Chapter 1

Trauma Care in India and Japan

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Chapter 1

Trauma Care in India and Japan

1. Trauma Care in India

With improving infant mortality rates, death rates, and quality of healthcare, India's developing economy has seen a sharp increase in life expectancy from 41 years in 1960 to 68 years in 2015. There has also been increased economic and urban development, especially in terms of the development of high-quality roads, highways, improved infrastructure, and advancements in the automobile industry. All this has happened at a rate much faster than the implementation of strict motor-vehicle and road safety laws, resulting in a significant increase in the number of high-velocity road traffic accidents. Even though the country has seen a sharp increase in the number of trauma centres to deal with this problem, India’s healthcare system has not kept pace with the increase in these accidents.

Unlike developed countries where many patients are brought to hospitals in private vehicles, police vehicles, and three or two-wheelers, India faces problems in bringing the victims of accidents to hospitals in a timely manner because of overcrowding in cities and lack of proper centralised infrastructure to respond critical accidents. Due to the lack of prehospital care, combined with delays in bringing patients to hospitals due to overcrowded roads, prehospital care remains a challenge. The government has come up with stricter laws, especially pertaining to traffic violations and drunk driving, to manage the incidence of such accidents but it remains to be seen whether these laws will make a significant impact.

Surgeons in India see a large number of trauma victims and hence are well versed with the management of such victims. However, patient care protocols vary greatly throughout country, given its size and diversity. With close to 10 years since the inception of Advanced Trauma Life Support (ATLS) courses in India and an increase in the number of sites where these courses are conducted, surgeons in India are increasingly applying common and uniform management methods for trauma patients across the country. However, many more of such courses and simulation-based learning activities need to be implemented over the coming years to equip surgeons across the country with important skills.

A trauma registry is a database of the trauma patients, with information on the causes of injury, severity, and patient outcomes. It is useful for improving the quality of trauma care in developed countries. India has not had a central trauma registry to date, making it difficult to produce exact statistical data on trauma victims in the country. Although many efforts have been made not just by private individuals but also by the government, a trauma registry has yet to be fully established across the country.

The unequal distribution of health resources across villages and cities has also been detrimental to victims of trauma in far-flung areas from even though the government has taken several steps to establish not just primary but also tertiary level hospitals across the country. In recent years, the government has also created stricter laws and established more and more health facilities which have improved survival rates and life expectancies but there remains much more to be done in a developing country like India to be able to catch up to the health standards in developed nations.

2. Trauma Care in Japan

2.1. Trauma Features in Ageing Countries

In developed countries such as Japan, the United States (US), and European countries, demographic ageing is proceeding rapidly due to extended longevity and low birth rates. Japan, in particular, is currently the world's top country for longevity. In such ageing societies, mild injuries caused by a minor external force (such when falling while walking) are increasing due to the decreased physical function of individuals, while traffic accidents amongst young people that could cause severe traumas are on a downward trend. The number of traffic accidents in recent years has been decreasing as a result of improvements in road environments, the introduction of severer penalties for traffic law violations such as drunk driving and dangerous driving, and the development and commercialisation of vehicle safety technology such as pre-crash systems and/or automatic and emergency braking.

With such changes, the type of patients seeking emergency medical care in Japanese institutions is also changing. Since 1963, the number of nationwide emergency transport cases has increased every year. From 1996 to 2016, the number increased from approximately 3.4 million to 6.2 million. The main contributing factor to this surge was the increase in the number of elderly emergency patients as a result of a rapidly ageing society. While general injuries amongst the elderly, such as falls, have increased, the number of traffic accident patients has decreased from 634,000 (18.8% of all ambulance dispatches) in 1996 to 491,000 (7.9% of all ambulance dispatches) in 2016 (Figure 1.1).

Figure 1.1. Trends in Numbers and Causes of Ambulance Dispatches, 1997–2017

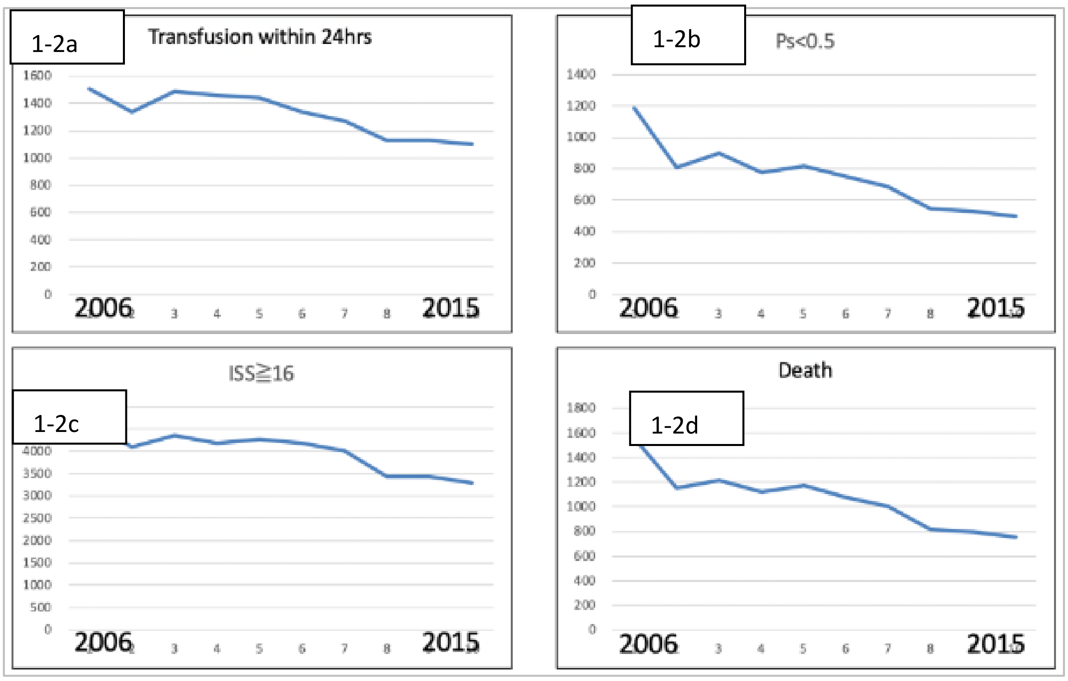
Source: Fire and Disaster Management Agency (2018), 'Report on Ambulance and Rescue' (Trans.).

Along with the decrease in severe trauma cases such as those due to traffic accidents, the number of trauma cases at advanced emergency medical care institutions such as emergency and critical care medical centres (ECCMCs) where severe trauma cases are treated, is also shrinking.

Japan Trauma Data Bank (JTDB) is a nationwide database where every case of trauma received by 264 institutions nationwide (as of March 2017) is registered. To investigate the changes in life-threatening severe trauma cases, we looked at the time courses for cases receiving emergency blood transfusion within 24 hours, cases with an Injury Severity Score (ISS)[2] of 16 or above, cases with a prognostic survival rate of less than 50%, and the total number of deaths (Figure 1.2). Our time courses show that from 2006 to 2015, all these cases were on a declining trend. As the number of severe trauma cases decreases nationwide, trauma surgeons working at ECCMCs are becoming less and less experienced.

[2] The Injury Severity Score (ISS) assesses the combined effects of the multiply-injured patients and is based on an anatomical injury severity classification, the Abbreviated Injury Scale (AIS). The ISS is an internationally recognised scoring system that correlates with mortality, morbidity, and other severity measures.

Figure 1.2. Trends in Severe Trauma Cases, 2006–2015



ISS = Injury Severe Score, Ps = probability of survival. Notes: These figures present the elements of severe trauma cases. Figure 1-2a indicates the number of patients transfused during the first 24 hours. Figure 1-2b represents cases where the probability of survival for the injured patient is over 50%, calculated using their ISS, the trauma type, and the patient's age. Figure 1-2c refers to patients with at least two serious or one severe injury. Figure 1-2d concerns the number of fatalities.

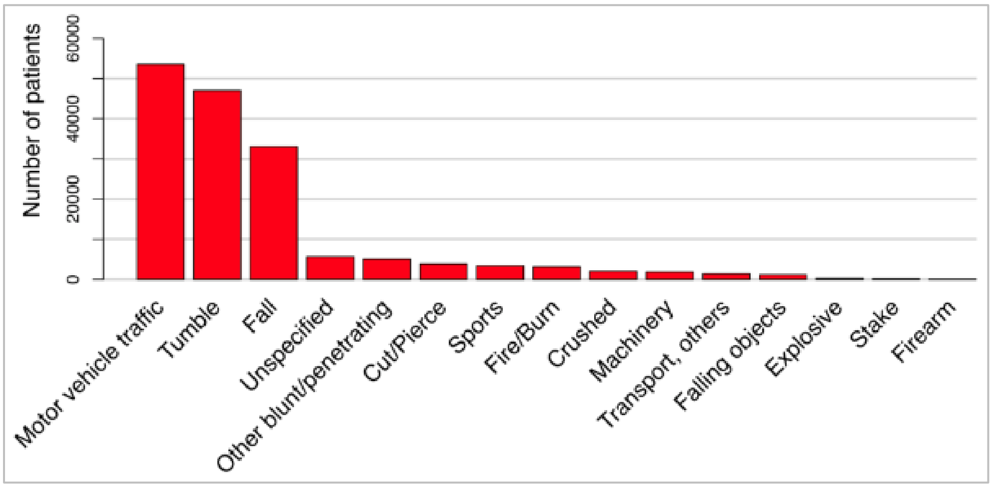
Sources: Japan Trauma Data Bank (JTDB).

2.2. Gunshot and blast injuries

In Japan, traffic accidents and falls (both from a height and from slipping or tripping) account for most cases of the trauma, while penetrating trauma such as a stab wounds, incision wounds, and impalement injuries account for only approximately 4% of all trauma injuries (Figure 1.3). Possession and carrying of guns is highly restricted so gun-related crimes are rarely seen. Physical trauma due to explosive accidents is also rare. Thus, trauma surgeons in Japan have limited experience in handling gunshot and blast injuries.

Random shootings and terrorist bombings, such as the Boston Marathon bombing in 2013, are becoming more frequent around the world. In preparation for possible terrorist attacks at large-scale events such as the Osaka Universal Exposition scheduled for 2025, ECCMCs are required to establish and secure an adequate medical care system.

Figure 1.3. Mechanisms of Injury (2010–2014)



Note: Mechanism of injury refers to the method by which damage or trauma is inflicted on the human body.

Source: Japan Trauma Data Bank (JTDB).

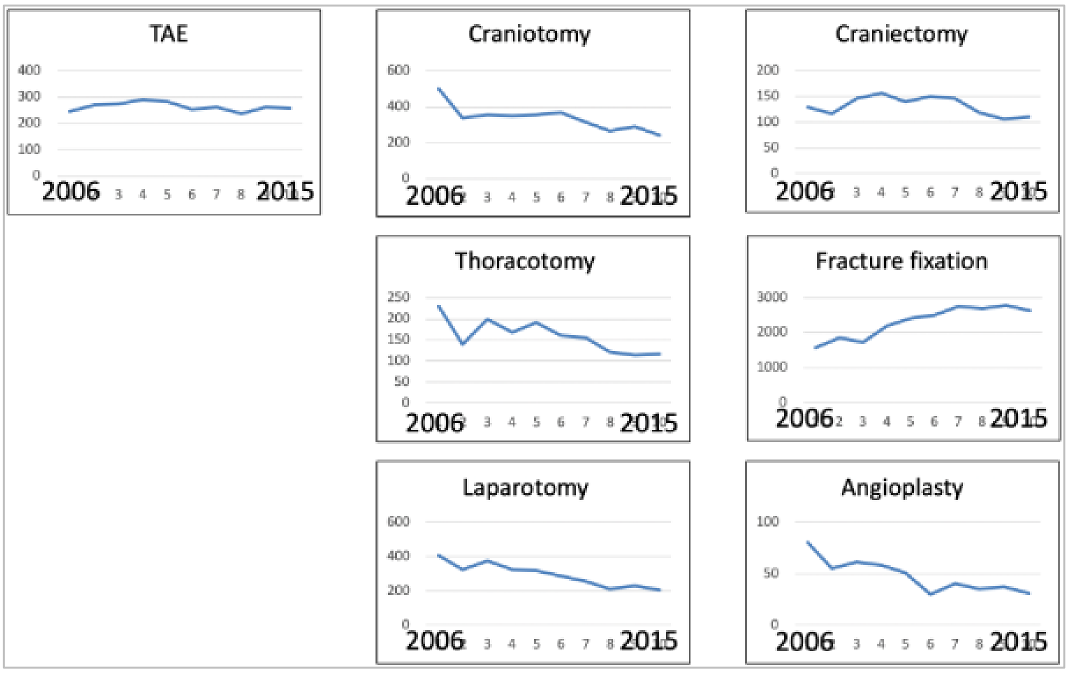
2.3. Features in the treatment of trauma patients in Japan

In addition to the decreased number of severe trauma cases at advanced emergency medical care institutions, the features of trauma treatment have changed.

The widespread use of computed tomography (CT) scans have enabled accurate and reliable diagnosis of chest and abdominal organ injuries. Many organ injuries that would have been treated with surgery are now treated with non-invasive therapies or endovascular treatment. According to JTDB, amongst the operative methods first performed after arrival, craniotomy, craniectomy, thoracotomy, laparotomy, and angioplasty were all on the decrease except for transcatheter arterial embolisation (TAE) which has not changed in the last 10 years (Figure 1.4).

Japan's trauma surgeons are experienced with interventional radiology in the treatment of severe trauma patients. In fact, Japan's trauma surgeons were among the first to recognize the effectiveness of TAE for severe trauma cases. This is something that can be shared worldwide. Of course, some severe trauma patients are unable to survive without surgical operation so the need to train trauma surgeons to perform trauma surgeries promptly and accurately remains.

Figure 1.4. Trends in Surgical Cases, 2006–2015



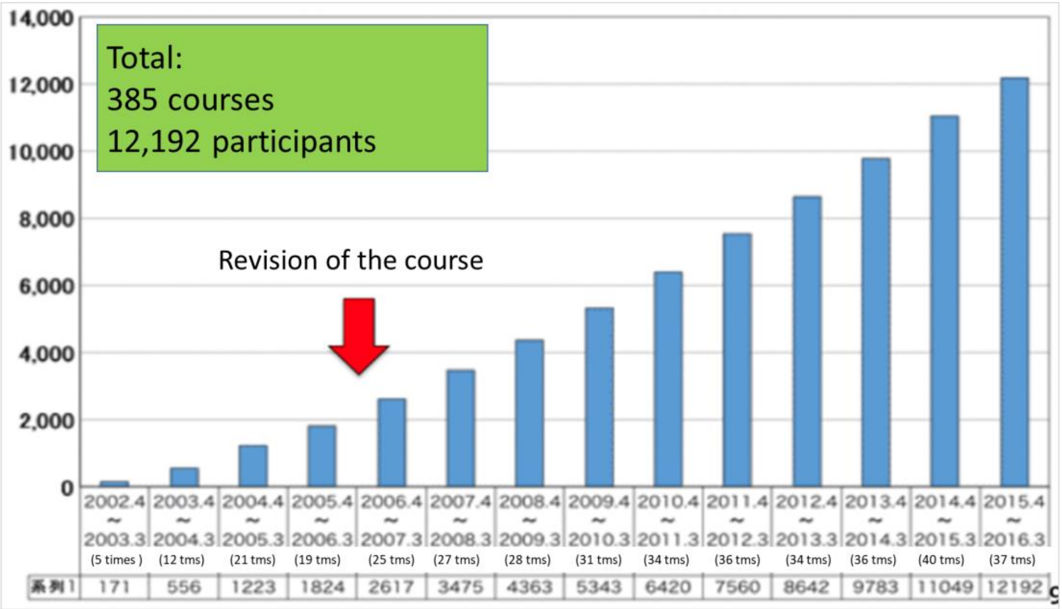
TAE = transcatheter arterial embolisation.

Sources: Japan Trauma Data Bank (JTDB).

2.4. Preventable trauma death and training for trauma care

Preventable trauma death refers to trauma death that could have been avoided if appropriate trauma treatment was provided. Otomo et al. (2002) reported that amongst 1553 trauma deaths at ESCCMs nationwide in 2000, 661 cases (38.6%) were preventable trauma deaths. The same survey was conducted the following year and 38.1% of all trauma deaths were considered potential preventable trauma deaths, similar to the previous year. To help mitigate these preventable deaths, the Japanese Association for the Surgery of Trauma (JAST) compiled and released 'Japan Advanced Trauma Evaluation and Care (JATEC)' to serve as a set of guidelines for primary trauma care, while the Japanese Association for Acute Medicine (JAAM) developed and disseminated off-the-job training courses on JATEC. JATEC courses are now being held more than 30 times per year, and more than 10,000 doctors have taken the course in the 20 years since its commencement (Figure 1.5).

Figure 1.5. Number of Japan Advanced Trauma Evaluation and Care (JATEC) Courses and Participants, 2002–2016

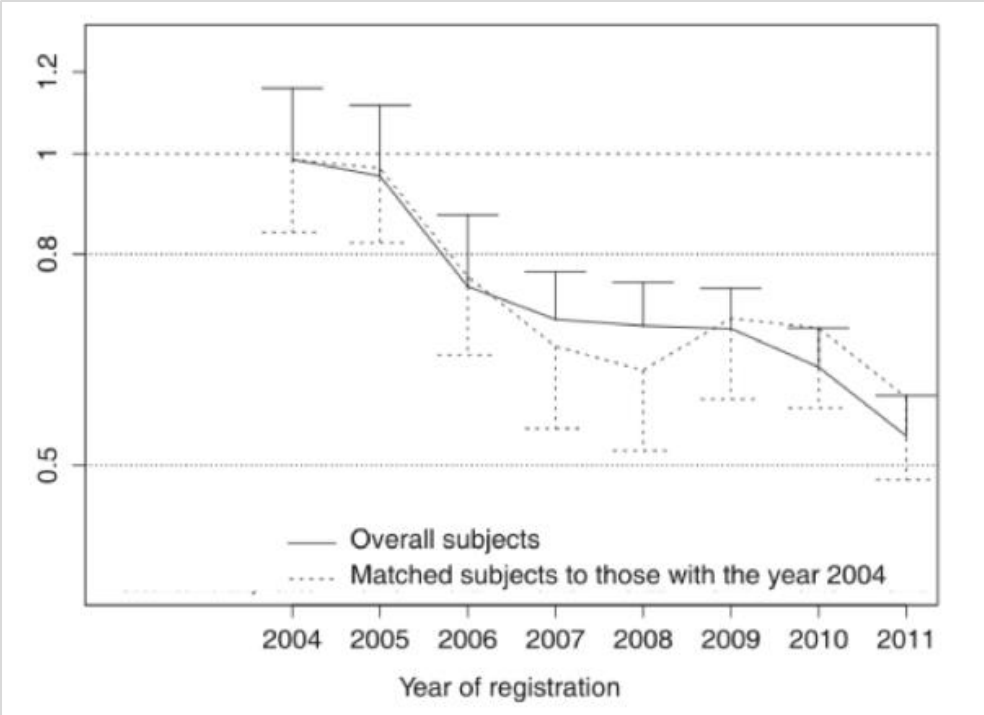


JATEC = Japan Advanced Trauma Evaluation and Care, tms = times.

Source: Japan Trauma Care and Research (JTCR).

To evaluate the impact of the JATEC training, a time course of actual death rate to predicted mortality was analysed. When actual death rate against predicted mortality was set at 1 in 2004 (the year JATEC was implemented widely), actual death rate declined gradually up to 2011 (Figure 1.6). The degree of decline has been growing greater, confirming that the quality of trauma treatment in Japan is improving every year because of JATEC training and other factors. The analysis yielded the same results when only those cases that had the same severity as the cases in 2004 were considered.

Figure 1.6. Trends in Case Fatality Adjusted by the Trauma Injury Severity Score (TRISS) Probability of Survival, 2004–2011



Notes: This table presents the odds ratio and confidence interval of observed survival rate relative to the TRISS probability of survival, plotted against the year of registration in the Japan Trauma Databank. The model was adjusted for logit value estimated using the TRISS method. The TRISS method refers to the Probability of Survival (PS) of each patient calculated from the Revised Trauma Score, Injury Severity Score, age and method of injury (blunt or penetrating), first used in 1984.

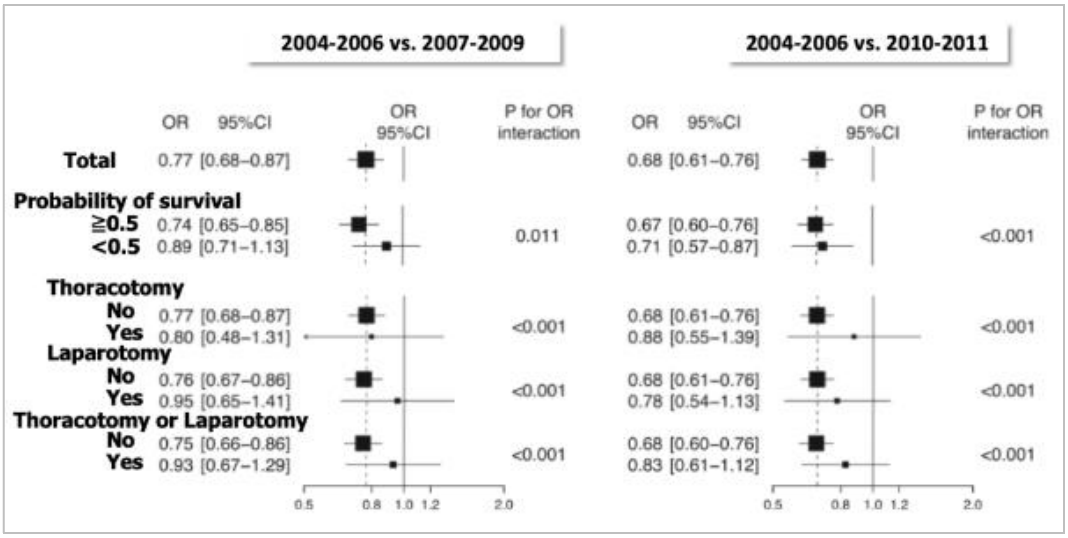
Source: Hondo K., A. Shiraishi, S. Fujie, D. Saitoh, and Y. Otomo (2013), 'In-Hospital Trauma Mortality has Decreased in Japan Possibly Due to Trauma Education', *Journal of the American College of Surgeons*, 217(5), pp.850–57.

Furthermore, multivariate subgroup analysis was conducted to investigate the types of cases where treatment was improved and how the quality of treatment was improved. The results showed that the subgroup with a probability of survival[3] of 0.5 or

[3] Probability of survival (PS) is calculated for each injured patient and entered into the Trauma Audit and Research Network (TARN) database. This allows researchers to perform comparative outcome analyses of hospitals and groups of trauma patients. Early Outcome Prediction Models using TRISS

In 1984 the Probability of Survival (PS) of each patient was originally calculated from the Revised Trauma Score, Injury Severity Score, age and method of injury (blunt or penetrating). This was known as the TRISS method. There were a number of reasons to develop a European model from this early method. The Revised Trauma Score incurred a high number of cases with unrecorded data (respiratory rate, systolic blood pressure and higher with mild trauma or not requiring thoracotomy or laparotomy showed a significant decrease in mortality within the time of treatment. On the other hand, the subgroup with a probability of survival of less than 0.5 with severe trauma or requiring a thoracotomy or laparotomy did not show a decrease in mortality (Figure 1.7).

Figure 1.7: Subgroup Comparisons Stratified by Baseline Characteristics for Risk of In-Hospital Death in Three Cohorts



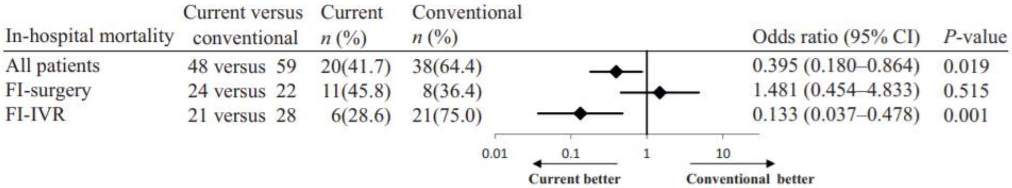
CI = confidence interval, OR = odds ratio.

Source: Hondo K., A. Shiraishi, S. Fujie, D. Saitoh, and Y. Otomo (2013), 'In-Hospital Trauma Mortality has Decreased in Japan Possibly Due to Trauma Education', *Journal of the American College of Surgeons*, 217(5), pp.850–57.

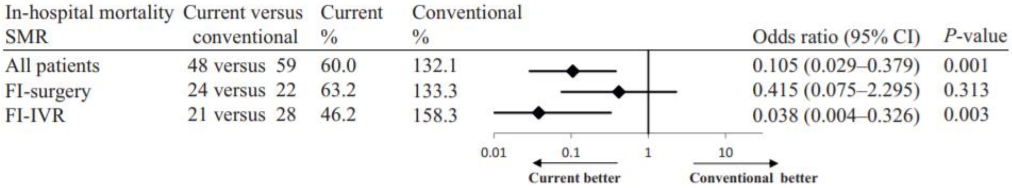
The results indicated that the outcome from treatment was improved in non-serious trauma cases which did not require emergency operation. This can be attributed to improved quality of primary care owing to JATEC, which came to be widely used as the standard for early-stage treatment in clinical practice since 2004. However, the results indicated no improvement in severe trauma cases that required a thoracotomy or laparotomy.

Glasgow Coma Scale). The way that the Injury Severity Score was incorporated into the calculation contradicted some statistical reasoning. Patients who were transferred to another hospital for further care were excluded. Patients who were intubated at scene were excluded. Children were included but not in a statistically acceptable fashion. https://www.tarn.ac.uk/Content.aspx?c=3515

Figure 1.8. Treatment Outcome for 107 Patients with Severe Trauma Treated at the Same Hospital by Date of Admission



In-hospital mortality	Current versus conventional	Current n (%)	Conventional n (%)	Odds ratio (95% CI)	P-value
All patients	48 versus 59	20(41.7)	38(64.4)	0.395 (0.180–0.864)	0.019
FI-surgery	24 versus 22	11(45.8)	8(36.4)	1.481 (0.454–4.833)	0.515
FI-IVR	21 versus 28	6(28.6)	21(75.0)	0.133 (0.037–0.478)	0.001



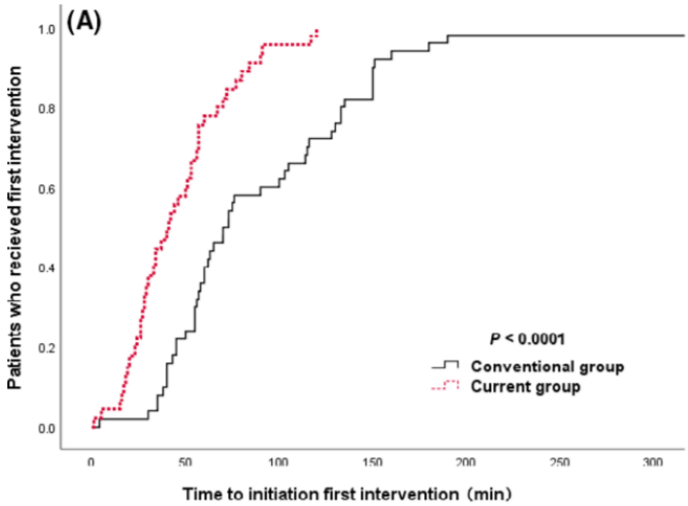
In-hospital mortality SMR	Current versus conventional	Current %	Conventional %	Odds ratio (95% CI)	P-value
All patients	48 versus 59	60.0	132.1	0.105 (0.029–0.379)	0.001
FI-surgery	24 versus 22	63.2	133.3	0.415 (0.075–2.295)	0.313
FI-IVR	21 versus 28	46.2	158.3	0.038 (0.004–0.326)	0.003

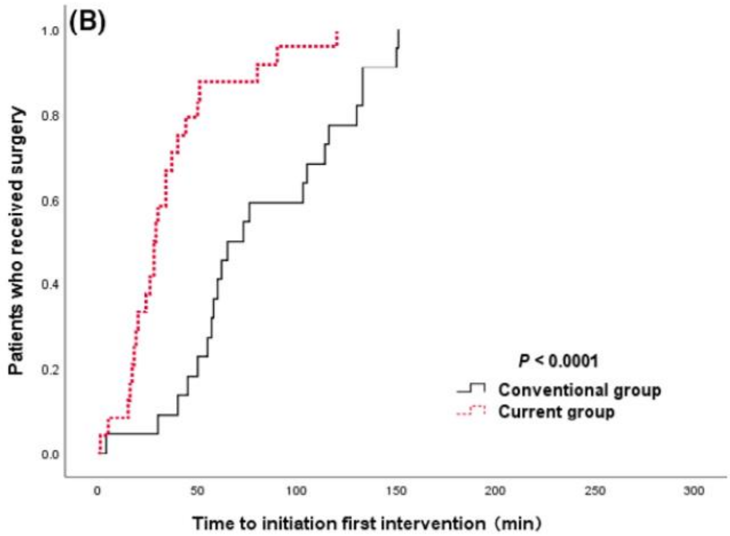
CI = confidence interval; FI = first intervention; IVR = interventional radiology; NA = not applicable; Ps = probability of survival calculated by Trauma and Injury Severity Score; SMR = standardized mortality ratio.

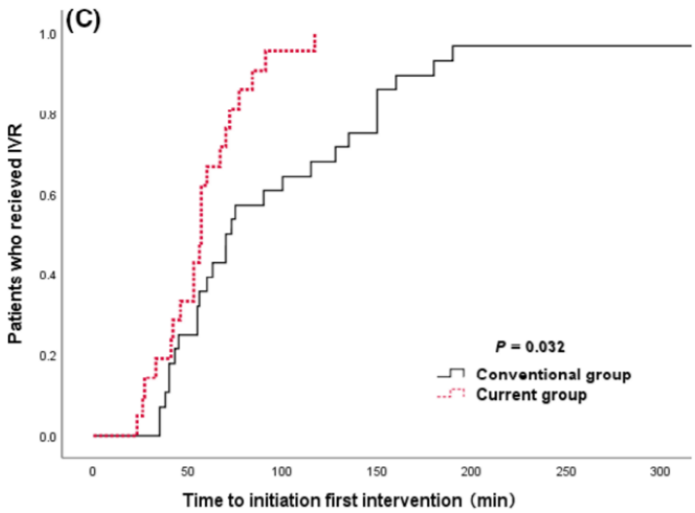
Note: Conventional refers to the period from January 2011 to September 2014, current refers to the period from October 2014 to January 2018.

Source: Otsuka, H. et al. (2018), 'Impact of Emergency Physicians Competent in Severe Trauma Management, Surgical Techniques, and Interventional Radiology on Trauma Management', *Acute Medicine & Surgery,* 5(4), pp.342–49.

Figure 1.9. Kaplan-Meier Curves of Time to Initiation of First Intervention in 107 patients with Severe Multiple Lethal Trauma







A = all patients; B = those with surgery only; C = those with interventional radiology only; conventional group = admitted January 2011–September 2014; current group = admitted October 2014–January 2018; IVR = interventional radiology; min = minutes.

Sources: Otsuka, H. et al. (2018), 'Impact of Emergency Physicians Competent in Severe Trauma Management, Surgical Techniques, and Interventional Radiology on Trauma Management', *Acute Medicine & Surgery,* 5(4), pp.342–49.

As these sources might indicate, surgical trauma operations may not have been performed promptly or accurately when needed because surgeons who have to deal with these emergencies are not adequately trained due to the low number of severe trauma cases and surgical operations for such cases in recent years.

3. Training for trauma surgery in Japan

In preparation for establishing an emergency medical care system at the Tokyo Olympic and Paralympic Games in 2020, the Ministry of Health, Labour and Welfare (MHLW) deployed the 'Trauma Surgeon Training Program' in 2017. This programme targeted surgeons and nurses who work at ECCMCs and aimed to train them to treat severe trauma cases such as blasts, gunshots, and stab injuries, and to assist medical institutions in establishing hospital functions to receive several trauma patients injured by deliberate detonations. The participants were required to participate in workshops designed and led by trauma care experts in Japan and overseas. These workshops consisted of practical group discussions and group work for team buildings. After the workshop, participants could take two of the off-the-job training courses: the Japan-original Surgical Strategy and Tactics for Trauma; the Surgical Strategy and Tactics for Trauma (SSTT) course, which contains practical training at an animal laboratory and the US Advanced Surgical Skills for Exposure in Trauma; and the ASSET course which included practical training using cadavers. Since then, 30 surgeons and 30 nurses have attended the programme every year and used their learnings to help improve their respective medical institutions' trauma treatment capability. These efforts reflect the recognition in Japan that the training of capable surgeons and trauma treatment teams is an urgent task, and continuous off-the-job training to complement current clinical practice is considered a national project. However, the programme had been suspended halfway because of the COVID 19 pandemic.