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**SIMPLIFIED STANDARDIZED  
TREATMENT OF BURNS UNDER  
EMERGENCY CONDITIONS WITH  
PARTICULAR REFERENCE TO  
ALLIED HEALTH PERSONNEL**

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## PREFACE

This report was prepared under the direction of the Division of Health Mobilization, Public Health Service, U. S. Department of Health, Education, and Welfare at the request of the Office of Civil Defense, Department of Defense. The purpose of this report is to present guidelines for simplified austere medical care for victims of thermal injuries during a national disaster. The report is designed to assist in emergency planning and for training of members of the allied health professions.

## TABLE OF CONTENTS

	Page
Introduction .....	1
Identification of Allied Health Personnel .....	3
Diagnosis and Triage .....	4
Categories for Treatment .....	4
Types of Burns .....	4
Special Burns .....	8
Extent of Burns .....	9
Austerity Therapy .....	18
General Plan of Management .....	18
Local Treatment .....	21
Fluid Therapy .....	24
Summary .....	28
Appendix I:    Diagnosis and Treatment of Major .....	i
Burns Under Civilian Conditions	
Appendix II:   Use of Polyethylene Bags and Twist.....	xix
Tapes	
Appendix III:  Airways for First Aid Use .....	xxiii
Appendix IV:   Rationale for Fluid Therapy.....	xxiv
Appendix V:    Suggested Supplies with Reference .....	xxvii
to Austerity Burn Therapy Program	
Appendix VI:   Suggested Burn Card .....	xxix

## INTRODUCTION

It is perhaps a twentieth century paradox that while, on the one hand we are endeavoring to lower the mortality rate and lessen the morbidity period in acute extensive burns through basic research and technical improvements, on the other hand, we are faced with the necessity of evolving a program of minimum standards of burn care to be put into effect in the event of a major disaster, such as a nuclear attack.

Following such a catastrophe, not only would there be hundreds of thousands of casualties suffering multiple injuries of every type along with varying degrees of sublethal radiation damage, but also problems of great magnitude in supply of sufficient trained medical and allied health personnel and of materiel in sufficient quantities to meet even the most limited needs. The basic question of which patients should receive priority treatment and which may actually benefit by treatment still requires clarification. Although it is difficult to plan for hypothetical and unpredictable conditions which involve a change of philosophy and which are concerned with emotional overtones, nevertheless, much has been accomplished in defense planning, and a constructive attitude to adopt is that while such disaster preparation may be inadequate in contemplation of nuclear warfare it will contribute substantially toward better management of casualties following nuclear explosions of conceivable magnitude and following natural disasters and industrial accidents of all types.

It has been estimated that one of the major categories of injury resulting

from an atomic disaster will be burns. This being true, any advance planning program must include in its scope the formulation of a simple concise burn therapy regimen which can be carried out by allied health personnel, if necessary working without medical supervision, during the initial emergency period in shelters and elsewhere.

This manual is designed to assist in planning for training of members of allied health professions and to evaluate their utilization under medical supervision during the early phases of definitive care under austerity conditions.

## IDENTIFICATION OF ALLIED HEALTH PERSONNEL

One of the problems contributing to initial confusion during time of disaster, as has been well demonstrated and documented on a number of occasions, has been that of securing proper identification of medical and allied health personnel. It is suggested, therefore, that allied health personnel be required to secure proper identification cards, to be carried on the person.

Fallout Shelter Medical Kit instructions to Shelter managers require that they delegate responsibility for use of medical supplies, in the absence of a medical doctor or an osteopathic physician, to one of the following categories:

1. Dentists
2. Veterinarians
3. Registered Nurses
4. Pharmacists
5. Licensed Practical Nurses
6. Trained Medical Corpsmen
7. Podiatrists
8. Students of medicine, osteopathy, dentistry, veterinary medicine, nursing, and pharmacy.

## DIAGNOSIS AND TRIAGE

Categories for Treatment. The basic philosophy of mass casualty care is to concentrate treatment on the more seriously injured patients who are good risks, sending away for self-care or ambulatory treatment those who are not seriously wounded and setting aside for delayed care those who are poor risks. Those include patients with multiple severe injuries, burns in which there would be less than a "50-50" chance of survival because of their extent and exposure to radiation, and elderly individuals with less severe burns but with pre-existing heart trouble and other disease states. Sorting into four treatment categories of (1) Minimal, (2) Immediate, (3) Delayed, and (4) Expectant (or Palliative) does not necessarily involve final decisions since sorting is carried on as a continuous process, and patients may be transferred to one group or another as their condition changes. Since allied health personnel may be responsible for entire medical care in shelters and elsewhere, they should learn to classify burns, to sort patients and to administer first aid and immediate treatment.

Types of Burns. Thermal or heat burns are ordinarily classified as first, second, or third degree. Both first and second degree are partial-thickness burns, whereas in third degree lesions there is complete loss of all layers of the skin and at times involvement of the deeper structures.

### 1. First Degree.

In first degree burns, which are characterized by redness and perhaps

mild swelling, only the superficial layers of the skin are involved, and healing occurs rapidly. Although this type may be very painful, it is rarely serious, and scarring does not occur.

## 2. Second Degree.

Second degree burns are deeper and are characteristically red or mottled in appearance with blister formation, perhaps shreds of tissue from broken blisters, considerable swelling, and, as a rule a wet surface from rapid loss of plasma which continues over several days time. Maximum swelling is reached in about 24 hours, and by the third or fourth day an eschar (or scab) forms. Unless the wound becomes infected, it may be expected to heal in two to three weeks with spontaneous regeneration of "new skin" but often with some changes in pigmentation which persist for a long period of time. Some deep second-degree burns require as long as six weeks. No preparation has yet been found which will accelerate healing, and for treatment of pain, medications taken by mouth are, in general, more satisfactory than those applied to the surface, although some burn preparations have a temporary cooling effect. Although in a localized small burn considerable relief may be obtained by application of cold in the form of packs or immersion in ice water for a short period, this type of treatment is not feasible for consideration in a mass disaster plan.

A second degree burn is serious only if it is extensive, covering, as a rule, about 15 to 20% of the body surface, or if it is so deep that it involves

most of the skin structures. In this case it may be easily converted later into a third degree burn by careless handling, pressure of dressings, maceration by bed clothing, infection and the like. Very deep second degree burns heal with thin, abnormal skin covering which may be vulnerable to injury and break down with ulcer formation.

### 3. Third Degree.

Third degree burns initially may resemble those of second degree depth or may be white and charred in appearance. As a rule they are not as painful as second degree burns because the nerve endings have been damaged, and the patient may not even feel a painful stimulus, such as a pin prick, on early examination. These burns, however, cannot heal without thick scarring and perhaps serious deformity, and skin grafts will be required unless the area is very small. No preparation can restore destroyed skin or prevent scarring if all the layers of the skin have been destroyed.

Extensive second and third degree burns are accompanied by shock, destruction of red blood cells, loss of plasma and changes in the balance of fluids and chemicals in the body. Shock may develop very slowly in a patient who appears initially to be in good condition. It is accompanied usually by thirst, vomiting, restlessness, rapid pulse, delirium and a decrease in output of urine.

Although it is impossible for even the most experienced burn specialist to distinguish at first examination between complete thickness loss of skin (third degree), in the absence of charring, and deep partial-thickness

loss of second degree depth, the cause of the burn is usually a reliable guide in estimating the depth of involvement. Thus we know that mild sunburn is first degree; severe sunburn, with blister formation, burns from hot liquids spilled on the skin, and flash burns from gasoline, natural and butane gas, and kerosene are usually second degree. Third degree burns are produced chiefly by flame, ignited clothing, immersion in hot water, contact with hot objects and electricity. Temperature and the length of exposure are important factors in estimating depth.

From knowledge gained in the atomic bombings in Japan and from experimental burns, we know that many survivors of a nuclear or thermonuclear attack could have typical second degree flash burns. These are produced by intense heat of short duration only; they are identical with those sustained from explosions of extremely volatile substances and generally occur only on exposed skin areas, where clothing is adherent, or through darker areas of a printed material with light background. This fact suggests possibilities for measures of prevention in the way of suitable clothing and provision of mechanical protection in the event of sufficient warning time and great enough distances from the bomb center to escape fatal irradiation, blast injuries and multiple traumatic lesions--lacerations, fractures, etc. It is anticipated, therefore, that many second and third degree flame burns would result from burning buildings, contact with hot objects and other sources related to those commonly encountered in hospital practice at the present time; with adequate protection these might exceed flash burns.

### Special Burns.

Chemical burns, particularly of the eyes, have first priority over thermal burns since continuing damage is produced by long exposure. These require immediate flushing with water, salt solution, or other bland fluids or constant rubbing of the eye with cloth until liquids are available. Electrical burns usually involve the deep tissues and are more severe than they appear on initial examination. This is true also of burns from liquids such as tar and molten metal which involve much higher temperatures than ordinary liquids. In addition, certain areas of the body require special consideration. These include the following:

1. Severe burns of the entire face, involving the eyelids or the mouth region. Burns of the eyelids may be accompanied by sufficient swelling to occlude vision, and patients will need help in getting about. Burns of the lower face may be associated with involvement of the mucuous membranes of the mouth and the upper respiratory tract, and several hours observation is required to determine whether or not difficulty in breathing results as swelling occurs in the mouth and upper respiratory passages. Patients should be propped up in a sitting position, meanwhile, so that accumulation of edema fluid will be minimized.

2. Severe burns of the hands. Patients with burns of the hands require protective temporary covering and instructions to keep the hands elevated higher than the level of the heart to prevent additional swelling from the dependent position. The hands, however, need not be kept in the vertical position. The patient may, for example, sit on

the floor with his arms resting on the seat of a chair, or the elbows may be placed on a table. When dressings are available, first priority should go to deep hand burns, which should be treated by medical or specially trained personnel.

3. Severe extensive burns of the lower extremities. Patients with extensive burns of the legs below the knee should lie down with their legs elevated. If they have severe face burns, also, they will require propping up. They will become non-ambulatory very quickly because of swelling and should be kept under observation until transportation is available.

#### Extent of Burns.

Ordinarily burns are considered to be of major extent if they involve 20% or more of the body surface, 15% in small children and in patients over 60. At these levels intravenous fluids are usually required. In patients with nuclear flash burns combined with radiation effects and perhaps with other injuries, percentages of 15% in adults and 10% in children and elderly individuals have been suggested as critical levels. Because of anticipated difficulties with supplies, equipment and personnel, decisions in sorting and treatment may have to be made by allied health persons without medical supervision. Responsible individuals should consider what can be done 1) in the absence of any supplies, 2) with minimum medications and equipment, and 3) with anticipated medical help and transportation facilities.

One of the most useful functions which can be served by allied health

personnel is to learn to estimate the extent of body surface area involvement in patients with burns. The time-honored method is according to the Rule of Nine or Nines, devised by Tennison and Pulaski:

#### Rule of Nines

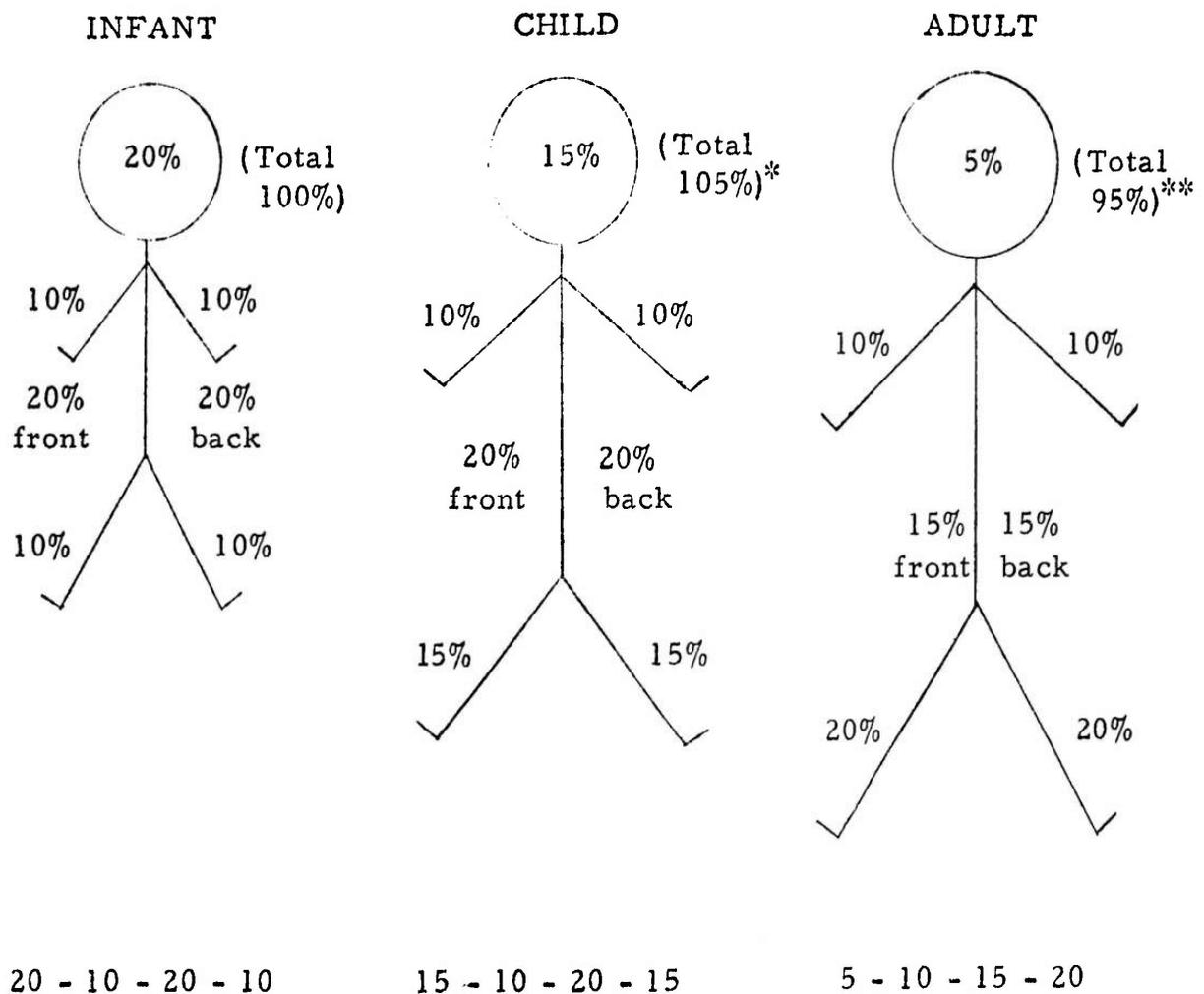
Head and Neck (Neck 1%)	9%
Posterior Trunk	18%
Anterior Trunk	18%
Upper Extremities, each	9%
Lower Extremities, each	18%
Genitalia and perineum	1%

Although tables are available for estimating the proportions for children of various ages, according to Berkow's rules (1924), it is very difficult to find these values in the majority of textbooks, and pediatric burns are usually dismissed with a word of caution to increase the percentage for the head and trunk and decrease the amounts allotted to the lower extremities.

On re-examination of Berkow's original figures it becomes evident that a Rule of 5's is just as accurate for practical purposes. As a matter of fact, after working out the values for adults, for infants and for children a reference to a similar "Rule of 5's and 10's" was encountered in the literature in an article by Berkow (1955) in an outline for emergency treatment of catastrophic burns prepared as a part of a Civil Defense program of Middlesex County Medical Society in New Jersey. The following percentages are easy to learn if the stick drawings are made and figures are recited in the following order: Head, Upper Extremity, Trunk and Lower Extremity. The buttocks

are included with the lower extremities posteriorly. (See Figure 1.)

RULE OF FIVES



\*5% may be subtracted from the trunk posteriorly.

\*\*5% may be added to the anterior chest or to both feet.

Figure 1

EXTENT OF BODY SURFACE INVOLVEMENT

	<u>BERKOW*</u>	<u>ADULTS</u> <u>RULE OF 9'S</u>	<u>RULE OF 5'S</u>
HEAD	6%	9%	5%
UPPER EXTREMITIES	9% each	9%	10%
TRUNK	19% ant. & post.	18% ant. & post.	15% (95%)
LOWER EXTREMITIES	19% each	18% each	20%
		Perineum 1%	

\*Berkow, S. G. A Method of Estimating the Extensiveness of Lesions (Burns and Scalds)  
Based on Surface Area Proportions. Archives of Surgery 8:138, 1924.

Figure 3

EXTENT OF BODY SURFACE INVOLVEMENT

CHILDREN

	<u>AGE 0</u>	<u>AGE 5</u>	<u>AGE 10</u>
*BERKOW			
Head	18	13	8
Upper Extremitities	8	8	8
Trunk	20	20	20
Lower Extremitities	13	16 1/2	18
		(100%)	(100%)

RULE OF 5'S

Head	20	15	10
Upper Extremitities	10	10	10
Trunk	20	20	20
Lower Extremitities	10	15	15
		(105%)	(100%)

\*BERKOW'S FORMULA FOR CHILDREN:

Head 6% + 12 - Age  
 Upper Extremitities 8% each  
 Trunk 20% anterior and posterior  
 Lower Extremitities 38% - 12 - Age

By examining the diagrams it is easy to observe that the major changes occur in head size and in the lower extremities, in particular. The schematic diagrams are as satisfactory for recording percentages as the conventional back-and-front diagrams and will aid in recalling surface areas for various ages. Note that the relative sizes of the upper extremities and the trunk remain fairly constant.

Since differences between a ten-year-old child and an adult vary no more than 5% for one section of the body, burns in a ten-year-old may be recorded according to the "5-10-15-20" percentage distribution on an emergency basis rather than as "10-10-20-15." (See chart). In calculating proportions for the extremities, the following may be considered as sufficiently accurate fractions:

Upper Extremity: Hand  $1/4$  Forearm  $1/4$  Upper  $1/2$

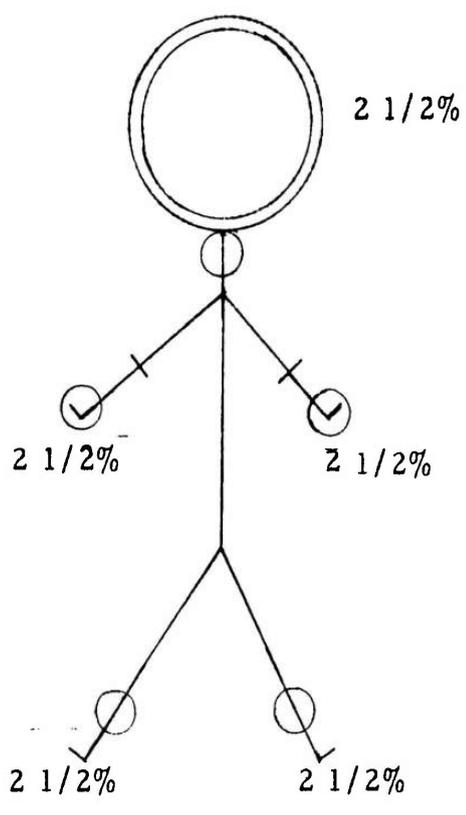
Lower Extremity: Foot  $1/6$  Leg  $2/6$  Thigh  $3/6$

It is suggested that allied health personnel be well drilled in learning the percentages, pointing to the head, arm, trunk, and lower extremity in turn, and that shelters and Civil Defense Emergency Hospitals be equipped with readily available diagrams.

Burns anticipated in a nuclear attack could be typical flash or flame lesions involving exposed skin and areas thinly covered with clothing, as for example, the lower extremities below the knees in women. It may be well, therefore, to practice making estimates of the extent of body surface involved in relation to type of clothing. The conventional rounding-off to the nearest 5% is sufficient for sorting purposes. Thus,

burns of the face, neck, wrist, hands, and ankle areas in a man with a long-sleeved shirt would total approximately 10% (2 1/2% for the face, 1% for the neck, 2% for the ankles, 5% for the hands). A man in a short-sleeved shirt would sustain perhaps 5% in addition; a man in shorts, 10-15% extra. Similar burns in a woman wearing a short-sleeved garment with a skirt to the knees or thereabouts would range from 15% to 20%. An infant with burns of the face, neck, lower arms and lower legs would probably sustain 20-25% depending on the clothing. In general, complete profile burns of one side of the body approximate in extent lesions of the anterior surface. A back burn, however, of exposed surfaces would be of less serious magnitude since some protection would be afforded by the hair and less of the neck and ankle region would be involved. It should be remembered in making calculations that the percentages for the extremities refer to both the anterior and posterior surfaces and that flash burns as a rule involve only one side of the body. A rapid estimation of burn involvement of 5% is to employ Berkow's suggestion of testing to see if the area in question is equivalent to twice the size of the patient's hand or the two hands together. In adults the examiner's hand may be used to estimate extent.

FLASH BURNS OF AREAS NORMALLY NOT COVERED BY  
CLOTHING ANTERIOR SURFACE



MALE

Maximum amount, long sleeves  
10% - 15%  
For short sleeves, add 5% for  
arm, maximum each amount  
15% - 25%

FEMALE  
Maximum amount, long sleeves  
15% - 20%  
For short sleeves, maximum amount  
20% - 25%

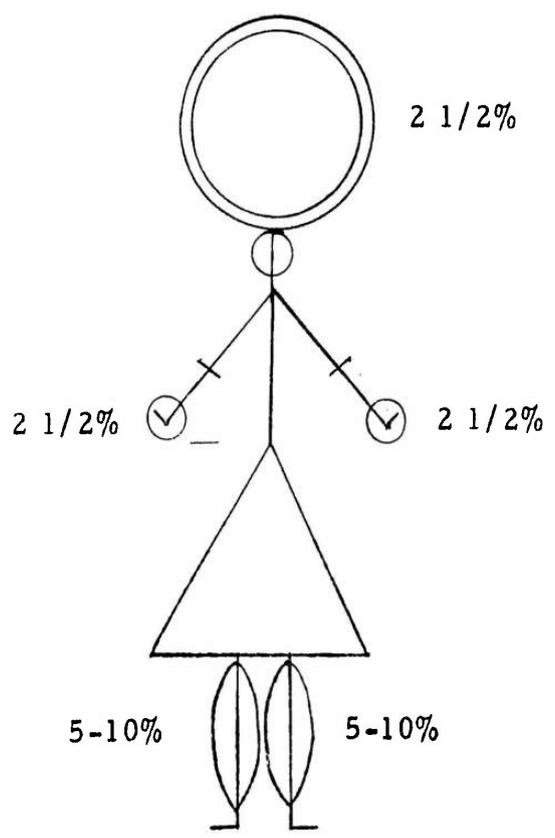


Figure 3

## AUSTERITY THERAPY

Under an austerity program carried out by allied health workers the following regimen is outlined for the treatment of burns.

### A. General Plan of Management

1. It is recommended that patients not be undressed for sorting prior to evacuation unless this procedure has been carried out in a decontamination area. If necessary, however, clothing may be cut away from burns for purposes of examination.

2. Meanwhile, sedation should be given for pain in conscious patients. In the absence of morphine or codeine, phenobarbital, 1/2 grain and aspirin, 10 grains, may be given to adults; "baby" aspirin of 1 1/4 grains may be employed in children under 12 (1 to 3 tablets according to age) together with 1/8 grain to 1/4 grain of phenobarbital, or children may be given a placebo in the form of hard candy.

3. Patients classified for self or home care or "buddy" care should include 1) those with second degree flash burns without other injuries, involving areas normally not covered by clothing (up to 20% or 25%) and 2) other burns of less than 15% to 20%. These patients should receive, in addition to pain medication, salt-soda tablets (or separate packets of salt and soda), instructions for taking fluids according to approximate weight, a supply of sulfadiazine for 4 or 5 days (or a broad-spectrum antibiotic), provided that there is no history of reaction to "sulfa" drugs, tetanus inoculations, if available,

and some sort of emergency protective cover (see below) of burns of the trunk and extremities, with instructions on home dressings.

4. All patients with burns of over 15% (with the exception of uncomplicated flash burns mentioned above), who are conscious and who are not vomiting or severely nauseated should be given as soon as possible an allocation of salt-soda solution from a stock prepared with 1 tsp. salt and 1/2 tsp. of sodium bicarbonate per quart of water, or 1/4 tsp. of salt and 1/8 tsp. of soda in 8 ounces of water (or a single tablet of 2 1/2 grains of salt and 1 1/4 grains of sodium bicarbonate combined, followed by a cup of liquid). For the total allocation see Table. In the absence of salt and soda, small sips of water or other fluids should be given. Double plastic bags or other containers should be supplied for collection of urine and for emesis, if necessary.

Later these patients should be started on sulfadiazine (7 1/2 grains 4 x daily), if no history of allergy is present, or a broad spectrum antibiotic 250 mgm. 4 x daily for 4 or 5 days (appropriate doses for children).

If tetanus toxoid is available, all patients should be given 0.5 to 1 cc. either as a booster dose or as the first immunization injection. Those who have not received toxoid previously should have tetanus antitoxin following skin testing, after recovery from shock. It is not anticipated that tetanus inoculations will be available in shelters and hence this therapy will have to be deferred in the majority of instances.

5. The most experienced medical or allied health worker available should scan rapidly and sort non-ambulatory patients, classifying them in Home Care and Immediate, Delayed, and Expectant Treatment categories. Immediate care patients shall consist, in general, of patients with non-flash burns of 15% to 40% of the body surface from flame, scalds, etc., and those with flash burns greater than 25%.

Following emergency sedation, as noted above, and preliminary oral fluids, they should receive first priority for intravenous or even subcutaneous shock therapy, if equipment and fluids are stockpiled and available. First intravenous fluids should be given to (1) those patients in severe shock who are not in the Delayed or Expectant Treatment Groups and (2) those who are unable to retain oral fluids because of vomiting. On an austerity program it is recommended that for intravenous solutions Ringer's lactate solution or 0.9% saline (in 250 cc, 500 cc, and possibly 1000 cc sizes) or 5% Dextrose in saline and either plasma or dextran be stockpiled. Dextrose in water is commonly employed in civilian practice for replacement of insensible and urinary losses, but this deficit may be met by additional intravenous saline if the patient is vomiting and unable to take the salt-soda solution by oral route.

6. In Delayed and Expectant Treatment Groups and when no intravenous solutions are available in the various Immediate Treatment Groups, salt, soda and water or salt-soda solution should be given as recommended in the Self-Care Handbook for extensive burns: 1

quart for every 20 pounds of weight in the 30 - 40% category. This amount, which includes the allowance for both replacement and ordinary needs, is so large (4 to 5 quarts for 100 pound person) that patients will have to be drinking in small sips almost continuously.

Patients in these groups should receive sedation, antibiotics, if supplies are not restricted in quantity, food as tolerated, and a simple covering dressing, i. e. a sheet or towels. Continuous sorting and observation should be maintained to determine if the patient's response justifies reclassification and priority for more vigorous therapy.

## B. Local Treatment

### 1. Self Care and Ambulatory Patients.

a. All ambulatory hand and upper extremity burn patients should be sent to a dressing station for rinsing of the wound with water, if it is available (re-rinsing if the patient has passed through a Decontamination Area) and for application of an emergency protective cover, i. e. a plastic bag secured by twist tape, a loose rubber band, adhesive tape, a cloth band or other available tie, or an emergency dressing or one improvised from household linen. Patients should be instructed to keep their hands above the level of the heart, either in a vertical position or resting on a table or the back of a chair, to maintain this position as constantly as is consistent with self-care and to report for specialized dressings when they are available. If water is at a premium, do not rinse wounds.

b. Patients with flash burns of the lower extremity, unilateral or bilateral, below the knee, should have the areas rinsed off rapidly (if water is available) and a protective covering applied, after which they should be dismissed with medications and instructions to keep the involved limb or limbs elevated at all times. Walking is contraindicated unless no nursing help is available.

If the patient cannot be dismissed for home care, he should be sent to an observation area and placed in a recumbent position, unless the face is also burned, in which case he must be propped up but with the legs elevated.

c. All patients with serious full-view face burns accompanied by marked swelling should be sent to an observation area (after care of associated hand, arm, and lower extremity lesions) and detained for several hours in the event that respiratory difficulty should develop. The face should not be covered by a dressing unless other wounds are present. Should they have difficulty in breathing as swelling occurs in the mouth and throat passages, they should be referred at once for insertion of an airway. If antibiotics are in short supply, patients with severe face burns should have first priority among the burn cases.

d. Patients should be given instruction in further care of burns of the arms, hands and lower extremities, which should be rinsed off with soap-and-water solution at home and covered with a loose, improvised dressing of household linen. The fingers, toes and all

surfaces which adjoin other areas, such as the back of the ears, the groin, the armpit, between the buttocks, etc. should be separated by a layer of dressing. Blisters should not be broken. The face should not be bandaged, and small patches of burns on the arms and legs may be left exposed to the air if the surface is dry. Patients should be cautioned to keep involved extremities elevated at all times.

e. Ambulatory patients who cannot be dismissed for one reason or another and who are not seriously or painfully injured should be given assignments to aid in the care of other patients, take care of children, perform housekeeping tasks, etc. When time permits, dressings may be applied, with first priority given to the hands and second to extensive "wet" burns. If space is adequate, and the area is clean, flash burns may be treated by exposure, continuing elevation of involved extremities.

## 2. Immediate Care Patients.

Priority for dressings of any kind in the management of severe burns should go initially to deep hand burns and wet burns characterized by outpouring of plasma from the surface. If trained personnel and supplies are available, the hands should be washed off with detergent or soap and water and placed in the so-called position of function with the wrist cocked back and the fingers flexed over a roll of fluff gauze placed into the palm. The fingers should be separated and the hand covered with a bulky dressing with outer bandage smoothly applied. Wet burns should be covered temporarily with several thicknesses

of cloth, e. g. bath towels or a burn pad.

Full thickness (third degree) circumferential burns of the upper and lower extremities should be covered with a burn pad or several thicknesses of cloth or, as an alternative, the posterior surface may be placed on a pad, on towels, etc., over paper or plastic to protect bedding and covered lightly with household linen. This same procedure may be employed in burns of the trunk accompanied by flash burns of the extremities; the majority of trunk burns will, however, be associated with other lesions which make them fall into Delayed or Expectant Treatment Categories.

In a shelter which may serve as housing of patients for a prolonged period of time, exposure therapy may be employed for unilateral burns with patients positioned so that burns do not come in contact with bed clothing but are protected by sheets over gauze strips. This technique is particularly applicable for flash and other second degree lesions.

### C. Fluid Therapy.

1. Schedule for self-care patients with flash burns of 15% or more and burns in immediate treatment category up to 20%:

Consider as 20% and calculate replacement fluid on the basis of 1 cc x wt in pounds x percent of burn. For a person weighing 100 pounds the amount would be 2000 cc.

For 25 pounds ..... 500 cc, 1 pint total or 2 8 oz. bottles with 1/4 tsp. salt and 1/8 tsp. soda in each

For 50 pounds ..... 1000 cc, 1 quart total solution or

1/4 tsp. salt and 1/8 tsp. soda dissolved in water followed by glass of liquid 4 x daily.

For 100 pounds ..... 2000 cc, 2 quarts total solution or 1/4 tsp. salt and 1/8 tsp. soda dissolved in water followed by glass of liquid 8 times daily.

For 150 pounds ..... 3000 cc, 3 quarts total solution or 1/4 tsp. salt and 1/8 tsp. soda dissolved in water followed by glass of liquid 12 times daily.

For 200 pounds ..... 4000 cc, 4 quarts total solution or 1/4 tsp. salt and 1/8 tsp. soda dissolved in water followed by glass of liquid 16 times daily.

For ordinary water needs add the following:

Infants up to 1 year ..... 200 - 500 cc or 1/2 to 1 pint of fluids  
 Children up to 12 years .. 500 - 1000 cc of 1 pint to 1 quart of fluids  
 Adults..... 1000 - 2000 cc or 1 to 2 quarts of fluids

2. Schedule for third degree burns of 20:30% and for flash burns of 20:30% which are accompanied by other injuries. Calculate replacement fluid on the basis of 1 cc x wt in pounds x percent, and use 25% as an average for the group. For a person weighing 100 pounds the amount would be 2500 cc or 2 1/2 quarts. Of this total give approximately 1/3 as plasma or dextran, if available, otherwise all Ringer's lactate, saline, or 5% dextrose in saline. Figures in the following table may be adjusted to conform to the size of saline and colloid containers to avoid waste.

	<u>Total cc.</u>	<u>Saline</u>	<u>Plasma or Dextran</u>
For 25 pounds .....	625	425	200
For 50 pounds .....	1250	900	350
For 100 pounds .....	2500	1750	750
For 150 pounds .....	3750	2500	1250
For 200 pounds .....	5000	3500	1500

For ordinary needs: Offer salt-soda solution in amounts indicated below or 1/4 tsp. salt and 1/8 tsp. soda per glass; if not well tolerated or if vomiting occurs, substitute one of saline solutions intravenously entirely or in part.

Infants up to 1 year .....	250 - 500 cc or 2 8 oz. bottles
Children up to 12 years .....	500 - 1000 cc or 2 - 4 glasses
Adults .....	1000 - 2000 cc or 4 - 8 glasses

3. Schedule for third degree burns of 30 - 40% and for less extensive burns accompanied by major injuries (but still considered amenable to treatment) using 35% as an average percentage:

As replacement fluid: 3000 cc or 3 quarts for a person weighing 100 pounds (1 cc x wt in lbs x %). Give 1/3 as plasma or dextran, if available, otherwise all saline.

	<u>Total cc</u>	<u>Saline</u>	<u>Plasma or Dextran</u>
For 25 pounds .....	875	575	300
For 50 pounds .....	1750	1150	600
For 100 pounds .....	3500	2500	1000
For 150 pounds .....	5250	3750	1500
For 200 pounds plus.....	7000	4500	2500

For ordinary needs: Normal saline intravenously in amounts indicated above, if available; otherwise, oral salt, soda and water or salt-soda solution in amounts as noted above.

4. An attempt should be made to administer about half of the total 24 hour requirements of all fluids in the first 8 to 12 hours after injury, or, if the patient is not seen early, to make up as much as possible of the amount in the first 24 hours.

For the second 24 hours salt, soda and fluids in half the above amounts should be given. After this time the salt and soda and oral replacement

fluids should be discontinued. Liquids should be supplied in quantities sufficient for ordinary needs and solid foods should be added gradually by the end of 4 or 5 days time.

5. In order to estimate the response of the severely injured patient to fluid therapy the general appearance, pulse and urinary output must be taken into account. If possible, the volume of urine should be measured, employing double plastic bags or paper cups for collection. A minimum volume of 25-50 cc (1 to 2 ounces) is satisfactory for an adult. For infants up to 1 year a corresponding volume is 10 - 20 cc (approximately 2 - 4 tsp.); for children 20 - 30 cc (approximately 4 - 8 tsp. or 2/3 to 1 ounce).

## SUMMARY

An outline has been presented for austerity care of burn patients during the early period after injury with simplification of procedures and adaptation of techniques so that they may be utilized by allied health personnel with assistance from non-professional workers. The salient features of the regimen are as follows:

### A. Classification

1. Use of the Rule of Fives as a substitute for the Rule of Nines with adaptation for infants, children and adults, employing "stick" figures for ready reference.
2. Increasing the percentage levels for second degree flash burns without other injuries to be grouped for self, home, or "buddy" care to include areas of the body which are not covered by ordinary clothing (up to 25%). Using the clothing criteria, percentages will not have to be calculated on the majority of patients for primary sorting.

### B. Oral Fluids

1. Recommendation that as an alternate to salt-soda solution individual doses be given (1/4 tsp. salt plus 1/8 tsp. -- or a "pinch" of soda), mixed with a small amount of water and followed by a cup or glass (8 oz) of water or other fluids; or that 2 1/2 grains of sodium chloride and 1 1/4 grains of sodium bicarbonate be combined in a single tablet, to be accompanied by 8 oz. of fluids. This same dosage may be given to all age and weight groups, with variation only in the total amount of fluids given during the first 24 to 48 hours, and the total number of doses.
2. Use as supplementary fluids for replacement therapy in 15% to 30% levels, unless intravenous fluids are available and patients have vomiting or severe nausea.
3. Estimation of quantities of fluids according to the Brooke modification of the Evans formula ( $2 \text{ cc} \times \text{wt in Kg} \times \% \text{ of involvement}$ ) with the following changes:
  - a. Changing Kg to lbs. for simplification, so that

the formula used as a basic guide will be 1 cc  
x wt. in lbs. x %, and

- b. Using weights at 25, 50, 100, 150, and 200 lbs.  
for printed instructions, and
- c. Grouping percentages at average levels to avoid  
frequent calculations.

#### C. Intravenous Fluids, First 24 Hours

1. Use of one of the following as saline replacement fluid  
(in order of preference): Ringer's lactate solution,  
isotonic saline, 5% dextrose in saline. Use of colloid  
(plasma, dextran, other plasma expanders, blood, blood  
derivatives, etc.) in approximate proportion of 1: 3  
with saline solutions, adjusting colloid to conform to  
size of containers stockpiled.
2. Priority for intravenous fluids to the immediate category  
group, with first preference to 30% to 40% burns and  
second to 20% to 30% burns who have vomiting or do not  
tolerate oral fluids well.
3. Fluid recommendations according to the formula 1 cc  
x wt. in lbs. x % but estimating quantities on the basis  
of 5 weight categories (25, 50, 100, 150, and 200 lbs.)  
and grouping 20% to 30% burns at 25% as an average and  
30% to 40% burns at 35% as an average (see Oral Fluids).
4. No intravenous fluids to patients with burns above 40%.

#### D. Replacement Fluid Therapy, Second 24 Hours

1. Use of half of the amounts recommended for the first  
24 hours, or
2. Disregard the formulas and recommend that additional  
fluids be taken according to availability and thirst.

#### E. Local Therapy

1. No treatment for burns of the face except to observe for  
several hours, if severe, to determine whether an airway  
is needed. Patients to be kept in an upright position to  
minimize swelling.
2. For burned hands, immediate elevation above the level of  
the heart, to be maintained continuously; emergency protective

dressing preceded by rinsing with water; first priority for burn dressings, preceded by gentle washing with detergent or soap solution and rinsing; hand dressings to be carried out by the most experienced personnel or trained helpers with separation of the fingers by gauze, use of fluff gauze in the palm and bandaging in layers with the wrist, hand and fingers in the "position of function" with wrist cocked up, thumb in opposition, metacarpo-phalangeal and phalangeal joints flexed.

3. For burned lower extremities, immediate or early elevation, preceded by rinsing with water if available, application of protective temporary dressing; later treatment by exposure if conditions suitable; otherwise washed with detergent or soap and water and covered with a simple dry dressing, stockpiled or improvised.
4. For localized burns, rinsing, if water available, followed by exposure or temporary protective dressing. If dressing applied following first-aid care, cleansing with detergent or soap and water as a preliminary procedure.
5. For generalized burns (under 40%) rinsing with water, if available, followed by temporary protective dressing and later either exposure therapy alone or combined with pads for the under surfaces or washing with detergent or soap and water and application of a dry dressing or clean household linen.
6. For burns of 40% and over, wrapping in a sheet or the equivalent, if available.
7. Note. If detergent or soap and water are not available, temporary protective dressing should be used only until burns can be treated by exposure. The open method is preferable to the closed technique if the burn cannot be cleansed prior to dressing. It is preferred whenever it is feasible from the standpoint of positioning, patient cooperation, and local environmental conditions.

#### F. Dressings

1. For temporary protective dressings, especially for upper and lower extremities, polyethylene bags are recommended, secured by rubber bands, tapes, ties, etc. Clean household linen, white cloth, or even paper may be substituted. First priority for temporary cloth dressings should go to wet burns.

2. Civil defense pads, which make ideal dressings, should be reserved for a) hands, b) upper extremities, c) lower extremities, d) trunk in burns of less than 40%, and e) in combination with exposure for circular burns.
3. Conventional dressings not required for other types of wounds may be employed for burns if available for application.

#### G. Pain and Sedation

1. For first aid adults may be given 10 grains of aspirin in combination with 1/2 grain of phenobarbital, and children may be given 5 grains (or less, according to age) in combination with 1/4 to 1/8 grain of phenobarbital. Hard candy may be used as a placebo in small children.
2. Cold applications may be used in localized burns as a first aid measure, if cold water is available and only a limited number of patients are to be treated.
3. Prompt elevation of involved hands and lower extremities will assist greatly in control of pain.
4. Any narcotics available (e. g. morphine or codeine) should be given first to conscious patients in the Immediate Treatment category with obvious pain.

#### H. Other Medications

##### 1. Antibiotics

- a. If antibiotics are available, they should be given for 4 or 5 days at least to patients with third degree burns, especially where there is obvious contamination with gross dirt, etc. Patients with burns of lesser extent, who have a better chance of survival, should be given first priority.
- b. The following medications may be employed:  
Sulfonamides, 7 1/2 grains every 6 hours following initial dose of 6 tabs. (Gantrisin or other "triple" sulfonamides preferable, but sulfadiazine satisfactory.  
Oral Penicillin, G, 250,000 units - 1 tablet every 6 hours following initial dose of 2 tabs.  
Any broad spectrum antibiotic, 250 mgm every 6 hours.
- c. Patients must be questioned about sensitivity to the above drugs. Sulfonamides and broad-spectrum

antibiotics are safer than penicillin if there is question or sensitivity to the latter.

## 2. Tetanus Immunization

- a. All patients should have a booster dose of 0.5 cc to 1 cc of tetanus toxoid or given this amount as a preliminary immunizing dose unless burns are superficial.
- b. T.A.T., preceded by skin testing, should be delayed until patients are safely out of shock. If tetanus inoculations are not available, efforts should be made to obtain material for injection within 3 or 4 days.

## APPENDIX I

## BURNS

This resume of Diagnosis and Treatment of Burns has been prepared with minor alterations in the text by T. G. Blocker, Jr., M. D. and Virginia Blocker, M. D. for the 1963 edition of CURRENT THERAPY edited by Howard F. Conn, M. D., edited by W. B. Saunders Company, Philadelphia. It is a revision of one prepared for the 1955 edition of Current Therapy and is directed at the level of the practicing physician. This material has been included as an Appendix so that Defense workers may have some guide as to current standards of hospital care of burns in a teaching hospital with which to compare an austerity program of therapy. It is less technical than the majority of textbooks, or medical journal articles.

## BURNS

### DIAGNOSIS: SEVERITY AND EXTENT

In calculating the extent of burns the standard "Rule of Nines" or an index based upon extent and estimation of depth is usually employed. A "Rule of 5's" has been recommended by workers at the University of Texas Medical Branch in Galveston, which is similar to a "Rule of 5's and 10's" advocated by Berkow (1955) a number of years ago in formulation of a mass casualty disaster plan. This Rule of 5's, which includes 5% for the head and neck, 10% for each arm (1/4 or 2 1/2% for the hand), 15% each for the trunk anteriorly and posteriorly (to include the buttocks), 20% for each lower extremity to the ankle and 5% for the feet, is as accurate as the Rule of Nines for general classification of severity of injury and has the added advantage of being easy to remember and of conforming more closely to the accepted methods of reporting extent of lesions in terms of multiples of 5. For children the extent of burn is increased for the head and trunk, decreased for the extremities (e. g. Newborn: 20% head, 10% arms, 20% trunk, 10% lower extremities; Child of 5: 15% head, 10% arms, 20% trunk, 15% lower extremities).

Estimation of the depth of burn is usually divided into three categories: superficial (involving the epidermis only); partial-thickness and full thickness, with accompanying first and second degree lesions distributed in involvement or surrounding a central third degree area. The

best guide to depth is still the burn history, including the type of causative agent, temperature, length of contact, and the thickness of the skin in the involved area. In a conscious patient the response to a pin prick is commonly employed in the immediate post-burn period on the theory that third degree burns usually destroy the epithelial pain receptors and thus produce anesthesia, but recent research indicates that a period of 2 to 4 days is required for degeneration of some nerve fibers. Also the pin prick test must be carried out early, since considerable distortion and blunting of sensation occurs.

#### MINOR BURNS

First degree and superficial second degree burns below 20% (II-a) usually will heal spontaneously within one or two weeks regardless of the type of therapy, assuming that there is no actual harmful substance present in topical agents applied or hypersensitivity to the particular ingredients contained in a preparation. These wounds will heal equally well, and, in fact, often more quickly without any local treatment or with only a dry protective dressing. Alterations in pigmentation, however, may persist for several weeks or even months regardless of the local treatment.

Gravitational edema and lessening of discomfort due to swelling may be minimized by elevating the involved extremities above the level of the heart. Small doses of codeine for adults and flavored aspirin or dulcet phenobarbital tablets (8 mg., 1/8 grain) for children may be

given for relief of pain.

### MAJOR BURNS

Lesions should be categorized as major burns if they involve more than 20% of the body surface (15% in children) or if deep lesions are present as a result of electrical burns or if they occur in specialized areas, such as the face, hands and lower extremities. For mass casualty purposes mild flash burns of 20-25% which involve exposed areas not covered by ordinary clothing may be considered for self, "buddy," or home care, but if there is evidence of severe radiation damage and/or associated injuries, levels of major burns should be reduced to 15% for adults and 10% for children.

#### Morbidity Estimates

Deep second degree burns without undue complications (II-b) generally heal within 2 to 6 weeks depending on the thickness of the skin involved, the extent of the surface area burned and the location of lesions. Burns of the lower extremities, for example, heal more slowly than those of the arms and trunk. Permanent changes in the character of the skin may occur, according to the amount of destruction of epithelial elements.

The time necessary for healing of third degree lesions depends on the type of early care received, local and systemic complications, and the number of skin grafting procedures involved. In general, there is a lapse of about three weeks from the time of injury to the initial

grafting procedure in acute patients, unless lesions are well demarcated and are suitable for early excision and grafting. Those with less than 20% burns usually will require 1 or 2 grafting procedures and will be ready for discharge between 6 to 7 weeks from the time of injury. In burns of between 20 to 50%, 9 to 10 weeks are required, and over 50%, at least 14 weeks on the average. These figures, obtained from a number of centers, are approximately doubled for chronic burn patients admitted for primary therapy to a burn unit 3 to 6 weeks following injury, who have had early care elsewhere and who must have extensive local and supportive care in preparation for grafting.

### Mortality

Age of the patient and extent of burn are the most important considerations in determining the critical levels for survival following severe thermal trauma, with the exception of respiratory burns, which carry a high mortality. Obesity and alcoholism are also poor prognostic signs.

The extent of burn increases the likelihood of systemic infection as a complicating or terminal factor, and age is associated with poor resistance to trauma and pre-existing degenerative diseases. Few patients of 60 years or more survive burns of over 30%. Otherwise, the critical level is 40% to 50% of third degree involvement.

### Pathophysiological changes

The complex pathophysiological changes following severe thermal

trauma which occur as both abrupt and continuing phenomena are still open to interpretation. The magnitude of the response is dependent upon the depth and extent of involvement and in a large measure upon the causative agent, the intensity of the heat, the duration of exposure, and the patient's age.

Burn shock is characterized by (1) signs of traumatic shock; (2) external loss of plasma, which disturbs both fluid and protein balance; (3) decrease in circulating red cells, both relative and absolute, due to actual destruction in the burn area, to increased fragility of cells as a result of thermal damage, to sludging, etc., and (4) the phenomenon of burn edema which depletes uninjured tissues of fluid and is accompanied by radical alterations in sodium potassium distribution. Sodium is trapped in the edema fluid and a high blood potassium may result from redistribution of electrolytes and destroyed red cells. According to newer investigative studies, decreased cardiac output precedes hypovolemia and myocardial injury may be a factor in early shock and later complications.

#### Early Systemic Therapy

1. Routine supportive therapy for severe burn cases during the initial shock period may require emergency hypodermic sedation (intravenous morphine in small doses), but the usual oral and parenteral analgesics, e. g. codeine, A.S.A., barbiturates, will generally suffice if anxiety is allayed by frequent reassurance. Children and elderly individuals often will not require hypodermic medication. Tranquillizing drugs

are not routinely employed.

2. Blood should be drawn for typing and cross-matching, red and white cell counts and hematocrit, and for baseline blood chemistry studies if these are available; these should be repeated in 12 hours, if possible.

At the same time the physician should evaluate the various portals for intravenous therapy since veins may be at a premium and the severe burn patient requires frequent and repeated intravenous therapy.

3. Oxygen should be given if required as in any patient with clinical shock; and respiratory tract damage, if any, should receive immediate attention. Maintenance of an adequate airway is of prime importance. Although actual damage to the lungs per se is rare, the possible inhalation of noxious gases and products of partial combustion presents a serious problem. An examination of the face and neck and oral mucuous membranes and a history of the circumstances of the burn are necessary in making a decision to perform an emergency tracheotomy. There is presently a trend toward conservatism in the use of this procedure in severe burns because of the hazards of mechanical injury from the cannula and of introducing antibiotic-resistant organisms into the lower respiratory tract. Certainly an experienced consultant should be available in doubtful cases.

4. Intravenous therapy should be started to restore the circulating blood volume to normal levels. The majority of burn workers are of the opinion that patients with major lesions require both salt and protein-

containing fluids during the first 48 hours. In burns of more than 20%, both Ringer's lactate and colloids (stored pooled plasma or Dextran alone in milder cases and in combination with whole blood in more severely injured patients) are usually given. There is a tendency currently to give somewhat less whole blood during the first 24 to 48 hours than formerly but recent studies on burn anemia and quantitative blood losses as the result of Swedish studies investigating severe burns by cardiac catheterization have emphasized the importance of early transfusion therapy as well as according to indications subsequently during the subacute, pregrafting and grafting phases.

The Brooke modification of the Evans formula, which provides 0.5 cc of colloid and 1.5 cc of saline-containing solution for each 1% of body surface involvement/Kgm. (up to 50%) during the first 24 hours - half of this amount in the second, is an excellent guide to fluid therapy. It must be remembered, however, that this is only a guide. The patient's clinical response, especially the pulse, the hourly urinary volume (25-50 cc minimum output for adults) and serial laboratory reports should determine the actual amount of fluids administered.

In addition to the above, fluids must be given for insensible and urinary water requirements. Wolferth (1959) suggests the following table as a guide for both intake and output:

<u>Age</u>	<u>Intake</u>	<u>Urinary Output</u>
0 - 12 mos.	200 - 500 ml.	8 - 20 ml. hr.
1 - 4 yrs.	500 - 575 ml.	20 - 24 ml. hr.
4 - 7 yrs.	574 - 650 ml.	24 - 28 ml. hr.
7 - 10 yrs.	650 - 725 ml.	28 - 30 ml. hr.
10 - 12 yrs.	725 - 800 ml.	30 - 33 ml. hr.
Adult	1500 - 2000 ml.	50 ml. hr.

5. Part or all of the non-colloid-containing fluids during the first 48 hours may be supplied by an oral hypotonic saline-bicarbonate solution (3.5 grams NaCl, 1.5 gm. Na HCO<sub>3</sub> per 1000 cc distilled water) as tolerated (or by a "dose" of 1/4 tsp. salt and 1/8 tsp. soda followed by a glass of water). Salt-soda solution has been advocated for Civil Defense purposes in mass casualty planning for both self-care and austerity therapy. Because of the danger of water intoxication in severe burns it is recommended that patients not receive ice, distilled or ordinary drinking water during the acute phase (unless accompanied by salt and soda) and potassium-containing solutions, e. g. milk and fruit juices, are also contraindicated.

6. No food should be given by mouth for the first 24 hours to patients with extensive severe burns since there is a tendency toward nausea and vomiting and, in infants, the danger of aspiration.

7. Temperature, pulse, respiration and blood pressure, if possible should be checked every two hours for 8 hours, and then every 4 hours.

8. Prophylactic tetanus therapy must always be given. A skin test for tetanus antitoxin should be made after the patient has recovered from

shock and 5000 units or more should be administered at that time and repeated at 2-week intervals as long as the wound contains necrotic tissue, since only transient passive immunity is obtained with antitoxin. If the patient has had tetanus toxoid, he should receive a 1 cc booster dose.

9. A retention catheter should be inserted and an hourly urine volume record kept for 24 hours, after which output may be recorded in 8 hour periods. An initial urinalysis should be made and repeated in 12 hours.

10. A complete intake and output record of fluid intake and output should be maintained.

11. Initial prophylactic systemic antibiotic treatment for prevention of invasive hemolytic streptococcus infection should be started in the form of aqueous sodium penicillin G 250,000 to 500,000 units intramuscularly or intravenously every six hours for five days. In patients with hypersensitivity to penicillin and in those with the possibility of respiratory tract involvement a broad-spectrum antibiotic is indicated or sulfonamides. Thereafter specific antibiotics should be prescribed according to wound and blood cultures.

12. For medical records, research information, and also possible insurance reports for the patient, it is important to obtain an admission photograph, a careful history and a general physical examination as soon as possible. The distribution of burns should be charted on a standard or improvised diagram. If it is necessary to transfer acute burn patients

to other hospitals, transportation should be arranged in the early period, preferably before 24 hours for those with lesions involving 25% or more of the body surface. Preliminary resuscitative measures should be carried out prior to moving the patient and also en route, and skilled professional personnel should accompany the patient. If immediate transportation is not feasible patients should not be moved for great distances until after the general condition is stabilized - at least 3 or 4 days. It should be remembered that those with lesions of 70 to 90% rarely survive, and palliative measures only may be indicated, especially in aged persons.

#### Local Therapy and Dressings, Acute Phase

Immediate care of the local burn should never take precedence over supportive therapy. The following regimen may be followed:

1. Gross dirt and adherent clothing should be removed with aseptic precautions, and the patient should be put to bed on clean (preferably sterile) sheets following initial sedations and appropriate intravenous therapy. The surface of chemical burns should be flushed with copious amounts of water and, if possible, neutralizing fluids.
2. Temperature and humidity control of the immediate environment is extremely important, since chilling by drafts produces shivering. Unduly warm room temperatures combined with dressings may produce hyperpyrexia in the extensive burn.
3. Exposure therapy is preferred for areas in which dressings are

technically difficult, e. g., the face, neck, axilla and perineum, and for burns limited to one surface of the body in which maximum exposure may be obtained by simple positioning of the patient. The Circa bed or Stryker frame are of value in the treatment of circular burns. If cover is needed, sheets and other bed clothing may be suspended on metal frames or gauze supports. The patient may be placed upon a dressing pad for treatment of circular lesions of the trunk or extremities, or standard layered occlusive dressings may be applied.

4. Severe burns of the hand are treated routinely with a bulky boxer-glove type dressing with the fingers separated by fine-mesh grease gauze, the thumb brought around in opposition, the wrist cocked up, and the meta-carpo-phalangeal joints placed in the position of function with a light splint or gauze molded into the palm. Dry fluff gauze is inserted into the web spaces and over the hand. This is held in place by elastic bandage and continuous elevation is maintained.

5. In circular burns of the trunk or extremities, in uncooperative patients or according to the personal preference and experience of the physician, occlusive dressings may be employed in lieu of exposure therapy at the time of hospital admission. These are generally applied over the fine-mesh gauze, dry or impregnated with petrolatum, glycerine or hygroscopic carbowax, or other material to promote absorption of wound exudates. This inner layer is then covered with a thick layer of fluffed gauze held in place by an elastic supportive dressing. Unless there is evidence of local infection or other complications, the initial

bandages should be left in place for 7 to 9 days.

6. In lesions treated by the open method the eschar should be inspected daily to detect cracks or moist areas at junctions with normal skin or in flexion creases. These should be covered with small patches of fine-mesh gauze cut to fit the defect, (avoiding overlapping onto normal skin) and moistened with saline to make them adhere. Loose crusts over healed second degree burns may be allowed to fall off spontaneously or may be picked off carefully with forceps (6 - 8 days). In circular burns of the extremities or thorax the entire area or distal part must be watched closely for evidence of circulatory or respiratory impairment in the early post burn period, and relaxing incisions should be performed aseptically if required on the thorax or extremities.

#### Supportive Therapy, Subacute and Later Phases.

On the third or fourth day, as patients enter the subacute phase, mobilization of edema fluid begins and oral alkaline solutions are now discontinued. A careful evaluation should be made of the patient's general condition, and by this time the hematocrit and hemoglobin estimates are more suitable indices for gauging fluid and blood requirements than initially. Many patients now require frequent or even daily blood transfusions to combat the secondary anemia which develops. On the average, 1 cc of blood per day for each 1% of body surface involvement will be required throughout hospital stay to maintain the hemoglobin at 12 grams or over.

By the end of the first week intensive feeding may be initiated to meet the needs for red cell regeneration, tissue repair, liver protection, and increased vitamin requirements and to supply additional calories in response to accelerated metabolism. Forced feeding may be accomplished by administration of supplementary nourishment prepared with palatable high-protein concentrates in a milk-base. The more severely burned patients should receive high-protein, high caloric formulas (1000-2000/ quart of liquid) administered through an intragastric polyethylene tube, by drip or syringe feeding. It is recommended that 2 to 4 grams of protein per kg of body weight be administered for a period of 4 to 6 weeks by a combination of house diet and nutritional supplements.

Integral parts of the program of supportive therapy in severely burned patients are the institution of bed exercises to avoid bone and joint lesions and the maintenance of high morale by constant nursing attention, visits from the staff and others, and diversional therapy.

#### Local Wound Care in Preparation for Grafting

The subacute or chronic full-thickness burn admitted following loss of burned tissue will require dressings, and exposure therapy in these instances is contraindicated. A modified exposure technique or "semi-open" method, however, has been developed to replace more conventional types of occlusive dressings. This consists of a single layer of fine mesh gauze over any raw area as the only covering bandage.

In many centers burn dressing procedures have been simplified

considerably by cleansing of all areas with detergent solutions and water spray, which serve not only to remove adherent dressings and to wash lesions of necrotic tissue, exudate, bacteria, etc., but also to carry out debridement in a more thorough manner and with less pain and blood loss than with older methods, including debriding agents and mechanical excision. Following a careful rinsing, all areas are blotted dry, and raw areas are covered with a patch of fine-mesh gauze. Beginning with the eighth or ninth day, cleansing is carried out in the operating room two or three times weekly until the patient is ready for grafting or healing has occurred.

To expedite mechanical cleansing a hose and nozzle spray have been devised by the group at Texas, and this apparatus has been employed with both canvas and plastic tube equipped with a funnel-drain or with a converted bathtub for drainage of water.

### Grafting Procedures

The first grafting procedure usually should be carried out as soon as an area suitable in extent is ready, provided that the patient's general condition is satisfactory. It is not generally possible to graft more than 25% of the body surface at one time. The face, hands, and the flexion joint creases should have first priority.

Where possible, split-thickness transplants should be applied in continuous sheets, and, if sufficient donor skin is available, the dermatome calibration should be set for .007 to .10 inch. If a second crop of grafts

must be taken from the same region within two or three weeks, however, thinner grafts of about .006 to .008 inch should be used. Preferably, donor sites should be on the same side of the body as the prospective grafting areas to simplify patient handling.

Donor areas should be covered with a single layer of fine-mesh glycerinized gauze, which is left in place and protected from moisture during dressing procedures until healing occurs. Grafts may be left open with one-layer patches of gauze placed over raw areas between, or conventional occlusive dressings may be applied. The first dressing change, which is identical to that carried out in the pre-grafting phase, should be scheduled about four or five days after surgery and every other day thereafter until time for subsequent grafting procedures or until the patient is covered with skin except for small, unhealed areas. At this time hydrotherapy in tubs or the Hubbard tank may be substituted, and the patient is now ready for a more active program of physiotherapy.

The problem of permanent homograft take except with identical twins or in cases of agammaglobulinemia is still unsolved. However, there is a trend toward greater use of homografts as "biological dressings" in patients with third degree burns of 50% or more, especially as a supplement to autografts.

Early excision-and-grafting is not indicated except in well-demarcated full-thickness burns of less than 20%. Excision in stages of more extensive lesions is being evaluated at a number of centers but has not

been adopted for general use.

### Infectious Complications

Local infections complications in burns are best controlled by a program of meticulous mechanical cleansing. All attendants should observe scrupulously hospital rules for thorough washing of hands between patients, and those who are known carriers or disseminators of strains of antibiotic-resistant organisms should be excluded from the wards, dressing and operating rooms.

Burn septicemia occurs rarely during the first few days and after granulation tissue has formed, but it is a great hazard to the intermediate period, and invasive infection occurs in relation to the total extent of burns, to factors of host immunity and to virulence and actual numbers of pathogens present in the burn wound. Chemotherapy for *Pseudomonas* septicemia is particularly unsatisfactory, and this complication is almost invariably fatal.

Death from infection occurs often as a terminal phenomenon in patients with burns above 50% or other critical levels of body surface involvement and in those who must be classified as poor risks because of age, obesity, associated disease and inadequate therapy from initial burn shock.

### Definitive Surgery

It is recommended that patients be discharged from the hospital for at least six months to eight months following primary coverage of burn

wounds with skin and healing of residual defects between grafts before attempting definitive surgery. This time lapse is necessary to provide for change in bacterial environment, for maturation of scar tissue, for psychological reasons, and to achieve metabolic stabilization before relief of functional and cosmetic deformities.

## APPENDIX II

## USE OF POLYETHYLENE BAGS AND TWIST TAPES

It is our belief that the most satisfactory type of emergency dressing for wounds limited to the extremities, from the standpoint of cost, accessibility and protection in time of need is the polyethylene bag commonly employed for bagging of shirts and clothing by cleaners and laundries and printed with warning against use on the face. These may be secured quickly with twist tape (paper over wire) which is available in 4" strips. Both of these products may be procured through paper product, cleaning-product, and other supply houses in cities of even moderate size in fairly large quantities.\* In emergencies, local supplies could be obtained also from cleaners and laundries, and the tape is also obtainable in fairly large quantities at the florist shops, nurseries, and florist supply houses. As substitutes, bags of various sizes are sold in super markets, variety stores and in department stores for general household use and for frozen food packaging.

Investigation of several sources in our area has revealed a Kordite Company bag, manufactured in Macedon, N. Y. with 10 x 15 (GL21550) and 10 x 16 sizes for shirts packaged 100 per Quick-Pack (with a cardboard backing), 2,000 per case (weight 13 lbs.) at approximately \$10.00 to \$12.00 (or \$8.00 to \$6.00 per thousand). Although it is a little wide,

\*For example, a small "laundrette" checked recently had on hand more than 15,000 each of all sizes.

this size is suitable for application of the hand and arm and on the foot, and may be secured satisfactorily with twist tape (one manufacturer Old Hickory Mfg. Co., Old Hickory, Tennessee as "Economy Ties." These ties, which are packaged 2,000 per box and 10,000 per case have a retail price of 95¢ per thousand in quantity lots).

Both 10" by 16" and the 21" x 36" bags supplied for men's suits are available in perforated rolls, the former 3,000 per roll at \$10.65 wholesale (\$3.55 per thousand) and the latter at 1,000 per roll at \$13.65. These have perforations which may be torn apart easily without the use of scissors or cutting instruments. They are both packaged flat, shirt bags at \$6.00 per 1,000 and suit bags at \$21.70 per 1,000; figures for the latter two were obtained from representatives of the Mehl Manufacturing Company, 2157 Reading Road, Cincinnati 2, Ohio; There are probably numerous sources of supply throughout the country and even better prices could be obtained for defense purposes. Dress bags in 21" by 54" sizes are available also, but these we believe would be difficult to handle for coverage of the trunk and lower extremities, and if other covering were available it should be used on these patients, since these do not hide lesions from public view although the transparency of protective coverings for the hands and lower extremities has a great advantage in enabling medical personnel to make rapid secondary triage of burns and other lesions.

It is possible for the hand to be moved inside the bag very satisfactorily and for the wound to be visible and yet protected from contamination

prior to definitive treatment. Incidentally, this type of material is similar to that employed by the British Military for defense purposes, as a glove. There is also available, as yet on a very limited basis in this country, a roll of disposable plastic gloves of polyethylene which may be obtained through department stores. It would be eminently satisfactory for use on the hand alone but would probably not be available in sufficient quantity for disaster purposes as an emergency dressing or glove unless stockpiled in advance.

The 10 x 16 size of shirt bag, although a little wide for the hand and arm, we believe to be the most useful size for collection of urine and, as mentioned, feces under emergency conditions and for emesis collection. For these purposes it is recommended that two bags be used together for greater strength and protection against minute perforations and that bags be placed as quickly as possible in the disposal area after closing with tape.

Patients with injuries involving more than flash burns of the upper and lower extremities and of the face and neck may be covered with bed, table and kitchen linens, diapers, etc., either wrapped around loosely or adjusted as improvised dressings. For stockpile purposes local groups should contact department stores (white piece goods) and supermarkets with regard to their available stocks, and the textile industry should be asked to furnish locations of mills and warehouses where cloth products are ordinarily stored and to estimate quantities available. We believe that the equivalent of one single sheet in surface area should

be stockpiled per person in the form of miscellaneous linens to be utilized for emergency dressings, and that the equivalent of a second single sheet and safety pins be stockpiled for clothing for patients coming into a shelter or hospital area who must be decontaminated prior to examination.

## APPENDIX III

## AIRWAYS FOR FIRST AID USE

Because of the likelihood of severe face burns followed by edema of the pharynx and other conditions accompanied by a respiratory distress, it is strongly recommended that some sort of simple airway be stockpiled. A very useful device is a tube of stiff plastic (or rubber) material, approximately six inches long and about one and a half centimeters in diameter. This may be placed through the nose into the naso-pharynx or through the mouth into the pharynx. It should be used with a large safety pin placed across the exterior end to prevent its slipping into the throat. An improvised airway has been recommended in the Manual for Self-Care, employing a teaspoon in the mouth with the rounded part pressed against the tongue. A satisfactory airway can also be made with two tongue blades taped together at an angle or with equivalent materials.

## APPENDIX IV

## RATIONALE FOR FLUID THERAPY

The Austerity Handbook recommends the Evans formula (1 cc each of saline and colloid x wt. in Kg x per cent of involvement) which requires twice as much colloid as the Brooke modification (1 1/2 cc of saline and 1/2 cc of colloid x wt. in Kg x per cent of involvement). Since most burn centers now employ the Brooke formula and because of stock-piling difficulties with plasma and dextran, it is therefore recommended that the latter be employed as a general guide, at least in shelters. The following overall plan is suggested on the basis of 1 cc x wt. in lbs. x per cent, converting Kg to pounds for simplification and changing 2 cc to 1 cc to avoid using 1/2 of the body weight in calculations in pounds.

1. Ordinary Fluid Requirements

All patients require fluids in the form of drinking water, beverages, fruit juices, milk and other foods containing water in the following amounts per 24 hours:

- |                                 |  |
|---------------------------------|--|
| a. Infants up to 1 year .....   | 200 - 500 cc or approximately<br>1/2 to 1 pint |
| b. Children up to 12 years..... | 500 - 1000 cc or 1 pint - 1 quart              |
| c. Adults .....                 | 1000 - 2000 cc or 1 - 2 quarts                 |

2. Replacement Fluids

Allied health personnel should be made aware of the fact that, although

the above amounts supply ordinary body needs, including so-called insensible water loss from normal perspiration, water in air expired from the lungs, etc., and water lost in the urine and from the bowel, requirements are greatly increased as a result of heat, fever, exercise and other conditions. When abnormal losses of fluid occur externally from profuse sweating, vomiting, diarrhea, hemorrhage or loss of plasma through a large severe burn or internally, as in shock and in the collection of edema fluid in burns, supplementary water and chemicals must be administered to overcome the deficits. Solutions which are given to relieve these conditions are called replacement fluids. These include salt-soda solution by mouth, Ringer's lactate, intravenous 0.9% saline (commonly called isotonic or "normal" saline), dextrose in saline, plasma and dextran, and colloid solutions, that is, plasma expanders, blood and blood derivatives.

### 3. Salt-Soda Solution

If large quantities of plain water without additional chemicals are given to severe burn patients or to others in shock, their condition will be aggravated by the development of nausea, vomiting, restlessness, delirium and even unconsciousness. For this reason a weak salt-soda solution has been recommended as a replacement fluid for self-care and for hospital use during the first 48 hours in patients with severe injuries and especially in those with extensive burns of 15% or more. If desired, 1/4 teaspoon of salt and 1/8 teaspoon of soda (a small pinch) may be dissolved in a small amount of water first or a special salt-soda

tablet may be taken, after which the patient should drink a glass of water. Tea, coffee, soft drinks, soup, liquids drained from canned goods, or milk, fruit juices, etc. from food stocks may be used in place of water with this method. Milk and fruit juices are less desirable but may be employed in an emergency.

Salt - soda solution is commonly employed as a supplement to intravenous therapy of major burns in hospital practice, but it is not very palatable unless kept cold, and patients do not tolerate extremely large amounts well. In a disaster situation, however, efforts will have to be made to substitute oral for intravenous therapy in the majority of patients with extensive burns.

## APPENDIX V

SUGGESTED SUPPLIES WITH REFERENCE TO AUSTERITY BURN  
THERAPY PROGRAM

A. The following supplies are indicated for the simplified, standardized plan of austere care of burns as outlined:

For Shelter and First-Aid Stations (assuming areas to which burned patients would come or be brought for care)

- a. Water-adequate amounts for ordinary drinking water; extra fluids for 24 - 48 hours, rinsing of wounds.
- b. 1 sheet per person for clothing; the equivalent of 1 sheet in area for improvised dressings; scissors; sewing kits; safety pins; adhesive tape.
- c. Emergency Protective Dressings: polyethylene bags,\* twist ties, rubber bands; also wax paper, aluminum foil, other paper may be substituted.
- d. Detergent solution or soap (may be household soap flakes); rubbing alcohol.
- e. Salt and sodium bicarbonate in bulk with measuring spoons or salt and soda tablets.
- f. Paper cups or other containers for drinking water to accompany salt and soda medication.
- g. Aspirin, 5 grain tablets; children's aspirin, 1 1/4 grain tablets; hard candy in medications area.
- h. Phenobarbital, 1/2 grain tablets.

\*To be employed as dressings for hands and feet - 2 sizes; also as gloves; also to cover contaminated hair; also to wrap clothing and contain personal effects; doubled, for emesis, collection of urine and feces, soiled clothing and other waste; also as diaper covers.

- i. Sulfadiazine tablets gr 7 1/2; oral penicillin; broad-spectrum antibiotics.
- j. Plastic airways (with safety pin across end)
- k. Plastic or other basins for washing hands and collection of rinsing water; plastic waste baskets or scrub buckets; cellulose sponges; containers for pouring water.
- l. (Tetanus immunization as available; morphine or codeine as available).
- m. Intravenous fluids as available, complete with sets for administration: Ringer's lactate, isotonic saline, or dextrose in saline; colloids as available.
- n. Tags and record forms (tongue blades may be substituted); paper; clipboards; ballpoint pens; flash lights; whistle; folding megaphone; thermometers; watch with second hand; stethoscope; burn cards or stamp and pad; log book; rope; folding table (if possible); arm bands; diagrams of Rule of Fives; adhesive tape (for identification tapes); instruction booklets; paper clips, rubber bands; spare reading glasses for presbyopic allied health personnel.
- o. Diversional material for patients, particularly children, if possible (comic books, in particular).

APPENDIX VI

SUGGESTED BURN CARD

<p style="text-align: center;">Name _____</p> <hr/> <p style="text-align: center;">Address _____</p> <p>Age _____ Sex: M <input type="checkbox"/> F <input type="checkbox"/></p> <p>Wt. _____ lbs. (estimate)</p> <p>Location at time of injury: _____</p>	<p style="text-align: center;">Distribution of Burns - Percentage</p> <div style="display: flex; justify-content: space-around; text-align: center;"> <div style="width: 30%;"> <p>Infant</p> </div> <div style="width: 30%;"> <p>Child (5)</p> </div> <div style="width: 30%;"> <p>Adult</p> </div> </div>		
<p style="text-align: center;">Cause of Burn</p> <p>Flash <input type="checkbox"/>      Chemical <input type="checkbox"/></p> <p>Flame <input type="checkbox"/>      Other _____</p> <p>Scald <input type="checkbox"/>      _____</p>	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <p style="text-align: center;">Percentage</p> <p>Less than 10% <input type="checkbox"/></p> <p>10% - 20% <input type="checkbox"/></p> <p>20% - 30% <input type="checkbox"/></p> <p>30% - 40% <input type="checkbox"/></p> <p>Over 40% <input type="checkbox"/></p> </td> <td style="width: 50%; vertical-align: top;"> <p style="text-align: center;">Other Injuries</p> <p>Minor <input type="checkbox"/></p> <p>Major Soft Tissue <input type="checkbox"/></p> <p>Avulsion wounds <input type="checkbox"/></p> <p>Fractures <input type="checkbox"/></p> <p>Head Injury <input type="checkbox"/></p> <p>Penetrating wounds <input type="checkbox"/></p> <p>Eye Injury <input type="checkbox"/></p> <p>Other _____</p> </td> </tr> </table>	<p style="text-align: center;">Percentage</p> <p>Less than 10% <input type="checkbox"/></p> <p>10% - 20% <input type="checkbox"/></p> <p>20% - 30% <input type="checkbox"/></p> <p>30% - 40% <input type="checkbox"/></p> <p>Over 40% <input type="checkbox"/></p>	<p style="text-align: center;">Other Injuries</p> <p>Minor <input type="checkbox"/></p> <p>Major Soft Tissue <input type="checkbox"/></p> <p>Avulsion wounds <input type="checkbox"/></p> <p>Fractures <input type="checkbox"/></p> <p>Head Injury <input type="checkbox"/></p> <p>Penetrating wounds <input type="checkbox"/></p> <p>Eye Injury <input type="checkbox"/></p> <p>Other _____</p>
<p style="text-align: center;">Percentage</p> <p>Less than 10% <input type="checkbox"/></p> <p>10% - 20% <input type="checkbox"/></p> <p>20% - 30% <input type="checkbox"/></p> <p>30% - 40% <input type="checkbox"/></p> <p>Over 40% <input type="checkbox"/></p>	<p style="text-align: center;">Other Injuries</p> <p>Minor <input type="checkbox"/></p> <p>Major Soft Tissue <input type="checkbox"/></p> <p>Avulsion wounds <input type="checkbox"/></p> <p>Fractures <input type="checkbox"/></p> <p>Head Injury <input type="checkbox"/></p> <p>Penetrating wounds <input type="checkbox"/></p> <p>Eye Injury <input type="checkbox"/></p> <p>Other _____</p>		