



# Trauma care in China: a systematic review

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**Abstract:** The country of China has one of the largest populations in the world. It has experienced a logarithmic growth in population and economy over the last 20 years. This has put a spot light on the delivery of health care and stressed the need for development of an organized systematic approach to trauma care. Adoption of western approaches to trauma care requires modification to fit the uniqueness of China. Most western systems of care have been in a continuous process of development and refinement since the end of World War II [1945] and trauma systems in particular since 1971. China has not had this benefit and this paper will point to the areas of success and suggestions for continued progress and improvement.

**Keywords:** Trauma system; trauma care; China

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## Introduction

China has the largest population in the world and is the second largest economy following the United States. The annual death from trauma in China has reached more than 400,000, making trauma the fifth most common cause of death following malignant tumor, cardiovascular diseases, stroke and respiratory diseases. Trauma is the number one cause of death in individuals between 20–60 years old (1). Economic development in China has resulted in more and more car accidents in China, which are now the most frequent cause of trauma. Other causes of trauma include falls, earthquakes, tsunamis, and violence. Emergency departments in China face now face a great challenge with such increases in the incidence and severity of trauma patients. This article will review the status of trauma care in China and the efforts to improve care with state-of-the-art evidence on the trauma care in China.

## Epidemiology and causes of trauma in China

The lack of a high-quality nationwide database for trauma in China makes an accurate estimate of trauma epidemiology in China difficult. However, there are some valuable reports on the epidemiological data, which may be representative of the Chinese population. The National Injury Surveillance System is probably the largest trauma surveillance system in China, however, it covers only 126 hospitals from 43 sample points (23 rural, 20 urban), which is far less than the total number of Chinese hospitals. This database does have the advantage of limiting data input errors. All the doctors and nurses in these hospitals have been well trained to ensure the quality of data entry. Preliminary reports for this database show that the annual recorded traumatic injuries have increased from 340,000 to 630,000 from 2006 to 2011. Over 70% of these were minor injury, with over 75% of injured patients discharged after treatment in the

Emergency Department. The majority (over 80%) were aged between 15 and 64 years old. The most common causes of injuries were falls (32%), road traffic injuries (23%) and other blunt injuries (19%) (2).

Electronic bicycles (EB) are becoming increasingly popular in Chinese urban areas. However, the traffic regulations on EB's are less than satisfactory and waiting to be improved. Accidents caused by EB's are on the increase. In a retrospective study involving a provincial hospital, Zhou and colleagues reported that among the 1,460 cases of traffic accidents, 482 cases were EB-related accidents (33.0%). The majority of EB-related cases (44.6%) aged between 41- to 60-year-old, and the median injury severity score (ISS) was 10 (3).

### ***Traumatic brain injury (TBI)***

The largest epidemiological data was reported by Li and colleagues, which involved 203,553 civilian patients with TBI from over 200 hospitals. The causes of TBI in descending order were motor vehicle-traffic (51.4%), falls (21.5%) and assaults (15.8%). When these patients were categorized by severity of illness as measured by the Abbreviated Injury Scale, 74,500 (36.6%) were minor, 40,900 (20.1%) were serious, 54,550 (26.8%) were severe and 32,000 (15.7%) were critical (4). This means that annually we can estimate greater than 125,000 significant TBI patients will be seen in these 200 hospitals. Although trauma is not the leading cause of hospitalization in older patients, the prognosis of old patients with trauma is very poor. Thus, the epidemiology of trauma in old population is also important. Using the Chinese trauma database, Li and coworkers also showed that among 13,802 elderly patients with TBI the two leading causes of TBI were motor vehicle traffic (MVT) (48.37%) and fall-related incidents (38.89%). When the severity of TBI was classified using the Abbreviated Injury Scale, they were classified as minor (24.3%), serious (19.4%), severe (38.0%), and critical (18.4%). The hospital length of stay (LOS) was  $17.87 \pm 23.31$  days, and the median hospitalization cost was US\$795, and the mortality rate was 9.4% (5). In pediatric patients, the same study group reported a total number of 26,028 pediatric patients with TBI. The reasons of the TBI were similar to that reported in adult patients. Listed in descending order, the causes were MVT accidents, falls and assaults. However, there were differences between different age groups. While falls were the leading cause of TBI in 0–4

years old children, MVT was the leading cause of TBI in the 5–17 years group (6).

### ***Splenic trauma***

Another epidemiological study reported splenic trauma in 16 military hospitals. The study found that splenic injury occurred most commonly in age group 20–50 years old, accounting for 85.59% of all age groups. In multivariable analysis, the authors found that transfusion, New Injury Severity Score and management strategies were significantly associated with mortality outcome (7). Splenectomy is the standard treatment of patients with massive splenic hemorrhage in China. However, in china there is evidence that splenectomy is associated with two-fold increase in subsequent development of diabetes mellitus (8), which may indicate damage to the pancreas during splenectomy or by injury.

### **Trauma related to disasters: epiphenomena of mass casualty incidents**

Mass Casualty events produce a stress and challenge to every medical care system in every country. China is a large country in geography and many disasters have been reported in the past several decades. The rescue work after the disaster reflects the capability of Chinese emergency trauma team. The Tianjin Port Explosion occurred on August 12<sup>th</sup>, 2015. The Pingjin Hospital treated 298 patients during the disaster and the authors reported some valuable data (9). There were two surges of medical demand. The first occurred one hour after the explosion, during which 147 wounded were enrolled. The second occurred 4 hours after explosion and a number of 31 seriously injured patients were admitted. The over-triage rate was as high as 62%, due to the pressure imposed by the social and governmental attentions. 17 patients underwent surgery and 17 patients were transferred to the intensive care unit (ICU). Organization of the trauma care team was of paramount importance when facing massive disasters. The authors divided the rescuing process into three phases which were the emergency response, emergency treatment and hospitalized management phase. They continued to suggest that a comprehensive rescuing system was mandatory to improve the quality of care. Such a system included green channel, triage ability, psychological counseling and social salvage system (10).

### *Posttraumatic stress disorder after disaster*

The Wenzhou CRH train disaster occurred on 23 July 2011. Two High speed trains collided with each other. A total of 537 children were involved in the disaster. A study showed that the incidence of posttraumatic stress disorder (PTSD) was 24.8% in these children. The study concluded that early psychological intervention and family care might improve the physical and mental status (11). Psychological problems were also prominent in patients and rescuers after the 2010 Yushu earthquake. 338 rescuers were assessed with two survey instruments [PTSD Checklist-Civilian Version (PCL-C) and the Chinese version of the WHOQOL-BREF], to assess the incidence of PTSD and quality of life and found PTSD in 21.8% of the group (12-15). Screening for independent predictors of PTSD, the authors employed multivariable analysis, and the results showed that aged between 40 and 50 years, a nurse, having been in serious danger, Tibetan, received mental health training before the earthquake occurred were significantly and independently associated with PTSD symptoms (16). The linkage between trauma and psychiatric problems is not restricted to PTSD. A study Chinese patients with schizophrenia found that childhood trauma was associated with the development of schizophrenia. They concluded that trauma-focused mental interventions for schizophrenia patients should be developed and routinely offered to patients (17).

### *Infectious diseases after earthquake*

Infectious disease outbreak is a major complication after earthquake. The Chinese government has successfully performed health education and promotion at the site of Wenchuan earthquake and the result showed that there was no infectious disease outbreak reported after the earthquake. After a short-term education for students from the Leigu Township Primary and Junior Schools, the proportion of students with personal hygiene increased from 59.7% to 98.3% ( $P < 0.01$ ) (18).

## **Management of trauma**

### *Perspectives from clinicians*

Clinicians' understanding of trauma care and attitude toward care is important for the quality of care delivered to trauma victims. A study to investigate Chinese doctors' experiences and knowledge on the management of TBI in children was recently conducted at Beijing Tian Tan

Hospital. The study collected 235 questionnaires. 85% of the doctors reported that there were no formal diagnostic criteria of TBI for children in China. Nine out of ten doctors believed that computed tomography (CT) is a routine in children with suspected head injury. A minority of them (20%) believed that radiation from CT might increase the risk of cancer in Children. The biggest problem in the management pediatric TBI is the lack of a guidelines suitable for the Chinese situation (19).

### *Grading of trauma centers*

Differently from western countries, there is no formal Trauma Center Designation for hospitals a formal Trauma System for treating trauma patients in China. Injured patients are sent to the nearby hospitals without considering the severity of illness or resources of the hospital. Since there is a large body of evidence showing that Trauma Systems and Verified Trauma Systems can improve the quality of caring for injured patients as well as better allocation of medical resources. There is an urgent need to establish Trauma Centers and a Trauma System in China. To provide a framework for the establishment of grading system in China, Cai and colleagues compared patient-level data from Sichuan Provincial People's Hospital of Sichuan Academy of Medical Sciences (SAMS), which is the largest trauma center in China and The UCLA Trauma Center in Los Angeles California, in the USA. The study showed that ISS-adjusted mortality of severe trauma patients admitted in a trauma center in China is comparable to that of the major trauma centers in California, US (20). Thus, it is feasible to establish trauma center systems in China by adopting the American College of Surgeon Committee for Trauma (ACS-COT) standard.

### *Trauma care training*

Establishment of Trauma Centers and Trauma Systems requires that these institutions provide care using guidelines and common protocols. Trauma care training is an important measure to improve the quality of trauma care in the emergency department. There are numerous training courses in the western countries. The advanced trauma life support (ATLS) training is probably the most widely used course to improve trauma care (21-24). There are also other training courses being reported. For example, the Basic Disaster Life Support (BDLS) Training has been shown to be indispensable to disaster rescue (25). However, the

trauma training system is not well established in China. To the best of our knowledge, there was only one report on the use of ATLS in China. Wang and colleagues compared response times before and after ATLS training. The results showed that while there was no difference in the baseline ISS score, other patient-important outcomes such as the mortality (19.9% *vs.* 15.1%;  $P < 0.05$ ), the LOS in emergency department (69.5 $\pm$ 11.5 *vs.* 47.8 $\pm$ 10.7;  $P < 0.05$ ) and the time from ED admission to operation (89.6 $\pm$ 9.3 *vs.* 61.5 $\pm$ 9.9 min;  $P < 0.05$ ) were markedly decreased after ATLS training (26).

More recently, our group reported a novel trauma team training program, which was developed under the instruction of Pro. Gregory from the division of Trauma/ACS Department of Surgery, Geisinger Medical Center, Geisinger Commonwealth Medical College, Danville, PA, USA. This training program was particularly suitable for the Chinese situation where the emergency department was extremely busy and there were not enough resources to conduct a formal ATLS training. The training program consisted of four days of team training sessions. These sessions involved both Emergency Department Physicians and Nurses. Day 1 focused on the role of trauma team leader/assigning roles and leading a team. Day 2 focused on coordination of nursing and physicians. Day 3 focused on the reassignment of roles in a complex case and day 4 focused on training the instructor and testing the team (27). The study employed before-and-after comparisons and the results showed that patients managed under trained team showed shorter times from emergency room arrival to initiation of hemostasis [31.0 (13.5–58.5) *vs.* 113.5 (77–150.50) min], other blood tests [21 (14.75–25.75) *vs.* 31 (25.0–37.0) min], blood routine report [8 (5–10.25) *vs.* 13 (10.0–21.0) min], computed tomography scan [29.5 (20.25–65) *vs.* 58.5 (30.25–71.25) min] and tranexamic acid administration [31 (13.0–65.0) *vs.* 90 (65.0–200.0) min] (27). However, our study failed to identify any statistically significant difference in mortality between the two groups, probably due to limited sample size (28).

## Summary

The changes in the economy of China over the last 30 years have resulted in a logarithmic growth in the wealth of individual Chinese citizens and the explosive growth of cities. Along with this has come increased risks of traumatic injury now parallel Europe and the United States. Chinese trauma care is now a major determiner for health care. The current state of trauma care in China is behind that of western

countries. There is an acute need to develop trauma systems and a process for verifying trauma centers. Several important steps have already been implemented. The recognition of the need for dissemination of medical knowledge is reflected by the establishment of this journal and the *Chinese Journal of Traumatology*. The results of the Trauma Team Training pilot program in Hangzhou in 2014 led to plans to develop a permanent Trauma Team Training center in Hangzhou under Dr. Yucai Hong. The next steps will be to train teams at all hospitals that care for trauma patients. Ultimately, we hope that the Province of Zhejiang will be able to develop a trauma system which will integrate pre-hospital care with hospital care via a unified protocol. Eventually it is hoped that this model will become a model of trauma care throughout the People's Republic of China.

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## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

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