Original Article

Compliance with Trauma Care Algorithms and Survival of Trauma Patients in Network of Private Hospitals in Thailand.

Chanin Pundee[1] ; Wassana Siriwanitchaphan[1] ; Ekkit Surakarn[1]

Chanin Pundee

[1] Center of Excellent (Trauma),Bangkok Hospital Headquarters, Bangkok,Thailand

*Address Correspondence to author:
Ekkit Surakarn, MD.
Center of Excellent (Trauma),
Bangkok Hospital Headquarter,
2 Soi Soonvijai 7,New Petchburi Rd.,
Bangkok 10310 Thailand
email:ekkit.su@bangkokhospital.com

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Abstract

OBJECTIVES: The study aimed to examine the correlation between compliance with trauma care algorithms and the survival of trauma patients within a network of private hospitals in Thailand.

MATERIALS AND METHODS: This retrospective study reviewed trauma registry data and medical records from twelve designated hospitals from January 1, 2019, to December 31, 2022. The study assessed compliance with trauma care algorithms for specific injuries and analyzed the association with survival rates, adjusting for injury severity using the Injury Severity Score (ISS).

RESULTS: Out of 2,592 trauma cases, 1,823 (70.33%) were included for analysis based on algorithm relevance. The study discovered that compliance (80-100%) with the trauma care algorithms was significantly associated with higher survival rates, particularly for severely injured patients (ISS 25-75). After adjusting for Injury Severity Score (ISS), the correlation's 95% confidence interval (CI) was 2.48, with a significant *p*-value of 0.048, indicating a statistically significant improvement in survival rates with higher compliance levels.

CONCLUSION: Compliance with trauma care algorithms significantly impacts the survival rates of trauma patients. High compliance rates are associated with better outcomes, emphasizing the need for rigorous adherence to established care protocols in trauma management.

Keywords: trauma care algorithms

Trauma is a leading cause of death and disability worldwide.[1] Each year, over a million people suffer from various causes of injury such as road accidents, abuse, self-harm, and natural disasters.[2] These losses of lives and abilities directly impact the well-being of patients and families.[3] Loss of productivity and the burden of healthcare costs also negatively affected the economy of society.[4]

The management of trauma patients usually requires multidisciplinary teams working together, such as doctors, nurses, paramedics, and emergency medical technicians. To ensure the best possible outcome of trauma care, healthcare providers should deliver appropriate management consisting of the initial systematic approach and integration of evidence-based practice for management of specific injuries.[5] The availability of standard practice guidelines and adherence to those guidelines can accelerate process of care, enhance communication between healthcare professionals and improve outcomes.[6-9]

The German Society for Trauma Surgery (Deutsche Gesellschaft für Unfallchirurgie, DGU) developed the S1-guideline issued in 2002 and S3-guideline[10] issued in 2012 as a comprehensive, evidence and consensus-based guideline for the treatment of severely and multiple injured patients. The introduction of the guideline resulted in an improvement in the survival rates of severely injured patients.[11]

BDMS Trauma Network, a network of private hospitals in BDMS Group, developed a workflow for trauma care and algorithms for specific injuries based on format of the S3-guideline to provide a step-by-step sequential approach for initial trauma care and management of specific injuries according to the level of care and facility of each hospital. The workflow for trauma care and algorithms were implemented in the network hospitals to improve the trauma care process.

There was one workflow for emergency trauma care and fifteen algorithms for specific injuries as follows:

- BDMS Emergency Care Workflow
- Traumatic Brain Injury (TBI)
- Moderate-Severe TBI
- Craniomaxillofacial and Ophthalmic Injury (CMF-O)
- Pneumothorax
- Hemothorax
- Thoracic Aortic Injury
- Cardiac Injury
- Abdominal Trauma
- Peripheral Vascular Injury
- Fracture/Dislocation Fixation in Polytrauma
- Pelvic Fracture
- Open Fracture
- Mangled Extremities
- Adult Cervical Spine Injury
- Adult Thoracolumbar Spine Injury

Since the adoption of management guidelines by trauma centers is inconsistent, with wide variations in practices across centers.[12,13] The actual delivery of trauma care requires both staff competency and compliance with the recommended care, and the deviation from evidence-based guidelines also increase mortality in critically injured patients.[14] The performance of trauma care at the designated hospitals was monitored by compliance with the trauma care algorithms and their association with survival.

Material and Methods

This retrospective study uses data from trauma registry and medical records review from the twelve designated hospitals between January 1, 2019, and December 31, 2022. The trauma nurses identified the delivered treatments that comply with the critical steps of care in related algorithms of specific injuries for compliance. The association between compliance with the trauma care algorithms and survival was measured after adjusting for severity of injuries by Injury Severity Score (ISS).[15]

Studied population

This study collected data from trauma patients aged 15 years and over whose injuries were compatible with the trauma care algorithms. Burn injury was not included in the study due to its unique pathophysiology and reconstruction. Incomplete data were excluded from the study (Figure 1).

Compliance with the trauma care algorithm

Compliance is processed as percentage by comparison of number of the delivered treatments and number of the expected treatment according to the related trauma care algorithms. Patients who suffered from multiple injuries may require treatments from more than one algorithm.

Level of compliance can be classified into two groups as follows:

1. Good compliance means a percentage of 80 – 100%.
2. Inconsistent compliance means a percentage of less than 80.

Measures of outcomes are:

- Survival rate derived from in-hospital mortality.
- Discharge status.
- Percentage of compliance.
- Correlation between percentage of compliance and survival and discharge status.

Data analysis

The percentage of compliance is calculated as number of the delivered treatments divided by the number of expected treatments according to the related trauma care algorithms.

Other information such as discharge status, gender, ISS Level will be presented with frequency and percentage values. Correlation between compliance and discharge status by using logistics regression statistics to display Odds ratio, 95% confidence interval. All research data were analyzed by the R Studio program.

A total of 2,592 trauma cases were initially assessed. 1,823 cases, accounting for 70.33%, were associated with the trauma care algorithms and were thus included for analysis.

Research ethics

Protection of the rights of the sample population in this study, the researcher applied for research ethics from the Human Research Ethics Review Committee before data collection. The researcher clarified the objectives of the research, data collection process, period of data collection, which will not cause any damage to the owner of the data. The data obtained from this research will be kept confidential. Data presentations are presented in an overview format. The name of the organization, first and last name, was not specified.

This study was reviewed for ethics in human subjects and was certified by the Human Research Ethics Committee on November 27, 2018. Research project code BMC IRB 2018-06-018.

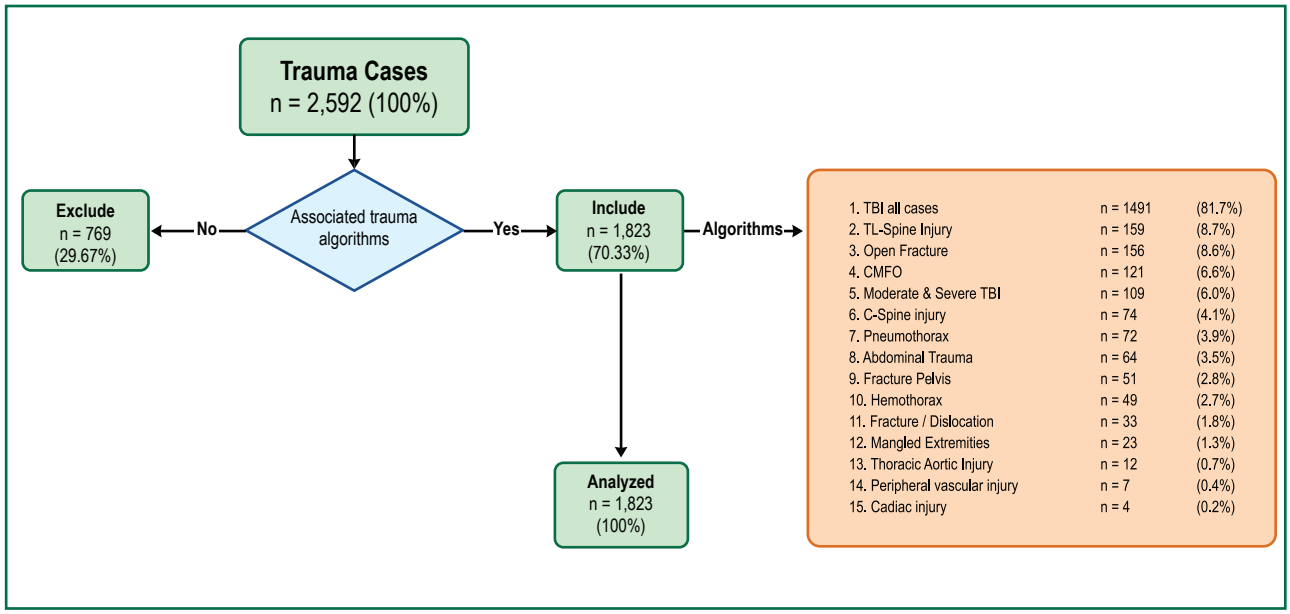

Figure 1: Inclusion and analysis of trauma cases based on injuries associated with the trauma care algorithms

Result

A total of 1,823 patients met the study criteria, representing 70.33%. Another 29.67% or 769 patients had no information or incomplete information that could not be processed, as shown in Table 1.

The researcher has analyzed the data, displayed, and interpreted the meaning in the following order:

1. Patient information
2. Compliance with the trauma care algorithms
3. Patient discharge status
4. Severity of injury and discharge status.
5. Correlation between compliance and discharge status classified by injury severity.

Most patients were between 30 - 65 years old with a total of 903 people (49.53%). The mean age was 51.6 years. 56.17% were male. The mean ISS was 9 with the range from 1 to 75 respectively. Severity of injury classified by ISS were minor injury 59.85%, followed by moderate injury 22.05%, serious injury 8.12% and severe injury 9.98%, respectively. The discharge status was survived 93.14%, in-hospital death 1.65%, and unrecorded 5.21% (Table 2).

Compliance with the trauma care algorithms show 997 cases (54.69%) had 80 to 100% compliance, of which 730 cases (73.21%) accomplished 100% compliance. 826 cases (45.31%) attained <80% compliance as shown in Table 3. Patient discharge status shows 1,698 survivors (93.14%), 30 deaths (1.65%), and 95 unrecorded cases (5.21%), as shown in Table 4.

Severity of injury and discharge status were 1,728 patients who had information on the severity of injury and complete hospital discharge status, representing 94.8% of all patients. Most are minor injuries, 1,070 patients (61.92%) and moderate injuries, 364 patients (21.06%). There was no fatality in both groups. In the serious injury group, there were 114 patients (6.60%) and one death (0.06%). The severe injury group consisted of 178 patients (10.30%) with 29 deaths, representing 1.68%, as shown in Table 5.

The correlation between compliance and discharge status classified by severity of injury: The inconsistent compliance group, there were 23 in-hospital death or 2.95% mortality rate. The survival rate in this group was 97.05%. The 95% confidence interval (CI) for this correlation after adjusting for Injury Severity Score (ISS) was 2.48, statistically significant at level the < 0.05 level (p = 0.048). In contrast, the good compliance group with 80 to 100% compliance witnessed significantly lower mortality at 0.74%, indicating a 99.26% survival rate. The results demonstrated a correlation between compliance and hospital discharge status, compliance below 80% was associated with a three fold increase in the risk of hospital death, denoted as Table 6.

Table 1: Number of patients who fit the processing criteria.

Discharge Status	Yes (n = 1823),(n (%))	No (n = 769), (n (%))	Total (n = 2592), (n (%))
Survive	1698 (93.14)	745 (96.88)	2443 (94.25)
Dead	30 (1.65)	1 (0.13)	31 (1.20)
Unknown	95 (5.21)	23 (2.99)	118 (4.55)

Table 2: Patient information (n = 1,823).

Data (N = 1,823)	n (%)
Age Group (Years)	
Adolescence (>15-30 yrs.)	389 (21.34)
Adult (>30-65 yrs.)	903 (49.53)
Elderly (>65 yrs.)	531 (29.13)
Mean ± SD	51.6 ± 21.5
Median, Min-Max	51, 16.0-99.
Sex	
Male	1,024 (56.17)
Female	799 (43.83)
ISS (Score)	
Mean ± SD	9.91 ± 10.3,
Median, Min-Max	6.0, 1.0 - 75.0
Severity of Injury by ISS	
Minor (1-8)	1091 (59.85)
Moderate (9-15)	402 (22.05)
Serious (16-24)	148 (8.12)
Severe (25-75)	182 (9.98)
Discharge Status	
Survived	1,698 (93.14)
Dead	30 (1.65)
Unrecorded	95 (5.21)
Total	1,823 (100)

Table 3: Compliance with the trauma care algorithms

Compliance (%)	n (%)
Good (80 - 100%)	997 (54.69)
Inconsistent (< 80%)	826 (45.31)
Total	1,823 (100)

Table 4: The number and percentage of the discharge status

Discharge Status	n (%)
Survive	1,698 (93.14)
Dead	30 (1.65)
Unrecorded	95 (5.21)
Total	1,823 (100)

These results underscore the critical impact of compliance on patient outcomes, with lower compliance linked to a significantly higher risk of death.

This chart in Figure 2 delineates correlation between adherence of trauma algorithms and survival rates across varying severity of injury, categorized by the Injury Severity Score (ISS). It reveals a consistent pattern of high survival rates—100% for both minor (ISS 1-8) and moderate (ISS 9-15) injuries—across all compliance levels. However, the survival rate is slightly higher in serious injury (ISS 16-24) with 80-100% compliance. The most significant improvement is observed in severe injuries (ISS > 24), where survival rates increase with 80-100% compliance. This data shown the importance of high compliance with the trauma care algorithms, especially given improvement in survival rates for the most severely injured patients as adherence increases (Figure 2).

Discussion

From this study, it is evident that the level of compliance with the trauma care algorithms is an important factor that determines patient care outcomes as addressed by Godier et al.,[16] in 2016. The results of the correlation test between compliance with the trauma care algorithms and hospital discharge status classified by severity of injury found that the survival rate in good compliance group (>80%) was higher. Compliance of less than 80% significantly correlated with higher in-hospital mortality rate in both serious and severe injury patients.

Several studies have investigated the relationship between adherence to the standard algorithm and clinical outcomes in trauma patients. For instance, a study by Kesinger et al.,[17] in 2014 examined a standardized trauma care protocol decreased in-hospital mortality of patients with severe traumatic brain injury at a teaching hospital in a middle-income country. Similarly, trauma team leader (TTL) involvement during resuscitations was associated with improved adherence to ATLS protocols, and increased efficiency (compared to

Table 5: Number and percentage of patients by severity of injury and discharge status.

ISS Level (n = 1,728)	Survive n (%)	Dead n (%)	Survival rate (%)
Minor (1 - 8)	1,070 (61.92)	0 (0)	100
Moderate (9 - 15)	364 (21.06)	0 (0)	100
Serious (16 - 24)	113 (6.53)	1 (0.06)	99.12
Severe (25 - 75)	149 (8.62)	29 (1.68)	83.71
Total	1,698 (98.26)	30 (1.74)	98.26

Table 6: Test results for the correlation between compliance and hospital discharge status.

Compliance	Hospital Death n (%)	Survival n (%)	95% CI	*p* (adj.ISS)
< 80%	23 (2.95)	756 (97.05)	2.48 (1.01 - 6.12)	0.048
80 - 100%	7 (0.74)	942 (99.26)	Ref.	

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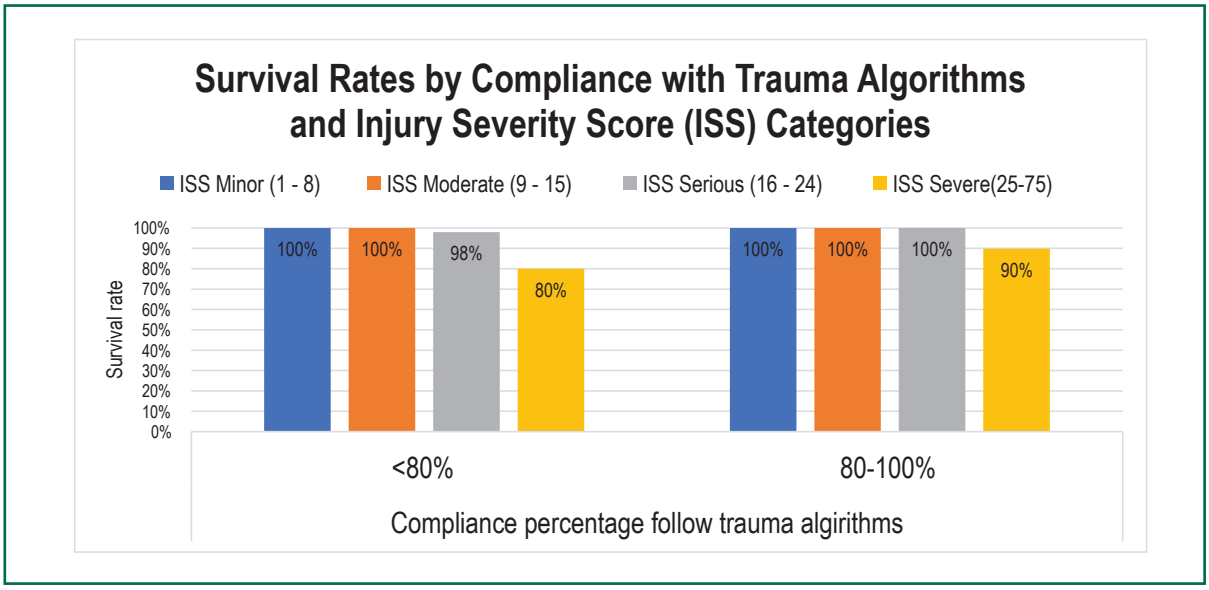

Figure 2: Survival Rates by Compliance with Trauma Algorithms and Injury Severity Score (ISS) Categories

non-TTL involvement) to diagnostic imaging. Findings from this study will guide future quality improvement and education for early trauma management.[18]

The findings of our study align with these previous investigations, providing further evidence for the importance of compliance to the standard algorithms of trauma care. By following the algorithm, healthcare providers can optimize the timely administration of appropriate interventions, ensuring a systematic and coordinated approach to trauma care which can significantly impact patient outcomes.[19]

The results of this study are in line with Vasse's et al.,[20] study that brought trauma management systems into the emergency room. It was found that after using the Trauma System for 30 days, the mortality rate of the patients decreased from 17% to only 13% which was statistically significant at the 0.05 level (p = 0.18), This was statistically significant at the 0.05 level (p = 0.18), indicating that compliance with management systems or standard work procedures had a direct effect on outcomes and mortality for the injured[20]. Similar results were found in studies and regulations from the American College of Surgeons requiring staff to comply with protocols for trauma care because it is clearly proven to improve the quality of care. Standard work procedures for trauma patients should be strictly followed, especially in emergencies where one's judgment and memory can be impaired by time pressures and expectations pressures.[21] Therefore, the trauma algorithm and working environment that enhance workflow compliance plays an important role in helping the healthcare team to control the process of care and also greatly reduce human error.[22]

Conclusion

Compliance with trauma care algorithms significantly impacts the survival rates of injured patients, as shown by the correlation between compliance and hospital discharge status. The good compliance group had a higher survival rate, while the inconsistent group had a higher in-hospital mortality rate. The association between high compliance rates and better outcomes emphasizes the need for adherence to the established trauma care protocols.

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