

Original Communications

BLOOD TRANSFUSION IN THE STATION HOSPITAL

BY

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INTRODUCTION

To every Station Hospital there will in due course be brought the very gravely injured, some of whom will need a massive and urgent transfusion. The supply of that transfusion is the subject of this article. If these occasions are rare, the keeping of a blood bank will not be practical, and, if the hospital is abroad, there will not be the National Blood Transfusion Service to call upon. Under these conditions the supply of up to a score of bottles of blood is an urgent, anxious, and very rewarding task.

Some of the lessons learnt in providing such transfusions are recorded here in the hope that they will be of use to others. The article is based on experience gained at the Station Hospital, El Ballah, M.E.L.F., in the troubles of 1953 and 1954. It does not deal with the problems of frank warfare, but with the uneasy state which is neither war nor peace but a wearisome succession of incidents. Because such incidents usually involve only small numbers of casualties, the full resources of the hospital transfusion service may often be turned to a single case. Transfusions may then be given of a size impossible where many casualties require to be transfused at once. In time of peace, accidents may be the cause of a similar need for blood, and, except for its rarity, the problem will be identical.

In the present unsettled condition of the world, medical officers in Station Hospitals abroad may frequently find themselves called upon to treat those injured in incidents. These may often be gunshot wounds in relatively small numbers. The problem is thus an important one, and, if the standard of medical care is to be high in Station Hospitals, the standard of their transfusion service must also be high.

THE DONOR PANEL

The foundation of an effective transfusion service is its donor panel. This is particularly important when there is no stored blood to rely upon, every pint being taken from a donor only when it is required. It has been found useful to keep two panels. The first is a panel inside the hospital made up of as large a fraction as possible of its staff. It is used to provide the first pint or two of an urgent transfusion and as a source of cells of known group. The second panel

is drawn from units outside the hospital and is used to provide the later pints of an urgent transfusion as well as for all transfusions where time permits.

The panel inside the hospital is easily recruited by a personal approach to each member of the staff, and, if the officer commanding will become a blood donor himself, so much the better. Forty or fifty donors inside the hospital form an adequate panel.

The panel outside the hospital is less easy to recruit. It is best made up of fifty to a hundred donors in each of a number of large static units close by. The temptation to rely upon a small number of donors in many scattered units is best avoided for they are of little use in an emergency.

It is not easy to recruit a large panel in a unit and the best way to start is a personal approach to the commanding officer. An appeal can be put on the unit notice board asking donors to come forward, or the transfusion officer can address a parade. Few donors will answer an appeal on the notice board, and, if he addresses a parade, the response depends on his powers of persuasion. The best method by far has been found to be to ask all those not wishing to be donors to say so and to parade the remainder.

This should be done at the unit's convenience, and is easily combined with the routine inoculations. If all is organized well, it is possible to take samples for blood grouping at the rate of just under a man a minute. Working with the unit medical officer, samples can easily be taken from a hundred men in the course of an afternoon.

Records of the donors on the panel are best kept in a card index. A copy of one of the cards actually used is illustrated (Fig. 1).

Laboratory reference number		GROUP
Number..... Rank..... Name & initials.....		Rhesus
Unit..... Date grouped.....		Kahn
Date of demobilisation.....		Signed
Date of donation	Blood serial number	To whom given

FIG. 1. Index card used for recording blood donors

Samples of blood for grouping are best taken into "bijou" bottles, but, if these are not available in the required numbers, empty penicillin bottles can be used, if previously plugged with cotton-wool and sterilized. Syringes for venipuncture are seldom available in the required numbers, but a large intramuscular needle attached to an inch of rubber tubing is a very effective substitute. These devices can either be sterilized individually in test tubes or else packed, layer upon layer, in a tin. They are very convenient and safe if each layer is packed between gauze and care taken not to touch the points of the needles. They are, however, not as easy to use as a syringe for venipuncture and some syringes must always be to hand in case veins are difficult.

On the parade the transfusion officer will need three assistants: two sit at a table, where one records the particulars of the donor on an index card, while the other records them on the label of a "bijou" bottle. Both the bottle and the card are then handed to the donor, who is asked to check them as he moves in a queue towards the transfusion officer. The transfusion officer himself checks these while his third assistant prepares the donor's forearm for venipuncture.

During this operation it is important to glance away occasionally from the donor's forearm to his face, for those about to faint give warning by their pallor. An occasional donor will always faint. To minimize the possible evil consequences of this it is important to choose a room with a carpeted or linoleum-covered floor. It is also desirable that as few as possible see their fellows being venipunctured.

Some of the men will have been donors at their depots and will possess blue National Blood Transfusion Service booklets. These can be collected, copied on to filing cards and returned to their owners. These donors form a convenient and reliable part of the panel, but great care must be taken to see that their booklets are copied correctly. The transfusion officer is well advised to check these himself to avoid clerical errors and their possibly serious consequences.

When taking samples from donors at a unit, arrangements should be made for calling them up when the need arises. The Medical Centre should keep a list of the unit donors; the larger this is the easier it will be to find donors in time of need and the less trouble will be caused to the unit. A telephone message straight to the Medical Centre is the best way of calling them, and great care must be taken to define the degree of urgency.

The donor panel is never static, for the members of a unit are always changing. Unless added to, the panel will inevitably diminish. The best way of doing this is to give each draft, as they arrive, the opportunity of becoming donors.

THE BLOOD BANK* AND ITS EQUIPMENT

Almost more important than the donor panel is the siting and equipment of the Blood Bank itself. The close proximity of the Blood Bank to the Operating

* The word "Bank" is used here in a restricted sense to mean the room where blood is taken and crossmatched. It is not a true blood "Bank" as that is usually understood.

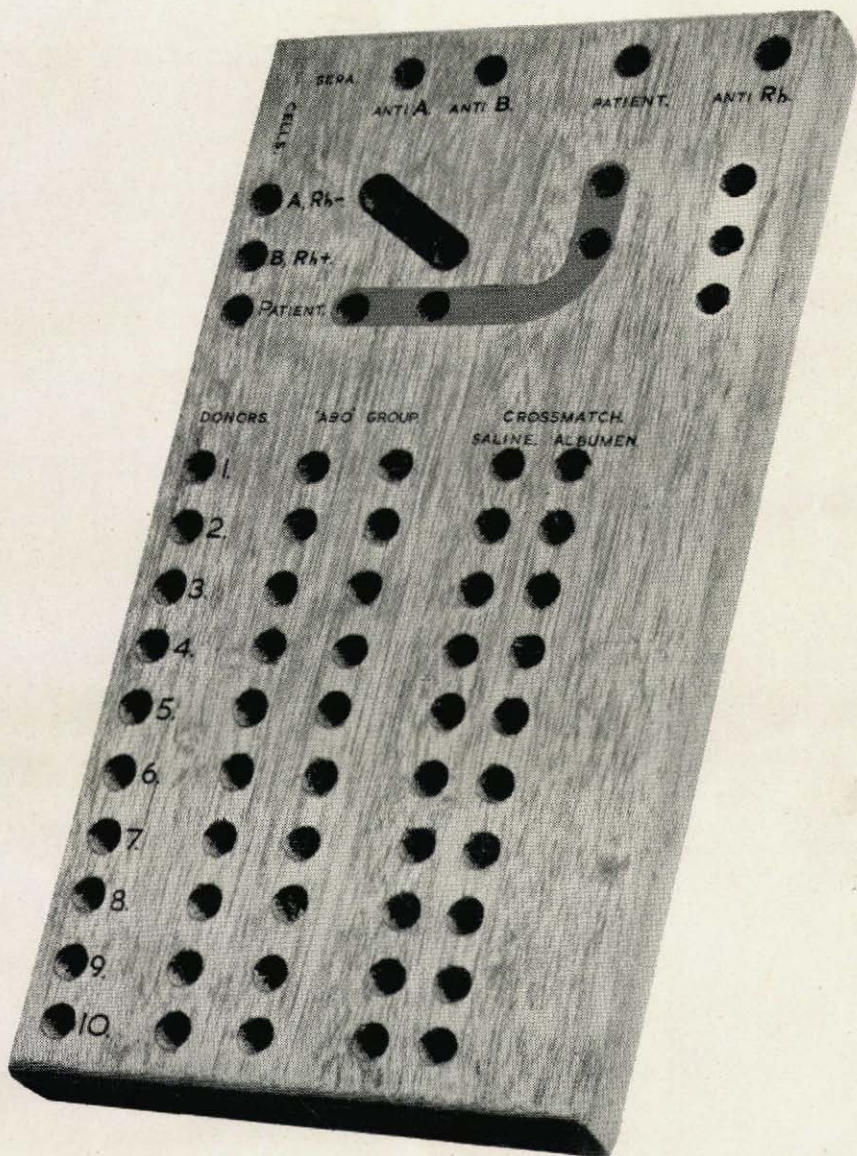


PLATE I. The Board used for Blood Grouping and Crossmatching.

Cell suspensions are placed in the tubes down the left-hand side of the board and sera in a row along the top; cells are transferred to the tubes of the same horizontal row and sera to the tubes of the same vertical row. Painted figures on the board distinguish the tubes used to determine the patient's "ABO" and Rhesus group as well as those used to test the antisera.



PLATE II. The bench of the Blood Bank at a Station Hospital during an urgent transfusion.
(For list of equipment see Appendix II)

Theatre is essential if proper liaison is to be possible between the transfusion officer and the anæsthetist, and indeed, the closer they are the better. If no other room is available it is possible to combine the Blood Bank and the Plaster Theatre. In this connection it is important to note that the transfusion officer and the anæsthetist cannot be combined in the same person, for, under conditions of stress, they may both be fully occupied at the same time, one anæsthetizing the patient and the other providing blood for him.

The Blood Bank must be large enough to contain two beds and a bench for the apparatus for blood grouping and crossmatching. Running water, a refrigerator, and a telephone are almost essential, and a cupboard to contain transfusion bottles and sets is very useful. Close by, there should be a room with arm-chairs, magazines, and arrangements for brewing tea. Here donors may wait and recuperate after being bled.

It may appear more convenient to do the grouping and crossmatching in the hospital laboratory or clinical side room. It has, however, been found less trouble in the end if a centrifuge, a microscope, and a water bath are provided in the Blood Bank where the technician can be supervised personally.

The only piece of specialized equipment needed by the Blood Bank is a board for holding numbers of small test tubes. The board illustrated (see Plate I) was evolved for this purpose and works well. There is need of a standard apparatus of this type, for it minimizes the chance of errors that are so easy under stress, permits the technician to be readily watched, and makes a change of operator easier, should this prove necessary. The cell suspensions are placed in a row down the left-hand side of the board and sera in a row along the top. The cells are transferred to every tube in the same horizontal row and the sera to every tube in the same vertical row.

Painted figures on the board distinguish the tubes used for testing the grouping sera from those used for the patient's "ABO" and Rhesus group. The tubes used in regrouping and crossmatching the donors are more obvious and require no special distinction.

Many minor articles of equipment are needed which must be readily available, for valuable time may be wasted in finding them. They are listed in Appendix II and illustrated in Plate II.

SUPPLYING BLOOD WHEN THE DEMAND IS URGENT

Procedure varies with the urgency of the call for blood, and for convenience it is proposed to consider here only cases of great urgency. The best way of appreciating the degree of haste required is for the transfusion officer to see the case himself.

Medical officers in the area should be asked to give prior warning, if they can, when sending in cases requiring transfusion. Valuable use can be made of the minutes thus gained in making sure that the equipment is ready, and in obtaining samples of "A" Rhesus negative and "B" Rhesus positive cells from members of the hospital staff. This is conveniently done from a prick in the finger straight

into a test tube of saline. The antisera can be reconstituted and one of the unit donor panels warned of an impending call for blood donors.

Thus prepared, the arrival of the patient can be awaited with confidence. In Reception 10 ml. of the patient's blood are taken into a centrifuge tube and at the Blood Bank a few drops of this are transferred to a tube of saline. This is then centrifuged, the supernatant removed, and the cell concentration adjusted to about 5 per cent. This washed cell suspension is then used for a preliminary "ABO" group on a slide, and, at the same time, a confirmatory "ABO" group and a Rhesus group are set up in the tubes of the board. As soon as the patient's blood has clotted it is centrifuged, and, when enough serum has separated, this is used to confirm the patient's "ABO" group further by being set up against "A" and "B" cells. Thus at an early stage the patient's blood group will have been determined by the slide method and confirmatory tests set up. Rhesus negative donors of the correct "ABO" group are then sent for from the inside and the outside panels. Donors from the hospital are immediately available and can be bled at once. Valuable time is saved if, while the transfusion officer prepares to do this, the technician takes a sample of blood from the donor's finger for grouping and crossmatching.

Shortly after the first pint has been withdrawn, a point will have been reached when the tube group will have been standing on the bench for twenty minutes, and the tubes for the crossmatch will have been in the water bath for a quarter of an hour. If the blood is wanted urgently, these tests can be read and if satisfactory it can be given. Second and subsequent pints of blood should be capable of following on very rapidly and supply should soon catch up with demand. If the donors are regrouped and crossmatched from a prick in the finger, the later pints for the transfusion will have been adequately tested before being given.

When the Rhesus group has been set up for twenty minutes it can be read, and if it is unequivocally positive the patient can then be given Rhesus positive blood. If it is negative it can be read again later, and for this to be possible it is important that it should be set up in sufficient volume.

The fascination of such work lies in the desperate importance of the issue, the extreme ease of a slip, and the nice judgment required in assessing the relative merits of giving inadequately tested blood on the one hand and withholding it on the other.

TESTING THE ANTISERA AND THE TECHNIQUE OF THE "ABO" GROUP

Testing both the serum and the cells is standard "ABO" grouping practice for routine purposes. It is, however, usual in emergency work to rely upon testing the cells alone and the extra work involved in doing both cells and sera must be justified. Suspensions of "A" Rhesus negative and "B" Rhesus positive cells can be used three times. Firstly, as controls in the Rhesus group where they are essential; secondly, to test the potency of the anti "A" and anti "B" sera; and finally with the patient's serum to confirm his "ABO" group.

The anti "A" and anti "B" sera issued have never been found to give false positive reactions in our hands, and, provided the cell suspensions are washed, are unlikely to do so. Danger lies in the possibility of false negative reactions due to low titre sera. While "in date" they are stated to be effective to a titre of not less than 1/64. This has been found to be true for all tubes tested before their expiry date, but owing to the exigencies of the service low titre sera may have to be used. To counter this, and the theoretical failure of a serum while still "in date," it has been our practice to test every tube of serum used. False negatives in the grouping of the recipient are fortunately less serious than false positives, but they are undesirable in that the donor's antibodies may cause the destruction of the recipient's cells, particularly when large volumes are transfused. A further advantage of routinely testing the antisera is the rapidity with which an incorrect "ABO" group, due to weak sera, can be suspected. With sera of standard titre agglutination is rapid in the tubes of the test. If this is not so the serum is probably of low titre.

Having established the potency of the antisera it should only then be necessary to test the patient's cells. To test his serum as well, though not essential, does, however, add a simple cross check that takes very little time.

It is worth recording that on one occasion, when the reading of the control tests just described was delayed, a patient was temporarily mistransfused as "O" instead of "A." On another occasion a patient was similarly mistransfused at another hospital where these controls had not been used.

Occasional anomalous reactions due to the " α_1 " antibody may complicate the grouping of the patient's serum. If test "A" cells are chosen at random they will in theory complicate approximately 0.3 per cent. of all "ABO" blood groups, but, provided that it is realized that this may happen, no trouble need ensue (Whitby and Britton, 1953). Ideally " A_2 " cells should be used, but to find them would be a complication that would outweigh their benefit.

RETESTING THE "ABO" GROUP OF EACH DONOR

The first few pints of an urgent transfusion may well have to be given without the correct time having elapsed for crossmatching. Under these circumstances an "ABO" mismatch is more likely to be picked up with the high titre antisera supplied than it is with the patient's serum where these isoantibodies are usually in lower titre. Under conditions of real urgency, regrouping of the donor is the test to be relied upon. Significant antibodies other than those of the "ABO" system appear to be rare enough in a population of young adult males to be disregarded under these conditions.

CROSSMATCHING IN ALBUMEN AND SALINE

An albumen and a saline crossmatch may seem an unwarranted complication where time is short and have in our practice sometimes been omitted. If blood for crossmatching is taken from the donor's finger before he is actually bled, and if the tests are read only when the blood is actually wanted, at least ten minutes

for crossmatching is always possible. If the tubes are centrifuged for a minute at a thousand revolutions a minute before being read, even this length of time is well worth while. There is usually ample time to crossmatch the later pints for a transfusion in albumen and in saline. This is standard practice because each type of crossmatch is to some extent specific for the type of antibody most easily elicited.

THE RHESUS FACTOR

The giving of Rhesus incompatible blood to women of child-bearing age, or to those likely to want subsequent transfusions, is seldom defensible and Rhesus negative blood should always be found for them. The problem that concerns the Station Hospital is the remaining majority of cases. If the transfusion can wait the standard two hours required for Rhesus grouping, all is simple. So often, however, the need is more urgent and the problem is then whether to waive the Rhesus group altogether, or to give Rhesus negative blood until the Rhesus group is known.

Five or more pints of blood may be required during this time, and, as these occasions may be frequent, a large Rhesus negative panel must be maintained. If this ideal policy is to be followed the total donor panel will have to be larger than it otherwise need be, with a corresponding increase in the work of the transfusion officer and the blood grouping laboratory. Should the work of the hospital merit the keeping of stored blood for emergency use, the problem will be even more acute, for some Rhesus negative blood will inevitably be discarded each time the bank is renewed. The earlier the Rhesus group is known the less the Rhesus negative blood used, and for this purpose a rapid Rhesus test is important. With the sera issued the standard time for the test is two hours. If, however, the test is set up in albumen initially, it can be read in a shorter time and Rhesus positive blood may be given as soon as a positive result is obtained. If the time for the Rhesus grouping is shortened the tubes should be gently centrifuged in the way described for the crossmatch.

It is a point of interest how much extra trouble is justified in avoiding the Rhesus sensitization of males which takes place only in some of those at risk. The evil effects of this can always be circumvented in good hands should they require subsequent transfusion.

It is the policy in this hospital to ignore the Rhesus group during the urgent transfusion of males, and the procedure described above is, therefore, theoretical rather than practical.

The technical complications of the Rhesus group are minimized using the board described above.

UNIVERSAL DONOR BLOOD

The use of universal donor blood under emergency conditions appears to have much to commend it. It is, however, open to two theoretical objections. The first and potentially the more serious is the possibility that, if the donor's blood

is not adequately regrouped and crossmatched at the time, blood of another group may be given in error. The second is the effect that the donor's iso-antibodies may have on the recipient's cells. The exact significance of this is difficult to ascertain, but Mollison (1951) quotes Ebert and Emerson as noting 1 per cent. of frank hæmolytic reactions in "A," "B," or "AB" patients receiving routine transfusions of group "O" blood. They also considered that some asymptomatic destruction of the recipient's cells was invariable after multiple transfusions of group "O" blood. Gardner and Tovey (1954) quote several authors as observing hæmolytic reactions under these conditions and it must be concluded that the danger exists.

For this reason it has been our practice only to give homologous blood. With a little organization the "ABO" group can be determined very rapidly by the slide method, and, if a tube group is set up at the same time, it can be confirmed before blood is given. Should, however, there be a delay in determining the patient's blood group, universal donor blood can be given and it undoubtedly has a place in Station Hospital transfusion practice.

DEXTRAN

Dextran has been widely used in preference to plasma because, until recently, the plasma supplied in M.E.L.F. was prepared in 1946, and was viewed with disfavour by the surgical staff who attributed reactions to it. No reactions have been observed with dextran which has proved invaluable in restoring the blood volume while blood was being obtained. One of the disadvantages of dextran is its power of inducing heavy rouleaux formation and thus complicating the task of grouping and crossmatching. Provided that at least 10 ml. of blood are withdrawn before any dextran is given the problem will not arise, but the transfusion officer must be able to face it when it does. Minor rouleaux formation can be dispersed by dilution with an equal quantity of saline. The use of 7 per cent. sodium salicylate as a suspending medium has proved effective and, where time permits, the Sheffield technique employing 20 per cent. albumen is said to be of value. Provided that the patient's cells are well washed they can always be grouped no matter how much dextran is present.

STORING BLOOD

Blood is usually needed too seldom in a Station Hospital to be worth storing. The occasion for doing this may, however, arise, and it is sometimes useful to store blood a few days for a particular patient. Storage facilities must therefore be available.

The optimum temperature for storing blood is 4° C. This can be satisfactorily maintained in a domestic refrigerator and recorded with a maximum and minimum thermometer. While blood is being stored the transfusion officer should visit the refrigerator daily and record the temperature at which he finds it as well as the maximum and minimum. These figures are conveniently plotted graphically, when it will be found that the only temperature to vary

greatly is the maximum, which will depend upon how much the refrigerator is opened. The setting of the thermostat required to maintain the temperature at 4° C. has been found to vary with the external temperature and to require altering as the weather changes. The post-transfusion survival time of blood is

Front view of label

ARMY BLOOD TRANSFUSION SERVICE

I certify that this blood has been cross-matched and is compatible for :—

Service No.	Rank	Name and initials	ABO	Rh

..... Date.....
(Signed)

..... Date.....
(Signed)

INSTRUCTIONS TO NURSING STAFF

MAKE ABSOLUTELY CERTAIN that the number, rank and name above correspond exactly with that of the patient and ask somebody to check this.

When this bottle is empty replace the cap and ask the medical officer to fill in the details on the back of this label. When this is done return the UNWASHED bottle to the blood bank with its label still attached.

NEVER tear this label from the bottle.

A full bottle of blood should not be put in a ward refrigerator ; an empty bottle is best kept there until it can be returned to the bank.

Do not send for blood until it is needed.

Blood is not to be warmed before use except under the direct supervision of a medical officer.

Back view of label

FOR THE TRANSFUSION OFFICER'S USE

Serial No. of blood or plasma. Blood group

	ABO Rh
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The donor's particulars :—

Service No.	Rank	Name and initials	Unit

Details of taking :—

Taken on :	Taken by :	Expires :

The authority for the donor's group is.....
I certify that this bottle has been retested and is :—

ABO	Rh	W.R.	Kahn

Signed..... Date.....

FOR THE MEDICAL OFFICER'S USE

Hospital.....

This blood was given ^{without incident} with reactions (Signed)

Details of the patient's clinical condition :—

If reactions ensue full clinical details are to be given to the transfusion officer. He will want a complete temperature chart with the times of all transfusions and other clinical events inserted.

Exact symptomatology must be recorded with particular reference to pains in the head, chest, or loin, rashes, rigors, oliguria, anuria, or jaundice.

FIG. 2. The "tie-on" label for blood bottles.

diminished if it is not stored at 4° C., and there should be no hesitation in discarding it if the storage temperature should alter significantly. It is easy to store blood in a domestic refrigerator if it is visited often and adjusted carefully.

When blood is stored the opportunity should be taken of testing its "ABO" and Rhesus group. This is standard practice and is a valuable safeguard, for no panel should be reckoned as being absolutely reliable.

RECORDS AND THE AVOIDANCE OF CLERICAL ERROR

These two problems are closely bound up with one another. In published accounts of mismatched transfusions "Clerical Error" ranks high as a cause; it is worth making a great effort to reduce it to a minimum. The system of checking already described should minimize the chance of error when samples are taken initially from volunteer donors. No "F. Med. 12" is needed if the filing cards accompany the specimens to the laboratory and a further source of error is avoided. These cards are returned for filing together with booklets for issue to the donors. When a donor is bled, this booklet or his filing card must be checked and his particulars recorded.

Under stress the record system needs temporary pruning. All that is then required is a simple serial number which is recorded on the bottle of blood, on the tubes for crossmatching, and against the donor's name in the record book. If the blood for testing is taken from the donor's finger before he is bled, this same serial can be recorded on his forearm in grease pencil and checked later by the transfusion officer as he withdraws the blood.

Records are simple when patients are transfused one at a time by one person. Under other circumstances records and labels become more important and deserve some attention. The "tie-on" label illustrated (see Fig. 2) is a modification of that at present used and contains some much-needed instruction to the staff on the wards who may have had little experience of blood transfusion. Coloured "stick-on" labels denoting the group of the blood have also been used and are invaluable. An excessive importance may appear to have been given to stationery; it is, however, believed to make an important contribution to the running of an efficient and reliable transfusion service.

REFERENCES

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APPENDIX I

This is a brief record of the cases transfused at the Station Hospital, El Ballah, during the last three months of 1953 and the first three months of 1954. They form a record of the variety of cases with which a station hospital may have to deal, and the quantity

of blood that may be required. During most of this time the organization of the Blood Bank was not up to the standard of that just described.

<i>Name</i>	<i>Injury</i>	<i>Quantity of Blood given Pints</i>	<i>Result</i>
(1) Dvr. B.	Road accident. Severe rotation injury to the thigh.	5	Survived.
(2) Civ. M. H.	Aged 6. Road accident. Head injuries.	1	Died.
(3) Pte. B.	Sprue. Megaloblastic anæmia. Melæna.	3	Survived.
(4) Spr. J.	Chronic diarrhœa due to Crohn's disease. Torrential melæna treated by emergency hemicolectomy.	12	Survived.
(5) Pte. D.	Multiple scalp wounds.	2	Survived.
(6) Pte. G.	Accidental G.S.W. of the abdomen. Given nine pints of blood at laparotomy and three some days later. Died after a second laparotomy for a secondary hæmorrhage for which he was given twenty-one pints of blood.	33	Died.
(7) Gnr. W.	Mortar bomb accident. Injured face and hands.	1	Survived.
(8) Pte. C.	Accidental G.S.W. of the abdomen.	11	Died.
(9) Civ. C.	Melæna from peptic ulceration.	5	Survived.
(10) Sgt. A.	Peritonitis from appendicitis.	2	Died.
(11) Civ. K.	Peptic ulceration.	2	} Blood supplied to an outside hospital. Both survived.
(12) Civ. M.	Bleeding œsophageal varices.	2	
(13) Pte. A.	Abdominal G.S.W.	6	Died.
(14) Pte. S.	Myeloid Leukæmia.	3	Died.
(15) Gdsm. D.	G.S.W. abdomen with cauda equina injury.	6	Survived.
(16) Major B.	G.S.W. abdomen.	10	Died.
(17) Civ. M.	G.S.W. thigh.	5	Died.

APPENDIX II

THE EQUIPMENT NEEDED FOR BLOOD GROUPING AND CROSSMATCHING

(This lists the equipment shown in Plate II)

Two bottles of blood being crossmatched.

A microscope, lamp, and centrifuge.

The board set out with antisera and tubes for crossmatching.

A dispenser for filling tubes with saline.

20 per cent. albumen and jars for saline and waste.

Pipette, grease pencil, diamond, and forceps.

Water bath and bowl for dirty tubes.

Slides and a porcelain tile with depressions.

A universal container with a Pasteur pipette graduated at 1 ml. This contains distilled water and is used for reconstituting the antisera.

Universal containers containing stock suspensions of "A" Rhesus negative and "B" Rhesus positive cells. These are kept aseptically in acid citrate dextrose and last at least a month.

A needle for withdrawing samples from the finger.

The record book.

This layout of the apparatus permits all the operations of grouping and cross-matching to be done without the operator leaving his seat.