

## BLOOD DONOR REJECTS—A STUDY OF THE CAUSES AND REJECTION RATES

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The proper selection of volunteer donors is one of the pre-requisites of any blood transfusion service. Whilst the primary function of the service is the collection and supply of blood, it is essential to first ensure that the volunteer is fit to donate blood without any detriment to the health.

The acceptance of any volunteer donor therefore depends on their satisfying certain definite criteria or standards which have been designed to protect both the donor and the recipient. For example, regular donations of blood make considerable demands on the iron reserves of the body and those who have increased demands for iron are not bled. This includes all pregnant women and those who have been pregnant within the previous year, those with bleeding conditions like piles, peptic ulcer, menorrhagia, etc. The presence of major disorders like tuberculosis, diabetes, epilepsy, goitre, hypertension, cardio-vascular or cerebro-vascular disease would also exclude the volunteer from being a donor.

The protection of the recipient involves ensuring that the donor shall be free of disease transmissible by blood transfusion like malaria, spirochaetal infections and viral hepatitis, etc.

It is usually not practicable, nor has experience shown it necessary to subject each donor to a comprehensive physical examination, but judicious questioning attended with sufficient clinical judgement will determine whether a would-be donor should be rejected at once or accepted subject to certain tests being satisfactory.

The rejection rates for volunteer donors and the reasons for their rejection have never

been studied or recorded in the past. This paper places on record the results of a three month survey carried out from October to December, 1964, on the incidence and reasons for the rejection of donors presenting themselves at the Singapore Blood Transfusion for the first time. In addition, an evaluation was made of the suitability of the copper sulphate method of haemoglobin estimation for the rapid screening of donors.

### METHODS

All volunteers presenting themselves for blood donation were required to complete an enrolment form in which among other details were recorded the age, sex and ethnic group. In addition, a history of major illnesses including tuberculosis, malaria, jaundice was sought. Their weight was recorded.

A haemoglobin screening test was carried out by the copper sulphate method, Phillips et al., (1945). The forefinger is first cleaned with alcohol and then wiped dry with cotton wool. A puncture wound is made with a disposable lancet. The first drop of blood is wiped away. Then with application of slight pressure a drop of blood is collected in a dry Pasteur pipette and dropped into a solution of copper sulphate of specific gravity 1.053 from a height of 1 cm. If the drop fails to sink, the blood has a haemoglobin content of less than 12.5 gm. % (Haldane 85%).

Volunteers who failed this screening test were rejected as donors in the first instance. They were then submitted to a more detailed hematological examination. The venous blood haemoglobin level was determined by the cyanmethaemoglobin method, Dacie & Lewis

TABLE I  
THE REJECTION RATES FOR MALE & FEMALE VOLUNTEER DONORS  
OF DIFFERENT ETHNIC GROUPS

	MALE			FEMALE		
	Volunteers	Rejected	% Reject	Volunteers	Rejected	% Reject
Chinese	613	46	7.5%	88	30	34.1%
Malays	365	11	3.0	40	10	25.0
Indians	127	7	5.5	7	2	28.6
Eurasians	19	3	15.8	2	-	-
British & Others	489	8	1.6	55	11	20.0
Total	1,613	75	4.6%	192	53	27.6%

(1963) using an Eel Hb. meter.\* The hematocrit and mean corpuscular haemoglobin concentration (M.C.H.C.) and the serum iron values were determined. The stools from cases rejected for "anaemia" were examined for the presence of ova and occult blood.

Following the screening test, volunteers were interviewed and examined by either one of the authors. They were asked a series of questions about the present health and recent medical history. A brief clinical examination of the heart and lungs was carried out. The blood pressure was recorded, after which if there were no reasons for rejection, they would be accepted as donors.

Volunteers rejected for any reason had their full data including results of clinical and hematological examination recorded on a special proforma which was analysed on completion of the survey.

## RESULTS

During the period of the survey, a total of 4,979 persons volunteered to donate blood. Of these, 1,805 had never been donors in the past. This study covers only these 1,805 persons who were offering to donate blood for the first time. Of these volunteers, 128 were rejected for various reasons, giving an overall rejection rate of 7.1%.

An analysis of the volunteers and rejects by sex and ethnic groups is given in Table-1 above.

The overall rejection rates for the different ethnic groups are as follows:—Chinese 10.8%, Malays 5.2%, Indians 6.7%, Eurasian 14.3%

and British and others 3.5%. The overall rejection rate for males and females is 4.6% and 27.6% respectively.

The number of volunteers who were rejected and the reasons for their rejection is given in Table 2 below:—

TABLE II  
THE NUMBERS OF VOLUNTEERS  
REJECTED AND THE REASONS

Reasons for rejection	No. of Volunteers
Failed copper sulphate screening test	47
Poor Veins	20
Underweight	10
Tuberculosis	8
Malaria	7
Hypertension	6
Respiratory infection	6
Jaundice:- Not specified	4
Definite infec- tive hepatitis	3
Miscellaneous	17
Total	<u>128</u>

Those rejected for miscellaneous reasons included the following—recent major operations, 5; pregnancy within 6 months, 3; asthenia and vague ill health, 4; orthopaedic disorders, 2; mental disorder, 1; hypotension, 1.

Of the 47 volunteers who failed the copper sulphate screening test, 46 were submitted to a more detailed haematological examination to confirm the "anaemia". One volunteer refused to have any further examinations car-

\* Calibrated against a standard solution of haemiglobincyanide solution obtained from Diagnostic Reagents Ltd., Thames, Oxon.

ried out. The analysis of those rejected for "anaemia" by sex and ethnic groups is given in Table 3 below. It will be seen that 33 (70.2%) of the rejects were female volunteers.

TABLE III  
ANALYSIS OF REJECTS FOR  
"ANAEMIA" BY SEX AND  
ETHNIC GROUPS

	Male	Female
Chinese	7	20
Malays	—	3
Indian	1	1
Eurasian	—	—
British & Others	6	9
Total	<u>14</u>	<u>33</u>

The haemoglobin values of those rejected for "anaemia" are given below.

TABLE IV  
HAEMOGLOBIN LEVELS OF REJECTS  
FOR "ANAEMIA" DETERMINED BY  
THE CYANMETHAEMOGLOBIN  
METHOD

Haemoglobin level	Below 12.0 gm. %	12.0-12.4 gm. %	12.5-13.0 gm. %	13.1 & above
No. of Rejects	6	15	12	13

Using the cyanmethaemoglobin method on the 46 donors who had failed the screening test, it was found that 21 rejects (45.7%) had their haemoglobin level of below 12.5 gm.% confirmed. 25 rejects (54.3%) had haemoglobin levels of 12.5 gm.% and above.

TABLE V  
SERUM IRON VALUE OF REJECTS  
FOR "ANAEMIA"

Serum Iron Value in Microgram %	No. of Rejects
40 mcg. % and below	1
41- 60 mcg. %	4
61- 80 "	5
81-100 "	20
101-120 "	7
121-140 "	6
141 and above	3
Total	<u>46</u>

The serum iron values of the rejects for "anaemia" are shown in Table 5. It will be noted that the majority of rejects (20) had serum iron values between 81 to 100 mcg.%, 16 had serum iron values above 101 mcg.%, and 10 had values below 80 mcg.%, the lowest value being 34 mcg.%.

The correlation between the haemoglobin levels and the serum iron values is shown in Fig. 1. There was no definite relation between two values. This will be discussed later.

Examination of the peripheral blood film of those rejected for "anaemia" showed that only 11 had a definitely hypochromic microcytic blood picture with a MCHC of 30% or lower. These 11 included the 6 with a haemoglobin of below 12.0 gm.% and 5 with haemoglobin values between 12.0 and 12.5 gm.%. The remaining 35 had a normal blood picture with a normal M.C.H.C.

In no instance was there any evidence to suggest a macrocytic blood picture which could point to a possible megaloblastic process. No marrow examinations were carried out as it was felt that there were no indications for such a drastic procedure in these mild cases of anaemia due to iron deficiency.

The stools from 16 of these rejects were examined for the presence of ova and occult blood. 3 showed the presence of trichuris ova and one had ascaris ova. All these 4 specimens had in addition a weakly positive occult blood test. There were no instances of a strongly positive occult blood test to suggest occult gastro-intestinal haemorrhage.

## DISCUSSION

As a general rule, any adult who is in good health and has not recently had any serious illness is suitable as a donor. Every transfusion service, however has detailed regulations which slightly modify this general statement and a few of the considerations which determine these rules will be discussed below.

In the Singapore Blood Transfusion Service, volunteers are only accepted if they are between the ages of 18 and 60. These are very arbitrary figures but ones which are generally followed in most blood transfusion services. This survey did not include those rejected because of age. A volunteer was only included in the survey if he was within the acceptable age groups.

During the period of survey there were 128 rejects out of a total of 1,805 persons volunteering to donate blood for the first time, giving an overall rejection rate of 7.1%. This is very much lower than the overall rejection rate of 19.0% reported by Pirofsky and Nelson (1964) from a Regional Blood Transfusion Centre in America. The rejection rates for the different ethnic groups ranged from as high as 14.3% for Eurasians to as low as 3.5% for the British. The high rejection rate for Eurasians is not significant in view of the very small numbers of volunteers (19) presenting themselves of whom 3 were rejected.

There was a significantly higher rejection rate for females, 27.6% as compared to that for males, 4.6%. This high rejection rate was found to be due mainly to the large numbers of women who were found to be "anaemic", 33; underweight, 5; or having poor veins, 5. This high rejection rate was not unexpected as in an analysis of the donor panel it was found that women donors constituted only 3.1% out of a total donor panel of 11,427 donors. In a similar study, Hervy, McIntire and Watson (1952) found a similarly high overall rejection rate of 20.7% for women as compared to 8.3% for men.

#### REJECTS FOR "ANAEMIA"

It is generally accepted that potential blood donors should be rejected if their haemoglobin level is below 12.5 gm.% (85% Haldane). This level applies to both sexes and is the standard adopted by the Singapore Blood Transfusion Service. However, there is now a trend to raise this level to 13.5 gm.% (90% Haldane) in the case of male donors taking into consideration the fact that males have been found to have higher haemoglobin levels, Mollison (1961), James (1958).

A total of 21 rejects (6 males and 15 females) were found to have haemoglobin levels below the minimum standard of 12.5 gm.%. This gives a rejection rate for anaemia of 0.3% for males and 7.9% for females. These are relatively low rates when compared to that of 0.8% for men and 12.6% for women reported by Hervy, McIntire and Watson (1952) and 1.4% for men and 4.1% for women reported by Pirofsky and Nelson (1964) from Blood Transfusion Services in America. Bryce and Jackobowicz (1943) similarly found a rejection rate for anaemia of 4.1% among women donors.

It will be seen from Fig. 1 that although 25 rejects had haemoglobin levels of 12.5 gm.% or above, no less than 15 of them had serum iron values below 100 mcg.%. In a recent report, Lie-Injo and de Witt (1964) found the mean serum iron values of the Chinese, Malays and Indians to be respectively 123 mcg.%, 112 mcg.% and 114 mcg.%. These 15 therefore could be described as being in latent iron deficiency and it would not have been in their interest to donate blood.

The five rejects with the haemoglobin levels below 12.5 gm.% and serum iron values of above 100 mcg.% is difficult to explain as it is generally accepted that there is a gradual depletion of the iron values before a fall in haemoglobin occurs, Bothwell and Finch (1962). The anaemia in the 21 rejects with a haemoglobin of below 12.5 gm.% was due to iron deficiency as shown by the hypochromic blood picture, low M.C.H.C. and low serum iron values.

In the clinical assessment, it was found that only 5 of the rejects with haemoglobin levels of below 12.5 gm.% had a possible cause for the anaemia. One was an adult male Chinese with the haemoglobin of 10.4 gm.% who had a partial gastrectomy for repeated hematemesis performed in 1953. Iron deficiency anaemia is a recognized complication following gastric operations, and it is generally believed that impaired absorption of iron due to some degree of gastro-intestinal hurry is one of the contributory causes for the anaemia Bothwell & Finch (1962), De Gruchy, (1964). Three women had a history of previous bleeding piles, two of whom had operations performed a few years ago; one of them, in addition, had a hysterectomy for uterine fibroid. The fifth was a woman with a history of menorrhagia, though she had never sought medical attention for the complaint. In addition, among those who were just above the border line, there were two with the history of bleeding piles and a third with menorrhagia. Apart from the five in whom there was a definite history suggestive of increased iron demands due to blood loss, there was nothing either in the history or the clinical examination to suggest a cause in the others. It might be presumed that these people were probably existing on a sub-optimal diet with a reduced iron intake. In the case of the female rejects the possibility

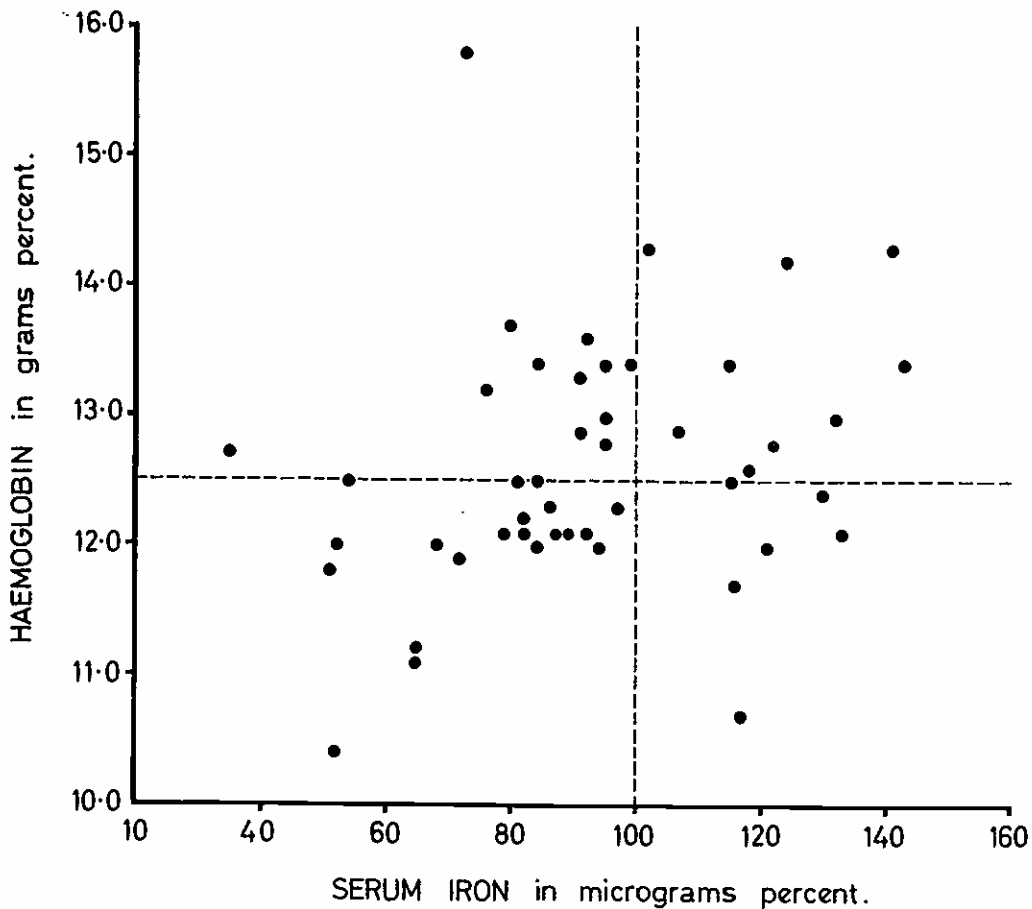


Fig. 1. The relation of serum iron values to Haemoglobin levels in the Rejects for "Anaemia".

of increased menstrual losses giving rise to increased iron demands has to be borne in mind.

**UNDERWEIGHT AND POOR VEINS**

It will be noted that a large number of volunteers (30) were rejected either for being under-weight or having poor veins. This was especially so in the case of female volunteers who often were rejected for either or both reasons. A minimum weight is necessary to ensure that the smaller built donors are not over bled. The presence of poor veins makes the process of venesection slow and tedious, often taking more than ten minutes, whereas normally it would not take more than four to five minutes to withdraw 400 ml. from a donor. Further, the slow flow of blood is often associated with the formation of clots which makes the blood less suitable for use.

The minimum weight adopted by the Service below which volunteers are not accepted is 100 lbs. for males and 95 lbs. in the case of females. This lower is than the minimum

weight of 110 lbs. adopted by other transfusion services. The large proportion of the local population with body weights of 8 stones (112 lbs.) or less has made it necessary to adopt a lower minimum weight. Coupled with this, the volume of blood withdrawn from such donors is proportionately reduced. By so doing, the Service has been able to accept many more volunteers than would have been possible if the higher weight requirements were followed. The blood donated is equally useful and is mainly used for paediatric cases where the transfusion needs are small, usually less than one pint.

**TUBERCULOSIS**

Volunteers with active tuberculosis, or who are under treatment or observation for the condition are not accepted as volunteers. This is designed to protect the volunteer against any possibility of a reduced resistance following the blood donation. Further, in these cases there is always the possibility of haemoptysis occurring necessitating a blood trans-

fusion. It is difficult to pick up the early cases on clinical examination alone and a quick inquiry regarding recent health including a history of cough, haemoptysis, weight loss or X-ray examination of the chest is always made as a routine. All those rejected for tuberculosis had volunteered the information that they were either having treatment or had recently completed treatment and were still under observation.

## MALARIA

Malarial parasites are known to survive for varying periods in blood stored at 4°C and there have been a number of reports of malaria developing in patients after blood transfusion, McClure and Lam (1945), Grant et al. (1960). In countries where malaria is not endemic, a history of malaria permanently bars a person from being a donor. In Singapore however, the strict observance of this procedure would render the build-up of a satisfactory donor panel difficult. This is especially so, as many of our older donors have been exposed to malarial infection during the 2nd. World War and would on inquiry give a positive history.

The problem of preventing the accidental transmission of malaria cannot be solved simply by storage of blood as in the case of syphilis. Neither can it be solved by examining blood films from potential donors, Nabarro and Edward (1940). Our experience has shown that it is not feasible to screen all donors for malaria by an examination of the blood film. This is because in a person who is asymptomatic, the presence of malarial parasites would be very few, and the likelihood of their being picked up in a random drop of blood taken for examination would be very small. Further, before a blood film can be passed as negative, it would require a careful search of the whole film for a minimum of ten minutes. This practice which was adopted as a routine earlier on was finally discontinued as it was found to be too time consuming and impracticable. Further, experience with many thousands of donors gave uniformly negative results.

The rejection of cases for malaria has therefore been made on a clinical history suggestive of malaria or of being treated for malaria within the last five years. So far, following this method, we have discovered only one

case of malaria which was proved to have been transmitted by blood transfusion. Subsequent follow-up of the suspect donor revealed that he was from the army and had been taking anti-malarial prophylaxis whilst undergoing training in the jungles of Malaya. Examination of his blood film showed the presence of an occasional parasite. The donor however never had any clinical symptoms of the disease and was unaware of it at the time of the donation.

## HYPERTENSION

Any volunteer suffering from a marked degree of hypertension has to be bled with care as in such cases the sudden removal of 400 ml. of blood may precipitate a cerebral catastrophe, Mollison (1961). This would be tragic for the volunteer who is otherwise in good health and often unaware of the condition. Generally, volunteers are rejected if the systolic pressure is above 200 mm. or the diastolic pressure is more than 110 mm. mercury. Those with high blood pressure are generally bled only if they have been advised to do so by their physician.

## HEPATITIS

The transmission of viral hepatitis from donor to patient is a very real possibility and danger. It has been demonstrated that a significant proportion of the population remain carriers of the virus after an attack of the disease or following a sub-clinical episode. The exact incidence of carriers is unknown, but Mollison (1961) estimates it to be one in 200. It is also known that a subject may remain a carrier for at least one year, Murray et al (1954) and perhaps for as long as five years, Stokes et al (1954).

The problem is that there is at present no satisfactory method available for detecting these carriers. Though some transfusion services routinely screen all donors using the thymol turbidity test, it is generally regarded as being of doubtful value, Alsever and Barger (1961). As Fitch et al (1955) point out, the rejection of 30% of donors on the basis of abnormal liver function tests would cause an acute embarrassment to donor panels and although some asymptomatic carriers of the virus would be excluded, not all carriers would be excluded since it is known that they may not exhibit abnormalities detectable by such tests.

There is some evidence that the newer liver function tests like serum glutamic oxalacetic transaminase (S.G.O.T.) or isocitric dehydrogenase (I.C.D.) may give a better discrimination.

Bang et al. (1959) showed that if all donors with a S.G.O.T. level of over 40 units were excluded, the incidence of hepatitis would have been reduced from thirty-nine in 1371 (2.8%) to nine in 600 (1.5%) but at a cost of rejecting 57% of all donors.

Steps to try and reduce the transmission of the virus therefore have taken the form of rejecting anyone suspected to have had infective hepatitis in the past or who have been in contact with the disease within six months. In addition, the W.H.O. Report, 1953, recommends that anyone with a history of jaundice should be rejected as a donor. However, many present with a history of "jaundice when young" the significance of which is doubtful. To exclude all such persons would result in a high proportion of volunteers being rejected. A history of contact with a case of hepatitis is even more difficult to obtain and was never volunteered during the survey. In this Service, every donor with a definite history of jaundice or hepatitis within ten years is rejected. Donors are accepted if the history of jaundice is more than ten years. A note is then made in the records of the donor.

Following this criteria, we have not found the number of patients reported as having developed homologous serum hepatitis following a transfusion to be high. When a report is received regarding the development of hepatitis in a patient who has received transfusions the records of all the donors involved are investigated. All those incriminated are called up and examined. A routine check on the liver function tests is carried out. If all the tests and the clinical examination are negative, the donor continues in the donor panel. If subsequently we find a donor being incriminated twice for causing hepatitis in a patient, then even in the absence of any positive findings, the donor is advised to stop donating blood. By this method, we have prevented an excessive number of donors being rejected. This wastage would have been significantly higher if every person incriminated for causing hepatitis in a patient were immediately removed from the donor panel as patients

developing hepatitis following transfusions usually have a large number of transfusion often numbering more than four pints.

#### RELIABILITY OF THE COPPER SULPHATE TECHNIQUE OF HAEMOGLOBIN ESTIMATION

The necessity for a rapid screening test when large numbers of donors are being attended to has led to reliance on the specific gravity method using copper sulphate solutions for detection of donors with levels of haemoglobin below the minimum standard adopted. The limitations of this method are recognised and before rejecting a volunteer who has failed the screening test, it has been our policy to recheck their haemoglobin levels by the more accurate cyanmethaemoglobin technique using the Eel Hb. meter.

Accepting a haemoglobin level of below 12.5 gm.% as the criteria for rejecting both male and female donors, it will be seen that 25 out of the original 46 donors who were initially rejected for failing the screening test could have been accepted. This meant that 54.3% of those rejected for "anaemia" should not have been rejected in the first instance. This would have reduced the overall rejection rate from the original 7.1% to 5.7%. However of the twenty five, 12 of them were really on the border line with haemoglobin levels between 12.5 and 13.0 gm.%. These 12 could possibly have given lower haemoglobin levels on a repeat determination making allowances for slight variations in techniques of collection and experimental error. These results are very comparable to those obtained by Perkins and Torg (1962) in a survey on 200 blood donors. However, Pirofsky and Nelson (1964) in a similar survey demonstrated that 83.9% of females and 80.4% of males rejected as having a low haemoglobin by the same technique actually had haemoglobin values above the minimum requirement. The higher rejection rate in this latter study was attributed to the fact that the performance of the screening test was carried out by volunteer Staff Nurses and not by qualified laboratory technicians as is being done in our Service.

The false low haemoglobin values were probably due to some degree of excessive massaging and forceful squeezing of the fingers during collection of the blood which gave rise to errors of sampling. Trapping of air in

the blood drop and varying heights from which the blood was dropped could lead to erroneously low values.

The reverse situation where false high values are obtained resulting in a volunteer being accepted as a donor but whose actual haemoglobin level is below 12.5 gm. % does occur occasionally though to a much lesser extent.

During the same period, the haemoglobin levels of 1,979 unselected donors, who had passed the copper sulphate screening test, were determined by the cyanmethaemoglobin method. It was found that only 16 of them had haemoglobin levels below the minimum of 12.5 gm. %. This gave an error of 0.3% only. Of these sixteen, 14 of them had levels between 12.0 to 12.4 gm. % which are values very close to the arbitrary dividing line. Only 2 had haemoglobin levels of 11.4 and 11.0 gm. %. It was felt that the donations made by these donors would not have in any way been detrimental to their health.

Our experience therefore agrees with that of other services in that the copper sulphate technique reflects the haemoglobin level with considerable success. Because of its simplicity and the rapidity of analysis it is the method of choice for any large transfusion service. The technique is a relatively simple one and the staff can be easily trained to perform the test with all the precautions necessary. It does not require any heavy, expensive or delicate equipment and is ideally suited for use by the Mobile Team at outdoor sessions. To prevent any unnecessary wastage of donors, however, it is essential to re-check the haemoglobin values by more accurate methods before rejecting those who have failed the screening test.

#### SUMMARY

A survey made on the rejection rate of volunteer donors presenting for the first time showed an overall rejection rate of 7.1%. There was no significant difference in the rejection rate of the different ethnic groups. The significantly higher rejection rate of women volunteers was associated with large numbers who were mildly anaemic, underweight or had poor veins. 0.3% of males and 7.9% of females were rejected for having haemoglobin levels of below 12.5 gm. %. The value of the copper sulphate technique as a method for the rapid screening of volunteer donors was confirmed. The various reasons for the rejection of volunteers are discussed.

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