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Measures of Intervention in Burn Disasters: Preparedness and Crisis Management

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Abstract

Burn disasters are special incidents in that small numbers of casualties rapidly overwhelm available services and resources. Contrary to the previously held hypothesis that people either escape with minor injuries or are killed immediately, a large number of severely burned patients do survive these events and require special medical assistance. To ensure adequate response appropriate crisis management planning and preparedness are required. Mass casualty triage and transport guidelines must be put into practice and coordinated with local, regional and national response plans. Decision-making and use of resources must be precisely tailored to allow the "greatest good for the greatest number". It is also incumbent upon everyone in the healthcare profession to become comfortable managing burn-injured patients until the patients can be moved to a burn center.

Keywords: Burn disaster; Fire disaster; Casualty triage; Preparedness

Introduction

Major disasters are unpredictable massive devastating events and are uncomfortably common resulting in multiple human casualties. They are an immediate threat to public health [1-3]. If a disaster is of major proportions, as may be the case in an earthquake or flood, an entire region or extensive national territory may be involved [1]. All disasters, whether flood, earthquake, cyclone, drought or extensive fire, inevitably cause upheavals not only in the physical but also in the social and economic context [1]. Such events have the potential to claim many lives and overwhelm local medical resources and healthcare facilities [2,4]. Natural or man-made disasters are a worldwide challenge. They become even more challenging when resources and technology are inadequate [5].

Burn disasters are special incidents in that small numbers of casualties will rapidly overwhelm available services resulting in the decompensation seen with any major disaster [6]. Although most burn incidents result in two or fewer injured people at any one time, every community has large gathering places sites in which multiple burn injuries are most likely to occur such as nightclubs, nursing homes, churches, schools, theaters or industrial plants [7]. Invariably, an incident with high numbers of burn victims poses a challenge to any health care system [8]. Although not unique to burn care, high-intensity areas of speciality such as burns, pediatrics, and trauma quickly become scarce resources in a disaster [9]. An incident resulting in critically injured burn victims exceeding the capacity of local and regional burn center beds may be a reality within any community and warrants a planned response [10].

One factor that makes all fire disasters dramatic is panic. When a violent fire breaks out, there is an initial moment of psychological paralysis, generally followed by total incapacity for logical thought; this leads to instinctive behavioral reactions whose one aim is to reach safety and save all that is most dear. This sequence of actions not infrequently serves only to worsen the extent of damage caused but also creates an even more dramatic and tragic situation [1].

Human security and defense management go hand in hand. Without any doubt, disasters represent a major threat and share similar characteristics with armed conflicts, civil strife, or terrorist attacks. Planning for optimal disaster response and crisis management are thus an essential component of any civil defense strategy. The present report is a review of published experiences following burn disasters. Ways to improve planning, preparedness, triage, allocation of limited resources, surge capacity, transportation, communication, and overall management of burn disaster victims are investigated.

Fire and Burn Disasters

As a result of massive heat production a "thermal agent disaster" or a "fire disaster" causes severe losses in material goods and human lives in a relatively short time. Although a fire disaster need not necessarily reach catastrophic proportions, a fire of vast proportions will present some of the characteristic aspects of a disaster because of its highly destructive effect and emanation of toxic gases and fumes in addition to the potentially considerable number of victims it may affect [1,11]. "Burn disaster", on the other hand, can be defined as the overall effect of the massive action of a known thermal agent on individuals [1].

Casualty in a disaster depends on circumstances, cause and place of the disaster [5]. Burn disasters vary in scope of injury and procedures required, and are much more labor and resource intensive than non-burn disasters [4]. Fires and explosions, either deliberate acts or accidents, are the cause of most such events. Fire is either the primary cause of the disaster or secondary to fuel spilled due to an accident then igniting [12]. It must be pointed that the civilian burn disaster scenario has many parallels to war but some distinct differences as well. War provides large numbers of casualties and sustained learning periods, whereas civilian disasters often provide unanticipated casualty loads. In war, government interest and funding is high, whereas in the civilian setting it seems this is far less forthcoming [3]. It is mentioned that

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burn disasters are characterized by a relatively high number of fatalities and seriously burned patients with a high rate of potential mortality and disability [2,11]. In fact, the number of burn casualties sustained during disasters in general is relatively small [12]. In a study covering 30 years of UK history of disasters resulting in burn casualties, most resulted in less than 10 fatalities usually occurring on the scene [12]. The pattern of injury following major burn disasters follows a well-defined trend. Patients with the most severe burns invariably perish at the scene, which means that standard techniques can be employed on survivors with usually 20-50% TBSA burns [3]. However, contrary to the previously held hypothesis that people either escape with minor injuries or are killed immediately, a large number of severely burned patients do survive these events and require special medical assistance [12-14]. Moreover, burns are often associated with other serious pathologies, such as open wounds, fractures, and blast injuries [11].

Difficulties in managing an incident with numerous burn victims are the same in all countries [6]. Burn treatment being challenging and highly specialized, its service provision has been centralized into burns units. With limited available facilities to treat major burns, a small number of large burns from seemingly modest sized disasters can completely overwhelm the local, regional or even national services and constitute a significant burn disaster [12]. In a low and middle-income community with precarious facilities, minimal resources, and lack of preparedness, even a smaller number of extensive burn injuries may constitute a burn disaster.

What constitutes therefore a burn disaster is the number of persons with extensive burns following an incident requiring special care in excess of what the existing burn care facilities can handle. The magnitude of the disaster depends on the specific burn hazards involved as well as on the vulnerability of the community. Optimal management greatly depends on the state of preparedness and the available infrastructure and resources.

Prevention Measures

Burns are responsible for significant mortality and morbidity worldwide and are among the most devastating of all injuries, with outcomes spanning the spectrum from physical impairments and disabilities to emotional and mental consequences [15]. It is estimated that 20-30 per cent of injuries from all mass casualty events result in serious burns, many requiring specialized complex care [16,17].

Most burn injuries are accidental. The growing acceptance over the past decade of such injuries as a preventable public health problem has lead to the development of preventative strategies and, consequently, a decrease in death toll [15,18]. Even though many risk factors are still not easily modifiable [19], it is clear that to prevent burn injuries, reduce burn care expenses, and relieve the social burden from long term disability, a multifaceted solution for burn prevention is required [15]. An investigation into the circumstances leading to the recent burn disaster in Hermosillo, Mexico, revealed that this disaster that has resulted in the death of 49 children was potentially preventable had standard prevention principals been respected. A review of other daycare centers in Mexico revealed similar safety lapses that could lead to future major disasters [20].

To assure best success rates, burn and fire preventive educative programs should be environmentally based and tailored to adapt social and education levels of the audience. In addition, common etiologies and applicability of preventive measures must be considered according to local resources and logistics [15,21]. Even though some manmade disasters, in particular burn disasters, can be easily prevented, unfortunately, the attention is today more directed at analysis of disaster management than at disaster prevention [11].

When viewed as a trend, the number of fatalities per mass casualty incident is decreasing with time. Unquestionably, this reflects improvements in building technique and fire-prevention technology, as well as stricter enforcement of building codes. It is clear, however, that even modern construction and strict fire codes cannot prevent all disasters from happening and will also not stop an intentional act of terrorism [22].

Preparedness and Planning

Gunn's Multilingual Disaster Dictionary states that "disaster Management is concerned with all phases of planning, preparedness, training, response, relief, rehabilitation and reconstruction of a major emergency or disaster situation" [11]. In that respect, an overall assessment of the consequences of the disaster is needed with a more specific evaluation of the physical damage inflicted on individuals not only on the basis of the number of dead but also on the number of persons with severe potentially lethal injury or at risk of disability, in addition to proper planning of measures aimed at mitigating the effects on persons, in terms of suffering, disability and risk to life [11].

To ensure adequate response to unforeseen adverse events appropriate crisis management planning is required. Preparedness is a necessity for proper handling of emergencies and disaster [21]. Plans must be developed along three lines: immediate care; rescue within three hours; and use of specific equipment and means for the treatment of burned patient [1]. In that regard a crisis management team is critical [8,23,24]. Unfortunately, when compared to business organizations, crisis management teams in health-related organizations are less; moreover, extent of crisis management training in health-related organizations is lower [23]. As a consequence, most health-care systems are not sufficiently prepared to respond to adverse events [23].

The International Society for Burns Injuries (ISBI) has published guidelines for the management of multiple or mass burns casualties, and recommends that each country has or should have a disaster planning system that addresses its own particular needs [25]. With only 1,850 burn beds available in the USA [17], it is obvious that, even the most affluent country, cannot handle a massive surge in severe burn casualties without proper planning, strict triage policy, and judicious allocation of available resources. Needless to say that in low and middle-income countries the situation is much worse, if not catastrophic.

All events that result in disasters are unique, and it is impossible to become fully prepared. However, through thorough planning and preparedness, it is possible to gain a better understanding of the typical injury patterns and problems that arise from a variety of hazards [4]. Four resource categories are the key to successful surge capacity implementation: (1) adequate physical space to care for patients, (2) sufficient, appropriately trained staff, including subspecialty staff, (3) sufficient pharmaceuticals and medical supplies and equipment to provide care for the arriving patients, and (4) considerations for specific events outside of the usual clinical resources (availability of airborne infection isolation rooms or decontamination, burn, or pediatric services) [26]. By increasing the capacity to respond, larger and larger incidents will be able to be managed before reaching the threshold between "incident" (when resources are adequate to meet demand) and "disaster" (when resources are inadequate to meet

demand) [26]. Results of recently published studies, suggested that a continuing education training course of pre-hospital and community hospital healthcare providers could be effective in improving the participants' knowledge and their abilities and confidence toward burn disaster management. More importantly, the changes in knowledge, abilities, and confidence appear to be translated to an enhanced sense of competence to perform during a burn disaster [7,27]. Facing a burn disaster, any given facility can handle a limited workload at one time [28]. In a study designed to predict surge capacity bottlenecks for burn mass casualties at a large academic medical center it was demonstrated that hospital utilization could be constrained quickly due to the limited number of beds. The first bottleneck is attributable to exhausting critical care beds, followed by floor beds [29]. In fact, the scarcity of specialized burn beds is the single most restricting factor in planning for major fire incidents [14]. A system to track daily nationwide burn bed availability is of extreme value when such facilities become overwhelmed locally. Although intended for military conflict, this system is equally applicable to civilian mass casualty situations [30]. Planning for disaster response must anticipate as well the need for rapid ICU expansion as recently described with a creation of a temporary burn unit [31].

A retrospective review of burn patients admitted to the National Burn Centre at Middle more Hospital, Auckland, New Zealand, concluded that a mean of 0.3 operating theater visits and 22.8 minutes of operating time was needed per percentage total body surface area (TBSA) burn. Length of inpatient stay equated to 1.1 days per percentage TBSA burn. There was an exponential relationship between operative requirements and burn surface area and total operating theater time could be predicted from a formula based on burn surface area, mean depth, and type of burn. Operative time required was greatest in the first week and roughly halved each week after this, whereas nursing and allied health hours remained relatively constant [28]. This information may provide an objective trigger point for the activation of a disaster plan and enables prediction of operative and staffing requirements on a week-by-week basis. It can be used to plan both the acute and protracted phase of a national response to a burn disaster [28].

Moreover, preparedness entails caching of supplies which increases the capacity of the system to provide conventional and contingency care by increasing the volume of patients who can be accommodated before shifting to crisis care [26]. However, ability to preserve inventories of beds, monitors, and clinical supplies for surge capacity may be limited. Supplies for contingencies should be cached according to hazard analysis. This is however easier said than actually implemented. Stockpiling of supplies is difficult because expenses for preparedness are a low priority in times of financial instability [26]. Moreover, the critical planning factor for supplies such as some pharmaceuticals is a short shelf life, whereas space may be the problem with more durable supplies such as beds [26]. Preparation also includes methods to maintain the equipment and supplies in terms of adherence to preventative maintenance, stock rotation, and restocking schedules [26]. With burn units historically having low bed occupancy, in this era of spending cuts and efficiency drives the argument for increasing or maintaining capacity is likely to be challenged [12].

All disaster plans tend to focus on triage and movement of patients as quickly as possible from the incident site to a trauma center giving the impression that these patients are safely placed to receive optimal treatment. Unfortunately, few involved in administrating burn disaster response, in responding at the site, in transferring burn-injured to a trauma center or those engaged in emergency management in those centers have insight into the urgency, complexity or duration of the subsequent burn treatment, enormous resource expenditure and expense of modern burn management, or the paucity of specialist burns personnel [32]. During an event, burn surgeons, regrettably, have little authority for policy or decision making and can have difficulty integrating plans into the existing, often multi-service, plan developed by emergency services and emergency department/trauma personnel [32].

Triage

Mass-casualty triage has developed from a wartime necessity. The concept of "triage" has been a fundamental component of mass casualty management since the time of Napoleon; it has not been widely used in civilian practice to ensure that constrained medical resources are directed at achieving the greatest good for the most number of people until the 1970s [33,34]. Several primary and secondary triage tools have been developed, however, evidence to support the use of one triage algorithm over another is limited [34].

Triage is a dynamic process of sorting casualties by priority according to severity of injury and the urgency with which care is needed [33,35]. In a major incident, correct triage is crucial. It takes into consideration the total number of patients, bed availability, and transportation capacity [2,36,37]. It is intended to maximize available resources by determining who will actually benefit from high dependency care when the ratio between resources and patients is low [35]. Based upon acuity and bed availability, the right patient must be sent to the right facility at the right time [17]. Triage should be prognostic and must be looked upon as a continuous and dynamic process. It begins on the spot and continues wherever the patients are transferred [1,2].

Despite the fact that each disaster event has its own unique features, there are common problems that disaster responders still face in the pre-hospital and hospital phases [4]. While adhering to an accepted standard of care, mass casualty triage and transport guidelines must be put into practice and coordinated with local, regional and national response plans [17]. Primary triage is the first level of evaluation and prioritization. It is accomplished before initial medical interventions [26]. Secondary triage to establish priority for diagnostic studies or treatment occurs after additional assessment and initial interventions are conducted. Tertiary triage involves assessment of the value of ongoing resource commitment during delivery of definitive care. As opposed to tertiary triage, which generally occurs in more proactive fashion, primary and secondary triage is usually reactive, that is, occurring before availability of reliable situational awareness and usually performed before diagnostic testing [26]. Tele-triage can be utilized if available wherein a burn specialist in a tertiary care center guides in triage and initial management [36].

A process of expert triage to identify those injured patients who require specialized burn care, is central to any planning for fire incidents [14]. Unregulated transport of patients to hospitals will merely displace the scene of chaos to the hospital environment. In that regard, elementary on-site stabilization of burn patients by trained trauma teams is essential. It will gain time for an orderly evacuation of victims to hospitals, which will have had some opportunity to prepare for the in- flux of casualties [14]. Expert triage must therefore take place before any patient is transferred to a burn unit [14].

Subsequent triage decisions can be difficult. Decisions can include withholding care from a severely ill or wounded patient who, under normal circumstances, would have been aggressively supported. These

patients are usually designated as expectant, meaning their care would require substantial use of resources, which could jeopardize the lives of many others [35,38,39]. In certain situations minimum qualifications for survival may have to be defined, beyond which further resource commitments to a given patient are unlikely to result in a good outcome and will consume disproportionate shares of scarce resources [26,40]. In addition to considering the amount of resources required, it is also reasonable to consider the duration of use of a resource [26,33].

With optimum resources available, every burn patient receives emergency care. With limited resources, reduction in the upper limits of TBSA burned that would benefit from aggressive treatment may be necessary and burn care resources should be applied to that group of patients in which greatest benefit will be realized, with less attention given to those with lesser burns or those with more extensive burns [35,41]. Although the concept of triage is accepted within the burn care community, no formal guidelines exist that define how specific patients should be "ranked" after burn injury [2,33]. Nevertheless, triage remains the cornerstone of effective burn disaster management and must be done at the disaster site by staff with knowledge of burn treatment [2]. Burn size itself provides a rough, objective index of injury severity, but other factors most importantly patient advanced age and inhalation injury, affect survival profoundly and definitely reduce priority for resources [26,33]. Unfortunately, prioritization of burn patients is difficult in a mass casualty situation particularly since the extensive burn is a singularly "resource-intensive" injury, which requires uniquely great commitment of supplies, personnel, and time to produce optimal outcomes [33].

A widely adopted primary triage method is to attach tags of various colors, in relation to priority of health care and critical condition [1]. Tagging triage system would include (1) red tag = First priority for evacuation: burns complicated by injury to the air passages, (2) Green tag = Second priority for evacuation: second degree burns covering >30% TBSA; third-degree 10% TBSA; burns complicated by major lesions to soft tissue or minor fractures; third-degree burns involving such critical areas as hands, feet or face but with no breathing problem present, (3)Yellow tag = third priority for evacuation: minor burns, second-degree covering less than 15% TBSA; third-degree <2% TBSA, first-degree <20% TBS/ excluding hands, feet and face, and (4) Black tag = dead [1].

Alternatively, triage decisions for burn victims could be based on anticipated outcomes compared with resource allocation: (1) "High" Resource/Benefit including burn patients with anticipated survival ≥90% with aggressive treatment, which may include hospitalization of as long as 40 days on average and one to two surgical procedures, (2)"Medium" Resource/Benefit for patients with anticipated survival of 50% to 90% with provision of aggressive treatment, which may require prolonged hospitalization and multiple surgical procedures, (3) "Low" Resource/Benefit for those with anticipated survival less than 50%, even with provision of prolonged, intensive resources, and (4) Expectant with anticipated survival less than 10%, even with prolonged, aggressive care [33].

Another triage system categorizes victims of a burn disaster into 5 groups: Group I: Minor burns (< 10% of total surface area in children, <20% in adults) to non-critical areas. Patients in this group are assigned to outpatient care, dressing, tetanus prophylaxis. Group II: Minor burns to critical sites (face, hands, genitalia) are assigned to short hospital stay, special wound care or surgery. Group III: Major burns (20-60%) assigned to intravenous resuscitation and admission to a burn unit. Group IV: Extensive burns (>60%) assigned to a lower priority for transfer. Group V: Minor burns with inhalational injury or associated injury assigned to oxygen, intubation a transfer to and intensive care unit. Patients in groups III and V are evacuated first, followed by group IV. Group II cases are evacuated at the end. Group I cases are either discharged after first aid or asked to make their own way to the nearest primary care center [2,36,42].

As such, these categorizations are somewhat arbitrary. With improving burn survival, surgeons are increasingly unfamiliar and uncomfortable with anything less than the most aggressive treatment [33]. However, in a situation with resource restrictions or large numbers of casualties, hospital care can be delayed for those patients with burns of 20% or less of the total body surface. Similarly, expectant care should be applied to those patients with burns exceeding 70% of the total body surface and the available care facilities and resources applied to those with burns of from 20% to 70% of the total body surface. With even greater restriction of health care availability, the upper limit of the maximum treatment group should be reduced by stepwise decrements of 10% until the surgical workload matches available resources. Triage modifiers include also significant coexisting inhalation injury and associated mechanical injury, each of which lowers the upper limit of the maximum treatment group by 10%. Conversely, burns of the hands, face, feet, and perineum, occurring in patients with lesser total body surface burns, will increase the medical care necessary for such patients [35,43].

It should be obvious that accurate assessment of the extent of burn injury is critical for the appropriate application of triage criteria [33]. However, accurate burn triage under field conditions is impracticable [14]. Unfortunately significant errors occur when burn-size is estimated by inexperienced personnel, including physicians [33]. TBSA usually is certainly not estimated reliably in a non-clinical environment as was the case for the Volendam fire disaster. Moreover, during that disaster the diagnosis of inhalation injury was adequate but resulted in over-triage on-site and at the emergency department and did not lead to transport priorities for the severely wounded. Instead, in a major burn accident, a field triage protocol for rapid evaluation of burn injuries may be all what is needed. Detailed assessment of injuries of burn casualties is practical only in a specialized clinical setting [27]. It must be acknowledged though that every rapid triage protocol has inherent significant limitations [44,45].

An ethical framework must ground all disaster triage decisions [26]. In principle the concept of triage dictates that patients be sorted according to severity of injury and the urgency with which care is needed. In routine practice, triage usually has meant identifying patients with the most severe injuries to receive the quickest and most concentrated treatment. In mass casualty situations, however, priorities may be forced to change; limited resources are used to care for those patients with the highest likelihood of survival, with the understanding that some severely injured patients, although theoretically salvageable, may be denied treatment [33].

Core components of ethical decision-making include (1) fairness to treat equally individuals who have equal needs, (2) best care for all victims, (3) attempt to obtain the best outcome for the greatest number of patients with the resources available, (4) transparency, though difficult in reactive triage decisions, (5) consistency, (6) restriction of resources proportional to the demands, and (7) accountability [26,46].

Stategies for Resource Utilization

During a crisis, the load of patients and the severity of their

injuries might overwhelm the physicians taking care of them [47]; moreover, when resources are inadequate to meet demand, health care responders must shift to a more utilitarian view and may have to significantly change standard practices [26]. Decision-making and use of resources must be precisely tailored to allow the "greatest good for the greatest number". The delivery of care may need to be rationed in the face of extreme demand, limited resource availability, or both [26]. Such decisions during disasters require a planned structured approach, with foundational elements of goals, ethical principles, concepts of operations for reactive and proactive triage, and decision tools understood by the physicians and staff well in advance before an incident occurs [26].

To properly respond to crisis situations that require resource triage, clear written plans and policies are necessary, including an ethical framework and a concept of operations that allows proactive clinical decisions to be made, documented, and reviewed [26]. Faced with a resource shortfall, providers may place restrictions on the use of certain none critical therapies or interventions to maintain supply, substitute a given therapeutic approach with a functionally equivalent medication or device, adapt the use of a device for purposes for which it was not intended, and reuse the majority of material resources after appropriate cleaning, disinfection, or sterilization. As a last resort, in extreme situations, certain critical resources (ventilators, extracorporeal membrane oxygenation) may be removed from patients with dismal prognosis and reallocated to those patients most likely to benefit from them [26].

Treatment strategies

In all events, certain principles in medical interventions must be kept in mind: (1) the larger the number of casualties, the less time intensive the interventions that should be performed, (2) treatment must be adapted to the scope and magnitude of the event, and (3) the larger the event, the greater the focus on treatment of the moderately injured individuals [26].

The peculiar nature of burn disasters dictates well-defined chronological and qualitative operative phases. A person with burns of the airways and associated trauma needs immediate care of a different type from that given to the victim of an earthquake, flood, or cyclone. It is also of fundamental importance, for prognostic reasons, that pending the arrival of organized relief some medical and/or surgical first aid be given within a very short time, according to the type of lesion present [1].

Management of fire disaster includes three phases: pre-hospital response, first-level hospital response, frequently involving physicians of various specialties in most cases not skilled in treating large numbers of severe burn patients, and second-level hospital response [5,47]. Immediate care is provided by people present at the scene of the disaster that may be survivors or passersby [2,36]. First responders are later guided by trained healthcare workers arriving at the scene. On site management includes first aid, patient triage, and ambulance staging with a basic aim of maximal use of resources [2]. The next step after triage is to provide medical interventions that offer the greatest benefit with the least use of resources [26].

Current practice standards recommend that seriously burn injured patients be referred to burn centers for specialized evaluation and care. Following a burn disaster, burn center resources may be rapidly overwhelmed. Should such an event occur, existing health care systems must accommodate these victims until they can receive tertiary burn care [10]. It is therefore incumbent upon everyone in the healthcare profession to become comfortable managing burn-injured patients until the patients can be moved to a burn center [9]. Performance of pre-hospital providers and non-burn center nurses and physicians who are usually involved in treating patients after a large-scale burn disaster until such time that a burn center bed and transportation could be secured can be greatly improved as mentioned earlier by education and training that is better included in every disaster response plan [48]. Training and education allow also the resources and expertise of a high volume emergency department without an in-hospital burn unit to be effectively used in the initial resuscitation and treatment of multiple burn casualties [49].

Disaster victims can have a broad range of injuries and often form a heterogeneous group [47]. Burn injuries when caused by a major disaster very rarely happen in isolation. They are usually associated with other traumatic injuries requiring urgent attention. Involvement of multiple specialties is thus critical for providing optimal patient care. This factor must be well addressed in local, regional and national disaster preparedness plans [12].

Conclusion

Mass burn disasters are among the most difficult disasters to manage [16,17] and their victims pose difficult and unique problems for both rescue teams and hospitals [50]. Burn disasters create incredible challenges for disaster planners [9]. Despite evidence available from recent disasters, provision for the management of burncasualties is unfortunately still lacking in most disaster plans [3,51,52] and the optimal approach to fire disaster planning is by no means certain. The most appropriate approach will vary according to such factors as geography, population density and the availability of health resources [14].

For proper burn disaster management there is a need for adequate preparedness, including planning and training, a need to manage surge and control flow through triage and team structure as well as a need for improved communication and use of specific interventions, such as forward teams [53]. Disaster planning is an eternal cycle of improvement [53]. It must be stressed also that although all disasters are local, regional and even national support is critical [9].

Organization of emergency treatment for multiple burn patients differs significantly from that of sporadic burns [54]. The disaster is usually characterized by multiple casualties and can be further exaggerated by an austere environment at the site. Moreover, chaos at the site can only magnify the difficulties in medical care [54]. Nevertheless, each disaster produces its own challenges, remedied by solutions that have relevance to the management of future disasters [3].

Basic points of any health management plan in the event of a burn disaster must include: (1)rapid evaluation of the extent of the disaster, (2)specific and rapid health assistance response on site, (3)assessment of the capacity of local specialized structures to receive burn victims, and (4) selective evacuation of casualties from the disaster area [1]. The situation is best controlled by prompt and vigorous leadership to execute sound triage, decisions on the best ways of evacuation, treatment of life threatening conditions before evacuation, and adequate preparation for treatment of emergency conditions that may occur during evacuation [54]. Initial stabilization is better obtained at the primary facility; it must be stressed however that burn victims tolerate transportation best during the early period following injury, and undue delay may complicate the transfer [36].

Even on a day-to-day basis, burn bed capacity can be problematic. In a disaster situation, similar to other high-intensity areas of specialty, burn units are quickly overwhelmed and become scarce resources [9]. For proper response increased capacity and burn care capability are invariably required [9].Since hospitals have limited surge capacities in the event of burn disasters, a special approach to both pre-hospital and hospital management of these victims is required [50]. It is critical that everyone in the healthcare profession becomes comfortable managing burn-injured patients until they can be moved to a burn center [9]. It is also important for those involved in medical disaster preparedness to understand the regional capacity, capability, and when a surge of patients may require the practice of altered standards of care [9]. As formulated in the Swiss burn plan, disaster preparedness plans involving burn specialists dispatched from a referral burn center can upgrade and significantly improve pre-hospital rescue outcome, initial resuscitation care and help prevent an overload to hospital surge capacities in case of multiple burn victims [50].

Communication and documentation remain problematic in most disasters. For obvious reasons, documentation may not have the highest priority when medical facilities are confronted with a large number of victims [47,53]. Moreover, information gathered from several burn disasters situations has indicated very limited civilian capability and a limited mass transport capability with an undue reliance on the military [53]. Typically, greater incidents have required the intervention of outside agencies in particular the military forces [14].

Optimal care of burn patients in large incidents is only possible if burn specialists become actively involved in disaster planning [14]. Whether occurring in a military or civilian setting, the importance of learning from such events is almost universally acknowledged. In practice, however, despite the success of some innovative interventions, there remain a number of issues to be resolved such as the need to standardize equipment, and to cross-train and cross-credential medical personnel. Unfortunately lessons are often overlooked or relegated to obscurity until the next disaster comes along [3,31,53].

Capacity increase, appropriate planning, and effective preparedness to be able to properly respond to all disaster situations are non-realistic and utopic. What must be achieved instead is the optimization of all available resources and facilities, civilian and military, for a more efficient utilization.

In summary, the contribution of burn specialists in planning, preparedness, and response coordination is essential and the dispatch of specially trained teams to the burn disaster site to perform triage and initiate resuscitation is of utmost importance. Moreover, as demonstrated by the USA national burn disaster plan, a system to track daily nationwide available burn and intensive care beds with proper communication and transportation facilities are necessary for optimal surge management. Finally, training of all health care workers in basic burn treatment, in addition to regularly conducted drills will improve the overall disaster response. Nevertheless, No community can face a disaster situation single handedly. Regional, national and even across borders collaboration as implemented following the Volendam disaster will certainly improve burn disaster response. New lessons are learned from each disaster; unfortunately, measures aimed at improving the response are governed by the financial and economical considerations as well as the political and tactical situation on the ground.

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