

The medical response to multisite terrorist attacks in Paris



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Introduction

Friday, Nov 13, 2015. It's 2130 h when the Assistance Publique-Hôpitaux de Paris (APHP) is alerted to the explosions that have just occurred at the Stade de France, a stadium in Saint-Denis just outside Paris. Within 20 min, there are shootings at four sites and three bloody explosions in the capital. At 2140 h, a massacre takes place and hundreds of people are held hostage for 3 h in Bataclan concert hall (figure).

The emergency medical services (*service d'aide médicale d'urgence*, SAMU) are immediately mobilised and the crisis cell at the APHP is opened. The APHP crisis unit is able to coordinate 40 hospitals, the biggest entity in Europe with a total of 100 000 health professionals, a capacity of 22 000 beds, and 200 operating rooms. It is very quickly confirmed that the attacks are multiple and that the situation is highly scalable and progressing dangerously. These facts led to a first decision: the activation of the “White Plan” (by the APHP Director General) at 2234 h—mobilising all hospitals, recalling staff, and releasing beds to cope with a large influx of wounded people. The concept of the White Plan was developed 20 years ago, but this is the first time that the plan has been activated. It is a big decision, and timing is key: it would lose its effectiveness if taken too late. On the night of Friday Nov 13 to Saturday Nov 14, the activation of the White Plan had a critical effect. At no time during the emergency was there a shortage of personnel. During these hours, as the number of victims increased, with a sharp increase after the assault was launched inside the Bataclan, we were able to reassure the public and government that our abilities matched the demand. And when we felt that it might be necessary to deal with an influx of severely injured people, two further “reservoir” capacities were prepared: other hospitals in the area were put on alert, together with some university hospitals, more distant from Paris, but with the ability to mobilise ten helicopters to organise the transport of the wounded. These other two reservoirs have not been used, and we believe that despite this unprecedented number of wounded, the available services were far from being saturated. While hospitals were receiving and directing patients to specific institutions based on capacity and specialty, a psychological support centre was set up. 35 psychiatrists, together with psychologists, nurses, and volunteers were gathered in a central Paris hospital, Hôtel Dieu. Most of them had played a similar role during the attacks against *Charlie Hebdo*. Most of the emergency workers and health professionals working on the evening of Nov 13 had already been involved in serious crises, were used to working together, and had

participated, especially in recent months, in exercises or in updating emergency plans.

In this report, we present the prehospital and hospital management of this unprecedented multisite attack in Paris from the viewpoint of the emergency physician, the trauma surgeon, and the anaesthesiologist. This is a testimony on behalf of the health professionals involved in the night of Nov 13.

The emergency physician's perspective

Triage and prehospital care were the duty of SAMU. In the minutes that followed the suicide bombing at the Stade de France, the Paris SAMU unit regulatory crisis team began to send out medical workers to the emergency sites from all eight units of SAMU in the Paris region and from the Paris fire brigade (*Brigade de sapeurs-pompiers de Paris*), alongside rescue workers and police. The regulatory crisis team was composed of 15 individuals to answer the calls, and five physicians. Their mission was to organise triage and dispatch mobile units (composed of a physician, a nurse, and a driver) to the wounded and to the most appropriate hospitals. As part of the White Plan and ORSAN (*organisation de la réponse du système de santé en situations sanitaires exceptionnelles*), 45 medical teams from SAMU and the fire brigade were divided between the sites (figure) and 15 were kept in reserve, since we did not know how and when this nightmare would end. This approach avoided early saturation of services—often, in emergency situations, all the resources are focused on the first crisis site, leaving a shortage for

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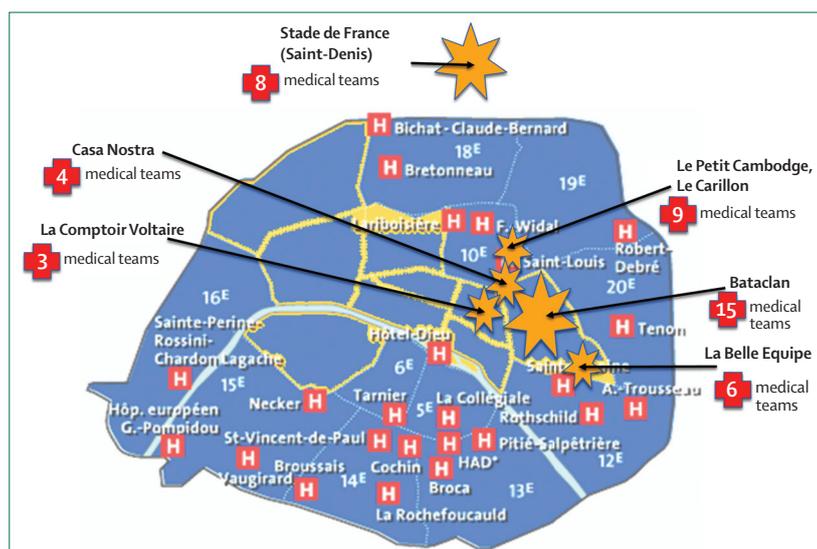


Figure: Map of Paris attacks and prehospital emergency response

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	Absolute emergencies	Relative emergencies	Total
Ambroise Paré	1	6	7
Antoine Béclère	0	1	1
Avicenne	0	8	8
Beaujon	5	0	5
Bicêtre	1	6	7
Bichat	2	17	19
Cochin	0	7	7
HEGP	11	30	41
Henri Mondor	10	15	25
Hotel Dieu	0	31	31
Jean Verdier	0	2	2
Lariboisière	8	21	29
Pitié-Salpêtrière	28	25	53
Saint Antoine	6	39	45
Saint Louis	11	15	26
Tenon	0	10	10
Total	76	226	302

Absolute emergencies require immediate surgery or embolisation; relative emergencies may need surgery and/or embolisation, but not immediately. Numbers do not include psychological trauma and delayed admissions. Because some patients were secondarily transferred from one hospital to another, numbers do not add up. Data are from Assistance Publique-Hôpitaux de Paris (APHP), Nov 20, 2015. HEGP=Hôpital Européen Georges Pompidou.

Table: Numbers of admissions of absolute emergencies and relative emergencies in the APHP hospitals within the first 24 h

following crisis sites. 256 wounded people were safely transferred to and treated in hospitals and the remaining patients arrived at hospitals by their own means. Three acute myocardial infarctions were treated. By the middle of the night, more than 35 surgical teams had operated on the most serious injuries (table).

Since the wounds were principally bullet related, the strategy applied was prehospital damage control to allow the fastest possible haemostatic surgery.¹⁻⁴ This is the civil application of war medicine. Indeed, four out of five people shot in the head or the thorax will die. Among those without lethal wounds, damage control consists of maintaining the blood pressure at the lowest level ensuring consciousness (mean arterial pressure 60 mm Hg) using tourniquets, vasoconstrictors, antifibrinolytic agents (tranexamic acid), and prevention of temperature lowering instead of fluid filling (the demand for tourniquets was so high that the mobile teams came back without their belts).

After initial treatment the wounded were transferred by the Mobile Intensive Care Unit (MICU) teams to trauma centres or nearest hospitals when appropriate. Saint Louis Hospital is a few metres from two of the shooting sites (Le Petit Cambodge and Le Carillon restaurants, figure) and its physicians were able to take care of the patients immediately. Some wounded people were able to walk to the nearby Saint Antoine Hospital. To avoid overwhelming the hospital emergency

department as ambulances arrived, triage also took place at the hospital entrances.

Despite their brutality and appalling human toll (129 dead on sites, and more than 300 injured) the attacks were not a surprise. Since January, 2015, all state departments had known that a multisite shooting could happen, and although the police and intelligence services had prevented several attacks, that possibility remained. For 2 years, the prehospital teams of SAMU and the fire brigade had been developing treatment protocols for victims of gunfire wounds, and three field exercises have mobilised doctors to practise prehospital damage control. SAMU is characterised by the presence of physicians who are able not only to stratify risk according to gathered information and send the patient to the appropriate place, but also to act during the prehospital period. In a cruel irony, on the morning of the day of the attacks, SAMU and the fire brigade participated in an exercise simulating the organisation of emergency teams in the event of a multiple shooting in Paris. In the evening, when the same doctors were confronted with this situation in reality, some of them believed it was another simulation exercise. At the attack sites and in the hospital, the training received by the emergency and medical workers was a key factor in the success of treatment. Analysis of the experience of bombings in many other countries—Israel, Spain, England, and more recently in Boston, USA—as well as lessons learned from Paris, during the *Charlie Hebdo* attacks in January, were essential to improving the management and application of damage control. It is important to point out that the scientific publications that issued from these horrible events have had a huge effect on the improvement of medical strategies.⁵⁻⁷ But no simulation had ever anticipated such a boost in the scale of violence. During long periods of shooting, the streets surrounding the attacks remained difficult and dangerous for emergency intervention teams. Seriously injured hostages in the hands of terrorists or obstructed by fire could not be evacuated. Although emergency physicians have been receiving training in disaster medicine for more than 30 years, never before had such a number of victims been reached and so many wounded been operated on urgently. A new threshold has been crossed.

The approach of the anaesthesiologist

Pitié-Salpêtrière Hospital is one of the five civilian level-one trauma centres in the APHP group involved in the treatment of patients after terrorist attack. It is located in the centre of Paris. The shock trauma room is included inside a post-anaesthesia care unit of 19 beds. The routine capacity of the emergency operating theatre is two operating rooms, which can be extended to three for multiple organ harvesting. After activation of the White Plan, which includes a process to call back all staff, but also because many physicians and nurses spontaneously arrived rapidly in the hospital, we were able to open ten operating rooms and treat injured

patients (mostly with penetrating trauma), absolute emergencies (mostly admitted in the shock trauma unit), and relative emergencies (all admitted in the emergency department).

The number of admitted patients was far beyond what we could imagine we would treat at the same time. The resources available were never less than required, despite the unprecedented number of patients admitted during a very short period. Several factors may have contributed to these favorable outcomes. First, the injured patients arrived very quickly (in small groups of four or five) because we had worked for several months with the medical service of the French national police counter-terrorism department (RAID), prehospital emergency teams, and in-hospital trauma teams to be able to provide a fast-track service for penetrating trauma, particularly during a terrorist attack.⁸ Although penetrating traumas usually represent only 16% of our severe trauma cases,⁹ injuries from firearms, including war arms, are no longer rare events, and our anaesthesiologists and surgeons have been trained to appropriately treat these cases. Before the arrival of the first patients, the postoperative care unit was rapidly emptied and the surgical and medical care unit made several beds available. This was important since, after emergency surgery, patients could be directly admitted into the units, enabling the shock trauma room to be free for new patients, in accordance with the so-called one-way progression concept (no return to the emergency or shock trauma room). A rapid triage was organised at the entrance of the emergency department, directing absolute emergencies to the shock trauma unit and relative emergencies to the emergency department, and this second rapid triage was able to confirm the initial triage done a few minutes previously by the prehospital team. Each absolute emergency patient was cared for by a dedicated trauma team (anaesthesiologist, surgeon, fellow, and nurse), who decided whether or not to perform CT scans, radiology, and to send the patient to a prepared operating room where an operating team was available (with appropriate senior and fellow surgeons, anaesthesiologist and nurse anaesthetist, and operating room nurse). Other post-anaesthesia care units were reopened to receive patients once surgery was done.

A key element was the excellent cooperation of all care-givers under the supervision of two trauma leaders in the shock trauma unit and an operating room allocation leader, who were not directly involved in the care of the patients and who continuously communicated between each other and regularly collated information concerning the entire cohort of injured patients. Furthermore, hospital management could immediately provide logistic support. Another key element was related to the dramatic characteristic of the event—each participant wanted to do more than his or her best for the victims. And they did it! Only 9 h after the event, we were able to decrease the number of operating rooms to

six and send back home some of the more exhausted staff. Within 24 h, all emergency surgeries (absolute and relative emergencies) had been done and no victims were still in the emergency department or the shock trauma unit. The hospital was nearly ready to cope with another attack that we all feared could occur.

The point of view of the trauma surgeon

If I had to summarise the “winning formula” in the recent tragic hours that we lived, in an orthopaedic centre of APHP, I would say that spontaneity and professionalism were the key ingredients. When I arrived in Lariboisière Hospital 2 h after the beginning of the events, I was surprised to discover that at least six or seven of my colleagues of different specialties were already there in addition to the doctors on duty that night. The on-call anaesthetists and intensive care doctors were helped by three colleagues who joined them spontaneously. Extra nursing staff also came to help. All these extra personnel allowed us to open two operating rooms for orthopaedic surgery, one for neurosurgery, one for ear, nose, and throat surgery, and two for abdominal surgery. The first seriously injured patients were operated on within half an hour of admission. The triage of the later patients was done in two locations: in the postoperative care unit next to the operating rooms for the most seriously wounded patients, who were brought directly by the mobile medical units, and in the emergency department for the less critically wounded patients. Triage was done by the most experienced physician in each specialty. During the first night, we operated continuously. On Saturday Nov 14, the orthopaedic surgery team was helped spontaneously by two other teams. The sequence of operations was determined after the last patients were admitted, including five patients who came from hospitals in which orthopaedic surgery was not available. With the anaesthetists and the nursing staff we operated continuously all day long. On Sunday Nov 15, the usual services resumed.

On Monday Nov 16, when all the medical staff reviewed what had been done during the weekend, the common observation was that all but one of the patients were less than 40 years old. All the patients we received had had a high-energy ballistic trauma. All upper limb fractures had been treated with external fixation because of the open nature of the fractures and extensive bone loss.¹⁰ The two lower limb ballistic traumas were treated with plates. Nerve damage was frequent, including two patients with median nerve section, one with radial nerve section, one with cubital nerve section, and one with peroneal nerve section. Only one nerve was repaired; for the others, gaps of several centimetres were observed and secondary reconstruction will be needed.¹¹ Vascular damage was not observed in our patients because patients with suspected problems of this sort were directed from the mobile medical unit to a hospital where vascular surgery was available. Psychiatrists were involved in treatment and had contact with all patients

during this early period to assess for acute stress disorder and begin the follow-up of potential post-traumatic stress disorder.

Professionalism was present at each level. While the operating room is often described as a difficult place—where the human factor is crucial—during this “stress test” difficulties vanished, working together appeared fluid and somehow harmonious. Trust and communication between different specialties and jobs were apparent. The common goal was so clear that no stakeholder tried to impose an individual view. Solidarity was observable inside the hospital but also between the different APHP hospitals: when a specialist was not available in one hospital the patient was transferred easily to another hospital where the expertise was available. The APHP network demonstrated its efficiency.

All operations were performed without any delay. The sterile supply chain was augmented to allow a fluid workflow, and administrative staff supported the medical work, finding logistic solutions when necessary (eg, patient registration, finding free beds, etc).

Timing might also have played a part in the success of the response. This disaster occurred at the beginning of a weekend and during the night. Some of the aspects might have been more difficult if it had happened during a working day, when the sterile stock is partly unavailable and when doctors and staff are already busy. Unfortunately, the current situation requires us to be prepared to face even more difficult situations in the future.

Conclusion

This is the legacy of history that led to the creation of the APHP hospital network as a single entity. Its huge size is regularly questioned, both internally and externally, as an obstacle to adaptation in a rapidly changing technological, medical, and social context. The decision circuits are complex, internal rivalries may develop, and changes are slow to spread. We sensed, however, that the size of the organisation could be an advantage in times of disaster. This advantage has now been demonstrated. No lack of coordination has been identified. No leakage or delay has occurred. No limit was reached. Furthermore, we believe that such a structure is not only an advantage in times of crisis, but also on a normal day. A large hospital complex is also able to produce powerful research, to process a considerable amount of data, and to play a major part in public health. What happened strengthens our belief that size can be combined with speed and excellence.

In the aftermath of this terrible experience, it is too early to report the details of the medical expense incurred

and the lessons that can be learned from this event. But we already know that as terrorism becomes more lethal and violent, nothing will prevent the medical community from understanding, learning, and sharing knowledge to become more effective in saving lives. However, we must remain humble and expect deaths to occur among the severely wounded patients in the upcoming days, despite the fact that we observed only four deaths (1%) among the 302 injured patients, including two deaths on arrival at hospital.

Contributors

All authors contributed equally to this report.

Declaration of interests

We declare no competing interests. We are all members of the Assistance Publique-Hôpitaux de Paris (APHP), MH is Director General of APHP.

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