Hospital Disaster Planning and the Flat Rock School Fire

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HOSPITAL DISASTER PLANNING AND THE FLAT ROCK SCHOOL FIRE

It will take only one small group of catastrophe patients to convince any hospital staff of the importance of disaster planning and organization. Much attention has been given recent catastrophes in lay and medical literature. The explosion in Texas City, the tornado in Worcester, Massachusetts, the hurricane along the Gulf coast, and even the recent food poisoning episode in Marion, North Carolina, are apt illustrations.

Colonel Joseph R. Shaeffer, M.C., consultant on Medical Care in Disaster at the Walter Reed Army Medical Center, in repeatedly emphasizing the need for civilian disaster planning, has said: "Let me give you ten severe burns, and I will disrupt your hospital." We thoroughly agree.

On February 22, 1957, at approximately 2:30 P.M., the Flat Rock Elementary School in Surry County near Mount Airy, North Carolina, burned to the ground. One child was burned to death in the building, and numerous others received burns of various extents.

The North Carolina Baptist Hospital in Winston-Salem, 40 miles away, received a telephone call that the fire had occurred and that as many as 150 severely burned children might be sent to us. Fortunately for us, a disaster planning committee had developed and submitted a first draft of a disaster plan for this hospital. This included provision for notification of personnel and staff, designation of various treat-

ment centers, and appointment of a triage officer and surgical teams. Also included were plans for identification of victims, dealing with relatives and the press through an information center, handling of blood donors, assignment of nurses and non-professional personnel, procurement of supplies that would be needed, and discharge of in-patients to make room for victims.

Instead of the anticipated maximum of 150 children, only 12 casualties were seen. Eight children and one teacher were admitted to this hospital for treatment, 3 other children receiving out-patient care.

Even with such a small number of casualties and a tentative disaster plan, there was still a great deal of confusion and numerous deficiencies were noted.

Our experiences and observations during this time may be discussed under three headings: triage or sorting, treatment of burns, and the cost of medical care.

Triage

Sorting is certainly the key to efficient management of more than a few patients, so that the greatest good can be given to the greatest number.

This process should begin at the scene of the disaster. The physician first on the scene must not become involved in rescue operations or immediate treatment of victims. His duties are those of a triage officer —namely, evaluation of (1) what has happened, (2) how many people are involved, and (3) the probable extent and types of injuries. He should select patients for disposition according to the extent of their in-

juries and dispatch them to the available treatment centers, using lay volunteers as aides for emergency work and evacuation. He should notify the receiving hospital, giving the above information and also the estimated time of arrival of patients.

One of the Mount Airy physicians, Dr. T. C. Britt, on finding his office suddenly jammed with victims and their relatives, alerted this hospital, prepared his station wagon as a mass ambulance, ordered his nurse to give morphine, and advised others to bring the seriously burned here. His call, and another from the State Highway Patrol, gave us about 45 minutes to prepare to receive the victims.

The Disaster Committee, upon receiving the alert, attempted to put the plan into action, realizing that all personnel had not been indoctrinated in their duties.

By 3:30 P.M., when burned patients began to arrive in automobiles and ambulances, the personnel of the hospital had been alerted and were in the emergency area. In the meantime the operating room had been cleared, the housekeeping department notified, and extra linens prepared. The engineering and housekeeping departments together were setting up beds in a ward which had been temporarily closed, and the out-patient department had been alerted to receive critical patients along with the emergency room.

For an hour or so there was much confusion. Many doctors, nurses, aides, orderlies, housekeepers, engineers, medical students, chaplains, and dietitians were milling around, wanting to help but not know-

ing how. The assigned triage officer was not present, and no one knew who was taking his place. The Disaster Committee members present assumed authority, but communications were inadequate for several obvious reasons. The Committee had no set headquarters at which to receive information and from which to direct personnel. And even if they had, the idle personnel were not in an assembly area apart from the receiving area. It would have been like yelling across a crowded football stadium to try to get an individual's attention.

Actually, there was no real delay in starting treatment for each victim, since sufficient space, equipment, and supplies for the 12 were available in the emergency room area, and enough regular house staff were present to give each individual initial attention.

It was obvious, however, that more than 15 or 20 victims would have inundated the regular areas, and there would not only have been much delay but also much worse confusion in preparing another site, the cafeteria, as a receiving area, and in securing necessary supplies.

No sorting was done, but should have been. Three victims with only 5 per cent of the body surface burned were at first admitted. These burns should have been dressed and the patients discharged from the initial treatment area.

The director of pediatrics did a rapid and efficient job of discharging and removing in-patients from the children's ward so that all victims except the adult could be admitted to one ward. He and his staff were

then of much help in identifying casualties and in talking with parents and others at the information center.

The information center was of great value; its importance in maintaining good family and press relations and in keeping treatment areas free of unnecessary traffic was amply demonstrated.

In summary, our experiences with this disaster and in a subsequent, simulated disaster emphasized the fact that, in addition to a written disaster plan, the following steps are necessary before an institution can consider itself prepared to care efficiently for any casualties above its normal emergency room capacity:

1. Specific assignment by name of permanent personnel to duties, and periodic and specific orientation of changing personnel (interns, nurses, and so forth) to their work assignments with the permanent personnel. Alternates should be assigned for each duty.

2. Discussion and agreement by the medical staff, in advance, on principles and policies of sorting and of treatment of various types of injuries (for example, open therapy of burns, debridement of wounds, and so forth). Estimates and storage of adequate supplies cannot be realistic until this is done. Treatment center officers must aid in this planning and stockpiling. Nonsurgical specialists need and are grateful for this orientation.

3. A drill session with simulated casualties (and simulated relatives). Only in this way can efficiency in all phases be perfected

in advance of the need. Defects in details of external and internal traffic, of communication controls, and of supplies will become glaringly evident. The greatest value of such a session is the realization by all personnel of the chaos that could exist without a rehearsed plan. Short of a real disaster it is the best missionary tool for any disaster planning committee. The enthusiasm and cooperation of all personnel will rise rapidly and steeply.

Treatment of Burns

Although there was no delay in starting therapy on each of the 12 casualties, early treatment of the burn wounds initiated by separate physicians showed the lack of an over-all policy of efficient handling and conservation of time and supplies. In one patient with 70 per cent of the body surface burned, debridement was done under general anesthesia within an hour of arrival. In another patient with 50 per cent of the body surface burned, debridement was done without anesthesia and a massive occlusive dressing applied. Other wounds were minimally debrided and treated by the exposure method.

As mentioned above, a pre-arranged plan for the immediate care of specific types of casualties is an important phase of disaster planning. The diversified methods of treatment used by us initially definitely testified to the need for pre-planning of treatment at each treatment center.

Acute phase

It became evident that except for the severely burned adult teacher, all

these patients could be handled in one pediatric ward. The definitive care of the burned patients was assigned to the authors as a team. This was thought advisable in order to assure uniformity and continuity of care as well as to avoid duplication of effort. Responsibility for orders must rest with one man or team. Consultation is permissible, but orders based on clinical judgment of each case must come from one source. This required about 72 hours of continuous duty, a trying experience. If we had had more patients, a second burn team would have been necessary.

The general plan of care was as follows: Indwelling polyethylene catheters were inserted into ankle veins for intravenous therapy. Blood was secured from peripheral veins for typing, crossmatching, and determination of hematocrit, hemoglobin, and blood counts. The least critical veins were used immediately. Indwelling urethral catheters were routinely inserted. Body weights, if unknown, were estimated and fluid therapy instituted. Burned areas were debrided by excision of loose skin. Unbroken vesicles were left intact, but if they became broken, they were debrided. Phisohex was used for cleansing. Sterile gauze sponges were used and no brushes were employed. All personnel wore masks. Sterile gloves and sheets were used, and sterile technique was observed as far as possible.

The open method of treatment was elected in preference to the time-consuming application of cumbersome and costly dressings. Bed cradles were used to prevent sheets from sticking to burned areas, and

sterile sheets were used when available. The extremities were placed in positions of function in anticipation of the splinting function of eschar formation. Efforts were made to support the extremities, thereby preventing cracking of the eschars.

Dependent areas in contact with the bedclothes, however, rapidly became wet and required the frequent changing of sheets. Telfa* pads were placed in direct contact with the burned areas. These were easily removed and tended to minimize pain at the time of changing of the dressings. Patients showing any degree of thermal conjunctivitis were treated with Neo-Delta-Cortef ophthalmic ointment.

Fluid therapy was instituted, using a modified Evan's formula: 1 cc. of fluid per pound of body weight per 1 per cent of body surface burned. For example, a 70 pound child with a 40 per cent burn required 2,800 cc. of fluid, consisting of 1,400 colloid and 1,400 electrolyte, plus a basal maintenance—for example, 500 to 1,000 cc. of 5 per cent glucose in water. These figures were rounded out to the nearest 500 cc. because of standardization of commercial fluid containers. All burns, regardless of degree, were treated as though they were of third degree. The extent of body surface burned was rounded out to the nearest 5 per cent; for example, 41 per cent was considered a 40 per cent burn.

During the early phase of anti-shock therapy an hourly urinary output of 25 to 30 cc. was considered satisfactory for these

*Telfa Pads, Bauer and Black, Chicago, Ill.

younger patients. Urinary specific gravity and urinary chloride (determined by the Fantus test) were determined hourly. These were only of slight supportive value in management. Dextran seemed to cause fluctuations in the specific gravity within one-half to one hour following administration, the reading being as high as 1.060 with a very light colored urine. Those with a normal or near-normal urinary excretion of chloride seemed to respond later in their clinical course than those with decreased urinary chloride values.

For those with burns covering up to 30 per cent of body surface, hemoglobin and microhematocrit determinations were secured by ear or toe puncture techniques every four hours. For burns greater than 30 per cent these determinations were made every two hours day and night until 24 to 48 hours following the onset of diuresis.

The hourly urinary output and the hemoglobin-hematocrit values were the most helpful laboratory data secured. Actually no blood chemistry determinations were made until the fourth to seventh day of hospitalization, and these were remarkably well within normal ranges.

Whole blood was used during the first 12 hours and then plasma and 6 per cent Dextran in saline were used. The Dextran was used electively during the first 12 hours in the less severely burned patients.

In many of these patients, only the veins at the ankle and foot were available for the repeated intravenous injections that were needed after the original intravenous catheters had become occluded. It was possi-

ble to perform open phlebotomy using incisions of 0.5 to 1 cm. in length. A piece of polyethylene catheter was inserted through a small nick in the vein as one would insert a needle, without the use of ligatures. This method permitted the smaller veins to be satisfactorily punctured without sacrificing the larger tributaries, thus decreasing the incidence of thrombosed veins from poor punctures or extravasations from movement of extremities by the patient. Scalp Vein Infusion Sets* (hubless needles attached to plastic tubing) became invaluable in preserving veins, and were used for both electrolyte and whole blood infusions. A syringe was needed to force adequate volumes of blood through these small sets. By this method concentrated serum albumin was administered daily or on alternate days to severely burned patients in an effort to maintain plasma albumin levels.

Contrary to certain ideas presented in the general literature, the early feeding of burned patients is much more easily said than done. The more extensive the burn, the less readily does the patient tolerate oral fluids. Generally, burn patients commence taking fluids on the second or third day, but sometimes later in their hospital course. Nasogastric suction may become necessary at times to combat ileus during the acute phase.

Nursing care

The nursing care of these patients was most demanding for weeks because of the extent of second and third degree burns in-

*Scalp Vein Infusion Sets: Abbott Laboratories, North Chicago; and Mead Johnson and Co., Evansville, Indiana.

volving the face, neck, and hands. Many could neither see, feed themselves, nor care for their personal needs. Constant 24 hour care was necessary not only to manage the intravenous fluids, measure urinary output, and maintain the extremities in a satisfactory position, but also to allay the fears of these young patients.

It was found advantageous to have circulating nurses or ward aides bring nourishment, drugs, and sickroom supplies to the rooms rather than have the special nurses leave their patients. It was felt that this method entailed less risk of infection than having the special nurses trying to supply themselves from some central source.

It was necessary to put two patients in each room, and, depending on the severity of the burn, to assign two special nurses to the room. It was most interesting to note the effect of the two patients upon each other in boosting morale. Each sympathized with and encouraged the other, and both showed an intense interest in the welfare of other classmates on the ward. All these children developed an intense *camaraderie* engendered by having gone through the same trying and painful experience, and they in turn were considered heroes by their more fortunate classmates and schoolmates who were not seriously burned. Months later when most of these children, even with markedly deformed features, had returned to school, they were accepted by their classmates and not subjected to the cruel derision and ostracism which often occurs when a lone victim of a fire returns to his community.

Despite the extensive face and neck burns of these patients it was necessary to perform only one emergency tracheotomy, that on the severely burned adult. She died on her sixth day from extensive respiratory tract burns, in addition to burns affecting 70 per cent of the body surface. Two elective tracheotomies were performed, one on the fourth day and another after the first month. The first was thought advisable because of extensive face burns, laryngeal stridor with respiratory distress, and some difficulty in swallowing; and the other was necessary for adequate control of anesthesia during grafting upon the face. Another patient coughed up sooty, blood-stained sputum for four to five days following the burn, but there was no other respiratory distress. Another patient with extensive second degree burns of the face seemed to be a candidate for a tracheotomy on his third day when he became strangled, but after expectorating two large ascaris worms, he had no further difficulty.

Therapy in later phases

By the end of the first week the acute phase was over, and the patients entered the phase of sloughing and healing. Surface infection was inevitable, and antibiotics were given in rotation in an effort to control sepsis. In our efforts to get raw areas covered as rapidly as possible, it was necessary in several cases to graft the upper arms before the third degree sloughs had begun to loosen on the forearms and hands. This required immobilization of both areas in the same dressing; yet for-

Table 1
Summary of Patients

Case No.	Age	Sex	Initial hospital days	Per cent body surface burned	Units blood*	No. operations	Anesthesia time hrs.	Anesthesia time min.
1	9	F	248	70	17	20	56	30
2	10	M	244	50	27	15	40	10
3	10	F	68	50	3	3	10	50
4	8	M	117	30	8	10	33	30
5	11	M	50	30	2	2	6	15
6	10	M	61	25	3	4	14	30
7	10	M	21	15	0	1	3	30
8	8	M	19	15	0	1	1	25
9**	53	F	5	55	5	1		
10	9	F	out-pt.	5				
11	10	M	out-pt.	5				
12	10	M	out-pt.	5				
Total								
Total								
12 patients			833		65	57	169	40

*Exclusive of Dextran

**Also received 1000 cc. plasma. Had tracheotomy. Died of respiratory burns

tunately most of the grafts, many of small, postage stamp size, survived even in a sea of purulent secretions from contiguous areas. At subsequent dressings, performed under anesthesia, further debridement was done; and, where possible, a period of wet soaks was used on the granulating surfaces for several days prior to the grafting of these areas.

Sites for donor skin were carefully guarded, and very thin grafts, 0.012 inches in thickness, were taken, so that these donor sites could be used again after three weeks. Many areas were used three times, and a few, four times.

In the most severely burned, repeated whole blood transfusions were necessary to

maintain and support healing. Failure of grafts to take or donor sites to heal was an indication for more vigorous protein therapy in the form of forced feedings and blood and albumin transfusions. Although total serum protein values were maintained at more than 5.5 Gm. per 100 cc. of serum, the albumin fractions were in several instances less than 2 Gm., the globulin fraction being significantly increased to more than 4 Gm.

Homografts from the father of one quite toxic patient were applied five weeks after the burn because neither donor nor grafted areas had healed. The patient improved noticeably and most of the homografts survived four weeks, 50 per cent five weeks, but none as long as six weeks. During this time older donor sites healed and fresh autografts were successful.

The two must severely burned patients were in critical condition for three months. By the fourth month all the patients were out of danger and progressing satisfactorily. It was most encouraging as patient after patient, after a grafting procedure, suddenly became less toxic, ate better, and began healing rapidly.

Summary of data

Figure 1 summarizes the significant data from these patients during their initial hospital stay. It is of interest to note the differences between each of the patients having 50 per cent of the body surface burned and of those with 30 per cent burned. Those having a preponderance of third degree burns stayed in the hospital longer,

Table 2

Cost vs. Insurance Coverage
9 cases (850 patient days)

Hospital charges	$19,516.61
Nurses fees	21,809.00
Total	$41,325.61
Insurance paid hospital	$17,775.84
Insurance paid doctors and nurses	5,096.55
Total	$22,872.39

received more units of blood, and underwent more operations in sharp contrast to those having mostly second degree burns.

We feel fortunate that all of the children survived, yet in retrospect we believe that the periods of toxicity and initial grafting might have been shortened in some by more use of homografts and by better local care of circumferential burns with the patients on Stryker frames.

Cost of Medical Care

The expense of the care of these burned patients has so far been staggering. It has entailed not only hospitalization, numerous operations, expensive antibiotics, blood, and so forth, but special nursing care, absolutely essential since the patients were not able to take care of themselves.

The cost of medical care, exclusive of doctors' fees and the amounts paid by all insurance, is summarized in table 2. The Red Cross, from the outset, not only supplied blood, transportation, and other services, but also assumed responsibility for providing all private nursing coverage necessary above that paid for by the various insurance plans. The largest single initial hospital bill was $5,627.15, and the largest

nursing charge for a single patient $9,005.59.

The total expense for plastic reconstruction and rehabilitation for at least 6 of these patients has yet to be determined. The severely burned have been, and will need to be, readmitted many times for staged procedures to release contractures and improve appearance and funtion. A conservative estimate will place this additional expense at about $40,000, making an estimated over-all cost of about $80,000. The Crippled Children's Section of the North Carolina State Board of Health has already cooperated to a great extent in providing for these readmissions.

The school insurance has been a blessing for all of these patients in helping meet the staggering expenses. Fortunately, all of the students were covered by this insurance. Credit should be given to Dr. R. B. C. Franklin, Surry County health officer, to Mr. J. S. Gentry, superintendent of Surry County Schools, and to the Surry County Board of Education for endeavoring to assure complete coverage of all students and teachers, and to the principals and teachers for pushing the program.

Mr. Gentry writes:

> Under the insurance plan offered the Surry County schools by Pilot Life Insurance Company of Greensboro, all of the children of the County schools are covered if 90 per cent of our enrollment takes the insurance.
>
> Realizing that often the ones injured would be the ones that did not have the insurance coverage, the principals and teachers in each school made a special effort to enroll as many as possible in the insurance program. With this special

Table 3

Value of School Insurance
$2,500 Medical Expense for $1.25

Total claims	41 (2 teachers)
Total medical expenses	$19,989.56
Total death benefits	3,000.00
Total all claims	$22,989.56

effort, it was possible to take the blanket coverage for all of the schools of the County. It was understood that where a school did not reach the 90 per cent that the school would underwrite the balance. So far, all of our schools have been able to collect suffiicient fees for this coverage and the insurance program has paid its own way.

At the time of the fire the premium was $1.25 per year for $2,500 medical expense coverage for accidents. Claims paid toward the expenses of 12 patients treated by us totaled $16,771.14. The total amounts for all claimants from this fire paid by school insurance alone was $22,989.56 (table 3).*

Summary and Conclusion

The problems encountered in the management of 12 burned patients from the Flat Rock School fire in Mount Airy re-emphasizes the importance of disaster planning for any hospital. With even this small number of casualties, considerable confusion prevailed initially, routines were disrupted, wards re-apportioned, laboratories overworked, and personnel imprisoned by important routines. Round-the-clock nursing by physician and nurse was required.

Burn therapy is discussed in the light of setting up a uniform system of care of

*Personal communication from J. M. Atwater, Pilot Life Insurance Co.. Greensboro, N. C.

similar patients to prevent duplication of effort and maximum efficiency in care. Three patients were treated as out-patients. The only death occurred on the sixth day. The longest initial hospital stay was 248 days, and the over-all, initial hospital stay for the group was 833 days. Total initial cost of medical care exclusive of professional fees was $41,325. The school accident insurance program paid a total of $16,771.14 toward the care of these patients, and a total of $22,989.56 for 41 separate claims from this one fire.

Our experience with this small group of casualties has done a great deal to crystallize our thinking in planning for catastrophies. We would urge upon every community the necessity not only for making a disaster plan but also for having an actual demonstration or trial run to iron out the deficiencies which will show up in any such undertaking. We feel fortunate that our "baptism by fire" was by a group of casualties small enough to be handled adequately, but large enough to convince us of our need for planning in advance of need.