conclusions suggest that a maximum of 5 donations per year (2.5 kg. plasma) may be preferable from the viewpoint of retaining donors on the panel. It was considered that the maximum of 30 donations per year (15 kg. plasma) would be unlikely to be achieved and the realistic maximum would be 20 donations (10 kg. plasma). The estimated number of donors required on the panels to obtain between 2.5 kg. and 10 kg. plasma is shown in Table 1.

The recruitment of donors for plasmapheresis would need to be the subject of further consultation but even at the level of 3.2 per 1000 of the population this should not prove insuperable if resources are made available.

The option of plasmapheresis has advantages over the procurement of plasma entirely from whole blood donations in that the wastage of red cells is avoided and donor panel size can be reduced because of the increased frequency of attendance of plasmapheresis donors. It is pertinent, however, to consider the cost implications of plasmapheresis particularly with respect to a comparison between manual and machine plasmapheresis.

7.2.3 Estimated cost of obtaining plasma by pheresis

Six estimates of the cost per kg. of plasma, three by the manual and three by machine pheresis, are analysed in Appendix 2. It can be seen that using the manual procedure there would be an estimated expenditure of £41-£44 per kg. whilst the cost of machine pheresis would be in the order of £50 per kg. No account has been taken in this exericse of possible reductions in this cost by obtaining discounts on bulk purchases of disposables such as plastic packs or pheresis sets for the machines.

Capital costs have not been defined exactly, but depreciation of capital equipment has been included in the revenue costs. The cost of purchasing machines for plasmapheresis results in a greater capital cost for setting up a centre using this method (greater than £100,000) compared with a centre employing manual plasmapheresis (approximately £30-35,000). However, since the time a donor is required to spend in the centre where machine plasmapheresis is carried out is less than that required for manual plasmapheresis, it would be necessary to have a greater number of manual plasmapheresis centres.

7.2.4 Total cost of obtaining 500,000 kg. plasma per year

200,000 Kgm.
× 5.6. at 180g/donation.

4.35 at 230/month

(a) Cost of obtaining 200,000 kg. plasma from whole blood donations. Of the £13 estimated blood collection and processing cost, it was estimated that the cost of the separated plasma was £6 per donation. At 180 g. plasma per donation there are 5.6 donations per kg. The cost of 1 kg. plasma from this source is, therefore, £33.6 and the total cost for 200,000 kg. is £6.72 M.

It should be noted that 150,000 kg. plasma should be available for fractionation of FVIII by 1982 to coincide with the interim expansion plan at BPL. Therefore, the additional expenditure involved in increasing this quantity to 200,000 kg. entails the cost of collecting an additional 125,000 donations and the separation of an additional 280,000 donations. This cost is estimated to be £2.5 M.

(b) Cost of obtaining additional 300,000 kg. plasma

(i) From whole blood donations at a cost of £56.55 per kg. (see section 7.1) total cost is £16.9 M.

(ii) By manual plasmapheresis at an average cost of £42.50 per kg., total cost is £12.75 M.

(iii) By machine plasmapheresis at an average cost of £50 per kg., total cost is £15 M.

In considering the costs involved in obtaining fresh plasma for self-sufficiency in FVIII, other coagulation factors, normal immunoglobulin and albumin preparations, the commercial value of the products obtained should be taken into account. At the present utilization rate, and that forecast for the foreseeable future, self-sufficiency for coagulation factors other than FVIII and normal immunoglobulin could be attained within the 200,000 kg. plasma obtained annually from whole blood donations. From the remaining 300,000 kg. plasma it would be necessary to fractionate FVIII and albumin. With respect to albumin preparations the 230 kg. per M per year obtained from this quantity of plasma has been equated with the 200 kg. per M estimated usage since completely accurate values of requirements could not be obtained.

Commercial costs reflect marketing strategies in addition to the cost of source plasma and production. However, analysis of the costs of FVIII and PPF from several firms suggests that in terms of the source plasma the combined value of these products is £60 per kg. Even with the highest estimate of £50 per kg. for the source plasma, £10 per kg. is available for production costs. The value of £60 per kg. is probably an under-estimate since it does not take into account the preparation of other products, e.g. salt-poor albumin, which are expensive to purchase. Also at self-sufficiency certain specialised products, e.g. activated factor IX, would be required.

Clearly, a more detailed cost analysis will be required, but economic viability at self-sufficiency could be attained if acceptable markets could be found for intermediate fractions which would otherwise go to waste or for products which are manufactured in excess of the requirements for England and Wales.

Plasma required per year Kg.	Plasma per donation Kg.	No. donations at 10 kg. per year	Est. No. donors on panel*	No. donations at 5 kg. per year	Est. No. donors on panel	No. donations at 2.5 kg. per year	Est. No. donors on panel*
300,000	0.5	30,000	40,000	60,000	80,000	120,000	160,000
		i.e. 0.8 per 1000		i.e. 1.6 per 1000		i.e. 3.2 per 1000	

* Estimate based on recruitment of 30% more donors than actually donate per year to compensate for non-attendances.

TABLE 1

ADVANTAGES AND DISADVANTAGES OF VARIOUS FVIII PREPARATIONS

1. Fresh-frozen plasma is prepared at RTCs. and whilst it is a valuable source of coagulation factors it cannot play a significant part in the treatment of haemophilia A.

2. Frozen cryoprecipitate is presented for clinical use in the transfer pack in which it is prepared. It is prepared in RTCs. but it is difficult to have a national programme based on this product because:

   2.1 the potentially high yield is not always attained in large-scale production and lack of confidence in the FVIII content leads to over-ordering and waste.

   2.2 there is a significant incidence of adverse reactions due to the presence of residual plasma.

   2.3 the product is not convenient to store, transport and infuse, particularly for home or self-therapy.

   2.4 there are difficulties in ensuring adequate quality assurance and control.

3. Freeze-dried cryoprecipitate:

   3.1 Small pool (8-12 donations) is produced in the Central Laboratories as the primary FVIII product in Finland, Switzerland and the Netherlands. The aim is to obtain a high yield and minimum donor exposure, together with greater stability and convenience compared with the frozen product. However, all production methods involve multiple aseptic connections without terminal sterilising filtration of the product and spin-freezing of a relatively dilute solution of FVIII before drying introduces intractable problems of hygiene and thus maintenance of good manufacturing practice (GMP) required in the U.K. would be very difficult.

   3.2 Large pool. Two approaches have been used:

   (a) In Belgium, about 1000 cryoprecipitates, prepared at RTCs. are transported to the fractionation centre, pooled aseptically without sterilising filtration, the pool dispensed in 50-100 ml. volumes, spin-frozen and freeze-dried.

   (b) In France, about 1000 donations of plasma undergo cryo-precipitation in an 'open' process and the redissolved cryoprecipitate is filtered through sterilising membranes before spin-freezing and freeze-drying.

   Compared with small pools greater security and consistency of the product can be achieved which means a representative sample can be taken for quality control. However, sterilising filtration is expensive in yield and 10% may be lost in rigorous quality control and the GMP problems of spin-freezing remain.

4. Intermediate purity concentrates. These concentrates begin with large-pool (500-5000 donations) cryoprecipitation of plasma. The cryoprecipitate is processed to give high potency (15-20 units per ml.), reliable assay, stability, solubility and safety. For each of these attributes there is a penalty in FVIII yield. It has been estimated at BPL that an additional 27% of the initial FVIII activity is lost in this preparation which does not occur in freeze-drying large pool cryoprecipitate.

5. High purity concentrate. Further purification is expensive in yield of FVIII. The product offers greater potency, potentially improved solubility and a reduction in contaminants such as fibrinogen. It has to be prepared from large plasma pools.

The characteristics of the above FVIII products and the advantages and disadvantages of each are shown in the Table attached.

Factor VIII product	Pool size dons.	FVIII iu/ml	Sp. Act. iu VIII/ mg protein	Yield iu VIII/ kg plasma	Advantages	Disadvantag
Fresh frozen plasma	1-4	0.7	0.011	700	Available in RTCs. Minimum pool size.	"Reactions". Hypervolaemia. ABO matching required. Frozen storage required. Variable, poor quality cont
Frozen cryoprecipitate	1-12	2-5	0.1-0.2	300-400	Available in RTCs. High yield of factor VIII. Minimum pool size.	"Reactions". Variable potency ? over-use. Frozen storage required. Difficult reconstitution. Poor quality control.
Freeze-dried cryoppt. (a) small pool	1-12	5-10	0.1-0.2	250-350	Stored +5°. High yield of factor VIII.	High capital investment and costs, therefore centraliza Q.C. compromises for small p
(b) large pool	>500	5-10	0.1-0.2	250-350	Stored +5°. High yield of factor VIII. Less variable potency.	GMP problems. Larger pool for HB transmissi Aseptic production or difficu sterilisation by filtration.
"Intermediate" purity concentrate	>500	15-20	0.3-0.5	200-250	Stored +5°. Good potency, solubility for HT. Precise statement of potency. Low risk of reactions. Isoagglutinins etc. predictable. Good GMP and QC potential.	Only feasible as part of cent comprehensive fractionation. High capital investment in co rooms, driers. (Large pools). Reduced yield of cryo (starts large-scale cryo).
"High" purity concentrates	>>1000	20-30	>0.5	?125	As Intermediate, but slightly greater potency and convenience. Potential improvements in solubility, reduction in e.g. isoagglutinins, ?HB, fibrinogen.	As Intermediate. Very large pools inevitable. Higher "purity" rarely signif High cost in plasma resources

ANALYSIS OF COSTS OF MACHINE AND MANUAL PLASMAPHERESIS CENTRES

In the Table attached to this Appendix a summary is given of three estimates of daily costs of a machine plasmapheresis centre and three estimates of the daily costs of a manual plasmapheresis centre. Of the six estimates that of the Yorkshire RTC, Leeds, is the only one based upon experience of operating the centre, although the estimate by Haemonetics Ltd. for machine plasmapheresis was calculated after examining the operation of the Leeds Centre.

Daily costs can be divided into staffing costs, other fixed costs, and costs per procedure. An analysis of the estimates of these costs is as follows:-

(1) STAFFING

There is close agreement in the three estimates of staffing costs for machine plasmapheresis and in general is based upon one medical officer, one SRN, one donor attendant to service two couches, together with part-time ancillary help in Leeds. The Brentwood estimate is lower than that of the others because the medical officer was only used half-time. This would be acceptable if the plasmapheresis centre was located within an RTC, but would be impractical otherwise.

Estimates of staffing for a manual centre differ, particularly the high value estimated by Haemonetics Ltd. This is based on the employment of one donor attendant per couch which was considered excessive. The staffing of a centre with 8 couches would be more economical than one with 4 couches.

(2) FIXED COSTS

The Brentwood estimates allowed only for a service contract for the equipment and represents a considerable underestimate.

In the machine plasmapheresis centres, Leeds considered that the machines would have a longer life than the estimate of Haemonetics Ltd. and they also had accommodation which was cheap to rent.

Excluding the Brentwood estimate, the estimate made at Lancaster Centre of the N.W. Region for a manual plasmapheresis centre is higher than that of Haemonetics Ltd., since in addition to equipment depreciation, rates and energy costs, the only factors considered by Haemonetics Ltd., it includes estimated costs for such items as publicity for donor recruiting, stationery, postage, renewal of uniforms, laundry and cleaning materials.

(3) COSTS PER PROCEDURE PER DAY

The costs per procedure are greater with machine compared with manual plasmapheresis. A variable cost was that of the cost of the citrate anticoagulant solution (£3.11 at Brentwood to £1.24 at Leeds). Only the Leeds and Lancaster estimates include an estimated cost for the disposable items required on a blood collection session and the cost of testing the donation for hepatitis and syphilis. The latter costs are approximately £1.00 per donation, i.e. £2.00 per kg. plasma. If this cost is added to the Brentwood and Haemonetics Ltd. estimates for machine plasmapheresis the costs per kg. become £51.45 and £50.67 respectively.

COMMENT

Despite the differences in estimates it appears that a realistic value for machine plasmapheresis is £50 per kg. The estimates for manual plasmapheresis by Haemonetics Ltd. seem to be high, due to the staffing costs, and that by Lancaster appears to be more appropriate.

The cost per kg. is related to the number of operations carried out per day. It has been estimated that the £42.50 per kg. estimated at Lancaster could vary between £41 and £44 on this basis.

These estimates (except Brentwood) take into account depreciation but not the capital cost of establishing the centres. In this regard it must be noted that manual plasmapheresis centres per couch will have a lower output (50-60%) than machine plasmapheresis centres and, therefore, to obtain a fixed quantity of plasma, fewer of the latter centres would be required.

	MACHINE PLASMAPHERESIS			MANUAL PLASMAPHERESIS		
	LEEDS (6 couches) £	BRENTWOOD (4 couches) £	HAEMONETICS (8 couches) £	BRENTWOOD (4 couches) £	LANCASTER (8 couches) £	HAEMONETICS (8 couches) £
STAFFING	191	93	232	122	201	344
FIXED COSTS	73	0.43	131	0.07	86	63
PROCEDURE COSTS PER WORKING DAY No.						
72			1390			
36						
45	877					455
38						
24		500			520	
				306		
Total	1141	593.43	1753	428.07	807	862
Kg. per day	22.5	12	36	12	19	18
Cost per kg.	£50.70	£49.45	£48.67	£35.67	£42.47	£47.85

SUMMARY OF DAILY COSTS OF PLASMAPHERESIS CENTRES AND ESTIMATES OF COSTS PER Kg. PLASMA