

**KEY POINTS AND GOLDEN STANDARDS FOR MASS BURNED EVENTS  
PREPAREDNESS**

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**Abstract**

**Background:** Massive fire events are the most challenging emergency situation, testing rapid response, efficiency, and resilience of the emergency medical systems.

**The purpose of the study:** We aimed to identify the key points of incident command system and golden standards of emergency management in scenes of massive fire with mass victims involvement.

**Materials and methods** -observational analysis of a series of 33 events and simulation of mass burned casualty in three different regions from Romania.

**Conclusions:** Incident Command System is crucial to assist simultaneously a massive number of severe injured casualty's, having three golden tasks: scene assessment and security, search and rescue and medical chain set up.

The white plan of the hospitals has to be set up immediately. For fire incidents in town buildings with inhabitants, the median time for the maximum influx of victims to the hospitals is about 25-39', all victims being in hospitals in about 1 h.

Dispatch center may be a keystone of the intervention success, through the correct and prompt decision of red plan triggering, hospitals alert, chief emergency director involvement, networking maintaining with different structures.

The red plan of pre-hospital intervention have to be started with maximal resources alert from the first emergency call, and all the subsequent information will be taken as soon is possible. The exact number of casualty s cannot be estimated accurately, so the emergency team has to be prepared for the worst case scenario.

All these aspects must become specific educational objectives of training programs in crisis management.

**Keywords:** Incident Command System, burns, mass casualty incidents, red plan, white plan, medical evacuation

## Introduction

Numerous emergency situations such as traffic, crashed structures, technological or domestic events, whether intentional or accidental can result in the production of a large number of burned patients, smoke inhalation, and intoxications. Regardless of their nature, they all have a common feature: they are collective accidents resulting from large amounts of burned victims whose management requires a high concentration of forces to be managed with early involvement of specialized centers.

On the other hand, medical intervention is strictly subordinated to operationally and succeeds in time technical intervention as causal factor control with absolute individual features for each of the forces involved (rescuers, first-aid, medical teams for recovery or disposal), whose accurate targeting and sizing require formation training, cooperation, and coordination of accuracy.

## Materials and Methods

An observational analysis was realized on a case series of 13 significant events and 20 exercises of mass burned casualty in three different regions from Romania from 2007 to the present. The situation occurred as a consequence of mine explosions (2 – in 2008), in building fire (6/2 of them in the high building), club fire (1), technological (1 wood manufacture), 1 car accident with chemical products involvement (ammonium nitrate), 1 hospital fire to a maternity.

The simulation was realized into a level I university hospital (1), 4 hotels, 5 schools, 3 malls, 1 business center, 2 multifunctional centers, 1 university, 1 university campus, 2 airplane events ( taking off and landing procedures).

Three administrative regions of Romania were analyzed (Oltenia, Central region and Bucharest).

We aimed to identify the key points of incident command system and golden standards of emergency management in

scenes of massive fire with mass victims involvement.

The results are stated as procedures, instructions, checklists, and standards for technical and medical interventions, communications, data recording, reports, pre-incident plan set up, exercises designing and debriefing objectives, media communication, family communication.

We analyzed fires occurrence condition and circumstances, building structure and specific design, people habitats, places and access roads, distances to the hospitals, hospitals facilities.

## Results & Discussions

There are few important common elements that correlate with severity, prognosis, and anticipation of the lesion profile of patients. These are related to explosions, fires in closed environments, fires in crowded places and fires associated with structures collapse.

Fires in closed spaces are followed statistically by many fatalities, including in scene. The association of airways lesions and smoke poisoning is common in these cases. If it is a very crowded space, it is expected that the disorientation and panic will lead to the production of a huge number of victims, not all showing burns, but presenting many trauma or smoke inhalation<sup>[1]</sup>. Outdoor burns, lead to less severe skin lesions, but higher, early addressability to emergency departments.

In turn, the associated explosions produce a high rate of blast lesions and secondary traumatic injuries and a high burn rate of the airway. If in the explosion there is a chemical substance involved, the scene and patient contamination should be considered and make the protective measures and treatments. Structural instability is a generating source for potential risks such as difficulties in localization, access and extracting the patient or may be due to the explosion itself<sup>[2]</sup>.

If the event is produced by a deliberate act, a subsequent event is also possible.

The main decision-making and operational key points that we identified are related to:

**Planning:** Need for proactive plans is proved. Anticipation, provision, prevention, planning, largely eliminates or shortens the initial phase of the chaos caused by the absence of the leader and unitary governance of the scene and also provides a coherent working base, consistent, favorable for the development of the advanced schemes as the order is taken of increasingly specialized echelons.

To accomplish the operating tasks, emergency Medical service chief physician have in the planning stage tasks which are <sup>[1,2]</sup> administrative – organizing the mode and workspace, program, protocols, shifts, responsible, specific tasks, purchasing, documentation, establishing and maintaining inventories and also planning tasks (alarm procedures and instructions, medical aspects of the intervention, communication, mobilization of stocks)

One of the planning elements is the creation and management of stocks of useful materials, that are used in burned patients or patient with related injuries, which should be placed in containers with constant inventory, ready to be used in a time equal to the time of the arrival at the scene of the event. They can be placed inside the ambulance used in transporting multiple victims which are mobilized in these situations and trailers used in interventions at collective accidents that are stationed in Inspectorate for Emergency Situations, departmental administrated in each county seat.

Also, stocks for catastrophe situations in hospitals and ambulance services must provide special packages for” intervention in the case of burned patients” to assist minimum 50 patients simultaneously.

These containers must include analgesics, sedatives, hypnotics, blankets, isothermal comforters, films for covering burn wounds for all body regions, advanced air management equipment (including air difficult airway or surgical), intravenous access, infusion solutions, solution heaters, sterile compresses, dry bandages.

In addition, in the event of additional needs for intervention, the regional collective unit for accidents and disasters, including equipment, supplies, and medication for at least another 50-75 patients at a time, can be deployed. The reaction time is 1 h and includes advanced medical posts, as means of special technical intervention - heavy extrication. **Dispatching and decision process for triggering red plan.** At the emergency call reporting an event that has produced a number of burned victims (according to the current capacity of intervention of the service), or evolutionary potential for this situation, integrated dispatch FIREFIGHTERS – emergency departments or medical dispatcher immediately alert, even during dialogue with the caller, the nearest first aid teams to the event venue, and emergency medical crews in the area, starting the intervention of Inspectorate For Emergency Situations.

If the situation reported is severe from the beginning, or is anticipated the possibility of a rapidly deteriorating situation, the dispatcher alerts from the beginning the chief inspector and chief emergency physician. If the information is not likely to clarify this issue, the dispatcher will wait for the first report of field crew arrived on the scene, to contact the chief emergency physician<sup>[3]</sup>.

We considered some reliable criteria for alerting chief emergency physician in scene, depending on system capacity: several or unknown but several seriously injured patients, several doctors on the scene, difficulties or special intervention needed, long-term intervention probability,

required complex networking, the different ground crew needed.

Once the criteria for alerting are met, early warning of the chief doctor is required, either by the medical dispatcher or by the integrated.

Thus, after consultation with the chief emergency physician, the Chief Inspector of Inspectorate For Emergency Situations proposes to the prefect of the region to trigger plan red, if appropriate.

With the onset of the red plan, all staff alarmed, according to the service's protocols (partial alarm - next turn, or general) and health centers from the area where are informed if necessary. Pre-hospital medical services intervention change their current routine, to replace crews involved in the scene, with priority for resuscitation & first aid crews, but also all of their available crews. Immediately, all on call crews alerted and all personnel will be ask to come in service.

**Incident Command System. Scene Command and Control.** A number of elements are recognized as having a fundamental impact on the effectiveness of intervention, which are its fundamental principles, such as unitary command - the chief physician intervention – Medical Security Director - (DSM) is subordinated to operational security commander of the operation (COS) - firefighter, medical prioritization (triage, treatment, discharge), involving a large device, the principle of succession to command constant negotiation between needs and resources.

**Medical Safety Director (DSM)** is the chief emergency doctor county or, where appropriate, regional level. It is crucial that it should be a predefined person, known, easily contactable, with rapid response, mobile, usually active in an emergency, with solid knowledge of legislation and local and regional health infrastructure. It must be easily identifiable in the field by all participants (helmet, inscription, jacket, etc.) and in possession of efficient means of

communication with medical teams, the commander of the operation and dispatch.

We defined the checklist that chief emergency physician has to satisfy, consisting of:

- own security
- Requesting/receiving reports
- requesting available resources from dispatch
- contact local mobile command & coordination center installed on the scene
- communicate with the dispatch center

Upon arrival chief emergency physician should consider answering the following questions:

- Terrain and conditions* -type of area - rural / urban, forest, slope, watercourse, road, rail - important for the access to the intervention, ADVANCED MEDICAL POINTS placement, opportunities for evacuation of victims., weather (temperature, wind direction / speed - impact on placement ADVANCED MEDICAL POINT and air evacuation)
- Brightness, humidity, visibility - affects working conditions, safety, aerial evacuation

*Type of event*

- Event assessment
- Situation assessment
- Scene assessment
- Needs assessment

*Onsite resources*

- crews - numbers, types
- equipment – disaster trucks, simple tents (ADVANCED MEDICAL POINT type)
- local medical facilities - permanent center, hospitals- distance, profile, capacity, access, alerting
- any alternative placement facilities for ADVANCED MEDICAL POINT, charging stations for oxygen
- medical evacuation types (ground/air ambulance transport including multiple victims), improvised/specialized

*Additional needs* materials, crews, oxygen, communications (be coupled with multiple victims ambulance transporting patients to the hospitals and bringing in additional staff). Psychological support cell must be appreciated.

*Specific actions of DSM in scene*

- Location/organization and functions of ADVANCED MEDICAL POINT, medical triage, control goal and level of management, preparing for evacuation
- treatment coordination
- organizing and directing the evacuation
- establish access and exit directions in the scene for medical means
- establish working rules, communication, location areas
- assessing and obtaining additional resources
- communication with hospitals, dispatch, COS
- organizing other facilities
- documentation control
- control of medical information that is sent to COS and communication cell
- integrating all existing medical and first aid resources

It is essential that during the placement of the medical device, there must be a direct collaboration between the DSM and the operation chief of security, which takes into account how best to ensure the security of the entire intervention device<sup>(4)</sup> (including medical) and a judicious distribution of intervention forces towards optimum illumination of the workspace, localization and rapid extraction of all victims who are in risk areas (where the medical team does not have access) and optimal placement of ADVANCED MEDICAL POINT and other medical facilities to the stage and doorways. So triage inside smoke flooded structures, or unstable structure is tasked for firefighters and possibly their first aid crews, properly equipped. Organizing field triage involves designating a triage officer (assistant),

assigning tasks and accurate work. The objectives are to rapidly identify categories of patients: code red, code yellow, green and black code START triage and providing immediate life-saving maneuver. We decided that medical triage remains reserved only for Advanced Medical point, not for field triage.

Immediate saving gestures (placing in the safety position, an external digital control of major bleeding wounds, covering an open pneumothorax) are usually performed by paramedics performing field triage.

The presence of doctors in scene can only be decided by the DSM, for advanced medicalization

To the Advanced Medical Points will be considered as a priority early management of patients with incomplete obstructed airway and progressive signs of obstruction, taking in the fact that the speed of development of glottis edema in cases of burned airway is very high, and risk of difficult or impossible intubation is high, a condition in which surgical airway is not an easy option. Also, an altered mental status condition due to inhalation of smoke is an indication of airway prosthesis in order to establish ventilator support for the reversal of carbon monoxide poisoning, given that in the condition of ventilation with FiO<sub>2</sub> of 1, the release time of carbon monoxide from hemoglobin decreases to 25-40 min. Also, suspicion of the pulmonary blast with impaired respiratory dynamic labor or oxygenation may be an indication of airway assistance and ventilator support as well as associations injuries requiring complex control of intracranial pressure, hemodynamic and respiratory mechanics and gas diffusion (serious head trauma, complex vouchers coastal, hemorrhagic shock, pulmonary contusion). In the same reasoning, large burns, requiring general anesthesia will benefit of airway control. Advanced airway management may also be a tactical decision to evacuate by air to burn

centers. Adapting the type of oxygenation or ventilator support to patient needs is initiated in the Advanced Medical Points and supported during transport, as a criterion for choosing the level of the transport crew. Circulatory support refers to the initiation of vascular access, adjustment of volume replacement.

Pain control, burn lesions assessment, thermal protection, specific management, since gravity, risk and existing resource lesions constitute medical decisions related to Advanced Medical Points and formal condition for disposal.

As far as availability of resources will decide as patients with burn injuries judged incompatible with survival benefit from analgesia to “humanitarian” general anesthesia.

When performing triage to discharge will be considered both initial lesions, and response to initial therapy applied and further possibilities of intervention per patient at the scene versus the need for surgical management. Thus, for example, smoke poisoning without hyperbaric therapy needs, assisted by a fan on stage, exhaust may be delayed initially for a patient with extensive circumferential burns and signs of acute ischemic stroke or a combination of internal bleeding.

Functional emergency evacuation (burning eyes, ears, etc.) will be made as an urgent major priority, even if their transport is carried by ambulance to transport several victims and not the pitch, even if these themselves were addressed to triage initially as deferred emergencies.

The evacuation decision, whether taken at a medical center exhaust (installed if there are a large number of victims, or the intervention scene is very large and requires placement of multiple Advanced Medical Points) or directly from the Advanced Medical Points shall include: time, destination, type of transport and the crew.

Land evacuation is carried out if there is good access paths if the distance to

the medical center can be reached in 30 minutes and stable patient condition.

Primary air evacuation is indicated where ambulance access and movement is limited by the characteristics of the area, the patient is critical or urgent and distances traveled to the most appropriate medical facility for the patient concerned is over 45-60 min by land means and weather conditions permit movement of the helicopter. If needed, you can opt for a combination of the two means, or secondary evacuation (helicopter or fixed wing for more than 250 Km away, or multiple victims).

The choice of destination for each patient will be decided on the basis of, the closest appropriate hospital", who can provide an acceptable level of care for patient injuries. Thus patients with minor burns and without serious lesion associations can be evacuated to the city or municipal hospitals in the area where it may grant general surgical care type. For patients with burns ranging from major emergencies, the main option is their discharge directly to a regional burns management center, including specialized intensive care for burn and if injuries are complex to a level I trauma center or IA.

Notification of the hospitals concerned to receive casualties from the accident is mandatory so that the DSM should take early steps to identify specific capabilities and the announce these hospitals, and keep in touch with them.

Choosing the type of ambulance and crews is consistent with a number of victims, the existing means, the severity of injuries and distances to hospitals.

The high gravity victims with assisted vital functions and advanced medical care needs during evacuation will be transported, depending on distances, road and weather conditions, by HEMS, ground medical ambulances, or, in combination - a multiple victims transport ambulance with a serious casualties, 1-2 moderate and 2-3

slightly injured accompanied by a resuscitation team.

DSM must ensure that all medical and administrative documentation is completed in each phase of work and evaluation the patient is accompanied by a medical report. Also, the evacuation officer constantly updates data on means of escape, destination and teams transferring the individual patient. All documents will finally be collected for the medical, forensic, balance sheet and identification.

It is also essential that the DSM ensure that no patient leaves the scene without being passed through the Advanced Medical Points.

DSM has to delegate a person to perform the management of the deceased - inventory, gathering protection from the weather, so as to make further contact with structures that will ensure collection, transport, morgue storage, medical - legal expertise, and identification. In the case of high temperatures, DSM will have to seek COS in order to obtain spaces and refrigerated vehicles to preserve the deceased.

DSM must also delegate a responsible for medical consumption on the scene, including pharmacy, taking in consideration using medication regimen handling, prescribing and special administering.

**Activating white plan.** Planning preparation of hospitals of different categories<sup>[5]</sup> from the area to receive casualties, called “white plan” has to be activated as early as possible when pre-hospital intervention plan was activated. This refers to carrying out the following steps:

- Initiating the plan (by the hospital manager based on quantitative trigger – volume of victims or qualitative - the geographic location of the hospital, external support and so on, in stages)
- establishment of the crisis cell (command, logistics, regulation action

plan, communication - internal and external media, government, family)

- alert personnel - the existing alert protocols for appropriate specialties by cell logistics
- Reorganizing traffic in and around the hospital and a separate entrance for media planning and adequate space for receiving the families.
- Reorganization of services and admission criteria in sections (early discharge, transfer chronic patients to hospitals or external wards or delaying planned interventions, hospitalization of burned in sections with related skills - general surgery, orthopedics, BMF, Otolaryngology - opening all capacities of investigation imaging, laboratory, morgue)
- Taking over the victims of the scene - the change in ER triage flow - booking a special circuit and a separate triage nurse for victims from the scene as well as a specially appointed registrar constantly updated data about victims brought from scene receiving families - cell communication with hiring social workers and psychologists.

**Secondary evacuation.** It is extremely important that the decision to the secondary disposal of patients with severe burns is not delayed beyond the need for formal resolution of surgical conditions or internal bleeding lesions that contraindicate major transfer. Patients receiving regional evacuation to specialized burn centers are those with severe burns<sup>[6]</sup>:

- burns over 25%, grade IIA - IIB, or over 20% in children under 10 years or adults over 50
- grade III burns over 10%
- burns of the face (airway), eyes, ears, hands, feet, perineum
- chemical burns, burns due to caustic substances and electrical high-voltage
- burns or smoke inhalation accompanied by major trauma

- burns to persons at high risk (significant comorbidities)

All arrangements for the transfer must be made according to the standardized methodology for critical patient transfer<sup>[7]</sup>, with completion and submission of all documents relating to the patient's previous management, investigations, notification of the recipient center and crew and means of most appropriate evacuation is mandatory.

### Conclusion

Incident Command System is crucial to assist simultaneously a massive number of severely injured casualties, having 3 golden tasks to accomplish: scene assessment and security, search and rescue of victims and medical chain set up.

The white plan of the hospitals has to be set up immediately. For fire incidents in town buildings with people inside, the median of time for the maximum influx of victims to the hospitals is about 25-39', and in 31 observed events, all victims arrived in hospitals in 1 hour.

Dispatch center may be one of the keystones of the intervention success, through the correct and prompt decision of red plan starting, hospitals alert, chief emergency director involvement, relationship networking maintaining with different structures with specific operation tasks.

The red plan of pre-hospital intervention have to be immediately started with maximal resources alert from the first emergency call, and all the subsequent information will be taken as soon as possible. The exact number of casualties cannot be estimated accurately, so emergency team have to be prepared for the worst case scenario

All these aspects should be constituted educational goals of some specific training programs in managing crisis situations, which all health care and technical coordinators with attributions to solve emergency situations must go through systematically, repeatedly and practice them

regularly exercises and simulations as realistic as, to create optimal prerequisites of the coherent application fluently and rapid of the intervention plan in a possible real situation.

Also, the role of the proactive planning of various logistical issues should be reconsidered so that resources can be mobilized effectively and promptly, according to reliable criteria but flexible enough to confer adaptability to the intervention.

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