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Managing Burn Victims of Suicide Bombing Attacks: Outcomes, Lessons learnt and Changes made from Three Attacks in Indonesia.

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Title: Managing Burn Victims of Suicide Bombing Attacks: Outcomes, Lessons learnt and Changes made from Three Attacks in Indonesia.

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Key Messages:

1) A burns disaster plan with emphasis on effective command, control and communication as well as organization of health care personnel following a 'team concept' will do much to ensure that the sudden onset of a crisis situation at an unexpected time does not overwhelm hospital manpower and resources.
2) The changing nature of terror attacks mandates continued vigilance and disaster preparedness.

3) In a mass casualty situation following a terrorist attack, "minimal acceptable care", with the selective treatment of burn patients to conserve hospital resources and maximize manpower may offer an alternative to an overwhelmed health care system.
4) Following a terror attack, the multidimensional burns patient, complicated by other injuries, is likely to become increasingly common, and hospitals should be prepared to treat this kind of patient.

ABSTRACT

***Background*:** Terror attacks in Southeast Asia were almost nonexistent until the 2002 Bali bomb blast, considered the deadliest attack in Indonesian history. Further attacks in 2003 (Jakarta), 2004 (Jakarta) and 2005 (Bali) have turned terrorist attacks into an ever-present reality.

Methods: The authors reviewed medical charts of victims evacuated to the Singapore General Hospital (SGH) Burns Center during three suicide attacks involving Bali (2002 and 2005) and the Jakarta Marriott hotel (2003). Problems faced, lessons learnt and costs incurred are discussed. A burns disaster plan drawing on lessons learnt from these attacks is presented.

***Results*:** 31 patients were treated at the SGH Burns Center in 3 attacks (2002 Bali attack (*n*=15), 2003 Jakarta attack (*n*=14) and 2005 Bali attack (*n*=2)). For the 2002 Bali attack,

median age was 29 (range 20 to 50), median total burn surface area (TBSA) was 29% (range 5 to 55) and median abbreviated burn severity index (ABSI) was 6 (range 3 to 10). 8/15 patients were admitted to the ICU. For the 2003 Jakarta attack, median age was 35 (range 24 to 56), median TBSA was 10 (range 2 to 46) and median ABSI was 4 (range 3-9). A large number of patients had other injuries. Problems faced included manpower issues, lack of bed space, shortage of blood products and lack of cadaver skin.

***Conclusions*:** The changing nature of terror attacks mandates continued vigilance and disaster preparedness. The multidimensional burns patient, complicated by other injuries, is likely to become increasingly common. A burns disaster plan with emphasis on effective command, control and communication as well as organization of health care personnel following a 'team concept' will do much to ensure that the sudden onset of a crisis situation at an unexpected time does not overwhelm hospital manpower and resources.

INTRODUCTION

Urban terrorism has been called the scourge of our times (1). Indeed, the number and scale of terrorist attacks occurring in the past few years have been unprecedented, with devastating consequences and massive loss of life. The increasing prevalence of suicide bombing attacks, striking at unexpected times and places and oftentimes causing multidimensional injuries with components of penetrating trauma, blast injury and burns (2) has made treating victims of these attacks a difficult and pressing concern. In addition, as victims of suicide bombing attacks are more severely injured compared with other trauma victims (3), with a large proportion requiring intensive care, hospital preparedness and formal protocols for dealing with mass casualty incidents (MCI) are paramount.

In South East Asia, terrorist attacks were almost nonexistent until the 2002 Bali bombing at Kuta beach. Following this attack, considered the deadliest act of terrorism in Indonesian history, further attacks targeting the Jakarta Marriott hotel in 2003, the Australian embassy in Jakarta in 2004 and further Bali bombings in 2005 have turned terrorist attacks into an ever present reality. While those responsible for the attacks have been arrested and charged, with the *Jemaah Islamiah*, an organization allegedly affiliated with *al-Qaeda* held liable for the attacks, the victims and relatives involved on those fateful days will forever bear the scars of terrorism.

Through three of these attacks, the Singapore General Hospital (SGH) Burns Center served as a receiving facility for some of the most severely burned victims in the immediate aftermath of the blasts. Singapore General Hospital is a level I trauma center,

with the SGH Burns Center being the only dedicated burn facility serving Singapore, receiving 93% of total burns cases in Singapore, a city-state with a population of 4.18 million (4). In addition, the SGH Burns Centre routinely receives severely burned patients throughout South East Asia requiring specialized burn care.

This report describes the characteristics of patients received in the aftermath of the 2002 and 2005 Bali bombings as well as the 2003 Jakarta Marriott hotel bombing, along with problems faced, the manner of response, lessons learnt and costs incurred. In addition, a disaster plan for management of future terrorist incidents in South East Asia involving large numbers of burn victims is presented, drawn up from the experience of these three devastating attacks.

METHODS

Terror Bomb Incidents

1) The 2002 Bali Bombing

On October 12, 2002 at 2305 hours at Kuta on the Indonesian island of Bali, a suicide bomber triggered a device hidden in a backpack, causing an explosion to tear through Paddy's bar. Fifteen seconds later, in front of the Sari Club, a much larger car bomb of close to 1000 kg concealed in a white Mitsubishi van was detonated by remote control. The blast left a one meter deep crater, with the shock wave blowing out windows throughout the town. Scores of victims were killed, with many more suffering severe trauma and burns. A third bomb had been detonated in front of the American consulate in Bali shortly before, causing only slight injury to one person. When all bodies were

accounted for, it was found that 202 people had lost their lives (5). 209 people were injured, with 15 patients with severe burns evacuated to our center.

2) The 2003 Jakarta Marriott Bombing

On August 5, 2003, near lunch hour in Jakarta, Indonesia, a car bomb exploded in the driveway of the Marriott hotel, killing 12 people and injuring another 150 (6). The force of the explosion shattered windows thirty floors up, and the attack left bodies lying among shattered debris and wrecked cars in the street. While this attack was smaller in scale than the preceding Bali blast, the psychological effect on the Indonesian people was no less marked, with terrorists striking at impunity in the heart of the capital city. 14 burn patients were evacuated to our center.

3) The 2005 Bali Bombing

On October 1, 2005 at 1850 hours in Bali, Indonesia, two explosions caused by suicide bombers ripped through a Jimbaran beach food court, and a third bomber struck at 1900 hours in the main square of central Kuta town. Unlike previous attacks, many of the casualties sustained shrapnel injuries as well as injuries due to ball bearings, suggesting a different modus operandi for the bombers. The final death toll was 20, with another 129 injured (7). Most of the injured were sent to Bali's Sanglah General Hospital, and treated largely for injuries caused by broken glass. Many of the casualties were foreign nationals. The two most severely injured victims, a father and daughter, were evacuated by air to Singapore General Hospital for further management by two flights on October 2nd and 3rd.

SGH Burns Center

The SGH Burns Center is less than two hours by air from much of Indonesia, located 1050 miles away from Denpasar, Bali and 555 miles away from Jakarta, and therefore was ideally placed to receive casualties following these attacks. It is a 29 bed facility, divided into a 4 bed intensive care unit (ICU), 6 bed high dependency unit and 19 bed general ward. Following the 2002 Bali attack, the facility was renovated with the ICU now able to nurse 8 patients in a crisis situation, as each of the cubicles are double-spaced (with patients only housed as such in a crisis with insufficient bed space). The mean annual admission to the Burns Center is 288 patients [4]. The mean number of ICU admissions was 9 (3% of total admissions) (range 8 to 10) between 2003 and 2005. However 16 patients were admitted in 2002 in the wake of the 2002 Bali attack. Patients were evacuated by air to our center by the International SOS (a non-for-profit first aid organization), following initial stabilization at Indonesian hospitals. Prior to evacuation, the International SOS corresponded with staff at the Burns Center to ensure that the most severely injured victims were evacuated first. Upon arrival, patients were admitted directly to the Burns Center for further management.

Data Collection

Data on patients was obtained from retrospective review of medical records. Information on demographic data, injuries sustained, complications, surgeries and outcome were obtained. Information on costs incurred in the wake of the terrorist attacks were obtained from records kept by the finance office of Singapore General Hospital, based on hospital bills incurred by individual patients. Data on cadaveric skin obtained

and skin banking protocols were obtained from the skin bank at the SGH Burns Center. Information regarding the events surrounding previous terrorist attacks was obtained from the public media.

RESULTS

Characteristics of Burn Patients Treated

From October 2002 to October 2005, the SGH Burns Center was involved in the management of 31 patients evacuated from three separate suicide bombing attacks in Indonesia. Table 1 presents the characteristics of patients evacuated to our center. For the October 12 2002 Bali bomb blast, 15 patients were evacuated to Singapore on October 14, 2 days after the incident, following stabilization and triage at local hospitals. Many of these patients were severely burned, with a median total burn surface area (TBSA) of 29% and 8 patients admitted to the ICU. Patients admitted to the ICU either had inhalational burns or required intubation due to severe burns. All patients with suspected inhalational injury had a diagnostic bronchoscopy. One patient died of multiorgan failure with septicemia and pneumonia following a protracted ICU stay, 24 days after admission, but the others survived. 11 patients required surgery, with a total of 36 burn and 3 nonburn surgeries performed.

In contrast, for the August 5 2003 Jakarta Mariott hotel bombing, patients evacuated to our center were less severely burned, with a median TBSA of 10%; and only 2 patients were admitted to the ICU. All patients survived. 13 patients required surgery, with 29 burn surgeries and 7 nonburn surgeries performed. Patients were evacuated to

Singapore in multiple waves from August 6 to August 9, with the two most severely injured requiring ICU care arriving first. This likely reflects the smaller scale of the 2003 Jakarta bombing, as opposed to the three bombs detonated in the 2002 Bali bombing.

Interestingly, all the patients from the 2002 Bali bombing treated at the SGH Burns Center were non Indonesian (comprising a mix of American, British, Swiss, French, Irish, Canadian, Singaporean and Japanese nationals), and of relatively young age (median 29 years). As the terrorists targeted crowded areas frequented by tourists, this likely explains why many foreign nationals sustained severe burn injuries. Six of these patients were evacuated back to their home countries after a 2-8 days hospitalization period in Singapore (where essential surgery and resuscitation was performed), on request from patients and national authorities. In contrast, for the 2003 Jakarta bombing, all the patients seen were either Indonesian or Singaporean, perhaps due to lesser numbers of foreign tourists visiting Indonesia.

Table 2 shows characteristics of patients admitted to the ICU. While a direct comparison cannot be made with other terror attacks as select patients were evacuated to our center, it is useful to make a comparison. In the Israeli experience (8), 55% of patients with burns or penetrating injuries required ICU care, with a median length of stay of 4 days. Our experience was similar for the 2002 Bali bomb blast, with 53% of patients admitted to the ICU, and a median length of ICU stay of 4.5 days. The median length of stay for ICU patients was the same (at 4.5 days) for patients admitted to Gregario Maranon University General Hospital following the Madrid train attack in March 2004 (9). This is in accordance with previous studies showing that terror victims stayed in the ICU considerably longer than other ICU patients (3).The severity of burn injury for

patients admitted to the ICU in the 2002 Bali attack, with an average TBSA of 39% was similar to that observed for burn patients requiring critical care in the 9/11 Pentagon attack (10), with an average TBSA of 34%. Of the two patients admitted to the ICU following the 2003 Jakarta attack, one had a protracted ICU stay with prolonged ventilation as he developed acute respiratory distress syndrome (ARDS) with pneumonia and septicemia.

A large number of the patients seen at the SGH Burns Center had other injuries as shown in Table 3. The most common concomitant injury seen was ear barotrauma. 8 patients (53%) from the 2002 Bali attack, and both from the 2005 Bali attack (100%) had ear barotrauma. In contrast, only 1 patient from the 2003 Jakarta attack (7%) had barotrauma. This could be explained by the different settings of the attacks. In the Bali attacks, victims were directly exposed to the full force of the blasts. However, in the Jakarta Marriott attack, which involved detonation of a car bomb in the driveway of the hoteol, victims were likely shielded from the blasts by the hotel walls. Of patients presenting with ear barotrauma, one from the 2002 Bali attack (7%) had other primary blast injury as well, with a pneumothorax of the left lung. The most severely injured victim of the 2005 Bali bombing, a 43 year old man who was evacuated to Singapore, had ear barotraumas and also sustained secondary blast injury, with a ruptured spleen and fractures as well as injuries from multiple ball bearings lodged in his thorax, abdomen and spine, causing Brown-Sequard syndrome.

Problems Encountered and Solutions Used

Through the three terrorist attacks, the SGH Burns Center continued to function normally, admitting burn patients from Singapore and abroad. This was unavoidable, as we are the only regional Burns Center in this part of South East Asia. The main problems faced were those of manpower, lack of bed space, shortage of blood products and lack of cadaveric skin. With the sudden influx of 15 patients in one day following the 2002 Bali bomb blast, the normal staff complement of the Burns Center was insufficient to manage the situation. As a result, off duty staff were recalled, additional critical care trained nurses were recruited from the surgical and medical ICUs, and surgical residents who had previously done a burns rotation were seconded to assist in managing the patients in the week following the incident. The 9 plastic surgeons in the unit with teams of surgical residents worked 12 hour shifts in the days following the attack, operating on the patients. Additional operating theatres were allocated for use in management of the victims of the Bali bomb blast. The estimated number of elective surgeries cancelled was about 20 to 30, particularly those requiring ICU care.

Of the 8 patients requiring ICU care following the 2002 Bali attack, 4 were housed in the surgical ICU, managed with the aid of additional surgical intensivists recruited during this period. Patients judged fit enough for step down care were discharged from the surgical ICU prior to the first patients arriving from Bali. The 2003 Jakarta and 2005 Bali attacks did not pose such a major manpower and resource problem due to the lesser number of patients requiring critical care and surgery, as well as better disaster preparedness due to experience gained from managing patients from the 2002 attack.

In our burn center, we practice early massive excision of burns, with temporary coverage by skin substitutes followed by definitive wound closure with autologous skin grafts in staged surgeries. As a result, a significant problem encountered following the 2002 Bali attack was an acute shortage of blood products following the many surgeries performed for victims of that attack. Fortunately the National Blood Bank was able to obtain more blood at short notice through blood donation drives and recalling regular blood donors during this period. However, many elective surgeries were also cancelled in the immediate aftermath of the attack, in order to conserve blood products.

The lack of cadaveric skin was another major issue following the 2002 Bali bomb blast. Prior to this attack, no contingency had ever called for the massive amounts of cadaver skin required. On October 14, 2002, when the patients arrived from Bali, there was 9100 cm^2 of cadaveric skin in our skin bank. By October 18, only 5450 cm^2 was left. Fortunately a prior request for substitute skin had been made to the University of Texas Southwestern Medical Center at Galveston, which responded by flying 22968 cm^2 of skin over to Singapore. The shipment arrived on October 18, 2002, forestalling the anticipated shortage of cadaveric skin. Better prepared for the 2003 Jakarta and 2005 Bali attacks, the SGH Burns Centre did not face any further shortages of skin substitutes.

Cost of the Terrorist Attacks

The cost of these consecutive suicide bombing attacks, at regular intervals in Indonesia, to those victims and families involved cannot be quantified. Numerous people lost their lives, and many more were injured. In addition, the previous absence of terror attacks was replaced by an almost annual bomb blast in Indonesia, changing the region

forever. The psychological effect has been no less, with a pervading sense of danger among the local populace and marked decrease in tourism to the region seen following these attacks.

In terms of costs incurred by patients during their stay, the 2002 Bali bombing cost S$765,702 (US$450,412). The 2003 Jakarta bombing cost S$603,008 (US$354,710) and the cost of the 2005 Bali bombing was S$38,535(US$22,667).

DISCUSSION

The number of patients suffering burns as a result of the 2002 Bali bombing was extremely high, with 15 patients treated at the SGH Burns Center and a further 48 evacuated from the Royal Darwin Hospital to Australian burns centers (11). We will never know of many more patients who were not evacuated from Bali. In contrast, only 18 burn patients were transferred to the Cornell Burn Center (12) following the September 11 attacks in New York and 9 patients admitted to the Washington Hospital Center Burn Center following the 9/11 attack on the Pentagon (10). The scale of the 2002 Bali attack may best be appreciated by the fact that even in Israel, over a period of 2 years, only 91 burn patients (out of a total of 623 victims injured by terror-related explosion) (8) in multiple terror attacks were hospitalized. The 2003 Jakarta Marriott bombing was of smaller scale, with only 14 patients evacuated, but still significant in relation to other terror attacks of these times.

Burn centers are never the first responders in terrorist attacks. However, they almost invariably play a pivotal role in subsequent management of burn patients. A

formalized protocol for mass casualty incidents (MCI) and limited mass casualty incidents (LMCI) is therefore essential to ensure proper workflow during a crisis situation as well as the ability to cope with a massive surge in patients transferred at short notice. From experience in previous terrorist attacks, the number of burn patients to be expected is significant. In Israel, of patients hospitalized following injury by terror-related explosion, 15% suffered burns (8). Following 9/11 in New York City, 14% of patients admitted to Bellevue Hospital and New York University Downtown Hospital were burn patients (12); St Vincent's Hospital reported similar figures with 19% of hospitalized patients sustaining burns (13).

Due to Singapore's position at the crossroads of air and sea traffic, as well as the presence of a petrochemical industry and high-density urban sprawl, burns preparedness has always been a priority. The SGH Burns Center Burns Disaster Plan was conceptualized, and designed in light of lessons learnt following the recent terror attacks in Indonesia. It emphasizes effective command, control and communication as well as a 'team concept' where medical and nursing personnel are organized into teams for better management of burns patients. Yearly drills ensure that staff are kept up to date on processes and procedures. Future validation of the disaster plan is planned. The major problems faced during the Indonesian terror attacks- such as manpower issues, lack of bed space and resource shortage were analyzed and solutions proposed. Cross-training of personnel to provide additional manpower in a crisis situation, as well as provision for opening of additional ICUs and wards was instituted. In addition, a directive from the Ministry of Health, Singapore, stipulated requirements for a minimum supply of cadaveric skin to be banked at the Burns Center at all times.

In a crisis situation, a Burns Disaster Command is formed with the Director of the Burns Center serving as the director of operations. He is assisted by a team comprised of senior nursing staff, administrative and communication officers. The Burns Disaster Command is housed in a specialized room serving as an operations center, and provides command and control of all Burns Center personnel (Figure 1). Medical staff are organized into teams comprising of 1 attending (team leader), 1 senior resident, 1 junior resident and 1 staff nurse attached directly to the medical team. Nursing staff are also organized into individual teams under the direction of each medical team. Each team, when activated is responsible for a specific task in the initial phase of the crisis, for example resuscitation, performing investigations or clerking patients. Subsequently, when the situation has stabilized somewhat, each team then takes on responsibility for the care of a specific group of patients, and takes turns admitting patients to prevent the same group of doctors or nurses being overwhelmed by a sudden surge of casualties. When activated, the team leader is stationed at the emergency department (ED) to triage patients, while the rest of the team is stationed in the ward.

Contingency plans also allow for the opening of additional temporary ICUs during a mass casualty incident in areas such as the operating theatre recovery rooms, endoscopy suite and day surgery suite. Intensivists are organized into teams comprising of 4 attendings and 4 residents, with 1 team covering each ICU.

A dedicated briefing and communications room for press conferences and communication with family members is manned by a communication officer, with easy access to social workers, psychologists, nurses and doctors. To ensure effective channels of communications are maintained, dedicated phone lines are maintained between the

operations center, communications room, ED, disaster site command and the rest of the hospital. The operations center serves as the nerve center of the communication network. A plan for activation and recall of medical and nursing staff is in place with varying levels of activation, the level of activation of personnel being decided by the Director of the Burns Center. The role of local authorities in a mass casualty situation is also vital to preserve lines of communication and transport. Civil defence and emergency services contingency plans are in place to prepare for such a situation.

Unidirectional flow of casualties is a priority, formalized into a protocol for reference of medical and nursing personnel (Figure 2). In addition, admissions are staggered to prevent staff in the Burns ward from being overwhelmed, with the observation ward in the ED serving as a holding area for patients. Debriefings are conducted regularly, with all medical and nursing teams meeting regularly and at daily intervals when the situation has stabilized to prioritise patients for surgery and discuss allocation of hospital resources and other pressing issues. While the immediate aftermath of a mass casualty incident will prove a strain to hospital resources, a formalized disaster plan will do much to ensure that in the midst of a crisis, good care is provided to all victims, with medical and nursing staff well looked after. At the National level, in a further effort to ensure that sufficient trained staff are available in the event of a mass casualty situation, cross-training of nursing staff was instituted, with surgical and critical care nurses in particular required to rotate through the Burns Center. A Burns course targeted at surgical residents was also instituted, to ensure that all surgical residents would be equipped to manage burn patients if called upon.

Despite all possible preparative measures and a formalized Burns Disaster Plan to forestall chaos, in a true mass casualty scenario, manpower and hospital resources may still be insufficient to cope with the situation. The concept of "minimal acceptable care" in terror attacks, where effort is concentrated on a maximal number of salvageable patients (8, 14, 15), has been proposed to optimize evacuation preferences and guide triage, as well as determine to which patients critical hospital resources are allocated to. A modification of this concept may be applicable in burns patients. As most burn centers now practice early massive burns excision with immediate cover by autologous skin and skin substitutes within 72 hours after the initial burn injury (4, 16), the strain on staff and resources such as cadaver skin in a true mass casualty incident may force burn surgeons to select patients to be operated on. Those with the maximal chance of survival- patients who are moderate in the severity of their burns, who require early burns excision to optimize recovery, and who are not so severely burned that they are likely to develop other complications, would be the natural candidates for surgical priority. In the event of severe shortage of cadaver skin, temporary skin substitutes such as Silon-TSR (Stat Pharmaceuticals, CA, USA) a semi-occlusive non-adherent dressing, or Biobrane (Mylan Laboratories, PA, USA) can be used to cover the burn wound and promote epithelisation, until autologous skin from the patient can be harvested.

There appears to be a clear difference between normal burn patients and victims of terror attacks requiring admission to a burn centre. From our experience, a large proportion of victims of terror attacks have multidimensional injury with other injuries besides burns. Similarly, in the Israeli experience, 68% of patients with burn injuries had penetrating and blunt injuries (8). This is exemplified by the 43 year old man previously

described, injured in the 2005 Bali bombing, who also sustained spinal cord injury, fractures, and penetrating injuries to the thorax and abdomen caused by multiple ball bearings. If the changing nature of suicide bombing attacks in Indonesia is an indication of tidings to come, with increasing use of ball bearings and heavy shrapnel in bombs, future victims of terror attacks with burns are also increasingly likely to present with multiple injuries besides the burn injury. The multidimensional burns patient, particularly those requiring critical care, presents a particular therapeutic challenge. He has an increased operative risk due to multiple injuries, but requires surgery more than others, to forestall problems related to delayed burns excision. To compound the problem, following burns excision, he is at increased risk of metabolic derangements and multiorgan failure due to other injuries, and therefore will likely require prolonged ICU support. Burns centers should be prepared for managing such difficult and unstable patients as part of disaster preparedness.

For patients with burn injuries sustained in bomb blasts there is also the need to appreciate that the blast wave caused by heavy explosives results in an additional element of soft tissue destruction. This is especially true for those victims closest to the blasts who survive. These wounds cannot be treated primarily as burn wounds, but require repeated reassessment in the next 48 hours for progression to deeper tissue destruction. Therein lies the problem for mass casualty incidents where facilities and staff are overwhelmed and the resultant level of care is therefore suboptimal.

CONCLUSIONS

The changing nature of terror attacks mandates continuing vigilance and disaster preparedness. The multidimensional burns patient, complicated by other injuries, is a particular challenge to manage, but is likely to become increasingly common. A structured burns disaster plan, with emphasis on control, command and communication, will do much to ensure that the sudden onset of a crisis situation at an unexpected time does not overwhelm hospital manpower and resources. In extremis, “minimal acceptable care”, with the selective treatment of burn patients to conserve hospital resources and maximize manpower may offer an alternative to an overwhelmed health care system.

List of abbreviations

ED	Emergency Department
ICU	Intensive Care Unit
SGH	Singapore General Hospital

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

HC conceived the study, carried out necessary research and wrote the manuscript. WSY and CS participated in care of patients and helped to draft the manuscript. All authors read and approved the final manuscript.

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FIGURE LEGENDS

FIGURE 1. Organisation of personnel in the Burns Center during a crisis situation. Emphasis is placed on effective command, control and communication and a 'team concept'.

FIGURE 2. Unidirectional flow of casualties is essential to ensure that health care personnel are able to cope with the flood of patients and adequate care is provided to all victims in a mass casualty situation.

Table 1. Characteristics of Burn Patients treated in the Three Attacks

	All Attacks (n = 31)	Bali 2002 (n = 15)	Jakarta 2003 (n = 14)	Bali 2005 (n = 2)
Number of victims	31	14	15	2
Age (yrs)*	32 (13-56)	29 (20-50)	35 (24-56)	28 (13-43)
Gender (male:female)	17:14	6:9	10:4	1:1
%TBSA[Ψ] Burn*	15 (2-55)	29 (5-55)	10 (2-46)	11.5 (7-16)
ABSI[Ψ]*	5 (2-10)	6 (3-10)	4 (3-9)	3.5 (2-5)
Inhalational Injury[#]	2 (6%)	0 (0%)	2 (14%)	0 (0%)
Number admitted ICU[#]	10 (32%)	8 (53%)	2 (14%)	0 (0%)
Number of burn surgeries*	2 (0-10)	2 (0-10)	2 (0-6)	1 (1-1)
Length of hospital stay*	11 (2-58)	6 (2-42)	16.5 (7-58)	10 (9-11)
Mortality[#]	1 (3%)	1 (7%)	0 (0%)	0 (0%)

*Data shown as median (range)

[Ψ]TBSA, total burn surface area; ABSI, abbreviated burn severity index

[#]Number (% total)

Table 2. Characteristics of Burn Patients admitted to the Intensive Care Unit

	All Attacks (n=10)	Bali 2002 (n=8)	Jakarta 2003 (n=2)
Age (yrs)*	29.5 (23-56)	28.5 (23-35)	45.5 (35-56)
Gender (male:female)	3:7	1:7	2:0
%TBSA[Ψ] Burn*	37.5 (23-55)	37.5 (23-55)	39.5 (33-46)
ABSI[Ψ]*	8 (6-10)	7.5 (6-10)	8.5 (8-9)
Ventilator days*	3.5 (1-40)	3 (1-18)	24 (8-40)
Length of ICU stay*	6 (2-40)	4.5 (2-24)	24.5 (9-40)

*Data shown as median (range)

[Ψ]TBSA, total burn surface area; ABSI, abbreviated burn severity index

[#]Number (% total)

Table 3. Number of patients with other injuries admitted to the SGH Burns Center

	All Attacks (n = 31)	Bali 2002 (n = 15)	Jakarta 2003 (n = 14)	Bali 2005 (n = 2)
Ear Barotrauma[#]	11 (35%)	8 (5%)	1 (7%)	2 (100%)
Fractures/ Dislocations[#]	7 (23%)	4 (3%)	2 (14%)	1 (50%)
Pneumothorax[#]	3 (10%)	2 (13%)	1 (7%)	0 (0%)
Ruptured spleen[#]	1 (3%)	0 (0%)	0 (0%)	1 (50%)
Neurological injury[#]	2 (6%)	0 (0%)	1 (7%)	1 (50%)
PTSD[#]*	3 (10%)	2 (13%)	0 (0%)	1 (50%)
Shrapnel wounds[#]	4 (13%)	1 (7%)	2 (14%)	1 (50%)
Lacerations[#]	3 (10%)	2 (13%)	7 (50%)	1 (50%)
Tendon injuries[#]	3 (10%)	0 (0%)	3 (21%)	0 (0%)

[#]Number (% total)

*PTSD, Post traumatic stress disorder

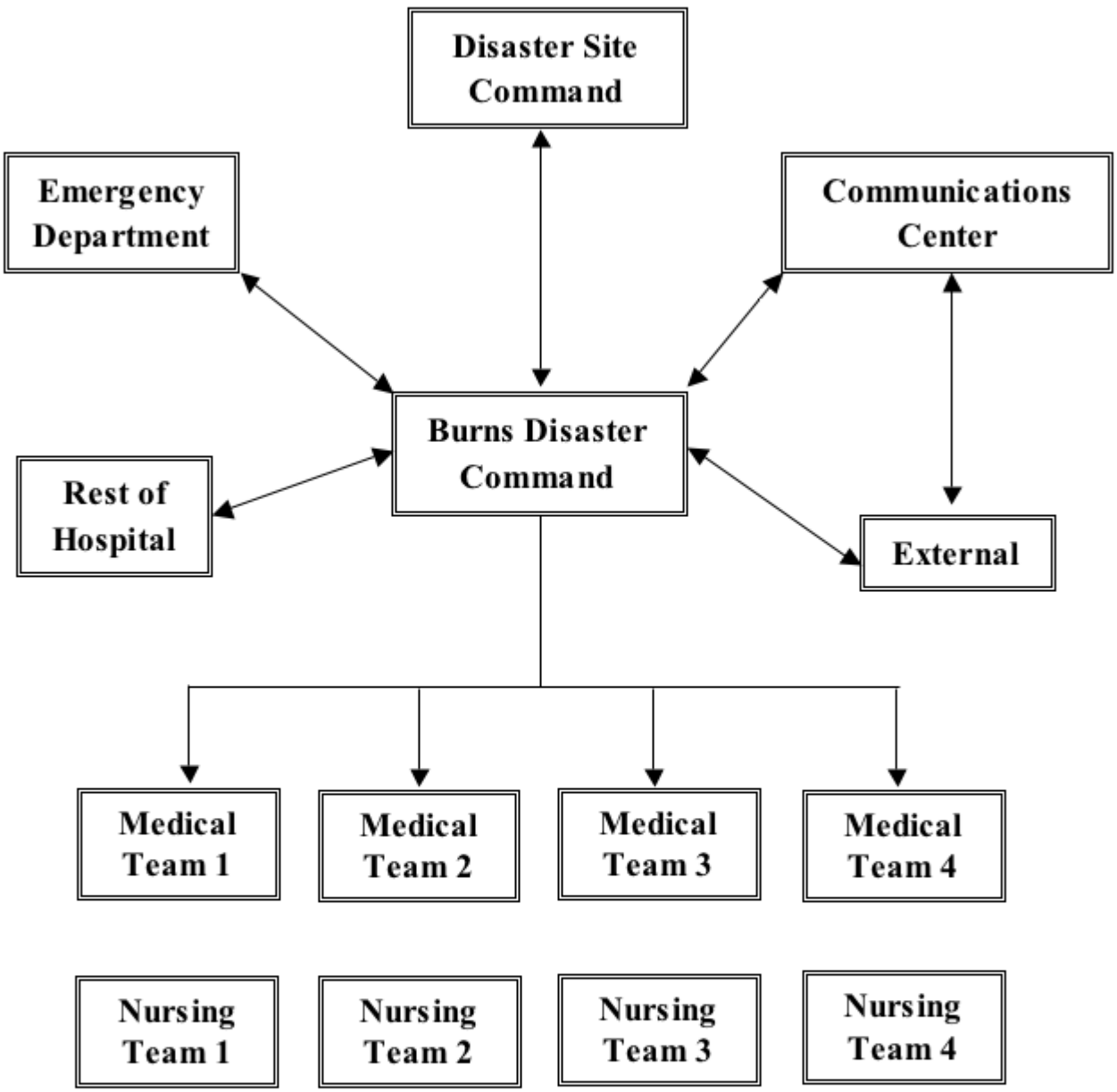
Disaster Site Command
Emergency Department
Communications Center
Burns Disaster Command
Rest of Hospital
External
Medical Team 1
Medical Team 2
Medical Team 3
Medical Team 4
Nursing Team 1
Nursing Team 2
Nursing Team 3
Nursing Team 4

Figure 1

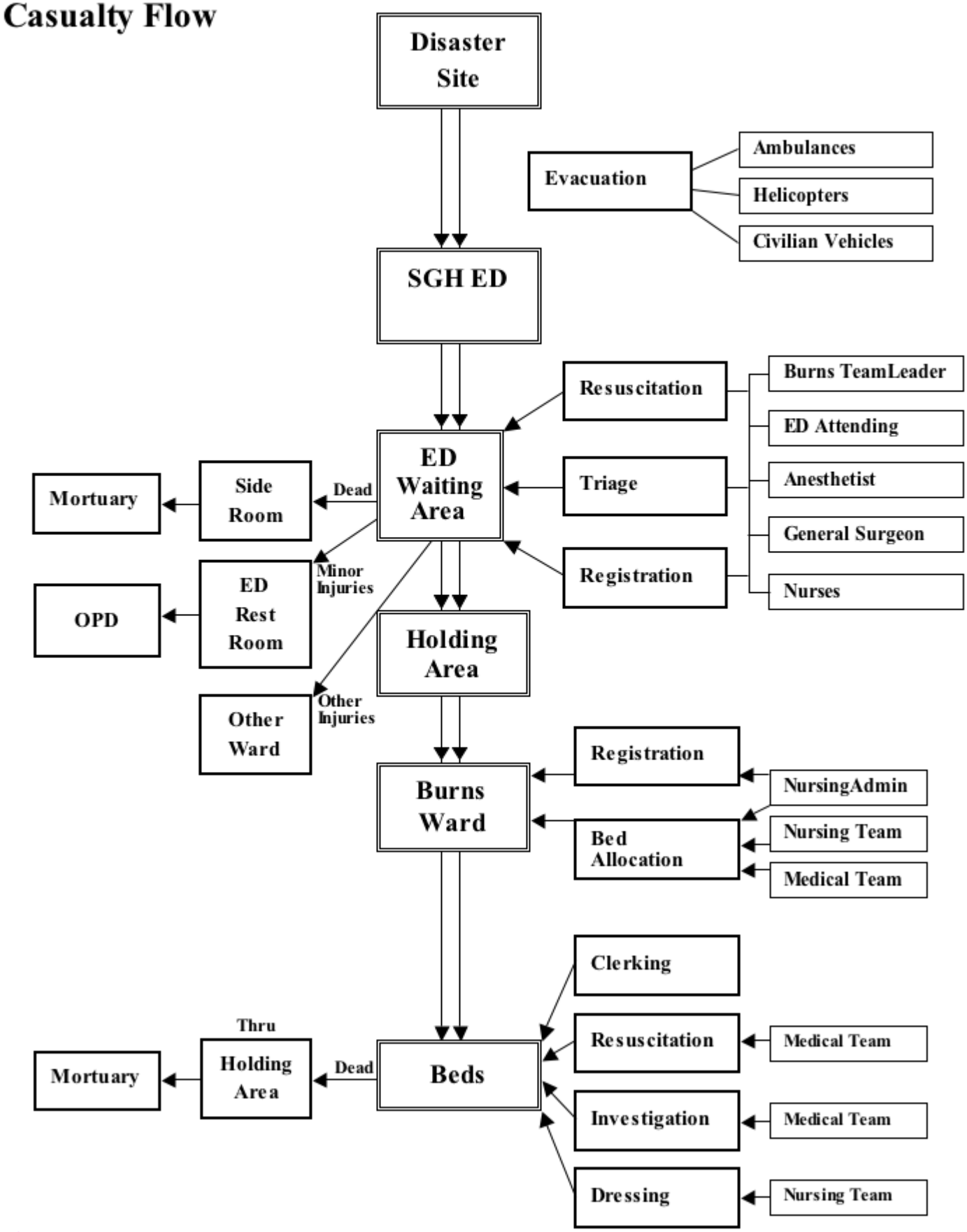
Casualty Flow
Disaster Site
Evacuation
Ambulances
Helicopters
Civilian Vehicles
SGH ED
Resuscitation
Burns TeamLeader
ED Attending
Anesthetist
General Surgeon
Nurses
ED Waiting Area
Triage
Registration
Mortuary
Side Room
Dead
Minor Injuries
ED Rest Room
OPD
Other Injuries
Other Ward
Holding Area
Burns Ward
Registration
NursingAdmin
Bed Allocation
Nursing Team
Medical Team
Clerking
Resuscitation
Medical Team
Investigation
Medical Team
Dressing
Nursing Team
Beds
Thru
Holding Area
Dead
Mortuary

Figure 2