INFRASTRUCTURE, RESOURCES AND PREPAREDNESS FOR MASS BURN INJURIES IN A DEVELOPING COUNTRY

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SUMMARY. Our aims were to evaluate resources and the preparedness of the health care facilities to respond to mass burn injuries in Vietnam. A survey was conducted in 19 provincial and central/regional hospitals using a questionnaire. The contents of the survey included infrastructure, human resources, medical equipment for burn care, and preparedness of hospitals for mass burn injuries. Results indicated that a variety of burn care facilities were set up, from separate burn departments (42.1%) to burn units (15.8%) or burn beds (42.1%) inside trauma or surgical departments. Medical staff/burn bed ratio was .7 and nurse/physician ratio was 1.7, with 52.7% of nurses having more than 5 years’ experience. Infrastructure and medical equipment for burn facilities were limited, with just under half of the hospitals equipped with an air conditioner and heater. Bronchoscopy for diagnosis and management of inhalation injury was available in 6 (31.6%) hospitals. Few health facilities had a mechanical ventilator, fluid warmer, hemofiltration machine, burn theater, electro-dermatome or skin mesher. Only 26.3% hospitals had a plan for the management of mass burn injuries. A burn specialist was a member of the hospital’s emergency medical team in 36.8% of the hospitals. Guidelines for burn emergency care were available in 63.2% hospitals. In the last 5 years, 21.1% of health facilities had conducted a drill for mass casualty incident management, but only 1 (5.3%) hospital had conducted a drill for MBI management. In conclusion, facilities, equipment, human resources for burn care and preparedness to manage mass burn injuries in Vietnam are still limited and need to be improved.

Keywords: resources, health facility, mass burn injuries, medical response

RÉSUMÉ. Nous avons étudié les capacités du système de santé vietnamien à répondre à un afflux massif de brûlés. Nous avons envoyé un questionnaire à 19 structures provinciales et régionales. Il portait sur les infrastructures, les moyens humains comme matériels, les structures de soins aux brûlés et la préparation à la prise en charge d’un afflux massif de brûlés. Nous avons repéré 3 types de structures de soins aux brûlés : CTB spécifiques (42,1%), unités (15,8%) ou lits (42,1%) pour brûlés dans des services de traumatologie ou de chirurgie. On recense 0,7 médecin par lit et 1,7 infirmière par médecin, 52,7% d’entre elles ayant au moins 5 ans d’expérience. Un peu moins de la moitié des hôpitaux avaient des systèmes de chauffage ou de climatisation. Seuls 6 (31,6%) des hôpitaux disposaient d’un fibroscope, permettant de diagnostiquer et prendre en charge les inhalations de fumées. Peu de structures disposaient de ventilateurs, réchauffeurs de perfusion, dialyseurs, salle d’opération dédiée, dermatome électrique ou Meshgraft. Seuls 26,3% des hôpitaux avaient élaboré un plan catastrophe spécifique, 36,8% des structures ayant un brûlologue dans leur équipe d’urgences. Des référentiels de prise en charge en urgence existaient dans 62,3% des hôpitaux. 21,1% des hôpitaux avaient réalisé un exercice catastrophe dans les 5 ans précédant l’étude mais 1 seul (5,3%) avait modélisé un afflux massif de brûlés. En conclusion, les infrastructures, le personnel et l’entraînement vis-à-vis d’un afflux massif de brûlés restent insuffisants au Viêt-Nam et doivent être améliorés.

Mots-clés : service de santé, ressources, afflux massif de brûlés, réponse

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Introduction

Mass burn injuries (MBI) may occur at any time in daily life, and increase alongside the development of industrial and economic systems due to natural or man-made accidents related to the work or domestic environment.1,2,3

Medical management for major burn incidents is more difficult than the management of individual cases.4,5,6 The reasons are unforeseen occurring accidents, a large number of patients with inhalation injuries and concomitant trauma at the same time, the immediate requirement for a large amount of medication and equipment, and insufficient medical staff. In addition, it is important to note that healthcare providers who participate in the pre-hospital and hospital phase of mass injury management must have sufficient knowledge, experience and practical skills in emergency care, triage and the transportation of burn patients. The success of MBI medical response depends on the preparedness of the burn care system.

It is noted that about 90% of burn-related deaths occur in developing or less developed countries.4 Limitations have been reported regarding the pre-hospital management of burn patients, especially for MBI in the developing world.7 To date, there have been few studies conducted on preparation for the management of mass burn injuries in developing countries.8 This study investigated the current situation of infrastructure, resources and planning for MBI response in Vietnam.

Material and methods

From March to July 2016, a questionnaire was sent to 19 provincial and central/regional hospitals registered as members of the burn care network of the Vietnam Burn Association. The contents of the survey included two parts with a total of 15 questions. Part one investigated type of burn care facility, human resources including number of physicians and nurses, nurses’ experience in burn care, available medical equipment for burn management including number of burn beds, the presence of flexible bronchoscopy for diagnosis and treatment of inhalation injury, mechanical ventilator, infusion pump, burn theatre, burn bathtub, hemofiltration machine, heater and guidelines for emergency burn management. Part two focused on preparedness to manage mass burn injuries with details of MBI response planning, lists of available medication and medical equipment packs, drills on the management of mass casualty incident and MBI conducted in the last 5 years, and the role of the burn physician in the mobile emergency medical team (see Appendix). Data were tabulated and analyzed using Stata 11.0 software.

Results

A variety of burn care facilities were set up in the 19 hospitals. There were 8 burn departments, accounting for 42.1%. The other facilities were burn units (15.8%) or burn beds (42.1%) inside trauma or surgical departments. Total burn beds in the 19 hospitals was 236, with medical staff/burn bed ratio and nurse/physician ratio .7 and 1.7 respectively. In addition, 52.7% of nurses had more than 5 years’ experience in burn care (Table I).

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Subgroup</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burn facility</td>
<td>Burn department</td>
<td>08 (42.1)</td>
</tr>
<tr>
<td></td>
<td>Burn unit in trauma/surgical department</td>
<td>03 (15.8)</td>
</tr>
<tr>
<td></td>
<td>Burn beds in trauma/surgical department</td>
<td>08 (42.1)</td>
</tr>
<tr>
<td></td>
<td>Total burn beds</td>
<td>236 (100)</td>
</tr>
<tr>
<td>Human resources</td>
<td>Medical staff/burn bed ratio</td>
<td>7/1</td>
</tr>
<tr>
<td></td>
<td>Nurse/Physician ratio</td>
<td>1.7/1</td>
</tr>
<tr>
<td></td>
<td>Nurses with ≤ 5 years experience</td>
<td>52 (47.3)</td>
</tr>
<tr>
<td></td>
<td>Nurses with &gt; 5 years experience</td>
<td>68 (52.7)</td>
</tr>
</tbody>
</table>

Infrastructure and medical equipment in the hospital burn facilities are shown in Table II. There were 3 burn ICU beds and 3 bath tubs set up in 3 (15.8%) hospitals. Nearly half of the burn rooms were equipped with an air conditioner (57.9%) and heater (47.4%). Bronchoscopy for the diagnosis and management of inhalation injury was available in 6 (31.6%) hospitals. Few health facilities had a ventilator, hemofiltration machine, fluid warmer, burn theater, electro-dermatome or skin mesher.

Over the last 5 years, 15 (78.9%) hospitals had...
received and managed mass burn injuries, and 26.3% had managed at least five cases of MBI. In addition, 26.3% hospitals had a plan for MBI management. Only 36.8% of hospitals had a burn specialist as a member of the mobile EMT. Guidelines for burn emergency care were available in 63.2% hospitals. In the last 5 years, 21.1% health facilities had conducted a drill for mass casualty incident management, but only 1 (5.3%) hospital had conducted a drill for MBI management (Table III).

### Table III - Hospital preparedness for mass burn injuries

<table>
<thead>
<tr>
<th>Contents</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management of at least 5 MBIs in the last 5 years</td>
<td>15</td>
<td>04</td>
</tr>
<tr>
<td>Guidelines for burn emergency management</td>
<td>12</td>
<td>07</td>
</tr>
<tr>
<td>Full plan for mass burn injuries</td>
<td>05</td>
<td>14</td>
</tr>
<tr>
<td>Preparing medical pack for MBI</td>
<td>05</td>
<td>14</td>
</tr>
<tr>
<td>Burn specialist is a member of mobile EMT</td>
<td>07</td>
<td>12</td>
</tr>
<tr>
<td>Drill for mass casualty incident management in the last 5 years</td>
<td>04</td>
<td>15</td>
</tr>
<tr>
<td>Drill for MBI management in the last 5 years</td>
<td>01</td>
<td>18</td>
</tr>
</tbody>
</table>

MBI = mass burn injuries

### Discussion

The concept of the burn center was first introduced in 1952, then further defined by Feller and Crane in 1971 to provide the most comprehensive care, with an emphasis on research and teaching, a minimum of six beds and at least 50 inpatients annually. Currently, guidelines of the American Burn Association (ABA) set the requirement for burn centers that at least 100 patients with acute burn injuries are admitted annually and an average daily census of three or more patients is maintained. There is a major emphasis on administration, pre-hospital planning, multidisciplinary specialized burn care personnel, prevention and education, rehabilitation and research. The guidelines for the operation of a burns center state that the infrastructure must have at least four beds with intensive care unit (ICU) capacity, with monitors, weight measuring devices, temperature control devices for patients and for warming intravenous fluids and blood products, and cardiac emergency carts with age-appropriate equipment. Furthermore, the burns center must have operating theatres with 24 h a day access and equipment for renal dialysis, radiology and clinical laboratory services. Based on ABA guidelines, numerous developed countries have established burn centers at national or regional level to deal with burn victims and mass burn incidents. For example, in Israel, the National Burns Center was opened in 2014 to ensure burn care and disaster planning at international standards, with improvement of patient outcomes, research and training for MBI.

In 2011 Vogt and Busche evaluated infrastructure and medical equipment in burn facilities in Germany, Austria and Switzerland, and found that they were nearly the same as ABA criteria: 83% of burn centers were located in the department of reconstructive and plastic surgery, 6% in the anesthesia department and 11% in the traumatology department. As for pediatric burn units, 10% were in the department of reconstructive and plastic surgery, 40% in the pediatric surgical department and 10% in the anesthesia and intensive care department. 100% of hospitals had a helicopter pad for transferring severe burn patients. In addition, 28% of German hospitals had a skin bank, a large room for burn patients (130m² for adults and 37m² for children) with full medical equipment, heater and air system.

However, it is also noted that unlike trauma centers,
the number of burn centers is low and may not be enough to deal with MBI, even in developed countries. In the United States there are thousands of trauma centers but only 132 burn centers with 1897 burn beds. Only 43 burn centers were verified to conform to the quality assurance of the American Burn Association. A survey by Faucher in 2004 also indicated a shortage of burn surgeons at that time and in the immediate future. In addition, there is still a lack of consensus regarding the optimal design of burn care facilities and the necessary equipment.

Insufficient infrastructure and resources have been indicated worldwide, especially in developing countries. For example, Zhangzeng and coworkers reported that in China in 2015 there were .5 burn units, 5 burn specialists, 8 burn nurses and 19 burn beds for 1 million of the population. Average burn bed number was 40 beds/burn department with 10% for severe burn patients. Physician : nurse ratio was .64; burn bed/specialist was 4.48, burn bed/nurse 2.67. In addition, lack of rehabilitation knowledge, shortage of specialized personnel and lack of standard guidelines for rehabilitation treatment and funding from the government were also recorded. In Turkey, a survey by Kut et al. in 2005 reported that there were 24 burn centers for a population of 68 million, with 225 beds and only 74 ICU beds (32.8%) and 43 rooms for burn patients, and a shortage of medical equipment and untrained medical staff. Our study indicated that burn facilities in Vietnam were significantly limited as regards human resources, medical equipment and infrastructure. In addition, a previous report indicated that also knowledge and practical skills for burn care and therapy were limited. The burn care system should be developed to cover the whole country, especially the industrial zone where there is a high risk of burn mass injuries occurring.

It is clear that plans for MBI management should be set up and ready at every burn facility. Even in cases where a plan is set up, the reality may be different and cannot be imagined, with significant difficulties and obstacles. A report by Abir et al. in 2012 on the model and standard operation procedures of the MBI management drill in Michigan for 100 burn victims, with an average time of 3 minutes per victim, indicated the significant difficulties involved in establishing ICU beds, spare rooms, provision of intravenous infusion fluid, topical agents and dressing and albumin blood group B.

It is important to conduct frequent MBI management drills for medical staff and adjust the plan as appropriate. In 1998, Glick et al. reported that in the United States only 31% of health care facilities felt confident about managing a mass burn incident: nearly 50% of them thought they did not have enough medical medication and equipment, and 68% believed human resources were inadequate. In our study, only a few drills for mass casualty incidents had been conducted, with or without burn victims, and few separate drills for the management of MBI had been conducted. The reasons for this may be that mass burn injury is not considered a priority sector compared to other incidents. In addition, healthcare providers have less experience in organizing drills and there is a shortage of funding.

**Conclusion**

We have shown that in Vietnam facilities, equipment, human resources for burn care and preparedness to manage mass burn injuries are limited and need to be improved.

**BIBLIOGRAPHY**


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