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A COOPERATIVE NORMAL HUMAN SERUM AND PLASMA PROGRAM

For Hospitals in The State of Illinois

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UNDER THE AUSPICES OF THE

Illinois Department of Public Health

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INTRODUCTION

Cooperative Normal Human Serum and Plasma Program

For Hospitals in the State of Illinois

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The great value of serum or plasma infusions in the therapy of shock, burns, and allied conditions is generally conceded. Like any other biologic, the preparation of these materials should be such as to ensure maximum safety to the patient. The technic of preparation of normal human serum or plasma for intravenous use should be in accord with the requirements of the established authority, the National Institute of Health.

The average hospital is not equipped nor prepared to make biologics and ordinarily purchases them. However, the purchase of normal human serum or plasma, of quality acceptable to the National Institute of Health, is expensive. This is, of course, in part due to the need for a most careful technic with frequent tests to ensure safety. A large part of the cost arises from the fact that distributing laboratories generally find it necessary to obtain blood from professional donors. The local hospital, on the other hand, can almost always obtain sufficient free or "family" donors for as much serum or plasma as it needs but lacks the equipment, facilities and trained personnel to prepare serum and plasma in accordance with the standard requirements of the National Institute of Health. The result of this situation is that in some instances serum or plasma is purchased but the use restricted because of the expense, in others the hospital feels compelled to prepare its own serum plasma in disregard of the established reqirements, and in some instances institutions do without these materials altogether.

To meet this problem, the Illinois Department of Public Health has sponsored the following plan which, it is believed, will serve to reduce the cost of serum or plasma without any compromise in quality and at the same time make possible a more widespread use of these materials.

The Plan, in broad outline, is as follows:

(a) It is completely voluntary. Any hospital desiring to participate must apply to Dr. Roland R. Cross, Director of the Illinois Department of Public Health. Any participating hospital may withdraw from the plan, if it so elects.

(b) When a hospital enters the plan, it agrees to abide by the rules.

(c) After a hospital's application is accepted, the Illinois Department of Public Health will, without charge, establish at the hospital a supply of serum or plasma prepared by the Samuel Deutsch Serum Center. Ordinarily one bottle per ten active adult beds will be furnished. This supply, although remaining the property of the State of Illinois, is to be used by the hospital for its own needs. The State of Illinois reserves the right to commandeer the hospital's supply for use elsewhere in emergencies. This is quite an unlikely possibility because the State will maintain an additional emergency supply.

(d) The hospital agrees to (1) store the serum or plasma properly; (2) administer it properly; (3) maintain its inventory; (4) replace within one week any of the stock

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used. Such replacements are to be made by the methods outlined below.

(e) Replacement of stock may be made in three ways*:

I - Outright purchase of the equivalent amount of plasma (300 cc. per unit) or serum (250 cc.) from any laboratory licensed by the National Institute of Health.

II - Send 500 cc. (net) of whole blood to the Samuel Deutsch Serum Center and pay a processing charge of $7.50 for each unit of serum or plasma secured. Credit for blood shipped will be allowed only if the blood is drawn in a container approved by the Serum Center, arrives at the Serum Center not later than 24 hours after venesection, and proves to be sterile, Kahn negative, non-fatty, and non-hemolyzed.

III - Send 1,000 cc. (net) of whole blood to the Samuel Deutsch Serum Center and pay no processing charge for each unit of serum or plasma secured. Credit for blood shipped will be allowed only if the blood is drawn in a container approved by the Serum Center, arrives at the Serum Center not later than 24 hours after venesection, and proves to be sterile, Kahn negative, non-fatty, and non-hemolyzed.

(f) Inventories will be checked at monthly intervals by the designated Public Health officer who will supervise the storage, administration, and maintenance of supply.

(g) The equipment used in venesection will be furnished from the Serum Center. There will be a service charge for cleansing bleeding sets improperly used, or wasted.

(h) The hospital will send to the Public Health Officer, designated by the Illinois Department of Public Health, a report on each unit of serum or plasma used.

(i) Representatives of the Samuel Deutsch Serum Center will be available as consultants for the State Department of Public Health in solving any problems that may arise.

In actual operation of the cooperative plan the Illinois Department of Public Health will:

(1) Consider the application of a hospital desiring to participate in the plan.
(2) Designate the supervising Public Health Officer.
(3) Furnish to the approved hospital without charge the initial stock of serum plasma together with two portable refrigerators and initial supply of venesection bottles (six such bottles per refrigerator).
(4) Furnish instructions and regulations relative to:
    (a) Use and administration technic of serum or plasma
    (b) Storage
    (c) Administration equipment preparation
    (d) Donor qualifications
    (e) Blood collection

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*The hospital, with these means of replacement available, will at its own discretion make arrangements with the patient, selecting in each case the most practical method.

used. Such replacements are to be made by the methods outlined below.

(e) Replacement of stock may be made in two ways*:

I - Outright purchase of the equivalent amount of plasma (300 cc. per unit) or serum (250 cc. per unit) from any laboratory licensed by the National Institute of Health.

II - Send 500 cc. (net) of whole blood to the Samuel Deutsch Serum Center and pay a processing charge of $9.50 for each unit of serum or plasma desired. Credit for blood shipped will be allowed only if the blood is drawn in a container approved by the Serum Center, arrives at the Serum Center not later than 24 hours after venesection, and proves to be sterile, Kahn negative, non-fatty, and non-hemolyzed.

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*Although the hospital can obtain serum or plasma from the Samuel Deutsch Serum Center through only these two plans, the hospital can distribute plasma to its patients in several ways. At the hospital's discretion, a patient may replace each unit of serum or plasma used by furnishing two donors, one donor, or no donors, the processing and handling charges varying with the method employed. Thus a patient furnishing no donors would be charged $19.50 (equal to two processing charges) + handling charge. A patient furnishing one donor would meet a $9.50 processing charge + handling charge. A patient furnishing two donors woud pay no processing charge. The hospital must, of course, watch the total use of each method to ensure a proper balance.

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(g) The equipment used in venesection will be furnished by the Serum Center with an initial charge for the equipment. There will be a service charge for cleansing bleeding sets improperly used, or wasted.

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    (a) Use and administration technic of serum or plasma
    (b) Storage
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    (e) Blood collection

(f) Blood shipment

(5) Make available consultation services through the Public Health Officer and representatives of the Samuel Deutsch Serum Center.

The designated Public Health Officer will:

(1) Check the inventory at monthly intervals
(2) Consult as to preparation of intravenous administration equipment
(3) Consult as to the methods of handling plasma and serum
(4) Supervise the technic of blood collection and demonstrate the equipment furnished for this purpose.

The hospital will:

(1) Appoint a staff physician who will consult with the Public Health Officer, familiarize himself with the equipment provided for venesections, supervise the venesections, and make sure the whole blood is properly drawn, packed, and shipped to the Serum Center to arrive in good condition. Shipments should be made so that they will arrive within 24 hours of venesection and on any day except Sundays and holidays. The donor card must be filled out properly; the donor card and separate blood sample for Kahn test must accompany the blood.

(2) Maintain the insulated shipping boxes (a minimum of two boxes - 1 per 50 hospital beds will be required) and bleeding sets (6 per insulated shipping box). This equipment will be used over and over repeatedly. There will be charges for breakage and for recleansing spoiled equipment. The insulated shipping boxes and the bleeding sets must be prepared by the Serum Center.

(3) Conform with the regulations for proper preparation of intravenous administration equipment.

(4) Conform with regulations for proper storage of its supply of serum or plasma.

(5) Consult with the Public Health Officer on problems that arise.

(6) Send a report to the Public Health Officer, of each unit of serum or plasma used.

(7) Prepay all shipments to the Serum Center.

The Serum Center will:

(1) Prepare bleeding sets and insulated boxes.

(2) Will furnish liquid serum (250 cc unit) or liquid plasma (300 cc unit) as requested - (Plan I) by hospital order for outright purchase; or on receipt of whole blood which proves to be sterile, Kahn negative, non-fatty, and non-hemolyzed, will furnish (Plan II) one flask of plasma or serum for each 500 cc of blood so sent, at a processing charge, or (Plan III) for each 1,000 cc of blood so sent will furnish 1 unit of serum or plasma without processing charge.

(3) Be available to the Public Health Officer for consultation on problems of venesection, storage, and administration.

(f) Blood shipment

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(5) Consult with the Public Health Officer on problems that arise.

(6) Send a report to the Public Health Officer, of each unit of serum or plasma used.

(7) Prepay all shipments to the Serum Center.

The Serum Center will:

(1) Prepare for purchase an initial supply of bleeding sets and insulated boxes.

(2) Will, on receipt of 500 cc. (net) of whole blood which proves to be sterile, Kahn negative, non-fatty, and non-hemolyzed, furnish one unit of plasma (300 cc. per bottle) or serum (250 cc. per bottle) for each 500 cc. of blood so sent, at a processing charge.

(3) Be available to the Public Health Officer for consultation on problems of venesection, storage, and administration.

(4) Cleanse and return all bleeding sets and insulated boxes shipped to it. A bleeding bottle arriving with all parts and with 500 cc. acceptable blood will be cleansed without charge. Equipment requiring recleansing due to unsuccessful efforts at venesection must be returned to the Serum Center for recleansing which will be done at a charge of 50 cents ($.50). Charges will be made for items broken or missing.

(5) Prepay all shipments to hospitals

(6) Furnish literature on the use of serum or plasma, storage, cleansing of administration equipment, etc.

Since this plan is experimental, certain possibilities may arise:

(a) A hospital may decide to withdraw from the plan. In this event, it must notify Doctor Roland R. Cross, Director of the Department of Public Health, balance its books, and return to the state a stock of plasma, together with portable refrigerators and venesection equipment, equivalent to the original issue.

(b) The various charges are subject to change.

(c) Experience may serve to modify many of the details presented herein.

(d) A participating hospital must conform strictly to the plan, on penalty of being eliminated from the plan and being required to return the equivalent of its original stock of plasma, portable refrigerators and venesection equipment, to the State of Illinois.

(4) Cleanse and return all bleeding sets and insulated boxes shipped to it. A bleeding bottle arriving with all parts and with 500 cc. acceptable blood will be cleansed without charge. Equipment requiring recleansing due to unsuccessful efforts at venesection must be returned to the Serum Center for recleansing which will be done at a charge of 50 cents ($.50). Charges will be made for items broken or missing.

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II - THE INDICATIONS FOR ADMINISTRATION OF SERUM AND PLASMA

II - The Indications for Administration of Serum and Plasma

The indications for administration of serum and plasma fall into two distinct categories.

SHOCK

It is beyond the scope of this booklet to enter into a detailed discussion of the etiology and mechanism of shock. Although controversies still wage on many of the details and most of the broad principles as well, the studies of recent years have tended to make clear that there is a common denominator in all or most forms of shock. This common feature in the mechanism of all forms is circulatory failure, which is primarily non-cardiac in origin, which is acute, and which causes damage to all the tissues of the body. Various authors have focused on different areas injured by the effects of a deteriorating circulatory system, but all emphasize the injury to capillary endothelium and resultant "leakage" of plasma out into the tissues. Shock may be considered clinically as due to an acutely slowed circulation in a leaking circulatory system. From the clinical viewpoint our problem is to determine why, what and how much has escaped from the circulation and how best to counteract these losses. In all our considerations we must constantly be aware of the time factor. The changes which accompany shock are frequently well established before shock is clinically obvious. The recognition of early shock is difficult, yet it is in just this early difficulty recognized stage that diagnosis is most important because treatment is most effective, for the injurious effects of shock create a "vicious circle", with progressive deterioration. The later that treatment is instituted, the less likely the therapeutic effects.

Although shock may be due to many different causes, from the clinical point of view the most important types are those associated with hemorrhage as the major factor, those associated with trauma or surgery, and those associated with burns.

Therapy of shock must be directed towards control of the original cause. Severe hemorrhage should be controlled, fractures reduced, etc. However, such measures though directed at helping the patient, might, if drastic, aggravate the shock state. It is a matter of individual judgment whether to treat the shock alone and for the moment ignore the cause, or whether to treat both simultaneously. Never, however, is shock to be ignored even for the moment, for in shock every minute counts.

HEMORRHAGE WITH SHOCK. Severe hemorrhage may give rise to shock. The collapse which is observed with massive obstetrical hemorrhage may be cited as an example. Theoretically, the ideal replacement therapy would be whole blood transfusion; practically, the loss of circulating blood volume rather than the loss of erythrocytes is the emergency problem. Purely on the basis of saving time and in an emergency where even minutes are of the greatest importance, massive serum or plasma infusions by restoring total circulating volume, save life and counteract shock. Subsequently, the patient may or may not require whole blood transfusion to overcome the anemia. In these cases, the important thing to do in the emergency is to restore total circulating volume, by whole blood infusion (if it be immediately available) or by either serum or plasma infusions. Crystalloid solutions such as isotonic solution of sodium chloride or glucose-saline mixtures are of little value because they leave the circulation rapidly and are therefore ineffective. The value of serum or plasma infusions in restoring circulating volume seems to depend on the general protein content. Diluted plasma or serum may be reckoned as undiluted plus the crystalloid dilutent; concentrated serum or plasma seems to be inferior to the iso-osmotic product.

If, as it is the case frequently, the patient is dehydrated, as well as in shock, the coincident use of crystalloid solutions to combat the accompanying dehydration is worth while.

SURGICAL AND TRAUMATIC SHOCK. Although hemorrhage, whether external or internal, is invariably present in this group of cases, the loss of erythrocytes is seldom of importance. Shock following trauma seems to be associated mainly with the loss of true plasma from the blood stream. It follows that the use of isotonic serum or plasma constitutes ideal replacement therapy. In these cases again, the immediate availability of liquid serum or plasma saves the precious minutes which are so important in counteracting shock and saving life.

BURNS. In Severe burns, massive amounts of plasma leave the blood stream. For perhaps seventy hours there is a marked tendency on the part of these patients to develop shock. At the same time the erythrocyte count rises markedly, cases with counts as high as 8,000,000 having been recorded. Early, repeated, generous, persistent infusions of isotonic serum or plasma are necessary to help tide the patient through this difficult and dangerous period.

HYPOPROTEINEMIA. Seldom diagnosed in past years because of the laborious methods then available for determination of serum proteins, this condition has, with the development of simpler methods, been found to be more common than previously thought. Hypoproteinemia seems to occur chiefly in three groups of cases: the nephroses, severe malnutrition, and in stormy post-operative cases. When present, it is ideally treated by administration of serum or plasma.

HEMORRHAGE OR ANEMIA WITHOUT SHOCK is mentioned only for the sake of completeness. Simple hemorrhage or anemia should be treated not with serum or plasma but with whole blood transfusions.

INFECTIONS

Immune serotherapy has been based on the antibody content of the serum. It is not intended, in this brief consideration, to discuss the use of specific antisera. Pooled adult human serum or plasma reflects in large degree the immunologic past of the donors who have contributed to the pool. On occasion, these antibodies may be of value clinically. If pooled adult serum is to be used in the hope that its antibody content may be of value, it seems advisable to use the material in doses of 250 to 500 cc. Liquid plasma is not recommended for this purpose, because its storage conditions (see section VI) are such as to lead to early and rapid loss of the antibodies.

III - THE NATURE OF SERUM AND PLASMA - THE VARIOUS COMMON FORMS

III - The Nature of Serum and Plasma - the Various Common Forms

SERUM may be defined as the liquid recovered from spontaneously clotted blood. For practical purposes, it may be considered as true plasma (i. e., plasma as found in the blood stream) minus the clinically unimportant clotting constituents.

PLASMA (strictly speaking, citrated plasma) may be defined as the liquid recovered from citrated blood. For all practical purposes, it may be considered as true plasma plus the diluting citrate solution employed.

Either serum or plasma may be maintained in the liquid state. The liquid can be frozen and maintained in the frozen state, being thawed immediately before use. The frozen material can be dried directly from the frozen state and converted to a powder, which can be redissolved just before use.

Inasmuch as the clinical use of serum or plasma is dependent upon general protein content or antibodies, serum or plasma, regardless of form - whether liquid, frozen or dried - may be considered equal and interchangeable. Any choice between them should be based upon practical consideration rather than theoretical.

The statement may be hazarded that the liquid material (as it is always actually administered to the patient) is preferable for general civilian use. There is no need to return the material to the liquid state before administration, a convenient and valuable time saving feature. The time required for thawing frozen serum or plasma is approximately 30 minutes; the dried material under ideal conditions may require 5 minutes for complete solution or may take longer. Economy of time is of vital importance in the emergencies which provide the major use of normal human serum or plasma.

The two factors which represent differences between serum and plasma have been the subject of considerable study. As regards the clotting constituents present in plasma and absent in serum, it appears that these elements are not of significant clinical value. Furthermore, the fibrogen present in liquid plasma is actually a drawback for it is unstable and shows a constant tendency to precipitate. This objection has, fortunately, been largely overcome by storing the plasma at room temperatures and the addition of dextrose. The citrate solution remains largely in the plasma fraction. This dilution by the sodium citrate solution must be kept in mind (see Problems of Administration)

More recently it has been pointed out that the sodium citrate which is generally considered innocuous may, if a sufficiently large amount of plasma be given in sufficiently short time, cause tetany and convulsions in the recipient, presumably by "suppressing" calcium ion in the patient's blood stream. This warning is based chiefly upon laboratory investigations, although convulsions have been noted in a few children. The possibility is to be kept in mind and if encountered may be overcome by intravenous injection of a calcium compound.

Although there is something to be gained by the administration of "concentrated" plasma or serum to cases with increased intracranial pressure and perhaps nephrosis, it seems clear that little is gained in the treatment of shock by the use of concentrated as contrasted with normal iso-osmotic plasma or serum. At the best, the concentrated material is restored after a time to iso-osmotic strength in vivo if the patient's condition permits; under these circumstances it may be considered equal to iso-osmotic preparations except that time is lost before equal benefits are obtained.

At the worst, the in vivo conversion to the iso-osmotic state may fail to occur, particularly in dehydrated patients, and the benefits of the infusion be largely lost. The use of diluted materials is probably well worth while in such dehydrated patients, rather than the concentrated. The objection to diluted plasma or serum is not serious: such materials are bulky and may present a problem in storage; in addition they may be expected to require a longer time for administration because of the greater volume, so that precious time may be lost.

Further discussion of the differences between the various forms of serum and plasma are brought out in the literature, but it seems clear that these differences are slight.

Chiefly on the basis of lesser expense, the Illinois Department of Public Health Program is expected to be standardized on the basis of normal liquid serum or plasma.

IV - PROBLEMS OF ADMINISTRATION

IV - Problems of Administration

Serum or plasma should always be administered in the liquid state and intravenously. Preliminary typing and compatibility tests are unnecessary. The temperature of the fluid seems to be of little importance, and efforts to warm the serum or plasma to body temperature or to maintain it at this temperature are unnecessary. Well intentioned efforts to bring the material to "body" heat may be harmful, for excessive temperatures may denature or frankly coagulate the proteins. In this connection, the application of hot water bags or electric pads to the administration tubing is especially likely to be injurious. All forms should be filtered immediately before or preferably during administration. (Liquid serum has been used for years without such filtration but the recommendations have recently been changed.) In the case of liquid plasma, a stainless steel mesh filter is conveniently incorporated into the intravenous administration equipment. The same technic may be employed for all other forms or a glass tape filter may be used. Plasma which has been frozen or dried and is restored to the liquid state frequently shows a tendency to copious precipitation of fibrin on standing. It is therefore recommended that these materials be restored just before use. If the precipitate is excessive, a stainless steel mesh filter is superior to the smaller glass tape device. It is usually advised that these materials be given at the rate of 4 to 8 cc. per minute; in emergencies a faster rate may be advisable: 50 to 100 cc. per minute or more.

Dosage depends upon the form of plasma or serum being administered. The fluid portion of approximately 500 cc. of whole blood is represented by the following amounts:

250 cc. liquid serum
300 cc. citrated plasma prepared from a mixture of 50 cc. 4% sodium citrate solution and 500 cc. blood. This is the method of citration to be used under the cooperative plan.
325 cc. citrated plasma prepared from a mixture of 70 cc. 2½% sodium citrate solution and 500 cc. blood.
750 cc. citrated plasma prepared from blood citrated by the Alsever-Ainslee technique.
1000 cc. citrated plasma prepared from blood citrated by the DeGowin technique.

Crystalloid solutions added at any stage of preparation will of course introduce additional dilution factors. IN THE FOLLOWING DISCUSSION, QUANTITIES MENTIONED WILL BE ON THE BASIS OF LIQUID SERUM; FOR OTHER FORMS, THE DOSAGE MUST BE REVISED.

Dosage depends upon the nature of the case, its severity, and whether the case is treated early or late. Obviously no absolute rules can be given. IN SEVERE HEMORRHAGE WITH SHOCK, the clinical condition of the patient will usually offer sufficient indication. The blood and pulse pressure is a fairly reliable guide in these cases. An unduly rapid pulse may indicate further serotherapy is needed or simply that the anemia is severe. The serum or plasma should be administered at once and in sufficient quantity to restore the blood pressure to normal. In these, as in all cases of shock, the restoration of blood pressure may be only transient and further therapy may be needed. Hence the blood pressure should be frequently observed. The possible need for whole blood transfusion should not be forgotten. The cause of the hemorrhage must be treated promptly and controlled as rapidly as possible. The treatment of shock should not be postponed, for intravenous infusion of serum or plasma does not interfere with other measures. The dose may vary from 250 to 1500 cc. IN

TRAUMATIC SHOCK, the clinical condition of the patient is an important guide; it may however be deceptive. It is precisely in the earliest stages when diagnosis is most difficult that serotherapy is of the greatest value; it follows that in severly injured cases the serum should be given practically routinely. Only too often laboratory facilities (if available) will demonstrate the wisdom of such a procedure. A rapid pulse suggests strongly that shock is impending or present. The cold clammy skin, profuse perspiration, and low blood pressure described as symptoms of shock may be relatively late signs; one should, if possible, prevent them rather than await appearance. In case of doubt, infuse with serum or plasma. The dose required in early cases will usually be the minimum of 250 to 500 cc. Late treatment may mean 3 to 4 times larger dosage. Blood transfusion is a valuable measure but must be prompt. The patient must be carefully watched lest shock recur. In BURNS, the amount of plasma required may be very great. In severe cases, during the first 72 hours, there is a persistent tendency for the patient to pass into shock. Serotherapy should be started at once and continued as long as necessary. Harkins has suggested that 500 cc. serum be given for each 10% of body area burned. This is usually inadequate. The hematocrit is of especial value in these cases. Blood transfusion has the objection that it provides erythrocytes to a cerculation already overloaded with red blood cells. In cases of severe burns, erythrocytes counts of as much as 8,000,000 have been found. In cases of HYPOPROTEINEMIA, whether postoperative or due to malnutrition or nephrosis, the amount of serum required is often very large. Since 250 cc. of serum contains approximately 18 gms. protein, it is readily understood that several liters may be required to restore the depleted blood and body proteins to normal levels. In SEVERE INFECTIONS the use of 250 cc.-500 cc. is recommended to be repeated at 24 hour intervals as circumstances dictate.

When serum or plasma is to be given, various laboratory tests are found of great value in guiding the clinician. Some of these are simple determinations, others difficult. The following list of determinations may be of value, although it is appreciated that some of them may not be available or at least not to be had in time to guide the physician:

Determination		Normal Range	Direction of Change in Shock
Erythrocyte count	(men)	4.7 to 6.0 million	Upwards
	(women)	4.3 to 5.3 "	
Blood pressure		105 to 240	Downwards
		75 to 140	
Hematocrit	(men)	40 to 50%	Upwards
	(women)	37 to 45%	
Blood specific gravity		1.050 to 1.060	Upwards

In the interpretations of these various tests, it should be remembered that it is the direction of change rather than the absolute value that is important. If, for instance, a man with blood pressure ordinarily above 200 mm. systolic is struck by an automobile and at the hospital is found to have a systolic pressure of 110 mm. this finding is obviously not to be interpreted as "normal" blood pressure.

The question of coincident administration of saline or glucose solutions is one that must be decided in each case. Inasmuch as these solutions leave the circulation rapidly, they can hardly be depended upon to combat shock. They do, however, provide water and salt or glucose which may be of value to the patient quite apart

from shock. Whole blood transfusion is another procedure which may be of the greatest value. In shock due to hemorrahge, it is theoretically superior to serum and practically is inferior only because of the time lost before it can actually be given. Obviously, if serum or plasma has been used to tide the patient over the immediate emergency, the time gained may be profitably used to prepare for whole blood infussion which may or may not be needed. In surgical and traumatic shock the same considerations apply. In burns, most investigators feel that serum or plasma is definitely superior to whole blood, even if the latter is available.

V - PREPARATION OF INTRAVENOUS ADMINISTRATION EQUIPMENT

V - Preparation of Intravenous Administration Equipment

It is a most discouraging experience to administer an intravenous infusion and find the patient respond, not with the anticipated beneficial change but with a reaction which is always alarming and may be dangerous or even fatal. Extensive and numerous studies seeking to determine the causes of such reactions have gradually led to the development of materials for infusion which are quite safe. Experience has led most of the students of intravenous reactions to focus upon the intravenous administration equipment employed to administer the infusion. It is believed that most reactions are due, not to the properly prepared solution, but rather to the small amount of reaction-producing substances added in the short time the solution is passing through improperly prepared tubing enroute to the patient's vein.

Although the greatest care is desirable with all infusions, experience has taught that three types of infusions are peculiarly susceptible to the presence of reaction-producing substances in administration equipment: whole blood, serum, and plasma.

The following technics have been developed in the interests of the patient receiving the infusion; though arduous they will be found well worth the effort for reactions are, to put it mildly, embarrassing to physician and hospital as well as to patient.

V (2) - Prepration of Stainless Steel for Intravenous Administration Equipment

Stainless steel mesh filters

1. Flush with tap water until grossly clean.
2. Boil in 4% sodium hydroxide solution for 10 minutes.
3. Rinse with tap water.
4. Soak in 3% acetic acid solution for 5 minutes.
5. Flush 3 times, or soak, with distilled water free of reaction-producing substances.
6. Inspect carefully; if not thoroughly clean repeat steps 1 to 6.
7. Soak in 95% ethyl alcohol.
8. Let dry in air, keeping covered with clean paper.
9. Reassemble into intravenous equipment, wrap and sterilize.
10. If desired, the filter can be kept until ready for use, by storing in a dry, covered and dust-free container.....a paper bag is excellent.

Needles

1. Flush with tap water under pressure until grossly clean. The needles should be plumbed thoroughly with a stylet and the hub carefully cleansed with a doubled-over pipe cleaner.
2. Soak in 4% sodium hydroxide solution over night.
3. Rinse with tap water.
4. Soak in 3% acetic acid solution for 5 minutes.
5. Flush 3 times, or soak, with distilled water free of reaction-producing substances.
6. Inspect carefully; if not thoroughly clean, repeat steps 1 to 6.
7. Immerse in 95% ethyl alcohol until just before use.
8. Dry by shaking immediately before sterilization.
9. Assemble, wrap, and sterilize.

V (3) - Preparation of Glassware for Intravenous Administration Equipment

1. Flush with tap water and brush until glass is grossly clean. Drain.
2. Immerse in the dichromate-sulfuric acid mixture. (To prepare this solution: place in an acid-proof container 30 grams potassium dichromate, add 30 cc. water, mix thoroughly to a saturated solution with surplus potassium dichromate, cautiously and slowly add 1000 cc. technical grade concentrated sulphuric acid. CAUTION -- corrosive -- protect skin and eyes at all times when handling this mixture -- acid-proof rubber gloves and rubber aprons are necessary for safe handling). If the mixture is cherry red in color, 3 hours immersion of glassware is adequate; if the solution is orange or yellow, overnight immersion is necessary; if the solution is green, it should not be used.
3. Flush repeatedly with tap water until the acid is removed (see 5).
4. Flush three times with distilled water free of reaction-producing substances.
5. Test the drainings from last distilled water rinse to ensure removal of acid as follows: Collect a few cc. of drainings in a clean test tube and add a few drops of 1% barium chloride solution. If acid is present a cloud or precipitate of white barium sulphate will form. If the test shows acid is present, repeat steps 3, 4, 5 until acid is removed.
6. Dry in hot air oven.
7. Reassemble into intravenous equipment, wrap and sterilize at once.
8. If desired, the glassware can be kept until ready for assembly by storage in a dry dust-proof container -- a paper bag is excellent.

Alternative Technic Employing 4% Sodium Hydroxide Solution

1. Flush with tap water and brush until glass is grossly clean. Drain.
2. Boil for 30 minutes or let soak over night in 4% sodium hydroxide solution (40 grams sodium hydroxide C. P. in 1000 cc. water).
3. Rinse with tap water.
4. Soak in 3% acetic acid for 5 minutes (30 grams glacial acetic acid in 1000 cc. warm water).
5. Inspect carefully; if not clean repeat steps 1 to 5.
6. Dry in hot air oven.
7. Reassemble into intravenous equipment, wrap and sterilize at once.
8. If desired, the glassware can be kept until ready for assembly by storage in a dry, dust-proof container -- a paper bag is excellent.

V (4) - Preparation of Rubber Tubing for Intravenous Administration Equipment

NEW TUBING should be of high grade translucent gum rubber. Before use (see below) each new batch should be "pyrogen" tested.

1. Boil the tubing for 20 minutes in 4% sodium hydroxide solution in a special basin. (The "special basin" used whenever either new or old tubing is to be boiled consists of a scrupulously clean stainless steel or unchipped enamelware basin fitted with a stainless steel plate which is heavy enough to hold the tubing fully submerged in the solution during boiling, small enough so that it can be lowered to the bottom of the basin or at least below the level of the solution, and yet fitting the walls of the container snugly enough so that no "ends" or portions of tubing covered by the plate can escape total immersion throughout the processing. In essence the plate consists of a cover which fits inside the basin instead of on top of it).

2. Rinse each section of tubing with tap water for one minute. To cleanse the lumen, pressure flushing is required, together with kneading of the tubing between thumb and forefinger, and "stripping" the tubing throughout its entire length.

3. Boil for 10 minutes in 0.5% acetic acid solution.
4. Repeat step 2.
5. Boil for 20 minutes in distilled water free of reaction-producing substances.
6. Repeat step 2.
7. Repeat steps 5 and 6 twice.
8. Repeat step 5. Take 100 cc. of solution from the basin into a clean container, add the calculated amount of clean sodium chloride to make a 0.9% solution, stopper and sterilize at once. Save the sterilized solution for pyrogen test (see below).
9. Hang each section of tubing so as to secure complete drainage in a clean room in the open air and permit to dry.

If the pyrogen test is satisfactory:

10. Assemble into intravenous equipment, wrap and sterilize.
11. The tubing may be kept while awaiting the results of the pyrogen test or until ready for use by storage (after it is dry) in a dry, dust-free container -- a paper bag is excellent.

If the pyrogen test is unsatisfactory, steps 2 and 8 may be repeated and the pyrogen test again performed.

OLD TUBING previously prepared as described above may be reprocessed as indicated below; however, no rubber tubing may be expected to be usable more than 10 or 15 times, and dark discolored tubing should be discarded.

1. Flush thoroughly with tap water under pressure (see step 2 under "new tubing").
2. Examine the tubing before a strong light by looking through the translucent rubber to ensure the absence of any particulate matter. If tubing is not grossly clean, repeat steps 1 and 2.
3. Boil in distilled water for 20 minutes.
4. Flush with tap water under pressure.
5. Repeat steps 3 and 4.
6. Rinse each section of tubing with distilled water free of reaction-producing substances.
7. Hang each section of tubing so as to secure maximum drainage in a clean room in the open air and let dry.
8. Assemble into intravenous equipment, wrap and sterilize.
9. The tubing may be kept until ready for use by storage (after it is dry) in a dry dust-free container.

PYROGEN TEST: This test is performed on all new batches of rubber tubing by utilizing the sterile 0.9% sodium chloride solution obtained in step 8 (new tubing). Each of 3 rabbits is given 20 cc. of this solution intravenously into an ear vein, after recording the rectal temperatures, and temperatures are recorded at half-hour intervals for two hours thereafter. A rabbit with initial temperature over 103° F should not be used. If the temperature does not rise (or rises no more than 0.5° C) following the injection, tubing may be considered satisfactory. Sharp rises in temperature condemn the tubing as pyrogenic and not to be used.

V (5) Preparation of "Cellophane" Tubing for Intravenous Administration Equipment

At best, the preparation of rubber tubing is an arduous task. The cost of good rubber tubing, considering the limited number of times it may be used is seldom less than one-half cent per foot, even if the labor and cost of cleaning be ignored. Because of the war satisfactory rubber tubing may become unavailable.

Although a different technic must be employed and the material is more fragile than rubber, Viscose tubing offers great advantages. The cost is sufficiently low so that one time use is at least as economical as the use of rubber and the task of preparing the tubing before incorporation into equipment is eliminated. Viscose tubing has been found consistently to be free of reaction-producing substances as it comes from the factory.

The use of Viscose tubing, although relatively new, offers an acceptable substitute for rubber tubing. A knowledge of the material's properties is essential to its use. Viscose tubing, in the size comparable to intravenous rubber tubing, comes in two thicknesses of walls; the heavy walled variety is preferable to the so called regular tubing, in our opinion, because it permits of more latitude in handling, although either can be used. The tubing comes flat in spools of 1500 feet each, wrapped in wax paper. The unopened roll keeps well under ordinary storage conditions, at least for several months. Once the roll is opened, however, the Viscose tubing, like all cellophane type materials, exhibits a slow tendency to dry out, becoming brittle and fragile. This characteristic is readily controlled by rewrapping the partly used roll and storing it in the refrigerator. If the material is too dry it "crinkles" when manipulated. The manufacturers impregnate Viscose tubing with glycerine because of the hydrophilic properties of this chemical. In contrast to its fragility when excessively dry, Viscose tubing is soft, supple, and resistant to manipulation when wet. Peculiarly also, when thoroughly wet it stretches (or by gently inserting a hemostat and gently expanding the instrument, can be spread) considerably. On drying, the tubing returns to its original size.

The following technic will be found, with little experience, to be practical:

1. Be sure ("crinkling" test) that the Viscose tubing is not too dry.

2. Cut suitable lengths of tubing, handling with care and avoiding sharp bends.

3. Inspect each length, discarding "milky" sections i.e. sections whose walls are imperfect because of innumerable small air bubbles in the substance of the Viscose.

4. Attach the final glass attachments which go to one end of a length as follows:
   (a) Pass a two inch length of rubber tubing over the Viscose tubing and move it down the tubing to expose the terminal one to one and one-half inches of cellophane.
   (b) Dip the end of the Viscose tubing into distilled water for one minute to permit wetting and expansion.
   (c) Insert a small hemostat to open the lumen and if necessary enlarge the lumen by gentle spreading of the blades of the hemostat.
   (d) Slip the expanded tubing over the glass tubing as far as possible (maximum 3/4").
   (e) Let dry until the Viscose shrinks and grips the glass.
   (f) Using ethyl alcohol as a lubricant, slide the rubber tubing onto the glass.
   (g) After clamping off the other end of the cellophane, inflate the tubing with compressed air or pressure bulb until a manometer or gauge connected shows

V. (B) Preparation of "Cellophane" Tubing for Intravenous Administration Equipment

At best, the preparation of rubber tubing is an arduous task. The cost of good rubber tubing, considering the limited number of times it may be used is seldom less than one-half cent per foot, even if the labor and cost of cleaning be ignored. Because of the very satisfactory rubber tubing may become unavailable.

Although a different technic must be employed and the material is more fragile than rubber, Viscose tubing offers great advantages. The cost is sufficiently low so that one time use is at least as economical as the use of rubber and the task of preparing the tubing before incorporation into equipment is eliminated. Viscose tubing has been found consistently to be free of reaction-producing substances as it comes from the factory.

The use of Viscose tubing, although relatively new, offers an acceptable substitute for rubber tubing. A knowledge of the material's properties is essential to its use. Viscose tubing, in the size comparable to intravenous rubber tubing, comes in two thicknesses of walls: the heavy walled variety is preferable to the so called regular tubing, in our opinion, because it permits of more latitude in handling, although either can be used. The tubing comes flat in spools of 1800 feet each, wrapped in wax paper. The unopened roll keeps well under ordinary storage conditions, at least for several months. Once the roll is opened, however, the Viscose tubing, like all cellophane type materials, exhibits a slow tendency to dry out, becoming brittle and fragile. This characteristic is readily controlled by rewrapping the partly used roll and storing it in the refrigerator. If the material is too dry it "crinkles" when manipulated. The manufacturers impregnate Viscose tubing with glycerine because of the hydrophilic properties of this chemical. In contrast to its fragility when excessively dry, Viscose tubing is soft, supple, and resistant to manipulation when wet. Peculiarly also, when thoroughly wet it stretches (or by gently inserting a hemostat and gently expanding the instrument, can be spread) considerably. On drying, the tubing returns to its original size.

The following technic will be found, with little experience, to be practical:

1. Be sure ("crinkling" test) that the Viscose tubing is not too dry.

2. Cut suitable length of tubing, handling with care and avoiding sharp bends.

3. Inspect each length, discarding "milky" sections i.e. sections whose walls are imperfect because of innumerable small air bubbles in the substance of the Viscose.

4. Attach the final glass attachments which go to one end of a length as follows:
   (a) Pass a two inch length of rubber tubing over the Viscose tubing and move it down the tubing to expose the terminal one to one and one-half inches of cellophane.
   (b) Dip the end of the Viscose tubing into distilled water for one minute to permit wetting and expansion.
   (c) Insert a small hemostat to open the lumen and if necessary enlarge the lumen by gentle spreading of the blades of the hemostat.
   (d) Slip the expanded tubing over the glass tubing as far as possible (maximum 3/4").
   (e) Let dry until the Viscose shrinks and grips the glass.
   (f) Using ethyl alcohol as a lubricant, slide the rubber tubing onto the glass.
   (g) After clamping off the other end of the cellophane, inflate the tubing with compressed air or pressure bulb until a manometer or gauge connected shows

250mm. of mercury pressure or more. Close off the source of pressure and observe the gauge: the reading should fall very slowly if at all. A rapid fall means that there is a leak either in the testing equipment or in the Viscose tubing. Defective Viscose tubing should of course be discarded.

(h) By suction or suction bulb, evacuate the tubing until it is again flat.

5. Without further testing, the glass fitting for the other end of the Viscose tubing should now be attached.

6. Fold the cellophane tubing on itself and hold by a band of paper which is itself held by a small strip of Scotch tape.

7. Slip the folded tubing into a wide mouthed test tube so that the rubber guards are partly within the tube.

8. Complete the assembly.

9. Wrap and sterilize.

When ready for use:

10. Unwrap.

11. After removing the cellophane tubing from the test tube and the paper band from the tubing, fill the test tube three-fourths full with water and immerse the tubing for one minute.

12. Proceed as with rubber tubing, avoiding twisting and excessive kinking. (Fluids will flow past the "kinks" if they are not too sharp).

This technic can if desired be used in combination with rubber tubing, rubber tubing being used for short connections and the Viscose tubing for sections requiring greater lengths.

VI - STORAGE OF SERUM OR PLASMA

VI - Storage of serum or plasma

LIQUID SERUM should be stored in an ordinary refrigerator at 35°F to 50°F. A temperature of 40°F. is recommended. Under these conditions, the antibodies as well as the general protein content are well preserved.

LIQUID PLASMA should be stored at "room temperatures" of from 60°F to 85°F. It is recommended that storage be at approximately 80°F in a room which does not become unduly cool at night. The plasma should not be stored in the refrigerator because precipitation becomes quite marked at temperatures lower than recommended. Exposure to sunlight should be avoided.

At room temperatures the formation of a surface layer or milky material may be observed. This need not cause alarm for it is due to the separation of the plasma lipoids. The lipoid layer readily redisperses on shaking.

FROZEN PLASMA should be stored in a special low temperature refrigerator at -18°C (-4°F) until just before use. Since water expands 1/6 on freezing the bottle should not be too full.

To bring the liquid plasma to the frozen state, place it in the refrigerator on a slant. The material can also be frozen by immersion in a cold alcohol bath lying in the refrigerator, by immersion in alcohol cooled by dry ice, or by shell freezing (rotating bottle on its side during freezing).

To return the frozen material to the liquid state, place in a water bath at 98°F (no hotter) until not only the ice has disappeared (15 minutes) but the resulting liquid has been warmed above the low temperatures at which fibrin precipitation is expedited (total time about 30 minutes). Then use at once. Thawed plasma may be murky but is quite safe.

FROZEN SERUM should be stored as is frozen plasma. The material may be brought to the frozen state by the same methods as is plasma. Frozen serum may be returned to the liquid state by the same methods as is plasma except that thawing may be considered complete when the ice disappears. Thawed serum may also be cloudy but is quite safe.

DRIED PLASMA may be stored at any temperature up to 120°F. To avoid injury to the accompanying bottle of distilled water, freezing temperatures should be avoided. The material should be kept in the carton to avoid exposure to sunlight.

To return the dried plasma to the liquid state, add the distilled water to the powder as indicated in the instructions accompanying the product and shake until solution occurs. Then use at once.

VII - PROCUREMENT OF WHOLE BLOOD FROM WHICH TO PREPARE PLASMA

VII - Procurement of Whole Blood from which to Prepare Plasma

The following technics are presented specifically as part of the normal human serum and plasma program of the Illinois Department of Public Health, applying to "replacements" by plan II and III of the basic plan. Many of the details may be of interest however, from the viewpoint of whole blood transfusion in general, for the procurement of whole blood for transfusion and for plasma to be prepared under the cooperative plan are the same.

VII (2) - Donor Qualifications

1. The donor shall be in good general condition.

2. The donor's weight shall be 120 lbs. or more.

3. The donor shall be fever free and shall have been fever free for at least one week.

4. Donors shall be excluded if:
   (a) There is a history of malaria.
   (b) There is a history of syphilis.
   (c) There is a history of tuberculosis.
   (d) Pregnancy is present or there is a history of pregnancy in the preceding six months.
   (e) There is a history of "allergy".
   (f) There is a history of jaundice in the preceding 12 months.

5. The donor's hemoglobin level shall be within the range of normal.

6. The donor shall have abstained from fat-containing foods for at least 4 hours before venesection. If blood is to be drawn in the morning, the donor may have black coffee or tea with a slice of toast or fruit juice but no fat-containing foods. If the donor is to give blood in the afternoon, lunch may be postponed until after venesection or eaten earlier. If blood is to be drawn in the evening, dinner may be postponed or eaten earlier. It is important to realize that a meal containing large quantities of fat may cause lipemia in the blood stream for fully 12 hours afterwards, hence meals eaten during this period should be of minimal fat content.

7. There shall have been no previous blood donation for 2 months before venesection.

VENESECTION

1. Fill out the donors card, indicating the serial number assigned this donor in the upper right hand corner and signing in the space at the bottom (see detailed instructions on the back of donor card).

2. The donor than lies down with both sleeves rolled up above the elbow.

3. A tourniquet (blood pressure apparatus is also suitable) is applied above the elbow. If the tension is properly adjusted the skin distal to the tourniquet will become pink or even cyanotic, the veins will be distended and show by palpation a marked increase in venous pressure. Frequently only one arm will show good sized veins. Frequently, also, good sized veins will be found only after the tourniquet has been applied for several minutes. Obese arms may require very tight application of the tourniquet to distend the veins.

VII - Procurement of Whole Blood from which to Prepare Plasma.

The following technics are presented specifically as part of the normal human serum and plasma program of the Illinois Department of Public Health, applying to "replacements by plan II" of the basic plan. Many of the details may be of interest however, from the viewpoint of whole blood transfusion in general, for the procurement of whole blood for transfusion and for plasma to be prepared under the cooperative plan are the same.

VII(2) - Donor Qualifications

1. The donor shall be in good general condition.

2. The donor's weight shall be 120 lbs. or more.

3. The donor shall be fever free and shall have been fever free for at least one week.

4. Donors shall be excluded if:
   (a) There is a history of malaria.
   (b) There is a history of syphilis.
   (c) There is a history of tuberculosis.
   (d) Pregnancy is present.
   (e) There is a history of "allergy".
   (f) There is a history of jaundice.

5. The donor's hemoglobin level shall be within the range of normal.

6. The donor shall have abstained from fat-containing foods for at least 4 hours before venesection. If blood is to be drawn in the morning, the donor may have black coffee or tea with a slice of toast or fruit juice but no fat-containing foods. If the donor is to give blood in the afternoon, lunch may be postponed until after venesection or eaten earlier. If blood is to be drawn in the evening, dinner may be postponed or eaten earlier. It is important to realize that a meal containing large quantities of fat may cause lipemia in the blood stream for fully 12 hours afterwards, hence meals eaten during this period should be of minimal fat content.

7. There shall have been no previous blood donation for 2 months before venesection.

VENESECTION

1. Fill out the donor's card completely, indicating the serial number assigned this donor in the upper right hand corner and signing in the space at the bottom.

2. The donor than lies down with both sleeves rolled up above the elbow.

3. A tourniquet (blood pressure apparatus is also suitable) is applied above the elbow and the tension adjusted as high as possible but not high enough to obliterate the radial pulse. If the tension is properly adjusted the skin distal to the tourniquet will become pink or even cyanotic, the veins will be distended and show by palpation a marked increase in venous pressure. Frequently only one arm will show good sized veins. Frequently, also, good sized veins will be found only after the tourniquet has been applied for several minutes. Obese arms may require very tight application of the tourniquet to distend the veins.

4. Paint the skin over the vein with Tincture of iodine and then with alcohol.

5. Inject 0.1 cc of 1% or 2% novocaine, intradermally, at the spot selected for insertion of the needle; this spot is generally 1 cm distal to the spot where one proposes to enter the vein.

6. Sterilize the top of the stopper of the venesection bottle with iodine and alcohol, noting the smaller of the two circular marks. Set the bleeding set in position convenient to the donor's arm.

7. Remove the cellophane envelope from the accessory equipment and carefully unwrap. The longer needle is to be inserted into the vein; the shorter needle is to be inserted through the smaller circular mark of the bottle stopper, but only after the vein has been entered.

8. Insert the needle, bevel up, into the vein in two distinct steps:
(a) through the skin at the site of the novocaine injection,
(b) into the vein approximately 1 cm proximally from the skin puncture.
ADVANCE THE NEEDLE DURING STEP (B) SLOWLY AND CAUTIOUSLY. The most common source of hematomas and difficulties is "lunging" which frequently carries the needle through the vein.

9. After inserting the longer needle into the vein, force the shorter needle through the smaller circular mark of the bleeding bottle stopper. If the needles are properly inserted, blood should flow into the tubing and then into the bottle. Keep the bottle inverted during filling to insure good mixture of blood and citrate solution. Agitate the bottle gently but persistently throughout the venesection. Since there is already 50 cc of citrate solution in the bottle before venesection is started, continue venesection until (use eye level for judging this) the bottle is filled to the 550 cc mark. Throughout the venesection, have the donor slowly opening and closing his fist on a folded towel, (with emphasis on good prolonged squeezing of the towel).

10. Difficulties encountered are generally due to:

a) The needle is not in the vein.
b) The needle is in the vein but has rolled or twisted until the bevel is against the wall of the vein, thus blocking the flow. Rotation or straightening of the needle will restore the flow.
c) The patient is not opening and clenching his fist properly.
d) The rubber tubing is kinked. Release the kinking.
e) A small section of tubing has (during autoclaving) collapsed and the walls adhered. Manipulate this section to re-establish a lumen.
f) The suction is excessive. In this case, the flow will cease or there may be audible buzzing. The buzzing need not cause alarm if the flow continues. If the flow ceases, however, momentarily close the needle tubing with the fingers to allow readjustment.
g) The tourniquet is too tight. This is shown by pallor of the arm distal to the tourniquet or by disappearance of the radial pulse and is corrected by releasing and retying the tourniquet.
h) The tourniquet is too loose. Tighten it.
i) The needle is occluded by formation of a clot within its lumen. This will inevitably occur if blood flow is too slow and too much time elapses. To prevent this, draw the blood as rapidly as possible from the start, keeping the patient working his fist conscientiously.

4. Paint the skin over the vein with Tincture of iodine and then with alcohol.

5. Inject 0.1 cc. of 1% or 2% novocaine intradermally at the spot selected for insertion of the needle; this spot is generally 1 cm. distal to the spot where one proposes to enter the vein.

6. Prepare the bleeding bottle by seating the rubber stopper firmly into the neck of the bottle before opening the bag. Open the bag and free the tubing. The air filter tube is to be attached to a rubber suction bulb. Set the bleeding set in a convenient position to the donor's arm.
7. Remove the test tube protecting the needle.

8. Insert the needle, bevel up, into the vein in two distinct steps:
(a) through the skin at the site of the novocaine injection.
(b) into the vein approximately 1 cm. proximally from the skin puncture.
ADVANCE THE NEEDLE DURING STEP (B) SLOWLY AND CAUTIOUSLY. The most common source of hematomas and difficulties is "lunging" which frequently carries the needle through the vein.

9. If the needle is properly inserted blood should flow into the tubing and then into the bottle. Agitate the bottle gently but persistently throughout the venesection. Since there is already 50 cc. of citrate solution in the bottle before venesection is started, draw (eye level for judging this) to the 550 cc. mark on the bottle.
Throughout the venesection have the donor slowly opening and closing his fist on a folded towel (with emphasis on good prolonged squeezing of the towel). The rubber bulb should be frequently compressed to maintain suction.

10. Difficulties encountered are generally due to:
a) The needle is not in the vein.
b) The needle is in the vein but has rolled or twisted until the bevel is against the wall of the vein, thus blocking the flow. Rotation or straightening of the needle will restore the flow.
c) The patient is not opening and clenching his fist properly.
d) The rubber tubing is kinked. Release the kinking.
e) A small section of tubing has (during autoclaving) collapsed and the walls adhered. Manipulate this section to reestablish a lumen.
f) The suction provided by the rubber bulb is inadequate. Force the stopper firmly into the neck of the bottle, or work the bulb more rapidly.
g) The suction is excessive. Remove the suction bulb momentarily and reattach.
h) The tourniquet is too tight. This is shown by pallor of the arm distal to the tourniquet as well as disappearance of the radial pulse, and is readily corrected by releasing and retying the tourniquet.
i) The tourniquet is too loose. Tighten it.
j) The needle is occluded by formation of a clot within its lumen. This will inevitably occur if blood flow is too slow and too much time elapses. To prevent this, draw the blood as rapidly as possible from the start, working the suction pump as much as possible and keeping the patient working his fist conscientiously.

11. To remove the needle:
a) Loosen the tourniquet.

11. To terminate the venesection:

(a) Remove needle from bottle and set into Kahn tube.

(b) Release the tourniquet.

(c) While maintaining pressure over the vein, pinch off the rubber tubing just behind the needle, remove the needle from the vein, hold the needle sufficiently high to permit the blood into the tubing to flow by gravity into the Kahn tube to provide a specimen for Kahn test. A specimen for Kahn test is absolutely necessary. Occasionally it may be necessary to "strip" the tubing or force a stylet through the needle. Rarely, a separate venipuncture with syringe and needle may be required to obtain a specimen for Kahn test.

VII (3) Continued

b) Remove the suction pump.

c) While maintaining pressure over the vein, pinch off rubber tubing just behind the needle, remove the needle from the vein, insert the needle into the test tube, lower the test tube and permit the blood in the tubing to flow by gravity into the test tube to provide a specimen for Kahn test. A specimen for Kahn test is absolutely necessary. Occasionally it may be necessary to "strip" the tubing or force a stylet through the needle. Rarely, a separate venipuncture with syringe and needle may be required to obtain a specimen for Kahn test.

VIII - TO PREPARE THE BLOOD FOR SHIPMENT

VIII - To Prepare the Blood for Shipment

a) Remove the serology tube with its specimen, cork the tube, and protect the needle with another blank test tube.

b) Label both serology specimen and the blood bottle with the donor's serial number and allow to stand at room temperature one to one and one-half hours.

c) Place serology specimen tube and the blood bottle in the hospital refrigerator until ready to ship.

To Ship the Blood:

a) Each bottle of blood must be accompanied by a serology specimen and donor card. The bottle of blood is set into a compartment of the shipping box.

b) Serology tubes and donor cards are packed in the specified places.

c) If the outside temperature is 50° Fahrenheit or less, use no dry ice in the compartment provided in the lid of the shipping box. If the temperature is over 50° Fahrenheit place dry ice in the cardboard folder in the space provided.

d) Ship the Blood to:

(1) Arrive at the Serum Center within 24 hours or less after venesection.
(2) Arrive during our working hours (9:00 A.M. to 5:00 P.M. daily except Sundays and holidays). Morning delivery is preferred.

e) Packing lists should be carefully checked.

f) Instructions for ready reference are affixed to the under surface of the portable refrigerator lid.

VIII

To Prepare the Blood for Shipment

a) Remove the serology tube with its specimen, cork the tube, and protect the needle with another blank test tube.

b) Hold the solid stopper within its paper cover, top up, and unfold the paper cover by touching only the outside. When properly opened the effect will be that of an inverted paper cup. Remove the bleeding head, taking care that the neck of the bottle is untouched, and force the solid stopper (still within its opened paper cover) into the neck of the bottle. Bind the paper cover against the neck with a rubber band.

c) Label both serology specimen tube and the blood bottle with the donor's serial number, and allow to stand at room temperature ½ to 1 hour.

d) Place serology specimen tube and the blood bottle in the refrigerator until ready to ship.

To Ship the Blood:

a) Each bottle of blood must be accompanied by a serology specimen and donor card. The bottle of blood is replaced within the bag and set into a compartment of the shipping box.

b) Serology tubes and donor cards are packed in the specified places.

c) If the outside temperature is 32° Fahrenheit or less, use no dry ice in the compartment provided in the roof of the shipping box. If over 32° F, place dry ice in the space provided.

d) Ship the blood to:
   (1) arrive at the Serum Center within 24 hours or less after venesection.
   (2) arrive during our working hours (9 a.m. to 5 p.m. daily except Sundays and holidays).

IX - CREDIT ALLOWANCE FOR BLOOD

IX - Credit Allowance for Blood

Credit will be allowed for blood sent to the Samuel Deutsch Serum Center under Plan II (section 1), providing it has been drawn as indicated in section 7, stored, and shipped as indicated in section 8, and subject to the following provisos:

1) If less than 500 cc. blood is drawn, a proportionately smaller credit can be allowed. The minimal amount of blood permitted is 250 cc.

2) If too much time elapses between venesection and arrival at the Serum Center, hemolysis will occur and may be great enough to make the plasma unfit for use. Such plasma must be discarded and no credit can be allowed.

3) Sterile precautions must be followed throughout; if the sterility test performed on the individual specimen of blood shows bacterial growth, it must be discarded and no credit can be allowed.

4) If the serology test is positive, the plasma must be discarded and no credit can be allowed.

5) If the donor has not followed the dietary restrictions and the plasma is excessively fatty, the blood must be discarded and no credit can be allowed.

6) To permit standard processing of the specimen, the blood must be drawn in the standard container provided for that purpose.

X - CHARGES

X - CHARGES

CHARGES

Charges are to be made for the following items. It is to be emphasized that these charges are minimal and are to be kept minimal but that they must necessarily, in these times, be subject to revision as circumstances dictate.

Under Plan I* (Outright Purchase of Serum or Plasma)

One Unit of liquid serum (250 cc): $17.00 + sales tax, express prepaid.
One Unit of liquid plasma (300 cc):$17.00 + sales tax, express prepaid.

Under Plan II* (Processing Plan on Blood provided by hospital)

Portable refrigerator boxes: $35.00 each.
Bleeding bottles, sterile and ready for use: $1.25 each.

For recleansing and repreparation of a bleeding bottle improperly or unsuccessfully used: 50¢ each.

For replacement of parts missing from bleeding sets or broken; the following charges are in addition to preparation:

Bottle: 15¢ each, glass elbows 3¢ each, rubber tubing: 8¢ per length, solid stoppers: 7¢ each, bleeding needles: 25¢ each, Kahn tubes: 1¢ each, cloth bags: 7¢ each.

For repair of refrigerator boxes: cost of repair.

There is no charge for recleansing and preparation of a bleeding bottle successfully used to obtain whole blood under Plan II.

One unit (250 cc.) liquid serum: $7.50 express prepaid plus 500 cc. whole blood sent to the Serum Center as provided in sections, VII, VIII, IX.

One unit (300 cc.) liquid plasma:$7.50 express prepaid plus 500 cc. whole blood sent to the Serum Center as provided in sections, VII, VIII, IX.

Under Plan III*

Charges for equipment are the same as Under Plan II.

One unit of liquid serum (250 cc.) will be sent, express prepaid, for each 1,000 cc. of whole blood sent to the Serum Center as provided in sections VII,VIII, IX.

One unit of liquid plasma (300 cc.) will be sent, express prepaid, for each 1,000 cc. of whole blood sent to the Serum Center as provided in sections VII,VIII, IX.

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* It is planned to make dried plasma available in the near future. A special announcement concerning dried plasma together with its costs will be forthcoming.

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CHARGES

Charges are to be made for the following items. It is to be emphasized that these charges are minimal and are to be kept minimal but that they must necessarily, in these times, be subject to revision as circumstances dictate.

Under Plan I* (Outright Purchase of Serum or Plasma)

One Unit of liquid serum (250 cc): $19.50 + sales tax, express prepaid.
One Unit of liquid plasma (300 cc): $19.50 + sales tax, express prepaid.

Under Plan II* (Processing Plan on Blood provided by hospital)

Portable refrigerator boxes: $35.00 each.
Bleeding bottles, sterile and ready for use: $1.25 each.

For recleansing and repreparation of a bleeding bottle improperly or unsuccessfully used: 50¢ each.

For replacement of parts missing from bleeding sets or broken; the following charges are in addition to preparation:

Bottle: 15¢ each, glass elbows 3¢ each, rubber tubing: 8¢ per length, solid stoppers: 7¢ each, bleeding needles: 25¢ each, Kahn tubes: 1¢ each, cloth bags: 7¢ each.

For repair of refrigerator boxes: cost of repair.

There is no charge for recleansing and preparation of a bleeding bottle successfully used to obtain whole blood under Plan II.

One unit (250 cc) liquid serum: $9.50 express prepaid plus 500 cc. whole blood sent to the Serum Center as provided in sections, 7, 8, 9.

One unit (300 cc) liquid plasma: $9.50 express prepaid plus 500 cc. whole blood sent to the Serum Center as provided in sections 7, 8, 9.

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CHARGES

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One Unit of liquid serum (250 cc): $19.50 + sales tax, express prepaid.
One Unit of liquid plasma (300 cc): $19.50 + sales tax, express prepaid.

Under Plan II*: (Processing Plan on Blood provided by hospital)

Portable refrigerator boxes: $35.00 each.
Bleeding bottles, sterile and ready for use: $1.25 each.

For reclaiming and reparation of a bleeding bottle improperly or unsuccessfully used: 50¢ each.

For replacement of parts missing from bleeding sets or broken: the following charges are in addition to preparation:

Bottle: 15¢ each. Glass elbows 5¢ each. Rubber tubing: 8¢ per length, metal stoppers: 7¢ each. Bleeding needles: 25¢ each. Vein tube: 1¢ each, cloth bags: 7¢ each.

For repair of refrigerator boxes: cost of repair.

There is no charge for reclaiming and preparation of a bleeding bottle successfully used to obtain whole blood under Plan II.

One unit (250 cc) liquid serum: $9.50 express prepaid plus 500 cc. whole blood sent to the Serum Center as provided in sections 7, 8, 9.

One unit (300 cc) liquid plasma: $9.50 express prepaid plus 500 cc. whole blood sent to the Serum Center as provided in sections 7, 8, 9.

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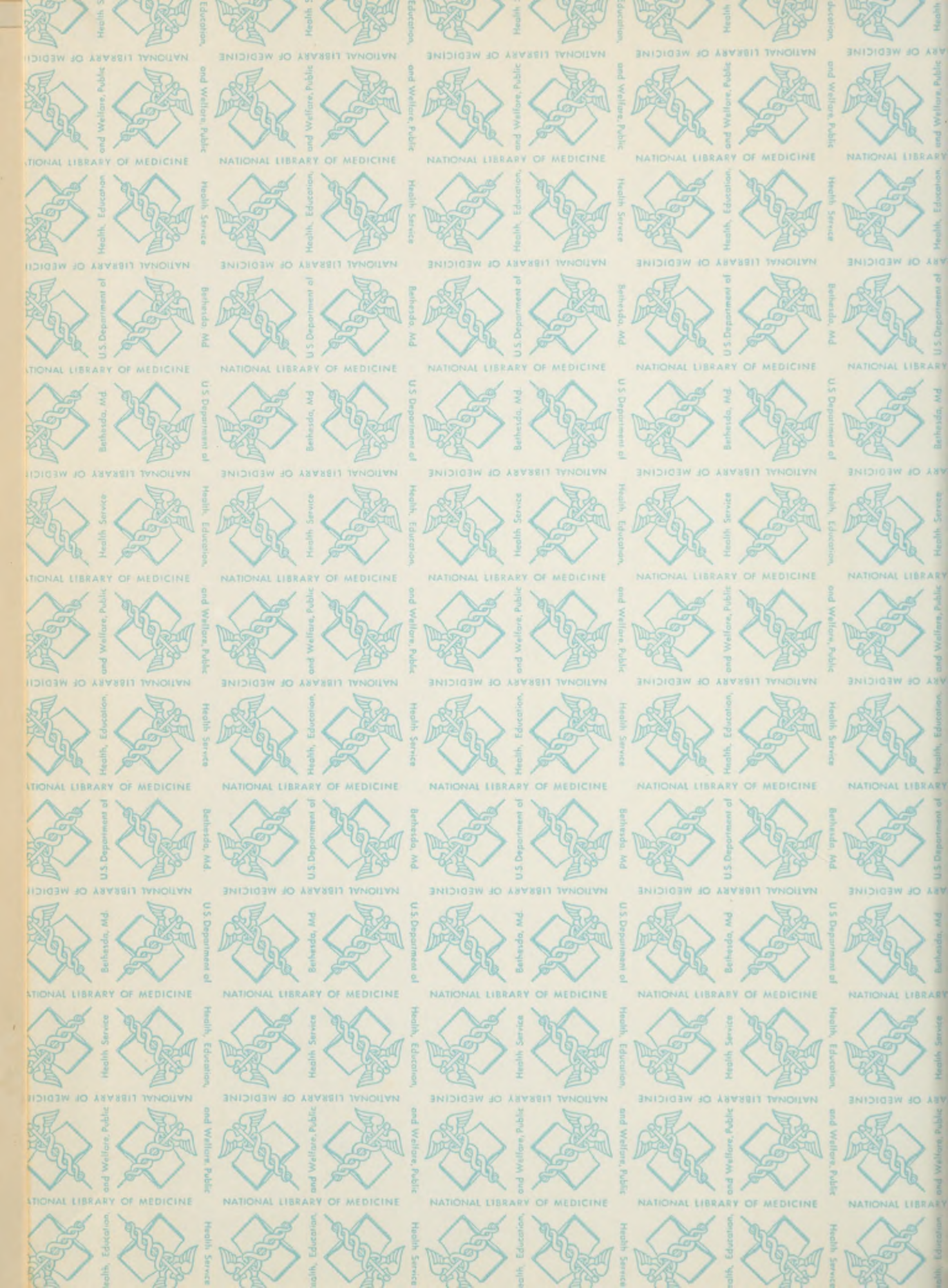
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