EMERGENCY RESPONSES IN CASE OF MASS CASUALTIES' DIFFERENT BIG BANG INCIDENTS: THE PARIS FIRE DEPARTMENT PREHOSPITAL MEDICAL CARE APPROACH

LEFORT H, TRAVERS S, BIGNAND M, MIHAI I, BÉGUEC F, CALAMAI F, HERSAN O, TOURTIER JP, CARPENTIER JP. Emergency responses in case of mass casualties' different big bang incidents: the Paris Fire Department prehospital medical care approach. Med Emergency, MJEM 2014; 21:3-9.

Keywords: Big-bang, disaster preparedness, mass casualties, resuscitation, terrorist, toxic, triage

ABSTRACT

Introduction: Taking into consideration the natural disasters, the industrial and terrorist attacks had changed significantly with time. The idea of terrorist threats such as chemical biological radiologic or nuclear (CBRN) have determined the authorities to change and adjust their approach.

Methods: Through the experience of the Fire Brigade of Paris (BSPP), we focus on the emergency services organization during a major event and on the triage of the victims, whether of a natural disaster or exposed to the CBRN.

Results: The new approach is based on a very clear and very well organized emergency care support, a very well organized commanding network, and last but not least a very well prepared logistic support.

Conclusion: The willingness and the necessity to anticipate the occurrence of such risks is materialized by the systematic well organized and clearly assigned functions: transport, triage, medical care, and evacuation of the victims. All of which are coordinated by the medical rescue direction.

Authors' affiliation:

Correspondent author: Hugues LEFORT, MD
Emergency Medical Service, Fire Brigade of Paris, Paris, France
1 place Jules Renard, 75017, Paris
hdlefort@gmail.com

Lefort H, MD[1], Travers S, MD[1], Bignand M, MD[1], Mihai I, MD[1], Béguec F, RN[1], Calamai F, MD[1], Hersan O, MD[2], Tourtier JP, MD[1], Carpentier JP, MD[3]
1. Emergency Medical Service, Fire Brigade of Paris (BSPP), France
2. SMPM, Military Health Services, Paris, France
3. Military Paramedics School, Toulon, France

Dr Hugues Lefort

Article history / info:

Category: Original article
Received: Nov 5, 2014
Revised: Nov 19, 2014
Accepted: Nov 26, 2014

Conflict of interest statement:

There is no conflict of interest to declare

INTRODUCTION

The number of natural disasters has increased three times fold in fifteen years, affecting more than 200 million people per year and resulting in 100.000 deaths. The most vulnerable to natural disasters are the developing countries due to increasing population, a disaster-favoring environment, most often in a logistic and medical care undeveloped context. On the other hand, the number of technology related disasters (fires, explosions, road accidents) is constantly increasing since the 1970s.

Whether accidental or intentional the chemical biological radiologic or nuclear (CBRN) threats are more and more present. Some countries haven't yet signed the Chemical Weapons Convention (CWC). The CWC aims to eliminate an entire category of weapons of mass destruction by prohibiting the development, production, acquisition, stockpiling, retention, transfer or use of chemical weapons by States Parties. States Parties, in turn, must take the steps necessary to enforce that prohibition in respect of persons (natural or legal) within their jurisdiction (www.opcw.org). Despite the Organization for the Prohibition of Chemical Weapons (OPCW) efforts, some countries such as Libya and Syria still have stocks of chemical weapons (Sarin, VX, Mustard gas, etc.). Mustard was used in Japan in July 1994 (Matsumoto city) and in March 1995 (Tokyo metro). In September-November 2001, anthrax-containing envelopes distribution in the United States denoted the first attempts of biological terrorism. Since 1993, the international Atomic Energy Agency (IAEA) has recorded more than 600 cases of illegal sale of radioactive elements. Undergoing investigations on the terrorist network confirm their interest in nuclear energy release and radioactive dispersion gears. A source of cesium 137 destined to explode was found in a park in Moscow in 1996.

The 9-11 attacks in the US are an example of hyper terrorism: a terrorist act based on the controlled use of new technologies resulting in hundreds of victims [1;2]. Between 1986 and September 2001, many proofs confirm the growing interest of terrorists for controlling CBRN weapons. Attacks of this kind occurred in Iraq between January and April 2007 (explosives containing chlorine). The attacks in Madrid in March 2004, in London in July 2005 and the Mumbai hostage situation in December 2008 confirmed the presence of both international and European terrorist networks. The severity of such acts is mainly due to the toxicity of the products involved, the way contamination and the persistence of the product, all which determines an exponential increase in the number of casualties in time, if actions of the first responders on the ground would be inappropriate. New reality of the 21st century, the acts of hyper terrorism are designed to make a large number of victims by touching several locations in a very short time and/or to destabilize permanently or for a long period of time a community or a state.

The management of these old and new risks is a matter for experts and requires anticipation, a continuous search for practical solutions [3] in addition to special training. However few triage tools are now validated [4;5]. We present the initial response of the Fire Brigade of Paris (BSPP) in mass casualties' different big bang incidents.

TRIAGE, AN ESSENTIAL ACT IN MASS CASUALTIES

In many countries, in case of mass casualties, triage is the task of para-medical personnel and not the medical physicians'. In situations like this, there is an imbalance between the available medical resources and the number of casualties. The goal of the triage is to save the highest number of victims. Historically, triage is the diagnostic medical action allowing the recognition of the injury and its consequences on the vital functions. The triage starts on-site, during the search and rescue during the first medical care which includes the categorization of the victims, in order to prioritize their treatment and evacuation. The concept of triage is inherited from the military doctrine, it evolves in catastrophic situations, and it is applied to the physical and psychological trauma patients [2;5;6]. In France, the French Society of Disaster Medicine (Société française de médecine de catastrophe or SFMC) is the one responsible for the triage classification, similar to the NATO classification [7;8] **(Table 1)**. The organization of the medical response on-site is based on the first rescuers' dual triage, performed on the site and that classifies the victims as either absolute emergency (AE) or Relative Emergency (RE).

Within the advanced medical post (Poste medical avancé or PMA), the triage is the responsibility of the chief physician (Directeur des secours médicaux or DSM) who will classify the absoluted emergency (AE) in: immediate emergency (IE), first emergency (U1) or functional emergency (FE), the relative emergency (RE) in: second (U2) and third emergency (U3). He will add a new category, the expectant emergency (EE). **Table 1** describes more accurately this categorization by comparing it with the Anglo-Saxon sorting resumed by NATO.

ANTICIPATING REALITY DISASTER MEDICINE: CONTINGENCY PLANS

From red plan to ORSEC-NoVi plan (Civil Security Response - Mass Casualty):

Through the years, faced with mass casualty events, the Emergency Medical Service (EMS) of the BSPP has developed a response method adapted to this such situation: the Red Plan. This plan is "the implementation of a pre-prepared doctrine with means and personnel are likely to deal with the consequences of a natural, technological or social event causing or likely to cause mass casualties, so that the emergency response resources" meets the "acute increase in healthcare needs". The red plan was conceived in the field of the operational military expertise, has gradually developed and improved in time because of numerous disastrous, mass casualties events that occurred in the Parisian region in the last four decades. The Red Plan has contributed significantly to improving the effectiveness of emergency care response. It is based on a policy of action, command and control of all responders: police, firefighters officers, medical personnel, rescue associations, private ambulances, guaranteeing its effectiveness. It is always coordinated by a DSM of BSPP in close cooperation with the EMS of the four departments of Paris

Direct triage by first responders	Medical Triage SFMC	Short definition/description	Management	Evacuation	Medical Triage Anglo-Saxon (OTAN)
AE Absolute Emergency	IE Immediate Emergency	Life threatening vital prognosis	Pre-hospital resuscitation team for one victim	Direct transfer to a hospital facility best suited to the unstable patient	T1 = Mention of Immediate Emergency (IE)
	U1 First Emergency	Alarming vital prognosis. Surgical intervention within the next 6 hours at best	Pre-hospital resuscitation team for 3-5 victims "Degraded" and adapted medicalization	Transfer by non medicalized (or medicalized convoy) to a specific hospital facility after stabilization	Other T1 = U1 within 4 hours T2 = Delayed Emergency = U1 between 4 to 6 hours
	FE Functional Emergency	Wounds of the eyes, hand, face, soft tissue near limb…	On-site medicalization		Not taken into consideration Categorized in T2 = Delayed Emergency
RE Relative Emergency	U2 Second Emergency	Invalid victims. Non-threatening vital prognosis if managed within 18 hours	Supine or semi-sitting transfer in a first aid vehicle	Non medicalized transfer, after stabilization, to a remote hospital from the event	T2 = Delayed Emergency and some T3 = Minimal Emergency
	U3 Third Emergency	Valid victims. Crippled and mentally injured	Management by the first responders and associations	Transfer by public transportation to a remote facility from the event	T3 = Minimal Emergency
EE Expectant Emergency or deceased		severely injured patient requiring long and heavy treatment with low survival rate	Comfort care and support services. Possible management within one hour following "damage control" for requalification in AE	Left on site, medicalization following management of the AE	T4 = Expectant After damage control, potential requalification in T1

Table I: Triage and patient evacuation of according to the French Society of Disaster Medicine (SFMC) and a brief correspondence with the Anglo-Saxon triage (NATO).

and Ile-de-France provided with the greatest resource of pre-hospital healthcare responders.

Learned lessons from feedback experience were taken into account, thus creating the 2004-811 Law 13 August 2004 on the modernization of Civil Security. The new generation general rules for the organization of Civil Security Response (ORSEC) integrate the ORSEC-Mass casualty (ORSEC-NoVi), as response to the catastrophic mass casualty events, instead of the original "Red Plan".

The ORSEC-Novi plan has three objectives:

1. Extract the victims from the hostile environment
2. Provide support and treatment for the victims
3. Mobilize departmental resources to ensure an appropriate response.

In France the ORSEC-NoVi plan is the reference plan for the mass casualty management. This management is characterized by grouping the medical services in and around the PMA and performing at this level the medical triage **(Figure 1)**. The AU victims will receive prehospital treatment and will be transported to a hospital after stabilization. The RE victims will be transported by para-medical teams to different emergency services if possible away from the site of the disaster. And that,

Figure 1: Red Plan of «Cité du labyrinthe», April 14, 2011 PoliceHeadquarter\BSPP\BurnerP©

in order to avoid the overcrowding of the nearby hospitals already particularly flooded, in case of a disaster, by "walking-in" patients that have not been filtered through the PMA [9-11]. This was the case after the explosion of the AZF factory in Toulouse in France on 21st September 2001.

The criteria to intervene depend on the actual or potential number of victims, type of disposed emergency services and the level of their possible involvement. When putting in action an ORSEC-NoVi plan, it is essential to corroborate the available medical means to the anticipated number of victims. Duncan et al., interviewed [12] a number of English experts in disaster medicine. Their goal was to establish, by using the Delphi method, whether there was a consensus concerning the 232 items involved when managing 100 victims. At the end, 23% of the interviewees reached an agreement on 54% of the questioned items (n-134). This anticipation can also avail the concept of multiplying coefficient following the retrospective experience of such situations: the ratio between the initial and the final number of victims. The number of casualties, being the unique variable, it should be completed by qualitative criteria:

- The deployment or organization difficulties.
- The technical complexity of the intervention: incarceration contamination.
- The vulnerability of the structure involved: a hotel, a hospital, a nursery, a nursing home, a school, or more generally, any place open to the public.
- The potential evolution of the event.

The resources' deployment is done in two stages:

- The first stage, available without delay in a predetermined manner: the deployment of means and personnel able to intervene promptly.
- The second stage, the volume and nature are based on information collected by the first responders. Predetermined groups and modules might be sent, depending on the needs (e.g. search and rescue, PMA, evacuation group, etc.)

The Red Plan Alpha: a Parisian specificity

France has not yet been faced with what is called acts of hyper terrorism like the ones that took place in Tokyo in 1995 [13;14], Madrid in 2004, London in 2005 or Bombay in 2006 [15-17], targeting massive destruction, on multiple sites and with possible use of CBRN substances [1].

Facing these new menaces, the authorities of the city of Paris have requested from the BSPP, in collaboration with the four EMS d'Ile de France, to be able to deploy simultaneously and on different locations the necessary means to ensure the command and control of at least four mass casualty sites, one of which may require the involvement of NRBC means, while maintaining a basic efficient operational activity. The Red Plan Alpha **(Figure 2)**, put in place in 2007, aims to address the risk of mass influx of casualties, multi-site and terrorists attacks and bombings by restricting the initial rescue means involvement in order to be able to respond proportionately on several sites [18;19]. It also aims to preserve the operational services of emergency units and anticipate the potential risk of another attack on the original site. In this management of a large number of victims, the triage closest to the event must be conducted according to the principle of disaster medicine and the distribution of victims must be done to the proper hospitals. Thus, the term of "reinforcement" employed in the ORSEC-NoVi Zonal plan can then be implemented to enable the concerned area to benefit from all the necessary resources (means of interventions, hospital resources, etc.). Last, but not least, the patients vital signs monitoring must be registered, on-site and

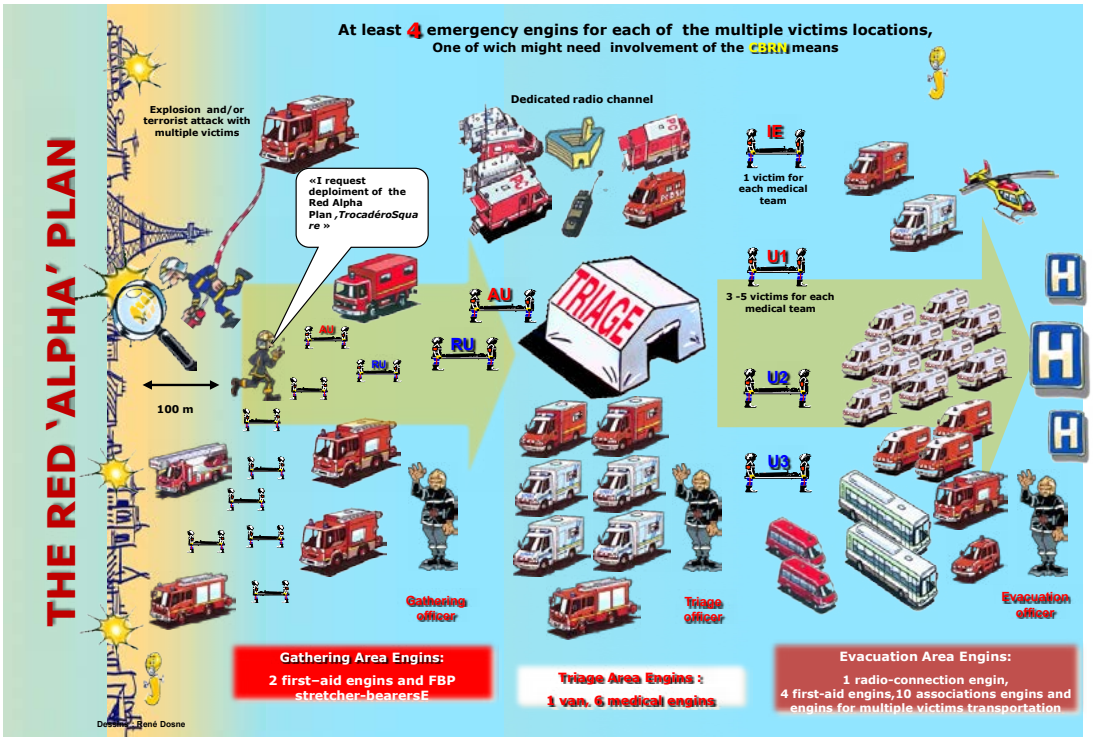

Figure 2: Modality of deployment of Red Alpha Plan. BSPP©

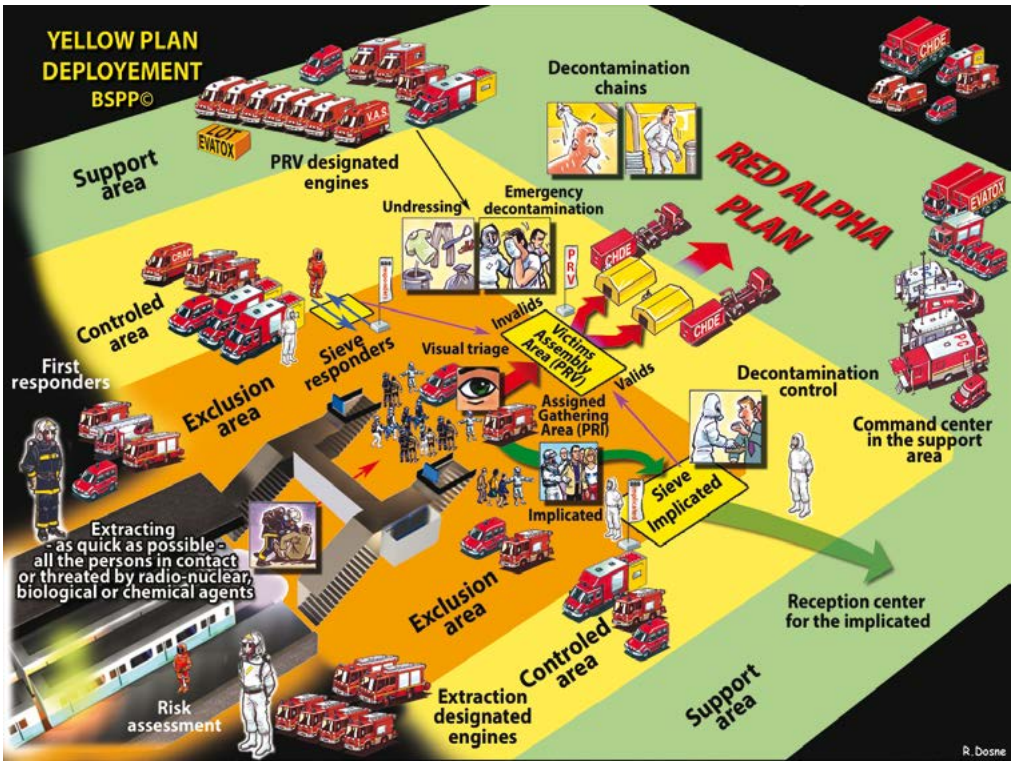

Figure 3: Deployment of yellow plan. The PIRATOX plan for the BSPP (Paris) and its suburbs. BSPP©

during the treatment and transport, on an assigned sheet or its biometric equivalent; the use of a numeral system [20] to follow the victims from the disaster site to the hospital proved to be of great help since it has been used in the Parisian region for years.

Specific response to a nuclear, radiological or chemical threat.

The Circulars 007, 700, 747 and 800 of the General Secretariat for Defense and National Security (SDGN) for the French national employment doctrine rescue services and care to the terrorist actions with chemical or radiological contents provide an institutional response like other countries [21-24]. The French authorities have elaborated, based on these circular, a CBRN-e Governmental Plan. Its goal is to ensure rapid, methodical and coordinated deployment of material and personnel resources in the areas of defense facing nuclear or chemical exposure. It also coordinates the commitment of individual and resources, as part of a major operation to contain the chemical or radiological area causing many casualties.

The involvement of medical staff under protective equipment in a contaminated zone, considered inappropriate for a long time, allows a minimal medicalization before complete decontamination intended solely to ensure the survival of the victims until the end of this step in accordance with CBRN-e Plan.

Established in 2007, this CBRN-e Government Plan is broken down from the yellow plan by the BSPP and provides an on-site solution **(Figure 3)** aiming at limiting the risk of spread of contamination and simultaneously providing medical care to traumatized victims. In Tokyo, sarin has been spilled in the wagons and the passengers exited the stations along the way. This spontaneous evacuation of victims by the witnesses and the multitude of attack sites prevented the completion of a pre-hospital triage.

In Saint-luke hospital, 35% of victims arrived all by themselves, 24% by taxi and 7% by ambulance. Three patients in cardiopulmonary arrest were transported to Saint-Luke's Hospital in the hour following the attack and could not be resuscitated.

The CBRN-e (Yellow Plan) has the objective to manage quickly the victims using these four actions:

- Fast extraction of all persons present in the affected area which expose them to an imminent
- Visual triage to differentiate between involved victims, the injured or those showing sign of possible exposure.
- Victim management by providing early treatment (use of antidote) and urgent decontamination.
- Emergency care and thorough decontamination.

Figure 4: Medicalization of an intubated patient in an exclusion zone (drill). BSPP\DSan©

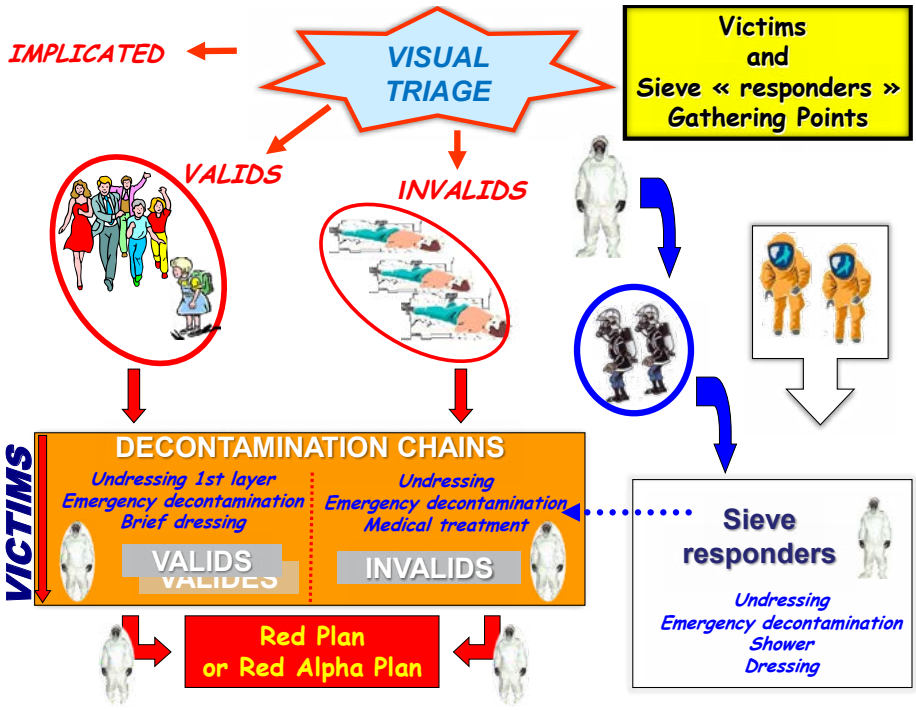

Figure 5: Triage on yellow plan. BSPP©

The US military recommends a triage adapted according to the chemical involved [25] but its implementation is not simple, and it might not be applied to the victims of an attack whose age and medical intercurrent conditions are more variable.

In France, it was long believed to be inappropriate to provide care before complete decontamination; that was the case till the late 90's. The French policy (civil and military) for management of chemical casualties has evolved [25]. The objective is an emergency decontamination with a minimum medicalization aiming solely to allow the survival of victims until the end of the complete decontamination.

The decontamination becomes a priority particularly in the presence of a persistent toxic. The initial screening is performed by rescuers and visually separates the clean victims from the contaminated ones (showing sign and symptoms of exposure by chemical or radiological agents). Only the patients showing signs and symptoms of intoxication or traumatic injury are grouped in the Victim Assembly Area (Point de regroupement des victimes or PRV) **(Figure 4)**, relevant ones are being grouped in the Assigned Gathering Area (Point de regroupement des impliqués or PRI). Both undressing and urgent decontamination take place only in the PRV. The aim is to provide the essential emergency medical care to allow the patient's survival until complete decontamination. For example, control a hemorrhage, administer antidotes and place in a recovery position. Intubation should be seriously evaluated taking into account the limitations it poses to the decontamination step. The resuscitation, intra-veinous access, ventilation and intubation can be still be performed using CBRN protection [26-31]. The sorting between contaminated or not contaminated is more difficult, especially when clinical signs are not obvious **(Figure 5)**. This medical classification is performed using the skills of CBRN experts under the orders of the Director of Medical Rescue (Directeur des opérations de secours or DOS) or the Commander of Rescue Operations (Commandant des operations de secours or COS). It is the same in case of an attack involving radiological materials. Apart from a few cases of a huge radiation exposure with fast clinical signs, most contaminated victims show no clinical sign in the relief operations. The CBRN expertise is needed to assess the intensity and type of radiation that will affect time-to-onset of symptoms that are often delayed [6-8;32].

CONCLUSION

Triage is a necessary action in the case of a disaster. Its aim is to save the maximum number of victims using all available means. Developing a back-up plan ahead of time can anticipate an institutional response to CBRN-e or in the case of a natural disaster. The expert involvement is required both in the design and development phase, during drills and definitely in emergency responses to mass casualties' events.

REFERENCES

1. Jenkins JL, McCarthy ML, Sauer LM, Green GB, Stuart S, Thomas Tl et al. Mass-casualty triage ; Time for an evidence-based approach. Prehosp Disaster Med 2008; 23:3-8.
2. Dudaryk R, Pretto EA. Resuscitation in a multiple casualty event. Anesthesiol Clin 2013; 31:85-106.
3. Hinton Walker P, Garmon Bibb SC, Elberson KL. Research Issues in Preparedness for Mass Casualty Events, Disaster, War, and Terrorism. Nurs Clin North Am 2005; 40: 551-64.
4. Dara SI, Farmer JC. Preparedness lessons from modern disasters and wars. Crit Care Clin 2009; 25:47-65.
5. Kilner TM, Brace SJ, Cooke MW, Stallard N, Bleetman A, Perkins GD. In 'big bang' major incidents do triage tools accurately predict clinical priority?: A systematic review of the literature. Injury 2011; 42:460-8.
6. Adnet F, Maistre JP, Lapandry C, Cupa M, Lapostolle. Organisation des secours lors de catastrophes à effets limités en milieu urbain. Ann Fr Anesth Reanim 2003; 22:5-11.
7. Ramesh AC, Kumar S. Triage, monitoring, and treatment of mass casualty events involving chemical, biological, radiological, or nuclear agents. J Pharm Bioallied Sci 2010; 2:239-47.
8. Macintyre AG, Christopher GW, Eitzen E, Gum R, Weir S, DeAtley C et al. Weapons of mass destruction events with contaminated casualties: effective planning for health care facilities. JAMA 2000; 283:242-9.
9. Laurent J, Richter F, Michel A. Management of victims of urban chemical attack: the French approach. Resuscitation 1999; 42:141-9.
10. Baker DJ. Critical care requirements after mass toxic agent release. Crit Care Med 2005; 33:S66-74.
11. Tucker JB. National health and medical services response to incidents of chemical and biological terrorisme. JAMA 1997; 278:362-8.
12. Duncan EA, Colver K, Dougall N, Swingler K, Stephenson J, Abhyankar P. Consensus on items and quantities of clinical equipment required to deal with a mass casualties big bang incident: a national Delphi study. BMC Emerg Med 2014; 14:5.
13. Okumura T, Takasu N, Ishimatsu S, Miyanoki S, Mitsuhashi A, Kumada K et al. Report on 640 victims of the Tokyo subway sarin attack. Ann Emerg Med 1996; 28:129-135.
14. Okumura T, Hisaoka T, Yamada A, Naito T, Isonuma H, Okumura S et al. The Tokyo subway sarin attack - lessons learned. Toxicol Appl Pharmacol 2005; 207s:471-6.
15. De Ceballos JP, Turégano-Fuentes F, Perez-Diaz D, Sanz-Sanchez M, Martin-Liorente C, Guerrero-Sanz JE. 11 March 2004: The terrorist bomb explosions in Madrid, Spain - an analysis of the logistics, injuries sustained and clinical management of casualties treated at the closest hospital. Crit Care 2005; 9:104-11.
16. Redhead J, Ward P, Batrick N. The london attacks-response: Prehospital and hospital care. N Engl J Med 2005; 353:546-7.
17. Lockey DJ, Mackenzie R, Redhead J, Wise D, Harris T, Weaver A et al. London bombings July 2005: the immediate pre-hospital medical response, Rescuscitation 2005; 66:ix-xii.
18. Horne S, Vasallo J, Read J, Ball S. UK triage – An improved tool for an evolving threat. Injury 2013; 44:23-8.
19. Bogle, LB, Boyd JJ, McLaughlin KA. Triaging multiple victims in an avalanche setting: The avalanche survival optimizing rescue triage algorithmic approach. Wilderness Environ Med 2010; 21:28-34.
20. Travers S, Bignand M, Raclot S, Domanski L, Tourtier JP. Difficulties of triage in mass casualties incident. Injury 2013; 44:1965-6.
21. Lyle K, Thompson T, Graham J. Pediatric mass casualty: triage and planning for the prehospital provider. Clin Ped Emerg Med 1999; 10:173-85.
22. Potin M, Sénéchaud C, Carsin H, Fauville JP, Fortin JL, Kuenzi W et al. Mass casualty incidents with multiple burn victims: rationale for a Swiss burn plan. Burns 2010; 36:741-50.
23. Vinson E. Managing bioterrorism Mass casualties in an emergency department: Lessons learned from a rural community hospital disaster drill. Disaster Manag Response 2007; 5:18-21.
24. Aylwin CJ, König TC, Brennan NW, Shirley PJ, Davies G, Walsh MS et al. Reduction in critical mortality in urban mass casualty incidents: analysis of triage, surge, and resource use after the London bombings on July 7, 2005. Lancet 2006; 368:2219-25.
25. Dorandeu F, Blanchet G. Chemical warfare agents and terrorism. Med Catastrophe Urg Collectives 1998; 1:161-70.
26. Schumacher J, Weidelt L, Gray SA, Brinker A. Evaluation of bag-valve-mask ventilation by paramedics in simulated chemical, biological, radiological, or nuclear environments. Prehosp Disaster Med 2009; 24:398-401.
27. Ophir N, Ramaty E, Rajuan-Galor I, Rosman Y, Lavon O, Shrot S et al. Airway control in case of a mass toxicological event: superiority of second-generation supraglottic airway devices. Am J Emerg Med 2014; doi: 10.1016/j.ajem.2014.08.067.
28. Castle N, Bowen J, Spencer N. Does wearing CBRN-PPE adversely affect the ability for clinicians to accurately, safely, and speedily draw up drugs? Clin Toxicol (Phila) 2010; 48:522-7.
29. Castle N, Owen R, Hann M, Clark S, Reeves D, Gurney I. Impact of chemical, biological, radiation, and nuclear personal protective equipment on the performance of low -and high- dexterity airway and vascular access skills. Resuscitation 2009; 80:1290-5.
30. Castle N, Pillay Y, Spencer N. Insertion of six different supraglottic airway devices whilst wearing chemical, biological, radiation, nuclear-personal protective equipment: a manikin study. Anaesthesia 2011; 66:983-8.
31. Wedmore IS, Talbo T, Cuenca PJ. Intubating laryngeal mask airway versus laryngoscopy and endotracheal intubation in the nuclear, biological and chemical environment. Mil Med 2003; 168:876-79.
32. Leslie CL, Cushman M, McDonald GS, Joshi W, Maynard AM. Management of multiple burn casualties in a high volume ED without a verified burn unit. Am J Emerg Med 2001; 19:469-73.