

## FEISTY - Fibrinogen Early In Severe Trauma Study: Fibrinogen Concentrate Vs. Cryoprecipitate In Severe Traumatic Haemorrhage: A Pilot Randomised Controlled Trial

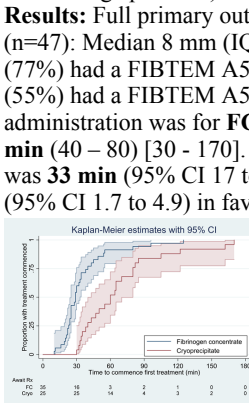
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**Introduction:** Trauma is a leading cause of death worldwide and represents a global health concern. Major haemorrhage in the setting of severe trauma is associated with significant morbidity and mortality. Hypofibrinogenaemia plays a significant role in traumatic haemorrhage and is associated with worse outcomes. It is postulated that early fibrinogen replacement may reduce haemorrhage and improve outcomes. This study assessed the effects of a targeted dose of Fibrinogen Concentrate (FC) vs Cryoprecipitate (Cryo) in traumatic haemorrhage. It was hypothesised that fibrinogen replacement can be achieved quicker with a more predictable dose response using FC compared to Cryo.

**Methods:** A multi-centre, randomised controlled, un-blinded, feasibility pilot study.

**Primary study aims:** 1) Investigate the feasibility of early targeted fibrinogen replacement in traumatic haemorrhage 2) Compare time to administration of fibrinogen replacement between FC and Cryo 3) Investigate feasibility of study protocol in a pilot multicentre study. **Inclusion Criteria:** 1) Adult affected by Trauma 2) Judged to have significant haemorrhage 3) Predicted to require significant transfusion with ABC score  $\geq 2$  or by treating clinician judgement. **Intervention:** 100 patients were randomised into FC (Intervention) or Cryo (Comparator) arms with requirement for fibrinogen replacement triggered by pre-specified ROTEM values – FIBTEM A5  $\leq 10$  mm. **Primary outcome measures:** 1) Time to administration of Fibrinogen Replacement 2) Feasibility of administering FC within 30 mins 3) Effects on Fibrinogen levels during traumatic haemorrhage. **Secondary outcome measures:** 1) Transfusion requirements 2) Duration of bleeding episode 3) ICU and Hospital LOS 3) Thromboembolic events 4) Mortality.

**Results:** Full primary outcome data was available for 94 patients. FC Arm FIBTEM A5 (n=47): Median 8 mm (IQR 7 – 10) Cryo Arm (n=47): 10 mm (8 – 14). FC Arm 36/47 (77%) had a FIBTEM A5  $\leq 10$  mm - median transfusion of 3g FC. Cryo Arm 26/47 (55%) had a FIBTEM A5  $\leq 10$  mm - median transfusion of 8 Units Cryo. Time to administration was for **FC 29 min** (IQR 23 – 40) [Range 10 - 125] compared to **Cryo 60 min** (40 – 80) [30 - 170]. The mean time to first treatment advantage for FC over Cryo was **33 min** (95% CI 17 to 48 min). The HR for commencement of treatment was **2.8** (95% CI 1.7 to 4.9) in favour of FC relative to Cryoprecipitate. Full data analysis for remaining outcome measures will be available by June 2018.



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**Conclusions:** FC therapy commenced a median of 31 minutes before Cryo. Assessed using a time to event method, patients in the FC arm were on average almost three times more likely to have commenced treatment compared to those in Cryo arm.

These results suggest that FC may have a substantial advantage in time to administration relative to Cryo. There is currently insufficient evidence to support one means of fibrinogen replacement over another; resulting in non-uniform practices within facilities and diverse transfusion guidelines. This study will add to the evidence base and inform the planning of a definitive multi-centre study with patient centred outcomes as primary outcomes.

## **ORGAN FAILURES FOLLOWING RESUSCITATIVE ENDOVASCULAR OCCLUSION OF THE AORTA: A PROPENSITY SCORE MATCHING ANALYSIS**

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**Introduction:** Despite the growing importance of resuscitative endovascular balloon occlusion of the aorta (REBOA) in critically bleeding trauma patients, reports on benefits and drawbacks regarding mortality and organ failure following REBOA have been heterogeneous and inconclusive in previous studies. This study aimed to compare and assess not only mortality, but also organ failure, in critically bleeding trauma patients who did and did not undergo REBOA.

**Method:** From the Japan Trauma Databank, a retrospective, observational, nationwide, registry-based, and propensity score-matched cohort study included adult ( $\geq 16$  years old) trauma patients who underwent torso emergency surgery. Patients whose systolic blood pressure was 0 mmHg at the baseline were excluded. After multiple imputation for all the study variables, propensity scores to predict the use of REBOA were generated from 54 covariates at the baseline as fixed-effect and hospital as random-effect by the logistic regression mixed effect model, and were used for 1:1 within-cluster (hospital) matching for patients who underwent REBOA with those who did not. The study outcomes included in-hospital mortality, organ failure including supra-diaphragmatic organ failure (brain, heart, and lung dysfunction), infra-diaphragmatic organ failure (abdominal organ dysfunction and pulmonary embolism following deep vein thrombosis), systemic organ failure (sepsis and coagulopathy), and a combination of in-hospital mortality and any kind of organ failure.

**Results:** Within-cluster propensity score-matching included 607 patients each who did and did not undergo REBOA. Baseline covariates were adequately matched (absolute standardized mean difference [ASMD]  $< 0.1$ ) between patients who did or did not undergo REBOA, including age (54 versus 53 years [median], respectively, ASMD 0.019), sex (68% male versus 68% male, respectively, ASMD 0.007), systolic blood pressure (84 versus 80 mmHg [median], respectively, ASMD 0.062), and the Injury Severity Score (34 versus 34 [median], respectively, ASMD 0.026). Undergoing REBOA was associated with higher in-hospital mortality (57% versus 37%, respectively, difference +20% [95% confidence interval (CI) +15%, +26%],  $P < 0.001$ ). Supra-diaphragmatic (13% versus 14%, difference -1% [95% CI -5%, +3%],  $P = 0.737$ ) and infra-diaphragmatic (2% versus 3%, difference -0% [95% CI -2%, +1%],  $P = 0.712$ ) organ failures did not differ in patients who did and did not undergo REBOA, respectively; however, excess prevalence in systemic organ failures was observed in association with REBOA (24% versus 18%, respectively, difference +6% [95% CI +1%, +11%],  $P = 0.011$ ). REBOA was also associated with the combined outcome including in-hospital death or any organ failure (68% versus 52%, respectively, difference +17% [95% CI +11%, +22%]).

**Conclusion:** In this retrospective, observational, propensity score-matched study, undergoing REBOA was associated with higher mortality, higher prevalence of systemic organ failures including coagulopathy and sepsis, and fewer organ failure-free survival.

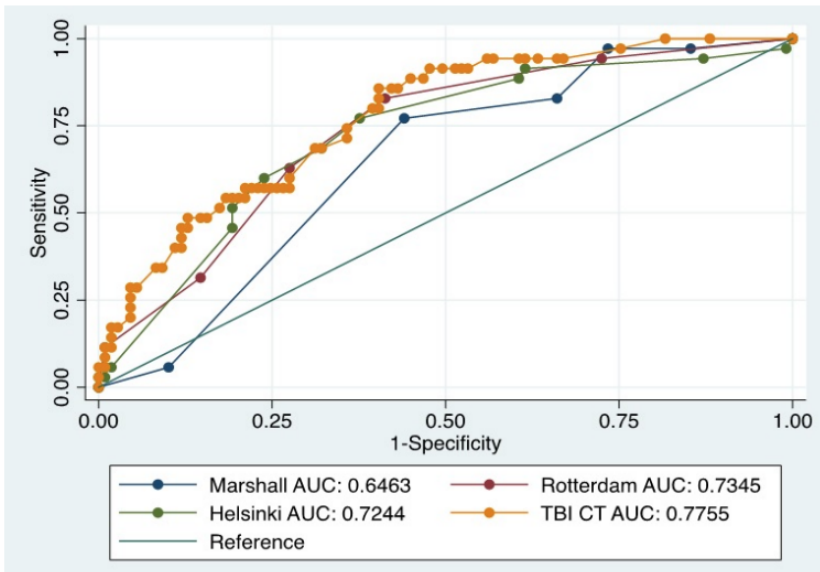
## PREDICTING MORTALITY AFTER TRAUMATIC BRAIN INJURY: PROGNOSTIC MODEL BASED ON ADMISSION CHARACTERISTICS

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**Introduction:** Traumatic Brain Injury (TBI) is a public health problem. It is a pathology that causes significant mortality and disability. Different models have been developed in order to predict the neurological outcomes. Marshall computed tomographic (CT) classification is widely used as a predictor of outcome. However, this grading system lacks useful variables to predict the outcome of the patient, which are subarachnoid/intraventricular hemorrhage, extradural haematoma, and extent of basal cistern compression. We aimed to develop and validate a practical prognostic model that include all the variables above and predict death at six months after TBI.

**Methods:** Prospectively collected individual patient data were analyzed. The CT model included midline shift over 5 mm, normal, compressed or absent basal cisterns, subarachnoid bleeding, basal bleeding, intraventricular bleeding, contusion and epidural, subdural or intracerebral haematoma. We considered predictors available at admission in logistic regression models to predict mortality at 6 months after TBI. The performance and accuracy of several model was assessment using the Spearman's rank correlation coefficient and the area under the receiver operating characteristic curve (AUC).

**Results:** A total of 145 patients were recruited for study, median age 33 (15-85) years, and 86.89% were male. The overall mortality was 24.82%. The median GCS of patients was 6 (3-12). The Marshall CT classification discrimination was AUC= 0.646, Helsinki CT Score discrimination was AUC= 0.724, Rotterdam grading discrimination was AUC= 0.735, all these with a low correlation with the outcome (Spearman's rho <0.40). Our model showed the best performance and correlation with 6-month mortality: AUC= 0.7755, Spearman's rho 0,4201, p= 0.000.



**Conclusion:** Our prognostic mortality CT model showed a great performance and accuracy and can be used to obtain valid predictions of relevant outcomes in patients with TBI.

## **ATLS® PROTOCOL ADHERENCE BY GENERAL SURGERY RESIDENTS IN THE EMERGENCY ROOM: A SIMULATION-BASED APPRAISAL**

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**Introduction:** Decision-making process has been insufficiently discussed in medical teaching. Recently, more importance has been given to the study of critical decision-making capacity in simulation-based scenarios. This study aims to evaluate adherence to the Advanced Trauma Life Support (ATLS®) protocol by general surgery residents when exposed to clinical simulation scenarios as well as their ability to take critical life-saving decisions in a stressful scenario.

**Methods:** 44 general surgery residents from a unique university teaching hospital were exposed to 23 identical trauma simulation scenarios between 2013 – 2016. A score was given according to Resident's performance and adherence to ATLS® protocol. All simulation case scenarios were also recorded and reviewed by a different evaluator of the live case-scenario. Performance scores were confronted and discussed all together in order to lower any possible bias. Here, this group of authors studied the adherence of 44 residents to the ATLS® protocol as well as their decision-making capacity in a critical scenario.

**Results:** Unconformities factors were identified on general surgery residents adherence to the ATLS® protocol. Lack of attention, failure to comply with rapid sequence intubation protocol with adequate pre-oxygenation, conceptual lapse in volume resuscitation and neglect of hypothermia prevention were the most important observed points. There were also identified failures in the process of critical decision-making.

**Conclusion:** Current protocols despite of objectifying a clear and logical method of attending trauma victims at the emergency room, are unable to exclude personal decision-making process. Focus by tutors and teachers should be given to physicians in training for general surgery in the pre-oxygenation, measures of confirmation of the process of intubation in the emergency room, massive transfusion protocol and hypothermia prevention.

## **PENETRATING INJURY TO THE CARDIAC BOX**

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**Introduction:** Classically, a penetrating injury to the “cardiac box” has been thought to be predictive of an injury to the heart, however, there is very little evidence available to support this association. This study aims to further evaluate the relationship between penetrating trauma to the cardiac box and a clinically significant injury.

**Methods:** All patients 18 years and older presenting to a Level 1 trauma center from 01/2009 – 06/2015 who sustained a penetrating injury isolated to the thorax were retrospectively identified. Patients were categorized according to the location of their injury: within or outside the historical cardiac box defined by the sternal notch superiorly, the xiphoid process inferiorly, and the nipples laterally. Patients with concurrent injuries both inside and outside the cardiac box were excluded. Clinical demographics, injuries, procedures, and outcomes were compared.

**Results:** During this 7-year period, 330 patients (92% male; median age, 28 years) sustained penetrating injuries isolated to the thorax: 138 patients (42%) within the cardiac box and 192 patients (58%) outside the cardiac box. By mechanism, 105 (76%) were stab wounds (SW) and 33 (24%) were gunshot wounds (GSW) inside the cardiac box, and 125 (65%) SW and 67 (35%) GSW outside the cardiac box. The overall rate of thoracotomy or sternotomy was significantly higher in patients with penetrating trauma within the cardiac box [35/138 (25.4%) vs. 15/192 (7.8%),  $p<0.001$ ]. These patients also had a higher incidence of cardiac injury compared to patients with wounds outside the box [18/138 (13%) vs. 5/192 (5%),  $p<0.001$ ]. There was no difference in overall mortality [9/138 (6.5%) vs. 6/192 (3.1%),  $p=0.144$ ]. On multivariate logistic regression, a penetrating injury within the cardiac box was an independent risk factor for undergoing a thoracotomy or sternotomy (adj  $p=0.008$ , OR 3.255, 95% CI 1.353-7.832) and for cardiac injury (adj  $p=0.008$ , OR 6.845, 95% CI 1.636-28.636).

**Conclusion:** Penetrating trauma within the cardiac box is associated with a higher risk of cardiac injury and need for thoracotomy or sternotomy than injuries outside the cardiac box. Injuries outside the cardiac box still warrant rapid assessment as they have a one in twenty chance of an associated cardiac injury.

## LOW VALUE SURGICAL PRACTICES IN TRAUMA CARE: A SCOPING REVIEW AND EXPERT CONSULTATION STUDY

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**Introduction:** Injuries lead to 200,000 hospital stays, 60,000 disabilities, and 13,000 deaths per year in Canada with direct costs of \$16 billion. Low-value medical interventions are estimated to consume up to 30% of healthcare resources and may expose patients to avoidable harm. However, little is known about healthcare overuse in trauma populations. We aimed to identify low-value clinical practices in trauma surgery.

**Methods:** We conducted a scoping review of peer- and non-peer-reviewed literature followed by a consultation with experts. We identified research articles, reviews, recommendations and guidelines that identified at least one low-value clinical practice specific to hospitalized injury populations. We searched Medline, Embase, Cochrane CENTRAL, and Web of Science databases, websites of government agencies, professional societies and patient advocacy organizations, thesis holdings and conference proceedings. Pairs of independent reviewers evaluated studies for eligibility and extracted data from included articles using a pre-piloted and standardized electronic data abstraction form. We documented the level of evidence by the number and type of studies reporting on each clinical practice. We then consulted experts in two phases: to classify, group and standardize identified surgical practices and to rate them according to their potential to be low-value.

**Results:** The systematic scoping review revealed 72,226 citations of which 1,486 were deemed eligible and led to the identification of 113 surgical practices. Following the first phase of consultation, 24 surgical practices were retained. Of these, 11 were considered clearly or potentially low value by experts (see Table 1 for examples).

**Conclusion:** This review contributes new knowledge on low-value surgical practices in acute injury care. This is the first study of the *Canadian Program for Monitoring Low Value Clinical Practices in Injury Care*, funded by the *Canadian Institutes of Health Research* and conducted in collaboration with *Choosing Wisely*. In addition to surgical care, the program targets injury care in the emergency department, the intensive care unit, and orthopedics. This review represents a first step towards developing valid and reliable metrics to monitor potentially unnecessary or harmful practices in acute injury care. These metrics will provide a solid basis for the development of interventions targeting de-adoption such as shared decision-making tools. Such interventions have the potential to reduce costs, delays and unnecessary hospital days and increase resource availability. They may also improve patient outcomes through a reduction in exposure to adverse events.

Surgical practice	RCTs & meta-analyses of RCTs	Meta-analyses observational studies	Observational studies	Other*
Stent graft for minimal aortic injury with regression on follow-up CTA				1
Surgical management in penetrating neck injury with soft signs on clinical exam and negative CTA			8	3
Surgical management in blunt, stable isolated splenic injury		1	2	3
Damage control laparotomy in physiologically restored trauma patients without massive transfusion	2	1	32	21

CTA: Computed tomography angiography, RCT: Randomized controlled trial

\* Case reports, case series, cross-sectional studies, expert opinion/letter to the editor, narrative reviews

## Effects of the Fully Enforced Affordable Care Act

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**Introduction:** The Affordable Care Act (ACA) of 2010 was created to expand insurance coverage for all Americans. This analysis was done to determine if the ACA, once it was fully enforced, expanded coverage and improved outcomes for trauma patients.

**Methods:** Trauma patient's ages 15-65 years who presented between 2007 and 2015 were identified in the National Trauma Data Bank (NTDB). Those patients with unknown disposition were excluded from analysis as well as patients who would have qualified for social security secondary to age. Patients were grouped by years: 2007-2009 pre-ACA, 2011-2013 post-ACA, and 2014-2015, once the ACA was fully enforced. Patient outcomes of interest included hospital length of stay (LOS), in-hospital mortality, and discharge disposition. Multivariate regression models for mortality and LOS were built controlling for injury severity (ISS), age, gender, race, patient comorbidities, and insurance status to determine if these grouped years affected outcomes.

**Results:** There were 10,830,716 patients included in this analysis. Patients were  $40 \pm 15$  years old and 72% were male. Mean ISS was  $9.9 \pm 9$  and LOS was  $6.0 \pm 9$  days. Prior to the ACA patients were significantly more likely to die controlling for all above covariates ( $p < 0.001$ , CI 0.0018-0.0023). Patients from 2011-2013 were less likely to die, while patients who presented from 2014-2015 once the act was fully enforced had the lowest mortality of all groups ( $p < 0.001$ ). In the same regression model, patients with insurance other than private and minorities were more likely to die as compared to their Caucasian privately insured counterparts ( $p < 0.0001$ ). Regression for LOS controlling for same covariates including comorbidities found patients from 2014-2015, despite having better outcomes, had the lowest LOS ( $p < 0.001$ ). Furthermore, patients from 2011-2013 had a significantly shorter hospital LOS than those patients prior to the enactment of ACA ( $p < 0.001$ ). Uninsured patients, excluding AMA, had significantly lower LOS than all other patients controlling for all years ( $p < 0.001$ ).

**Conclusion:** This analysis demonstrates that once the ACA was fully enforced, the group of Americans trauma patients with the highest rate of uninsured patients had better outcomes. Not only did their outcomes improve immediately following implementation of the ACA from 2011 to 2013, but improved significantly more once the act was entirely engrained within the US healthcare system.

**PREDICTION MODELS FOR HEALTH STATUS 6-MONTHS AND 1-YEAR  
AFTER INJURY: A PROSPECTIVE COHORT STUDY**

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**Introduction:** Trauma patients often perceive an impaired health related quality of life after trauma. This study aims to develop a prediction model for health status in the general trauma population, based on 6-months and 12-months outcome. The model should incorporate easily accessible predictors.

**Methods:** A total of 9774 adult trauma patients were included from August 2015 through November 2016 if they were admitted to one of the ten hospitals in the county. Outcome measures were the EuroQol-5 dimensions (EQ-5D) and the Health Utilities Index (HUI) 6 months and 1 year after trauma. Summary scores were calculated for all outcome measures. Possible predictors were pre-injury health status, injury severity, patient characteristics and frailty pre-injury (measured with the Groningen Frailty Index). All potential predictors were assessed with univariable linear regression. Predictors were included in the multivariable model if  $p < 0.2$ . The model performances were assessed with Nagelkerke R-square ( $R^2$ ).

**Results:** A total of 2,106 patients and 1,938 patients were used to develop a prediction model for functional outcome, respectively 6 months and 1 year after injury. Pre-injury health status and frailty pre-injury were the strongest predictors for functional outcome in the general trauma population. Age, comorbidity, social economic status, functional capacity index, injury severity score, length of stay in hospital were also included in the multivariable prediction models. The model explained 50% of the variance for EQ5D-utility score ( $R^2=0.5$ ) and 40% of the variance was explained for HUI 2 or HUI 3 index scores ( $R^2=0.4$ ).

**Conclusion:** To our knowledge, these are the first models to predict health status 6 months and 1 year after trauma. The models seem promising for predicting health status of trauma patients in the western society. However, future research is recommended to externally validate the models.



## **Causes of preventable and potentially preventable death in trauma patients in a comprehensive trauma center in China**

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**Introduction:** Trauma and accidental death account for the five common causes of mortality in China as well as worldwide. Introduction of trauma centers improves severely injured patients care. Since the trauma centers are established in China, there are advances in trauma care management. In this retrospective study, we analyzed the causes of preventable and potentially preventable early in-hospital death in a comprehensive trauma center in China. the purpose of this study was to analyze the deficits in medical care for injured patients, and to provide clue of how to improve the trauma care system in the future.

**Methods:** The clinical data of early in-hospital mortality from 2000 to 2014 in the Trauma Center of Tongji Hospital were collected. The demographic data, causes and mechanisms of injury, anatomy of injury, as well as pre-hospital care of these patients were assessed. The medical deficits were also studied. The data were acquired from medical records. The classification of inevitable or potentially avoidable death was determined on the basis of available data, mainly by clinical consideration. We analyzed data by GraphPad Prism 5,  $P < 0.05$  was set statistically significant.

**Results:** Seventy-four percent of our patients were males and the median of age was 42. Traffic injury was the leading cause of trauma death in 49%. The site of injury was cranio-cerebral in 72% of our patients. From 2010 to 2014 the number of deaths increased with a rate of 33%. In all groups, the number of deaths was increased in less than one hour from the time of injury in 54% ( $P < 0.05$ ). Most of deaths were inevitable in all groups in 79% ( $P < 0.05$ ). Among deaths considered as potentially avoidable or avoidable, a total of 182 deficits are noticed. The inappropriate transfer is the leading deficit encountered. Other deficits are: inadequate resuscitation, inappropriate airway management, inadequate bleeding control and missed diagnosis.

**Conclusion:** Inappropriate transfer, inadequate fluid resuscitation, airway management and bleeding control, and missed diagnosis are major deficits of medical care for severely injured patients. More training for trauma management and better patient-doctor relationship will help to improve the outcome of severely injured patients.

### **Trauma Tertiary Survey: Improving Compliance in Four Steps**

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**Introduction:** Missed injury rate is a commonly used quality indicator of trauma care performance. The routine completion of trauma tertiary surveys (TTS) has been recommended to minimize the rate of missed injuries amongst hospitalized trauma patients. However, poor compliance in the routine documentation of TTS is commonly reported. In this study, we sought to determine whether the implementation of a standardized TTS template increases the compliance of TTS completion and documentation.

**Methods:** The current project was developed in four steps: 1) development of a standardized TTS template in collaboration with multiple stakeholders at a Level I Trauma Center; 2) education campaign and dissemination of TTS documentation guidelines; 3) project launch in March 2016; and 4) data collection and analysis. For the last phase, we retrospectively reviewed the medical charts of all patients admitted under the care of the trauma surgery service over the 6 month period from September 2015-February 2016 (pre-implementation group) and from September 2016-February 2017 (post-implementation group). Compliance and timeliness of completion of TTS in the charts was compared for the pre- and post-implementation groups.

**Results:** A total of 918 records were reviewed: 495 pre- and 423 post-implementation of a standardized TTS template. Patients in the pre-implementation group were more likely to be male and have longer length of stay compared to patients in the post-implementation group ( $p<0.05$ ). Other demographics, clinical, and injury-related characteristics of patients were comparable between pre- and post-implementation groups ( $p>0.05$ ). Compliance in documenting TTS in the medical charts was 58% before and 79% after implementation of the template ( $p<0.001$ ). Furthermore, 96% of TTS were documented within the first 48 hours of admission in the post-implementation group, compared to 85% in the pre-implementation group ( $p<0.001$ ). After implementing the template, the TTS template was used to document TTS in 85% of patients with a completed TTS.

**Conclusion:** The introduction of a standardized TTS template significantly improved compliance and timeliness in TTS documentation in medical charts. A standardized template for TTS completion and documentation and the regular education of health care providers on TTS guidelines may improve compliance with TTS documentation.

## Propensity-score matched analysis of endovascular vs. open repair of isolated superficial femoral and popliteal artery injuries

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**Introduction:** Endovascular therapy of traumatic vascular injuries has increased dramatically during the past decade. No large studies have reported the outcomes for endovascular versus open repair of isolated superficial femoral (SFA) and popliteal artery (PA) injuries.

**Methods:** Analysis of the National Trauma Data Bank (NTDB: 2007-2014) was performed to identify all patients with a superficial femoral or popliteal artery injury. Isolated SFA and PA injuries were defined as cases with abbreviated injury scale (AIS) severity score <4 for non-lower extremity injuries. Nearest neighbor propensity score matching was used to account for pre-surgery differences in patients' demographic and clinical characteristics. Variables were selected for matching based on evidence of association with the exposure (repair type) and at least one patient outcome. Logistic regression models were used to assess associations between repair type and patient outcomes.

**Results:** A total of 11,395 patients with SFA or PA injuries were identified, of which 2,873 were defined as isolated SFA/PA injuries (163 endovascular repair and 2,710 open repair) and were included in the full analysis dataset. A propensity-matched dataset was derived from the full dataset using pre-treatment characteristics (gender, age, systolic blood pressure, pulse, ISS, SFA injury, PA injury, femur fracture/knee dislocation) and a 1:4 matching ratio (157 endovascular, 628 open). In the full analysis dataset, the percentage of patients who underwent endovascular repair increased from 3.2% in 2007 to 7.6% in 2014. Patients with isolated SFA/PA injuries had morbidity rates of: deep venous thrombosis (DVT) (endo 7.4%, open 4.2%,  $p=0.06$ ), fasciotomy (endo 12.3%, open 49.7%,  $p<0.001$ ), amputation (endo 4.3%, open 9.5%,  $p=0.025$ ), acute kidney injury (AKI) (endo 3.1%, open 2.1%,  $p=0.403$ ). In the propensity-matched dataset, endovascular repair was not associated with improved amputation-free survival (OR 1.16, 95% CI [0.60-2.10],  $p=0.65$ ). However, there was a higher mortality (OR 3.69,  $p=0.008$ ) and decreased fasciotomy risk (OR 0.23,  $p<0.001$ ) among endovascular repair patients compared to open repair patients.

**Conclusion:** In patients with isolated SFA/PA injuries, endovascular repair was not associated with improved amputation-free survival. Mortality was higher in the endovascular repair group and the rate of fasciotomy was higher in the open group.

**Table 1: Associations between Repair Type and Patient Outcomes in Propensity Matched Dataset**

		Number of Patients with Outcome	OR	[95% CI]	p-value
Amputation-free survival	Open repair	579 (92%)	ref	--	
	Endovascular repair	143 (91%)	0.86	[0.48, 1.67]	0.65
In-hospital mortality	Open repair	9 (1%)	ref	--	
	Endovascular repair	8 (5%)	<b>3.69</b>	<b>[1.37, 9.82]</b>	<b>0.01</b>
Lower extremity amputation	Open repair	43 (7%)	ref	--	
	Endovascular repair	7 (4%)	0.63	[0.26, 1.35]	0.28
Fasciotomy	Open repair	242 (39%)	ref	--	
	Endovascular repair	20 (13%)	<b>0.23</b>	<b>[0.14, 0.37]</b>	<b>&lt;0.001</b>

Odds ratios and 95% confidence intervals were calculated using a 1:4 propensity matched dataset using nearest neighbor matching. Propensity scores were calculated using gender, age, systolic blood pressure, pulse, ISS, SFA injury, PA injury, femur fracture/knee dislocation.

## THE EFFICACY OF A NOVEL TWO-ROOM TYPE ALL-IN-ONE TRAUMA RESUSCITATION SUITE: THE RETROSPECTIVE EVALUATION OF THE BENEFITS OF TIME-SAVING AND COST-EFFECTIVENESS.

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Invited Discussant:

**Introduction:** Recently, an all-in-one trauma resuscitation unit, comprised of computed tomography (CT) scanner, intervention radiology (IVR) system, and operation room (OR), known as a “Hybrid emergency room (ER)” was developed and the survival

benefit of using that type of facility in severe trauma has been shown. This is assumed to reflect the shortened times to CT scan, subsequent diagnosis and decision making, and definitive therapies. From an economic aspect, however, the Hybrid ER could be too resource-intensive for many trauma patients. In October 2017, we installed a novel “two-room type” Hybrid ER in our shock trauma center. This facility combines a resuscitation room with an OR/IVR system and a standard CT examination room. The gantry of the CT is shared by both rooms, so the facility can be used as a standard CT room for scheduled examinations when the resuscitation room is not in use. We hypothesized that this type of hybrid ER could be as effective for trauma resuscitation as the conventional, one-room type Hybrid ER and resolve the concern about cost recovery.

**Methods:** This was a single center, retrospective, historically controlled observational study. **(A)** To evaluate the benefit of time-saving, we selected consecutive trauma patients with an Injury Severity Score (ISS)  $\geq 16$  who were admitted at a tertiary care hospital before and after the installation of the Hybrid ER. Patients who were dead on arrival or needed immediate ER thoracotomy were excluded. The time to CT scan was calculated for each case. **(B)** We evaluated costs for all patients, both trauma and non-trauma, who used the Hybrid ER for resuscitation after its installation. The stay time in the resuscitation room was also recorded, and the occupancy rate of the resuscitation room was calculated. The number of scheduled CT examinations performed within the Hybrid ER was also counted and the profit from them was estimated.

**Results:** **(A)** 106 patients were included in the study population. 50 patients were admitted before the Hybrid ER was installed, whereas 36 and 20 patients were admitted into the Hybrid ER or a conventional trauma bay after the installation, respectively. By using the Hybrid ER, the mean time to CT scanning was significantly decreased from  $24.8 \pm 1.1$  [min] to  $10.4 \pm 0.8$  [min] (mean  $\pm$  standard error,  $p < 0.0001$ ). **(B)** Including non-trauma cases, there were 193 patients who used the Hybrid ER for their resuscitation. Their mean stay time in the resuscitation room was  $74.4 \pm 5.7$  [min] and the average number of cases per day was 1.6, therefore the total room occupancy rate was 8.1% of the day. While not in use for resuscitation, an average of 14.1 scheduled CT scans were done within the facility earning at least an estimated \$1,355 per day.

**Conclusion:** The time to CT scan was significantly shortened in the Hybrid ER. This result is similar to that of a previous study, and the shortened time is expected to contribute to better survival. Meanwhile, the occupancy rate of the resuscitation room was less than one-tenth. Low operation rates might be a common characteristic of Hybrid ERs, leaving the potential for improved efficacy in its operation. The two-room type Hybrid ER would be one possible solution to the problem, contributing to the hospital’s profits by enabling scheduled CT examinations.

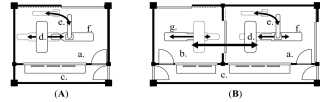


Fig. 1. Comparison of (A) one-room type and (B) two-room type Hybrid ER. Legend: a. resuscitation room; b. examination room; c. control room; d. gantry; e. C-arm; f. operation table; g. examination bed.

**RESUSCITATIVE ENDOVASCULAR OCCLUSION OF THE AORTA 'REBOA':  
INDICATIONS-ADVANTAGES AND CHALLENGES OF IMPLEMENTATION  
IN TRAUMATIC NON-COMPRESSIBLE TORSO HEMORRHAGE - A  
SCOPING REVIEW**

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**Introduction:** Resuscitative Endovascular Balloon Occlusion of the Aorta 'REBOA' is recently gaining popularity in the treatment of traumatic non-compressible torso bleeding. Refinement of the technique supported by advances gained from the invasive radiology experience, endovascular treatment of AAA, added to other damage control measures nonavailable previously, helped in bringing back the technique with very promising outcomes. The literature is still having substantial heterogeneity about the clear indications of the procedure, the population that will benefit the most from its use, and the challenges faced while implementing the technique in a level I trauma center. Scoping reviews are excellent platforms to assess the diverse literature of a new technique. It is for the first time that a Scoping review is adopted for this topic.

**Methods:** Critical search from MEDLINE, EMBASE, BIOSIS, COCHRANE CENTRAL, PUBMED and SCOPUS was conducted from the earliest available dates till January 15,2018. Evidence-based papers as well as grey literature at large were analyzed regardless of the quality of manuscripts.

**Results:** Identification of 1176 articles related to the topic. Retrieval of 128 full papers for assessment. Quantitative and Qualitative measures included Demographics, Study design, Study Objectives, Methods of data collection, Indications, REBOA protocol used, time to deployment, Zone of deployment, Occlusion time, Complications, amount of blood used, Outcome, and level of expertise at the concerned Trauma Centers.

**Conclusion:** Growing levels of evidence are supporting the use of REBOA in selected indications. Analysis showed advantage for its use in terms of morbidities and physiologic derangement as compared to other methods. Challenges in implementation, competency assessment and credentialing are areas to be addressed. Recommended systematic reviews to identify proper indications, terms of use and possible advantage of pre-hospital and partial REBOA are topics for further researches.

## **THE ROLE AND AVAILABILITY OF TEVAR WITH DEBRANCHING TECHNIQUE FOR BLUNT TRAUMATIC AORTIC INJURY IN THE SEVERE MULTIPLE TRAUMA PATIENTS.**

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**Introduction:** The multiple trauma patients concomitant with blunt traumatic aortic injury (BTAI) tend to be severe and have high mortality and morbidity. The evaluation and treatment for BTAI needs accurate and immediate cooperation with many departments as trauma, radiology, and also cardiovascular surgery. We strive to perform thoracic endovascular aortic repair (TEVAR) ± debranching technique for thoracic BTAI and retrospectively reviewed the roles and short-term results of emergent TEVAR for BTAI.

**Methods:** The records of the BTAI patients were retrospectively reviewed for the vital signs on arrival, mechanism of injury, characteristics, time flow, concomitant injuries, injury description, operation procedures, and the outcomes. The patients arrived under cardiopulmonary arrest were excluded. All statistical data are described as median (25-75% interquartile range [IQR]) or number.

**Results:** From January 2015 to February 2018, 15 patients administrated as BTAI and 7 patients were treated by TEVAR. The median age was 44 (28-57) years old and 57.1 % was male. The grade of injury was all 3 or 4 and the time from admission to operation was 171 (127-216) minutes. One patient was hemodynamically unstable on arrival. The ISS was 34 (29-34) and Ps was 0.82 (0.16-0.94). Three were performed simple TEVAR (LSCA occlusion:1) and four were performed debranching TEVAR (LSCA occlusion + LCCA-LSCA bypass) because of detected anomaly of vertebral artery. Two were performed under unheparinization. The concomitant injuries were one intracranial hemorrhage, three intra-abdominal injuries, three pneumo or hemothoraxes and six pelvic / extremities fractures. The other emergent interventions which performed concurrently or within 24 h after TEVAR were two transcatheter arterial embolizations, one external fixation of pelvis and three indirect tractions for fractures of extremities. There was no intraoperative complication or delay for interventions for other injuries and hospital death.

**Conclusion:** The short-term results of TEVAR with debranching technique for BTAI in multiple trauma patients were acceptable and no complications or delay of intervention for other injuries in the multiple trauma patients.

## Endovascular management in traumatized patients: Experience at a Level 1 Trauma Center in an Upper-Middle Income Country.

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**Introduction:** Endovascular and hybrid therapy is a new treatment for complex trauma. We describe a case series of trauma patients with endovascular management at a Level I Trauma Center in an upper-middle income country.

**Methods:** Retrospective study of patients who received endovascular therapy from 2010 to 2017. Patients were divided in two groups (With single endovascular therapy (SET) and those with hybrid therapy (HT: endovascular and surgery management). Demographic data, injury details and treatment were registered.

**Results:** Were included 74 patients. 21 patients with SET and 44 with HT. In SET group, median age was 35 (IQR 22-56), ISS 16. The mechanism of trauma by gunshot was 53.3%. 26.7% arrived in shock. 43.3% the vascular trauma was subclavia artery. 46.7% were managed with covered stent. There were no deaths. HT group median age was 25 (IQR 20-42), ISS 25. 51.4% of trauma mechanism was penetrating by gunshot. 34 patients arrived in shock. In 84.1% the surgery was prior to endovascular procedure. In 50% were due to vascular trauma in areas of complex surgical approach (25% subclavian, 18% hypogastric and 10.8% hepatic arteries). 5 patients with non-compressible torso hemorrhage needed REBOA. 47.7% presented active hemorrhage at angiography. 39.2% underwent Coil embolization. There were 6 deaths, none attributable to endovascular management.

	<b>Endovascular Management N=30 n (%)</b>	<b>Hybrid Management N= 44 n (%)</b>	<b>P value</b>
<b>Shock</b> (SBP<90 mm Hg)	8 (26.7%)	26 (59.1%)	0.006
<b>Trauma mechanism</b>			
Penetrating	19 (63.3%)	25 (56.8%)	NS
Blunt	11 (36.7%)	19 (43.2%)	NS
<b>ISS*</b>	16 (9 – 25)	30 (22- 43)	p<0.001
<b>RTS*</b>	7.8(7.1-7.8)	7(5.7-7.8)	0.005
<b>Multiple Trauma</b>	17 (56.7%)	34(77.3%)	NS
<b>Complications</b>	3 (10%)	19 (43.2%)	P<0.001
<b>Endovascular complications</b>	2 (6.7%)	4 (9.1%)	NS
<b>ICU stay*</b>	3 (1-6)	9 (6-16)	P<0.001
<b>Hospital stay*</b>	6 (3-10)	15 (9 – 20)	P<0.001
<b>Mortality</b>	0	6 (100%)	0.004

\*Median (interquartile-range), ISS: injury severity score, RTS: revised score trauma, SBP: systolic blood pressure, ICU: Intensive care unit.

**Conclusion:** Endovascular and hybrid trauma management are still evolving. They seem to be a safe option and may be able to reduce mortality in penetrating trauma.

## **CLINICAL, LABORATORY AND VENTILATORY PREDICTORS FOR INTRA-ABDOMINAL HYPERTENSION IN SEPTIC SHOCK ICU PATIENTS**

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**Introduction:** Intra-Abdominal Hypertension (IAH) is a frequent complication in critically ill patients. According to the World Society of the Abdominal Compartment, physical examination is not an accurate diagnosis method and there are no predictive factors whatsoever. The objective of this study is to search for IAH predictors in ICU septic shock patients.

**Methods:** This is a prospective, single institution, observational study involving all septic shock patients admitted at the ICU between April and October 2016. Sepsis criteria was determined either by SEPSIS-3 and Surviving Sepsis Campaign concomitantly. Patients with primary abdominal pathologies were excluded. Intra-Abdominal Pressure (IAP) was assessed following WSACS protocols every 6 hours. Statistical analysis was performed using Generalized Estimation Equations (GEE) method. Level of significance was 5%.

**Results:** Twenty-five patients were followed up for 10 days of hospitalization. The mean age was  $51.13 \pm 16.52$  years, 64% males. The pulmonary sepsis was present in 76% of the cases. The increase in IAP correlated with the increase in CVP ( $p=0.0421$ ); PEEP ( $p=0.0056$ ); ventilatory support pressure ( $p=0.0015$ ); accumulated water balance (AWB) ( $p=0.0273$ ) and SOFA ( $p=0.0393$ ). Acidosis reduction ( $p=0.0096$ ) and increase in bicarbonate ( $p=0.0247$ ) in blood gas analysis were associated with lower IAP values. Cut points values for AWB, PEEP, SOFA, pH and bicarbonate were found.

**Conclusion:** Clinical, ventilatory and gasometric parameters can be used as predictors for IAH. Patients with values above the cut points should be actively monitored for IAH.



## **EXTERNAL VALIDATION OF THE HELSINKI COMPUTED TOMOGRAPHY SCORE IN THE PREDICTION OF MORTALITY IN SEVERE TRAUMATIC BRAIN INJURY**

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**Introduction:**Traumatic Brain Injury (TBI) is a public health problem. It is a pathology that causes significant mortality and disability in Colombia. Different calculators and prognostic models have been developed in order to predict the neurological outcomes of these patients. The Helsinki computed tomography (CT) score was developed for prognostic purposes in TBI. We aimed to examine the accuracy of the prognostic discrimination and prediction of mortality of the Helsinki CT score in a cohort of trauma patients with severe TBI in a university Hospital in Colombia.

**Methods:**We analyzed 145 patients with severe TBI treated in a regional trauma center in Colombia over a 2 year period. Bivariate and Multivariate analyses were used. The discriminatory power of the score, its accuracy and precision was assessed by logistic regression and as the area under the receiver operating characteristic curve. Shapiro Wilks, chi2 and Wilcoxon test were used to compare the real outcomes in the cohort against the predicted outcomes.

**Results:**The median age of the patient cohort was 37 years, and 86.9% were male. The median injury severity score (ISS) was 27, the median GCS motor score was 3, the basal cisterns were closed in 37.93% of the patients and a midline shift of >5mm was seen in 41.98%. The six-month mortality was 24.8%, and the Helsinki CT score predicted a mortality of 26% p <0,0001 (AUC 0,724 IC 95% 0,628-0,820).

**Conclusion:**The Helsinki CT score predicted mortality at 6 months in patients with severe head trauma in a university hospital in Colombia. The Helsinki CT score is useful for predicting early death and the prognosis of patients with TBI.

## **OPTIMIZING CRITICAL CARE OF THE TRAUMA PATIENT IN A COST-EFFICIENT WAY: THE INTERMEDIATE CARE UNIT**

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**Introduction:** The organization of specialized trauma care is an ongoing topic of debate, especially with regard to the critical care facilities needed to optimize patient outcome. The aim of this study was to describe the caseload, safety and cost-efficiency of critical care of the trauma patient provided at the surgical Intermediate Care Unit (IMCU).

**Methods:** This cohort study included all trauma admissions between 01.01.2011 and 01.07.2015 at the general ICU, stand-alone neurosurgical IMCU and stand-alone surgical IMCU of a level I trauma centre. Trauma mechanism, abbreviated injury scale (AIS) and injury severity scores (ISS), vital signs, laboratory parameters, admission duration, intubation duration, ICU transfer rate, and in-hospital mortality were prospectively collected. Expected cost savings were calculated using the cost price per IMCU (\$1,500) and ICU (\$2,500) admission day.

**Results:** A total of 1320 admissions were included, of which 645 (48.9%) at the ICU and 675 (51.1%) at the IMCU. Nearly all (n=620, 96.3%) ICU admissions were mechanically ventilated. The IMCU admissions had a mean age of 54.2 (CI 53.1, 55.3) and median ISS of 17 [IQR 11, 22]. The median duration of IMCU admission was 32.8 hours [IQR 18.8, 62.5]. At the IMCU one patient died due to a neurogenic shock. A subsequent ICU transfer was required in 38 (5.6%) IMCU admissions, after a median admission time of 28.1 [IQR 16.3, 51.0] hours. Of these transfers, 4 patients died due to neurological deterioration (cerebral herniation). Expected total cost savings due to the presence of the IMCU were \$1,772,785.

**Conclusions:** A substantial amount of trauma patients in need of critical care can safely be admitted at the stand-alone specialist driven IMCU, without the need for further mechanical ventilation. Thereby, the IMCU fulfils an essential and cost-effective role in the management of severely injured trauma patients.

## INTRODUCTION AND EVALUATION OF THE ACS “B-CON BASICS” COURSE IN ZARAGOZA, SPAIN

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Jacqueline Vazquez MD, Lozano Blesa Clinical University Hospital

**Introduction:** Our commitment as fellows of the ACS is to spread and promote the principles of basic life saving techniques in massive bleeding patients using the methodology of the “B-Con Basics” course. This course is new in Spain and we consider it a very useful teaching tool for our society and for the public in general. Our objective was the introduction, development and evaluation of the Bleeding Control “B-Con Basics” course of the ACS among the college students and medical employees of the public health system of Aragon in the city of Zaragoza, Spain. We also set out to assess the degree of usefulness, relevance and applicability of the course content, as well as the overall satisfaction of the course valued among the study population of city of Zaragoza from December 2017 to March 2018.

**Methods:** To achieve our objectives we first had to obtain the official instructor accreditation for the “B-Con Basics” course in the US. We accomplished it by doing the regular course in October of 2018 in a level 1 Trauma Center in the state of California. Having obtained instructor accreditation, we organized in a public university hospital in Zaragoza and in the main university of the city an awareness campaign of the importance of the stop the bleeding. Subsequently we conducted from December 2017 to March 2018, 4 free access courses. Of the four courses 2 were done in the university hospital among nurses and physicians and 2 in the university for students. The methodology used for the evaluation of the activity among participants was to conduct an anonymous survey at the end of each course. The survey evaluated the variables of sex, age, occupation and personal opinion of the participants regarding the relevance, usefulness and applicability of the course content as well as the overall satisfaction. The surveys course content variables were classified with a quantitative scale from 0 to 10 and converting them to a qualitative scale of poor when graded from 0 to 3, fair from 4 to 6 and good from 7 to 10 for each of the four variables studied (relevance, usefulness, applicability and overall satisfaction), the rest of the variables were analyzed in percentages.

**Results:** From December of 2017 until March of 2018 we organized 4 courses in total with 83 assistants with an average of 20 participants per course. Most of the attendees were female 51(61%) vs. 32(39%) males and the age ranged from 21 to 52 with an average of 26 years. In the study population there were 46(56%) university students, 25(30%) hospital nurses and 12(14%) physicians. The results of the surveys for the course contents were broken down by category for each of the variables. Overall satisfaction and usefulness were the best valued with a good result by 70(84%) and 61(73%) of the participants respectively, followed by applicability and relevance with a good evaluation in 58(70%) and 55(66%). There were no poor results in any of the course content variables studied. In general, the attitude during the development of the courses was friendly and of interest to the trainees.

**Conclusions:** The ACS “B-Con Basics Course” is a good valued course for teaching the Basic techniques of hemorrhage control in the bleeding patient among university students and public health employees of Aragon, Spain. Its content was considered as good for relevance, usefulness and applicability by most of the studied population. The overall satisfaction was good for the population to which it was taught in Zaragoza.

## VOLUME-OUTCOME RELATIONSHIP IN BURN CARE: ANALYSIS OF NATIONWIDE ADMINISTRATIVE DATABASE

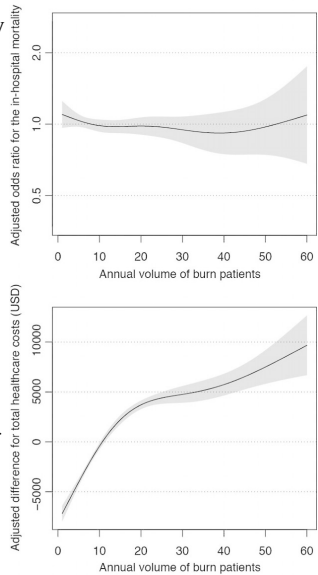
Akira Endo MD,Ph.D., Atsushi Shiraishi MD,Ph.D., Kiyohide Fushimi MD,Ph.D., Yasuhiro Otomo\* MD,Ph.D., Trauma And Acute Critical Care Medical Center, Tokyo Medical And Dental University Hospital Of Medicine

**Introduction:** Although hospital patient volume has been suggested to affect patient outcomes in several diseases, it has been still under debate whether this association could be observed in burn care. Assessment of healthcare costs based on burn patient volume has been scarce.

**Methods:** We conducted retrospective observational study including burn patients, using a Japanese national administrative database between 2010–2015. We established a case-mix adjustment model using burn index, patient demographic, and interventions in acute phase. A nonlinear generalized additive model (GAM) was used to evaluate the associations between hospital volume and the outcomes (in-hospital mortality and total healthcare costs per admission). Logistic or linear generalized estimating equation (GEE) models, adjusting for patient severity and hospital characteristics simultaneously, were also performed.

**Results:** Of 48,112 burn patients, 26,779 eligible patients from 1,316 hospitals (maximum of 58 burn patients annually) were analyzed. The case-mix adjustment model established had well accuracy with the area under receiver operating characteristics curve of 0.89. The GAM plots suggested little association between hospital volume and in-hospital mortality; however, the higher hospital volume was associated with the higher healthcare costs (Figure). While GEE models showed no significant association for in-hospital mortality [adjusted odds ratio (95% CI) = 1.00 (0.99–1.00),  $p = 0.336$ ], a significant association was observed for healthcare costs [adjusted difference (95% CI) for each patient increase = \$332 (\$297–\$368),  $p < 0.001$ ].

**Conclusion:** High hospital volume was not associated with in-hospital mortality but significantly associated with high healthcare costs. Further study is needed with a range of higher hospital volume than this study.



## ADMISSION OF ISOLATED HIP FRACTURE PATIENTS TO A TRAUMA SERVICE IMPROVES OUTCOMES

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**Introduction:** Isolated hip fracture (IHF) is a common injury in the elderly. In late 2014, in preparation for ACS verification, our trauma center changed admission practices for this group of patients so that they are largely admitted to the trauma service. Previously, IHF patients were most often admitted to a medical service. In this before-after quality assurance study, we evaluated the effects of this change on outcomes.

**Methods:** A retrospective review of the trauma registry at an ACS level I trauma center was performed for all elderly (age  $\geq 65$  years) blunt trauma patients discharged between 2013 and 2016, with a focus on patients with IHF. IHF was defined as a fracture of the femoral head, neck, and/or trochanteric region with no other injuries other than minor skin or soft tissue injuries, occurring after a fall. Comorbidities and complications were recorded concurrently, and as defined by the annually revised National Trauma Data Standard data dictionary.

**Results:** There were 3437 geriatric blunt trauma admissions. Of these, 656 (19.1%) had an isolated hip fracture, 264 were admitted before change and 298 were admitted after the change in admission practice. The patients were generally female, had comparable median age and comorbid conditions (Table). Both had ISS of 9. After the change, hospital length of stay (LOS) remained similar (7 [IQR 5-9] vs 7 days [IQR 6-10],  $p=0.27$ ), but more patients were admitted to the stepdown unit (68.2% vs 19.8%,  $p<0.001$ ) and to the ICU (5.1% vs 0.4%,  $p<0.001$ ) than before the change. Fewer patients were admitted to the floor (after 8.9% vs 75.9% before,  $p<0.001$ ). After this change in our practice, fewer patients developed a complication (10.7% vs 17.4%,  $p=0.02$ ) than before. Discharge disposition was not significantly different, with the majority of patients in both groups being discharged to rehabilitation facilities (80.5% after vs 79.5% before,  $p=0.77$ ). While the percentage of patients with in-hospital mortality decreased to 0.7% after the change from 1.5% before, this did not reach statistical significance ( $p=0.33$ ).

**Conclusion:** Nearly 20% of our elderly blunt trauma admissions, excluding ED deaths and burns, were for IHF. After implementing a practice change of admitting elderly isolated hip fracture patients to the trauma service, fewer patients developed complications. This reduction in complications corresponds to an increase in the intensity of care provided, as measured by increased step-down and ICU utilization. Likely, patient admission to a single unified trauma service with protocols and a unified qualified assurance process contributed.

	Before Change (2013-2014)	After Change (2015-2016)	p-value
n	264	298	n/a
Age (years, median, IQR)	83 (77.5-89)	83 (77-88)	0.77
Female gender (%)	66.7%	64.8%	0.64
$\geq 2$ comorbidities (%)	75.8%	78.2%	0.49
Fall from < 3 feet (%)	98.5%	97.7%	0.48
Admitting service (%):			
Medical	67.8%	8.1%	<0.001
Trauma	5.7%	87.6%	<0.001
Orthopedics	26.5%	4.4%	<0.001

## WHICH IS THE BEST TREATMENT FOR DISPLACED INTRA-ARTICULAR CALCANEAL FRACTURES: A SYSTEMATIC REVIEW AND NETWORK META-ANALYSIS

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**Introduction:** Displaced Intra-Articular Calcaneus Fractures (DIACFs) represent a source of tremendous disability to the patient, economic burden to the society and a treatment challenge to the average orthopaedic surgeon. Open reduction and internal fixation (ORIF), minimally invasive surgery (MIS), external fixator (EF), external fixator combined with limited internal fixation (EFLIF) and non-surgical treatment (NST) are mostly used for the treatment of DIACFs. However, no single approach is universally applicable to all calcaneus fractures. More over, previous studies was still unclear and have offered conflicting recommendations. The purpose of this study is to comprehensively review the literature and ascertain the relative efficacy and safety of ORIF, MIS, EF, EFLIF and NST for patients with DIACFs using a Bayesian network meta-analysis.

**Methods:** We will comprehensively search PubMed, EMBASE, Cochrane Library, Medline, Science Direct, CBM and CNKI from the inception dates to January 01, 2018, to include potentially relevant randomized controlled trials (RCTs) and cohort studies (CSs) that evaluated interventions for treating adults with DIACFs. The quality of included studies was assessed using the Newcastle-Ottawa Scale and the risk of bias according to the Cochrane Handbook. After independent study selection by 2 authors, data were extracted and collected independently. The primary outcome measures were anatomical measures, functional measures, and complications. The data of RCTs and CSs were pooled respectively using the fixed-effect model or random-effect model. Mean differences (MDs) with 95% confidence intervals (CIs) were calculated for continuous data, and relative risks (RRs) with 95% CIs were calculated for dichotomous data.

Statistical heterogeneity was assessed with the Q test and  $I^2$ . Sensitivity analysis was developed to assess the reliability of pooled results.

**Results:** Seventeen trials (5 RCTs and 12 CSs) including 2369 patients were considered in the study. EFLIF had significantly the highest AOFAS Ankle Hindfoot Scale (MD, 9.54 [95% CI, 5.97 to 17.42]) and lower total incidence of complications (RR, 1.65 [95% CI, 1.27 to 2.54]) than ORIF, MIS, EF and NST. Moreover, EFLIF resulted in a lower incidence of additional surgery (RR, 3.47 [95% CI, 2.28 to 6.95]) than ORIF and NST. The rank of anatomical recovery was: EFLIF, ORIF, EF, MIS and NST. The rank of functional recovery was: EFLIF, ORIF, MIS, EF and NST. For reduction in total incidence of complications, the rank was: EFLIF, NST, EF, MIS and ORIF.

**Conclusion:** EFLIF has the highest probability of improving the functional outcome and reducing the total incidence of complications and additional surgery among the five interventions for treating adults with DIACFs.

## **OPERATIVE MANAGEMENT OF TALUS FRACTURES: FUTURE DIRECTIONS**

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**Introduction:** Controversies remain regarding the preferred treatment strategy for talus fractures. The aim of this study was to evaluate the long-term outcome after operative management of talus fractures and identify those factors that affect the outcome and define strategies to improve the outcome.

**Methods:** This study concerns a retrospective outcome study of 84 patients with an average follow-up time of 9.1 years. We assessed the functional results, return to daily activities and general health status using the Foot Function Index-5pt, a Visual Analog Scale for pain and the Short Form-36 Health Survey. Furthermore, we conducted a correlation analysis between outcome and 14 demographic, clinical and radiological variables.

**Results:** We found moderate mean Foot Function Index pain and disability scores of 30.2 and 28.7, respectively. The mean Visual Analog Scale was 3.2. Of all responders, 41% (27/66) did not return to their daily activities. We reported low physical, but good mental Short Form-36 component summary scores of 42.7 and 48.3, respectively. We recorded a complication rate of 56%. Osteoarthritis, articular incongruence and talar body fractures correlated significantly with a poor functional outcome. Delayed surgery after trauma was associated with a better outcome measures.

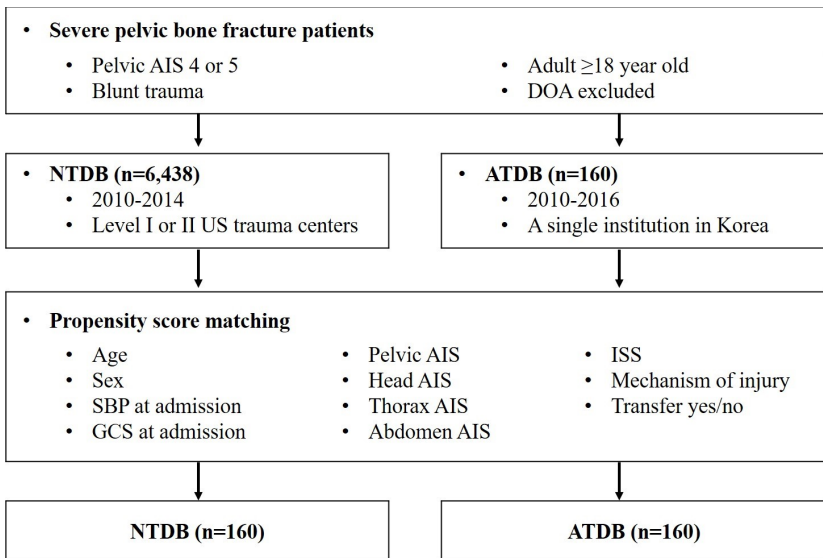
**Conclusion:** Talus fractures have a major long-term impact on ankle and hindfoot function and physical health. Success of operative treatment depends on the occurrence of osteoarthritis postoperatively, type of fracture, and quality of fracture reduction. Since only the latter is modifiable, efforts should be made to restore articular congruence in order to improve the outcome. Therefore, it is necessary to review the quality of the reduction, preferably peroperatively, on CT. Furthermore, talus fractures should no longer be considered as operative emergencies, but rather treated after recovery of the soft-tissues.

## Comparison of outcomes in severe pelvic fractures between a South Korean trauma center and matched patients treated in the United States.

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**Introduction:** This study aimed to compare treatment outcomes between patients with severe pelvic fractures at a representative trauma center which was established in Korea since 2015 and matched cases in the United States.

**Methods:** Two cohorts were selected from a single institution trauma database in South Korea (ATDB) and the National Trauma Data Bank (NTDB) in the United States (US). Adult blunt trauma patients with a pelvic Abbreviated Injury Scale >3 were included. Patients were matched based on covariates that affect mortality rate using a 1:1 propensity score matching (PSM)



approach. We compared differences in outcomes between the two groups, performed survival analysis for the cohort after PSM, and identified factors associated with mortality. Lastly, we analyzed factors related to outcomes in the ATDB dataset comparing a period prior to the implementation of the trauma center according to US standards, an interim period, and a post-implementation period.

**Results:** After PSM, a total of 320 patients (160 in each cohort) were identified for comparison. In-hospital mortality was significantly higher in the ATDB cohort using chi-square test, but it was not statistically significant when using Kaplan-Meier survival curves and Cox regression analysis. Moreover, the mortality rate was similar comparing the NTDB cohort to ATDB data reflecting the post-trauma center establishment period. Older age, lower SBP and GCS on admission were factors associated with mortality.

**Conclusion:** Mortality rate following severe pelvic fractures was significantly associated with older age, lower SBP and GCS scores on admission. Efforts to establish a trauma center in South Korea led to improvement in outcomes, which are comparable to those in US centers.



## HIP FRACTURE TIME-TO-SURGERY AND COMPLICATION/ MORTALITY RATE: IS THERE A SIGNIFICANT DIFFERENCE?

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**Introduction:** Post-operative complications impose a significant burden on patient outcomes and cost of medical care. Our aim was to determine the relationship between time to surgery and post-operative complications/mortality in patients with hip fracture.

**Methods:** A retrospective review of data collected from our institution's trauma registry for adult patients with hip fracture and subsequent repair from 2015-2017. Patients were stratified into two groups based on time to surgery after admission 24-48 hours (Group 1) vs >48 hours (Group 2). Demographic variables included age, gender, race, and Injury Severity Score (ISS). Outcome variables included Intensive Care Unit Length of Stay (ICU-LOS), DVT/PE rate, mortality, and readmission status. ANOVA was used for data analysis with statistical significance defined as p-value <0.05.

**Results:** A total of 485 patients with hip fracture required surgical intervention. Of those, 460 had surgery at <24-48 hours, and 25 had surgery >48 hours post-admission. Average ISS was the same in both groups. The average ICU-LOS was statistically significant higher in >48 hours group compared to <24-48 hour group (4 vs 2) (p-value <0.0002). There was no statistically significant difference between groups when comparing DVT/PE rate, 30-day readmission, or mortality.

**Conclusion:** Time to surgery may affect overall ICU-LOS in patients with hip fracture requiring surgical intervention. Time to surgery does not affect complication rates or mortality. Future research should investigate long-term outcomes such as functional status and Disability-Adjusted Life Years.

Table 1. Comparing time to operation vs outcomes in patients with isolated hip fracture

	Time to operation 24-48 hours	Time to operation >48 hours	p-value
Total# of patients with isolated hip fracture	460	25	0.001
Gender			
Female	75%	76%	>0.05
Race			
White	98%	96%	
Other	2%	4%	>0.05
Age in years (mean)	84	85	0.14
Average ISS	9	9	>0.05
DVT/PE	0.50%	0%	>0.05
Readmission rate at 30 days	3%	4%	>0.05
ICU-LOS (Days)	2	4	<0.0002
Mortality rate	3%	0%	>0.05

## Implementation Of New Standard Operating Procedures: What Are The Benefits For Geriatric Trauma Patients With Multiple Injuries.

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**Introduction:** The demographic changes towards ageing of the populations in developed countries imposes a challenge to trauma centers, as geriatric trauma patients require specific diagnostic and therapeutic procedures. This study investigated whether the integration of new standard operating procedures (SOPs) for the resuscitation room (ER) has an impact on the clinical course in geriatric patients. The new SOPs were designed for severely injured adult trauma patients, based on the Advanced Trauma Life Support (ATLS) and imply early whole-body computed tomography, damage control surgery, and the use of goal-directed coagulation management. We investigated whether there were changes in the in-hospital mortality, infection rate, and rate of palliative care after the implementation of new SOPs.

**Methods:** Single-center cohort study. We included all patients  $\geq 65$  years of age with an Injury Severity Score (ISS)  $\geq 9$  who were admitted to our hospital primarily via ER. A historic cohort was compared to a cohort after the implementation of the new SOPs. Person's chi-square, Fisher's exact and Mann-Whitney U test were used to compare the treatments. Binary logistic regression analysis was conducted to measure the strengths of associations and to identify possible risk factors.

**Results:** We enrolled 311 patients who met the inclusion criteria between 2000–2006 (group PreSOP) and 2010–2012 (group SOP). In group SOP, the mortality rate was significant lower (64.1% vs. 44.4%; standardized mortality ratio 0.90 vs. 0.70,  $P = .001$ ) whereas the rate of infections (21.4% vs. 21.9%) and palliative care (23.7% vs. 28.3%) was comparable and not significant different with group PreSOP. TBIs were the leading cause of death in both time periods (60.2% vs. 72.5%). However, the rate of exsanguinating patients decreased from 26.5% to 7.5%. This benefit was seen only for severely injured patients (ISS  $\geq 16$ ), but not for moderately injured patients (ISS 9–15).

Differences in mortality and infection rates between 2000–2006 (group PreSOP)

and 2010–2012 (group SOP). ISS: Injury Severity Score; PT: prothrombin time.

Outcome	Subgroup	PreSOP [n] / %	SOP [n] / %	P-value
Mortality rate	ISS = 9–15	4 / 28.6%	7 / 20.6%	.71*
	ISS $\geq 16$	80 / 68.4%	73 / 50.0%	.003 <sup>‡</sup>
Infection rate	ISS = 9–15	1 / 7.1%	5 / 14.7%	.66*
	ISS $\geq 16$	27 / 23.1%	34 / 23.6%	.92 <sup>‡</sup>

\*Fisher's exact, <sup>‡</sup>Pearson's chi-square.

**Conclusion:** Our findings suggest that the implementation of new SOPs comprising early whole-body CT, damage control surgery, and the use of goal-directed coagulation management significantly reduced the mortality rate in severely injured geriatric trauma patients, whereas moderately injured patients seemed not obtain the same benefit and with no influence on the infection rate. Further research is needed to improve the outcomes for this fast-growing population.

## CHARACTERISTICS OF TRAUMA MECHANISMS AND ANATOMICAL DISTRIBUTION OF INJURY IN GERIATRIC PATIENTS; A DESCRIPTIVE ANALYSIS OF THE NATIONWIDE TRAUMA REGISTRY OF THE WORLD'S FASTEST AGING COUNTRY

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**Introduction:** The burden of trauma among elderly patients has been increasing in developed countries and is characterized by a higher prevalence of post-injury mortality and requirement of more substantial healthcare resources. People aged 65 years and older comprised 26.7% of the entire Japanese population in 2015 and were nearly twice that of the United States. We performed a comprehensive analysis of Japan's nationwide trauma registry that may include the highest proportion of the aged population to study the age-related changes in characteristics of trauma patients.

**Method:** We performed a retrospective observational study of the Japan Trauma Data Bank between 2004 and 2015 to evaluate the age-related changes in mechanisms, anatomical distribution of injury and injury severity, physiological status, and outcomes of trauma patients. Characteristics of the trauma patients were assessed according to age, which was categorized into 10-year intervals. The nonlinear correlation between age and in-hospital mortality of trauma patients were assessed using a generalized additive model (GAM) where the model was adjusted for both anatomy- and physiology-based trauma severity (Injury Severity Score [ISS] and Revised Trauma Score), and age was incorporated into the model as a continuous variable.

**Results:** Of a total of 128,036 severe trauma patients (ISS  $\geq$ 9) included in the analysis, 67,279 (52.5%) patients were 60 years or older. The proportion of the elderly patients aged  $\geq$  60 years increased from 31.4% to 59.1% over the observation period. The majority of trauma in the older groups was caused by ground-level falls, while younger groups experienced high-energy mechanisms such as traffic accidents (Figure 1). The proportions of lower extremity injuries were higher among those aged 70 years and older (31.6%, 50.1%, and 70.5% corresponded to the 70-79, 80-89 and 90+ year age groups, respectively) in comparison to the younger groups (26.1% among those younger than 60 years). The GAM plot revealed that the adjusted odds ratio for in-hospital mortality increased monotonically with increasing age (Figure 2).

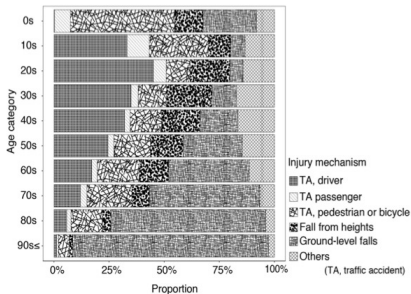


Figure 1. Proportions of injury mechanisms according to age groups

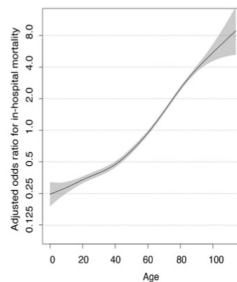


Figure 2. Relationship between age and adjusted odds ratio for in-hospital mortality

**Conclusion:** Here, we described the unique mechanism of injury and pattern among elderly trauma patients, as well as age-related increase in risk for in-hospital mortality. These results may provide valuable information to societies faced with aging to recognize the specialty of geriatric trauma care.

## **EMERGENCY/TRAUMA SURGEONS REPORT PRESCRIBING LESS OPIOIDS OVER TIME**

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**Introduction:** Confronted with the opioid epidemic, surgeons must play a larger role to reduce risk of opioid abuse while managing acute pain. Having a better understanding of the beliefs and practices of emergency/trauma surgeons regarding discharge pain management may offer potential targets for interventions beyond fixed legal mandates.

**Methods:** An IRB-approved electronic survey was sent to emergency/trauma surgeons who are members of AAST, and separately, emergency/trauma surgeons and nurse practitioners at a Level I Trauma Center in February 2018. The survey included 4 case-based scenarios and questions about discharge prescription practices and beliefs.

**Results:** Of 66 respondents, most (88.1%) were at academic institutions. Mean number of opioid tablets prescribed was 20-30 (range 5-90), with the fewest tablets prescribed for elective laparoscopic cholecystectomy and the most for rib fractures. Few prescribed both opioid and non-opioid medications (22.4-31.4%). Most would not change the amount, dose, or type of medication prescribed at discharge (53.9%-83.1%) if patients used opioids regularly prior to their hospitalization. The most common factors that made providers more likely to prescribe opioids were high opioid use in the hospital (32.4%), history of opioid use/abuse (24.5%), and if the patient lives far from the hospital (12.9%). The most common factors that made providers less likely to prescribe opioids were frailty (24.4%), older age (23.3%), low body-mass index (7.6%), and history of drug/alcohol abuse (7.6%). Most providers (56.9%) give patients detailed instructions on how to wean off opioids. Less than half (47.0%) reported their hospital has prescriptive opioid practice guidelines. For providers in practice >5 years, most reported a decrease in opioids (71.9%) and an increase in non-opioids prescribed (76.6%) at discharge.

**Conclusion:** Emergency/trauma surgeons and nurse practitioners reported decreasing the number/amount of opioids prescribed over their practice. Patients with high opioid use in the hospital, history of opioid use/abuse, or who live far from the provider may be prescribed more opioids at discharge. Offering detailed instructions for weaning opioids and hospital-based practice guidelines are potential interventions to help decrease risk of opioid abuse.

## TRAFFIC ACCIDENTS FOR GERIATRIC CYCLIST IN JAPAN

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**Introduction:** Traffic injuries among the elderly are increasing in Japan. A bicycle is an important transportation for elderly people who are not able to walk long distance or drive a car. The purpose of this study was to describe injured body regions among the elderly cyclists compared with young population and the fatal injuries among them with the sample of Japan Trauma Data Bank (JTDB).

**Methods:** We extracted data of cyclist injuries from the JTDB2016. Those with complete data of Age, ISS, Max AIS of 9 body region, and mortality were analyzed. The subjects were divided into two groups by age. Young group (YG) was defined as the age from 15 to 64 and old group (OG) was done as more than 65. We also conducted subgroup analysis for old group between the survived and dead. Mann-Whitney's U test was used for non-parametrical analysis.

**Results:** In YG, 120037 subjects were extracted and median ISS(IQR) was 13(9-21). In OG, for 4618 subjects, median ISS(IQR) was 16(9-25) ( $p < 0.001$ ). Median Max AISs(IQR) for head, abdomen and spine by YG vs. OG were 3(2-4) vs.4(3-4) ( $p < 0.001$ ), 2(2-3) vs.2(2-3) ( $p = 0.001$ ), 2(2-4) vs.3(2-4) ( $p < 0.001$ ) respectively. Subgroup analysis for OG revealed that Median(IQR) of Max AISs compared death to survive were 5(4-5) vs.3(3-4) ( $p < 0.001$ ) in head, 4(3-4) vs.3(2-4) ( $p < 0.001$ ) in chest, 3(2-4) vs. 2(2-3) ( $p < 0.001$ ) in abdomen.

**Conclusion:** Geriatric cyclists tended to sustain severe injuries in their head, abdomen and spine. For 65 and over population, severe injuries in head, chest and abdomen were associated with mortality. We must advocate more strongly about helmet wearing for geriatric cyclist. Prevention for chest injury and abdominal injury is the next target of intervention by medicine-engineering collaboration.

		65+			15-65			p	survive-			survive+			p				
		n	Median(IQR)		n	Median(IQR)			n	Median(IQR)		n	Median(IQR)						
Max AIS	Head	4478	3	2	4	3007	4	3	4	0.000	666	5	4	5	2209	3	3	4	0.000
	Neck	2005	1	1	2	887	1	1	2	0.129	101	1	1	2	744	1	1	2	0.187
	Face	57	1	1	2	24	1	1	2.75	0.961	4	3	1.5	3.75	20	1	1	1.75	0.056
	Chest	1877	3	3	4	1236	3	3	4	0.417	293	4	3	4	888	3	2	4	0.000
	Abd.	620	2	2	3	334	2	2	3	0.000	96	3	2	4	224	2	2	3	0.000
	Spine	1285	2	2	4	743	3	2	4	0.030	94	2	2	3	624	3	2	4	0.093
	Upper Ext	1949	2	1	2	1166	2	1	2	0.467	140	2	1	2	960	2	1	2	0.196
	Lower Ext	2447	2	1	3	1872	3	2	3	0.000	280	3	2	4	1495	3	2	3	0.000
	Surface	516	1	1	1	219	1	1	1	0.448	35	1	1	1	171	1	1	1	0.431
ISS		7136	13	9	21	4466	16	9	25	0.000	723	26	25	38	3526	14	9	21	0.000

## **Prediction of Mortality and Morbidity evaluating with Sarcopenia in Japanese Geriatric Trauma Patients**

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**Introduction:** Sarcopenia is assumed as a predictor of the poor outcome after surgery. However, an association between a prognosis of trauma and sarcopenia has not been documented well. The purpose of this study was to evaluate the outcome of trauma with sarcopenia, by comparing it with non-sarcopenia in the Japanese elderly patients. We hypothesized that sarcopenia had a great influence on the outcome of geriatric trauma.

**Methods:** Medical records of over 65-year-old trauma patients, who were transported to our center from 2010 to 2017, were retrospectively reviewed. Psoas muscle index (PMI), where total psoas muscle area at L3 level on computed tomography on arrival divided by body surface area, was measured in each case. Sarcopenia was defined that PMI was less than lower inter quartile range in each gender. Patient's background, Injury Severity Score (ISS), mortality, and morbidity were analyzed. Via a questionnaire mailed to the patients, 1-year survival and activity of daily living (Barthel index) were obtained.

**Results:** Overall, 405 patients were included in this study. There were 101 in Sarcopenia group (S) and 304 in Non-sarcopenia group (NS). Patients' background and ISS were not significantly different. Concerning morbidity, more pneumonia tended to occur in S (S; 17.5% vs NS; 23.8%,  $p=0.065$ ), but numbers of cases, complicating urinary tract infection and venous thromboembolism, were similar in both groups. It was noted that mortality was higher in S than NS (S; 15.8% vs NS; 7.9%,  $p=0.032$ ). Although 169 patients answered the questionnaires, the results had no significant difference between groups. [1-year survival: 34/37 (91.9%) in S vs 118/132 (89.4%) in NS. Barthel index; 100 (63.5-100) in S vs 100 (75-100) in NS].

**Conclusion:** Sarcopenia, defined by PMI, can be a trusted predictor in mortality among geriatric trauma patients.

**MATCHING THREE CLINICAL SCORES WITH SURGEON-PERFORMED  
 ULTRASOUND IN THE DIAGNOSIS OF ACUTE APPENDICITIS:  
 PRELIMINARY RESULTS OF A PROSPECTIVE STUDY**

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**Introduction:** Clinical scores are used in clinical practice as a tool for diagnosing acute appendicitis, such as the Alvarado, Acute Inflammatory Response Score (AIR), and the Adult Appendicitis Score (AAS). At present, no studies integrating ultrasound (US) with all the three clinical scores are available in literature.

**Methods:** Eighty-one patients (pts) with a suspicion of acute appendicitis were prospectively enrolled (37 M, 44 F). The Alvarado and AIR scores were calculated for all pts, the AAS for adult pts only (> 18 y/o). Stratification consisted of 3 groups for each score: low, intermediate, and high probability of acute appendicitis. A surgeon-performed US completed the assessment. Differences between proportions of positive US (US+) vs. negative US (US-)/other diagnosis were tested within each score level using "N-1" Chi-squared tests. 95% Confidence Intervals (95%CI) were also computed. Accuracy, sensitivity and specificity of US were computed. Significance level was set at alpha = 0.05. A phone follow-up was done on non operated pts at three months.

**Results:** US sensitivity, specificity and accuracy in the overall population are shown on

	Value (%)	95% CI
Sensitivity	93,1	81.7-99.9
Specificity	100	91.2-100.0
Accuracy	97,5	92.1-99.9

Table 1: results of US diagnostic tests.

Table 1. US was positive in 27, negative in 41 (1 false negative in an adult, 1 in a child), and in 13 obtained an alternative diagnosis. Histology confirmed appendicitis in all operated pts. The phone follow-up excluded relapse of symptoms or appendectomy in all US- pts. The comparison between US+ vs. US-/other diagnosis in the overall population is shown in Table 2. The rate of pts with

US proved appendicitis in the low probability groups ranges from 17,1% (Alvarado) to 19,2% (AIR) [p<0.001]. Conversely, 23,5% in the high probability Alvarado score had

SCALE	SCORE	US+		US- / other diagnosis		$\chi^2$	p
		COUNT	CI (%)	COUNT	CI (%)		
Alvarado	≤ 4	6/35	8.1-32.7	29/35	67.3-91.9	30,06	<0.001
	5-8	8/29	14.7-45.7	21/29	54.3-85.3	11,04	<0.001
	≥ 9	13/17	52.7-90.4	4/17	9.6-47.3	8,93	0,003
AIR	≤ 4	10/52	10.8-31.9	42/52	68.1-89.2	39,59	<0.001
	5-8	16/28	39.1-73.5	12/28	26.5-60.9	1,08	0,299
	9-12	1/1	20.7-100	0/1	0-79.4	1,00	0,317

Table 2: proportions and 95% Confidence Intervals of proportions (CI %) for all patients (n=81), according to the evaluation scale; p: "N-1" Chi-squared test.

SCALE	SCORE	US+		US- / other diagnosis		$\chi^2$	p
		COUNT	CI (%)	COUNT	CI (%)		
Alvarado	≤ 4	6/24	12.5-45.0	18/24	55.1-88.4	11,75	<0.001
	5-8	7/21	17.3-55.2	14/21	45.4-81.9	4,46	0,035
	≥ 9	10/14	44.8-88.1	4/14	11.9-54.7	4,76	0,029
AIR	≤ 4	9/36	14.2-41.4	27/36	59.3-85.8	17,75	<0.001
	5-8	13/22	39.4-77.2	9/22	22.8-61.4	1,39	0,238
	9-12	1/1	20.7-100	0/1	0-79.4	1,00	0,317
AAS	≤ 10	14/48	18.2-43.4	34/48	56.8-82.1	14,83	<0.001
	11-15	9/11	52.1-94.9	2/11	5.1-47.7	8,60	0,003
	≥ 16	0	NA	0	NA	NA	NA

Table 3: proportions and 95% Confidence Intervals of proportions (CI %) for all patients aged ≥18 (n=59), according to the evaluation scale; p: "N-1" Chi-squared test.

had appendicitis, only 27,5% in the intermediate [p<0.003 and 0.001, respectively]. Among AIR intermediate score pts, 42,8% had no appendicitis (p=NS). Table 3 shows the comparison of proportions in the adult population (all scores). AAS got 81% of US+ in the intermediate risk group.

**Conclusion:** Surgeon-performed US can potentiate the accuracy of clinical decision making. Whatever is the therapeutic strategy (non-operative vs. surgery), US reduces both over- and under-treatment rates. Its role seems higher in the low probability groups for all scores, avoiding undiagnosed appendicitis (17-29%). AIR score seems unreliable in the intermediate risk group (> 40% of US-). Its use in algorithms without imaging should be questioned.

## **PROGNOSTIC VALUE OF P-POSSUM AND OSTEOPENIA FOR PREDICTING MORTALITY AFTER EMERGENCY LAPAROTOMY IN GERIATRIC PATIENTS**

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**Introduction:** Portsmouth - Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity (P-POSSUM) score is widely utilized for operative mortality prediction. Its applicability to emergency laparotomy operations in geriatric patients is lacking. The present study evaluates the P-POSSUM in a comparison with other risk factors for mortality including osteopenia as an indicator for frailty in geriatric patients subjected to emergency laparotomy.

**Methods:** Retrospective analysis of all consecutive patients ( $\geq 65$  years) subjected to an emergency laparotomy between 1/2015 and 12/2016. Data accrued included demographics, pre-operative laboratory values, Charlson's co-morbidity index, American Society of Anesthesiologist (ASA) Score, indication and type of operation, osteopenia, P-POSSUM score, post-operative complication, ICU and hospital length of stay, and 30-day mortality. Association between prognostic markers and 30-day mortality was assessed using log-binomial regression model. Confounding variables were selected using backward stepwise method. Prognostic value was evaluated using receiver operating characteristic (ROC) curve and Youden's J statistic was used to find optimum cut-off point.

**Results:** A total of 209 patients were available for analysis. The main surgical procedures were small bowel resection, adhesiolysis, large bowel resection, diverting stoma, and miscellaneous procedures at 15% (n=31), 18% (n=38), 21% (n=43), 16.7% (n=35), and 30% (n=62), respectively. Poor association was observed between P-POSSUM and mortality [relative risk (RR)=1.01, 95% (CI): 1.00 - 1.02, p=0.21]. Also, a poor prognostic value for 30-day mortality (area under ROC=0.49) was noted. According to Youden's optimum cut-off point on the ROC curve, the optimal sensitive and specificity for P-POSSUM were 0.26 and 0.83 respectively. Age, systolic BP, ASA= 4, BMI, PRBC transfusions and postoperative infections were associated with 30-day mortality. Osteopenia was not statistically significant in multivariate analysis (adj. RR=1.05, 95% CI: 0.67 – 1.66, p=0.82). Multivariate log-binomial regression model outperformed the P-POSSUM ( $c^2=28.61$ ,  $p<0.001$ ). However, osteopenia contributed little to the prognostic value of the regression model (area under ROC increases from 0.8087 to 0.8092).

**Conclusion:** The P-POSSUM and osteopenia performed poorly in prediction of 30-day post emergency laparotomy mortality. External validation of these findings is warranted.



## **REBOA: NOT JUST FOR TRAUMATIC HEMORRHAGIC SHOCK ANYMORE**

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**Introduction:** Resuscitative endovascular balloon occlusion of the aorta (REBOA) effectively improves survival among traumatically injured patients with uncontrolled hemorrhagic shock. REBOA can also be used in non-trauma patients with similar success. We report our experience using REBOA in obstetric, general surgery, and cardiology patients.

**Methods:** REBOA has been used extensively in our Level 1 trauma center with relatively high success (56% survival rate). As part of our hospital quality improvement process, we identified several non-trauma indications where rapid control of hemorrhage could be beneficial. The concept of REBOA was introduced to the non-trauma surgical services including the 24/7 availability of trauma surgeons to perform REBOA. All non-trauma REBOA insertions were reviewed.

**Results:** 6 non-trauma patients underwent REBOA for hemorrhagic or cardiogenic shock. Two emergent and 1 elective obstetric REBOA insertions were performed for either placenta previa or accreta. Both emergent patients were in profound hemorrhagic shock requiring massive transfusion protocol; 1 was in cardiac arrest. REBOA was performed without complication and all 3 patients survived to be discharged home. One elective splenectomy patient developed profound hemorrhage intra-operatively. REBOA was performed allowing the procedure to be completed with little additional blood loss. The patient subsequently had care withdrawn due to their medical comorbidities. One pancreaticoduodenectomy patient returned 3 weeks post-operatively with acute hemorrhage from the right hepatic artery. REBOA was performed, controlling the hemorrhage and rescuing the patient allowing them to be discharged home. One patient presented following motor vehicle crash due to a witnessed cardiac arrest. The patient regained perfusion through cardiopulmonary resuscitation in the field, but arrived hypotensive in cardiogenic shock. No traumatic injuries were found. REBOA was performed with improvement in cardiac perfusion resulting in patient survival and discharge home.

**Conclusion:** While REBOA was originally intended for control of traumatic hemorrhage, we have successfully used REBOA for several non-trauma indications with similar patient survival. Trauma surgeons who perform REBOA can be a valuable resource to both elective and emergent non-trauma surgical patients.

## **DAMAGE CONTROL OR DEFINITIVE REPAIR? A RETROSPECTIVE AUDIT OF ABDOMINAL TRAUMA AT A SOUTH AFRICAN CENTRE.**

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**Introduction:** The indications for damage control surgery (DCS) rely heavily on clinical judgement. This audit set out to assess and compare the presenting physiology and organ injury pattern of the DCS patient vs the non-DCS patient and to use this data to assess if any of four clinical prediction scores, namely PATI (penetrating abdominal trauma index), ISS (injury severity score), AIS-abdomen (abbreviated injury scale-abdomen) and AIS-chest, are predictive of the need for DCS.

**Methods:** All patients undergoing a laparotomy for trauma over the period from December 2012 to December 2017 at a Major Trauma Centre in South Africa were retrieved from the regional database. Statistical analysis was performed using STATA 15.0 ©.

**Results:** A total of 562 patients were included in this analysis, all of which underwent trauma laparotomy. 99 of these (18%) had a DCS procedure vs 463 (82%) non-DCS. In a multiple logistic regression model, the only predictive scoring system significantly associated with the need for DCS was the PATI score (p 0.044). Neither ISS (p 0.293), AIS-abdomen (p 0.194) nor AIS-chest (p 0.325) were statistically significant. A multiple logistic regression model revealed a significant association with SBP <90 mmHg (systolic blood pressure) (p 0.005), pH <7.2 (p 0.001), PATI score (p 0.019) and liver injury (p 0.004). Pancreatic-duodenal injury (p 0.586) and IAVI (p 0.156) were not significant in this model in their prediction for DCS.

**Conclusion:** This comprehensive analysis proves that even aggregate anatomical scores are not nearly as predictive as physiology when considering the need for DCS. This is in keeping with the central tenet of damage control surgery, which focuses on the correction of *physiological* rather than *anatomic* status.

## A CHANCE TO CUT: DEFINING A NEGATIVE EXPLORATION RATE IN PATIENTS WITH SUSPECTED NECROTIZING SOFT TISSUE INFECTION

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**Introduction:** Multiple predictive models exist for the identification of necrotizing soft tissue infection (NSTI), yet a subset of patients will not have NSTI at exploration. We hypothesize non-NSTI patients are clinically similar to those patients that have an NSTI and seek to report a rate of negative exploration for this disease process.

**Methods:** We conducted a retrospective review of patients (n= 295) undergoing surgery for suspected NSTI at our county funded, academic medical center between 2008-2015. Patients with NSTI identified surgically were compared to patients with negative explorations.

**Results:** Over the 7-year study period, 232 (79%) patients were diagnosed with an NSTI at the initial surgery and 63 (21%) were not. Of these 63 patients, 5 (7.9%) had an abscess and 58 (92%) had cellulitis resulting in a total of 237 (80%) patients with a surgical disease process. NSTI patients had higher white blood cell count and blood glucose levels, but were less likely to have violaceous skin changes. Other presenting clinical variables were similar between patients with and without NSTI (Table). Eight (14%) patients initially diagnosed with cellulitis had an NSTI diagnosed upon return to the operating room for failure to improve.

	<b>NSTI, n = 232</b>	<b>Non-NSTI, n=63</b>	<b>p-value</b>
Temperature	98.9, 98.1-100.5	99.1, 98.5-100.6	0.2
Heart Rate	101, 91-115	100, 88-109	0.3
Violaceous Skin	9.2%	23.8%	0.004
WBC	18.5, 13.5-24.4	14.9, 11.9-22.7	0.02
Band Forms	16.5, 9.0-30.0	17.5, 12.0-26.0	0.7
Lactate	1.7, 1.3-2.6	1.8, 1.3-2.3	0.6
Creatinine	1.2, 0.9-1.8	1.3, 0.9-2.0	0.6
Glucose	244, 131-393	114, 102-136	<0.0001
Corrected Na	134, 131-137	134, 132-137	0.7

Median values with IQR unless otherwise specified

**Conclusion:** Given the known implications of delayed surgical management, we propose a 20% negative exploration rate for suspected NSTI. Ongoing vigilance of this cohort is warranted as a small subset may progress.

## A comparison of trauma outcomes between Japan and United States using national trauma registries.

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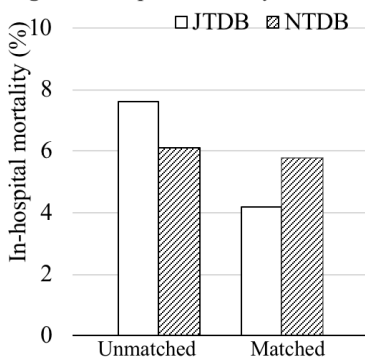
**Introduction:** Japan has recently made concerted efforts to improve trauma outcomes over the last decade. The United State (US) has developed advanced regional trauma systems in the last four decades. The National Trauma Data Bank (NTDB) should serve as a benchmark of quality of care and outcomes for international trauma registries. Here, we compared patient characteristics, trauma management, and outcomes in Japan using the Japanese Trauma Data Bank (JTDB) dataset to US level I trauma centers using the NTDB dataset.

**Method:** A retrospective cohort matching study was performed to compare trauma outcomes between the JTDB and the NTDB in order to evaluate Japanese trauma quality using NTDB as a benchmark. Patients aged  $\geq 16$  years old, with Injury Severity Score (ISS)  $\geq 9$ , treated at level I trauma centers in 2013 were included in the analysis. Patients who were dead on arrival or with gunshot wounds, were excluded. The primary outcome measure was in-hospital mortality. Secondary outcome measures included hospital length of stay (LOS) and the rate of use of radiologic diagnostic modalities. A 1:1 matching strategy was used.

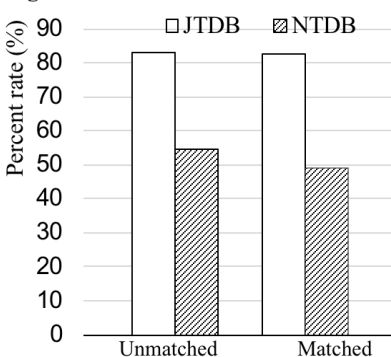
**Results:** During the study period, 22,535 patients in the JTDB and 112,060 patients in the NTDB were eligible for inclusion in this study. Using one to one exact matching, 14,960 pairs were generated. Significant differences were found between the two cohorts; in particular, the JTDB group had a higher rate of elderly patients and self-inflicted wounds. After 1:1 matching, patient characteristics were well balanced in both the groups. Before matching, the in-hospital mortality was higher in the JTDB group compared to the NTDB group (7.6% vs. 6.1%; Odds ratio (OR), 1.28; 95% CI: 1.21-1.35). However, after matching, in-hospital mortality was lower in the JTDB (4.2% vs. 5.8%; OR, 0.72; 95% CI: 0.65-0.80) (Fig. 1). After matching, the median hospital LOS was more than three times higher in the JTDB group than in the NTDB (17.0 [7.0-32.0] vs. 5.0 [3.0-8.0],  $P < 0.001$ ). CT scans were used in more than 80% patients in the JTDB and more than 1.5 times as often in the JTDB than in the NTDB (Fig. 2).

**Conclusion:** We reported marked differences of trauma care between Japan and the US. However, the quality of the recent Japanese trauma care appears to be approaching that of the US. These comparisons may contribute to further improvements in Japanese trauma care.

**Fig. 1** In-hospital mortality



**Fig. 2** The use of CT scans



## **THE IMPACT OF GEOCODING A TRAUMA REGISTRY.**

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**Introduction:** Within the current Trauma landscape, injury location by zip/postal code is a mandated field within trauma registries such as the American National Trauma Data Standard and the Australian Trauma Registry. Postal codes in Australia do not have a defined geographic boundaries, these codes are for postal distribution system and are not related to specific address. Geocoding in population health epidemiological studies is common practice, although within trauma this has been isolated to only a few studies, focusing on planning and design of trauma systems. The Midlands Registry (New Zealand) has demonstrated the potential benefits of geocoding in trauma registries identifying 'hot-spots' and engaging with local communities for injury prevention. The aim of this study is to establish the viability of collating geocode of injury in a consistent methodology and examine the difference between retrospective and prospective collection practices.

**Methods:** Upon ethics approval, Gold Coast University Hospital Trauma Service undertook a retrospective spatial review of 927 incidents ISS>12 (AIS2005(08)), examining medical records and emergency medical services (EMS) records for 38 months (Jan 2014 - Feb 2017) for identifiers of specific injury location, then using a standardised Global Positioning System (GPS) address locator and collated the information within the trauma registry. For 9 months (Mar – Dec 2017) geocoded injury location has been collected from all trauma service patients at the bedside, where they had a presentation time to discharge >12hours. Analysis of the information was extracted from our trauma registry (Imagetrend®) utilising Tableau® and Qlik Sence® for spatial visualisation. Statistical significance was calculated on injury severity to ensure both groups collected were consistent.

**Results:** Retrospective GPS was collected on n=647/927 (69.8%) with an average ISS=21.41. The remaining retrospective non GPS group of 310 with an average ISS=23.07. The prospective (n=572) group was split for comparison into two groups where ISS>12 (same as retrospective group) this group achieved geocode collection n=180/232 with (77.6%) an average ISS=21.10. No significance between the groups in the Injury Severity Score was demonstrated (p<0.01). Early results of prospective collection identified a significant increase in data capture >80% for ISS>12, this result decreased in the latter part of the year with a change in EMS records. The remaining group collected prospectively (admission >12 hrs where ISS<13) n=392 had an average ISS=5.06. This showed we were collecting prospectively injury locations (68%) that were not achieving ISS>12.

**Conclusion:** We have demonstrated that injury geocode location is feasible, with prospective collection demonstrating improved collection methodology. The source of location derivation and quality of location information vary and impact on the interpretation of the spatial analysis. The improved geocoded locations have improved the specificity and heat analysis. The this study has informed our understanding of traumatic injury eg mortality due to traumatic brain injury and insights into paediatric trauma due to recreational activities. Geocoding is the key in the development of partnerships with government and community agencies for trauma prevention.

## CAUSES AND OUTCOMES OF UNINTENTIONAL AND INTENTIONAL TRAUMATIC BRAIN INJURIES IN UGANDA: ANALYSIS FROM HOSPITAL-BASED REGISTRY

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**Introduction:** Traumatic brain injury (TBI) is an important cause of morbidity and mortality especially in low-and-middle income countries. The objective was to assess causes and outcomes of unintentional and intentional TBI among patients presenting to a tertiary-care hospital in Uganda.

**Methods:** This prospective observational study was conducted at Mulago National Referral Hospital, Kampala, Uganda for 15-months in 2016-17. Patients of all age groups, males and females, presenting to the emergency department of the hospital with suspected or documented TBI were enrolled. Patient demographics, TBI causes and outcomes were recorded. TBI was grouped into mild, moderate and severe categories based on Glasgow Coma Scale (GCS). The outcome of interest was unintentional and intentional TBI. Ethical approval was taken from Johns Hopkins School of Public Health and Makerere University School of Public Health.

**Results:** Total 3944 patients were enrolled, of these 66.2% were unintentional TBI and 30% were intentional TBI. The average age of patients in both groups was similar ( $28 \pm 14$  years) with over 70% patients between 19–45 years age group. More than 80% were males in both groups. The main causes of unintentional TBI were road traffic injuries (RTIs) (89%) and falls (11%). Pedestrians (42.3%) and motorcycle drivers (28.1%) were common road users. Only 16% of RTI patients were wearing helmet at the time of the crash. Assault (97.1%) was the main cause of intentional TBI, however, there were 33 (2.9%) self-harm cases. Common assault methods were use of bodily force (33.7%), iron bar (24.2%) and hammer (12%). Gun was used in 3 cases. Around 16.5% of RTI patients and 23.3% of fall patients had GCS below 8. TBI patients with self-harm were likely to be in severe GCS category (39.4%) compare to victims of assault (14%). Among unintentional TBI patients, about 40.6% of the patients were admitted to ward, 32.8% were sent home. There were 73 deaths; 63 were RTI patients and 10 had a fall. Among intentional TBI patients, 42.6% of the patients were admitted for inpatient care and 42.6% were sent home. There were 30 deaths; 29 were assault victims and 1 of self-harm.

**Conclusion:** Unintentional TBI caused by RTI and intentional TBI caused by assault are common among young males in Kampala. This has consequences for Uganda which has a young population contributing to a broad population pyramid. Most young males are vulnerable road users including pedestrians and motorcycle riders. Having designated pedestrian crossing for pedestrians and mandatory helmet use can reduce TBI caused by RTIs. There is need for further exploration of intentional injuries among youth in the country and to develop programs to engage youth in productive activities for contribution towards country's economic development.

## **REJUVENATION OF AGED BONE MARROW STEM CELLS TO IMPROVE THE POTENTIAL OF OSTEOGENIC DIFFERENTIATION BY MICROENVIRONMENTAL REGULATION**

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**Introduction:** The accumulation of aged adult stem cells and attenuation of tissue repair capacity characterize the aging process of the body. The microenvironment of aged cells is defined as senescent associated secretory phenotype (SASP), which might stress adjacent stem cells to age and jeopardize the homeostasis of tissue repair. We tried to find the key secretory factors to intervene the senescent microenvironment and rejuvenate the aged stem cells.

**Methods:** The aged bone marrow stem cells (BMMSCs) were obtained from osteoporotic patients over 65 years old, and young stem cells 20-35 years old health donors. The extraction from the culture medium of young cells were collected and add to the culture medium of aged cells. Then we detected the effects on cell proliferation, cellular senescent protein markers and oxidative responses to assess the rejuvenation of the aged cells. We also observed the change of potential of osteogenic differentiation after the treatment. The young cells-derived exosome was also collected to observe its effects on the biological functions of aged stem cells.

**Results:** The senescent phenotype of aged BMMSCs were reversed by the treatment of young culture medium and exosome, demonstrated by the down-regulation of cellular senescent markers including: SA-b-Gal activity, p16 and p53. The declined cell proliferation of aged BMMSCs was also rescued by the secretory factors of young cells. Similar results on the osteogenic differentiation induction assay also suggested the function of BMMSCs increased after the young secretory factors treatment.

**Conclusion:** The microenvironment of aged stem cells is characterized by their secretory factors, which are crucial to the cellular functions of BMMSCs. Rejuvenation the aged stem cells with secretory factors provide a promising way to resist the functional attenuation of stem cells.

## **DECREASED LEUKOCYTE VIABILITY IN SURGICAL PATIENTS: A NEWLY DESCRIBED PHENOMENON.**

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**Introduction:** Non-viable leukocytes were incidentally found in critically ill patients after trauma. Not much is known about this phenomenon and its implications for leukocyte functioning. The aim of this study was to investigate the incidence of a decreased leukocyte viability in surgical patients and reveal the mechanisms behind this decreased leukocyte viability.

**Methods:** Leukocyte viability was routinely measured in every blood analysis with propidium iodide staining and was stored in the hospital database. Propidium iodide stains DNA of non-viable leukocytes. The incidence of a decreased leukocyte viability among surgical patients and trauma patients was investigated. Then, the propidium iodide signal that indicated decreased leukocyte viability, was investigated. Based on distinct propidium iodide signals, underlying mechanisms for a decreased leukocyte viability were simulated *in vitro*. A prospective analysis was carried out in surgical patients with a leukocyte viability  $\leq 95\%$ . The analysis included reassessing leukocyte viability, measuring leukocyte receptor expression and investigating leukocyte functioning (phagocytosis and responsiveness to a bacterial stimulus).

**Results:** Decreased leukocyte viability was found in 3% of all surgical patients. The propidium iodide signal in patients with decreased leukocyte viability ( $n = 10$ ) was suggestive for non-viable leukocytes in half of the patients and adherence of DNA to leukocytes in the other half. Both adherence of DNA and non-viable leukocytes could be simulated *in vitro*. Next, nine surgical patients were prospectively included. All 9 patients had a diagnosed or suspected infection. Analysis of all patients showed the presence of leukocytes with low viability characterized by either increased leukocyte autofluorescence ( $n = 6$ ) or by the presence of fragile circulating leukocytes ( $n = 3$ ). Fragile leukocytes were leukocytes that became non-viable when kept in certain tubes (such as EDTA) or after *ex vivo* manipulation (such as red blood cell lysis).

**Conclusion:** A decreased leukocyte viability in surgical patients such as measured by routine hematological analyzers, reflects either fragile circulating leukocytes or leukocyte autofluorescence. Further analyses will be performed to get better insight in leukocyte functioning in these patients and to get a better understanding of how these data can be used in clinical practice.



## ONE HUNDRED PERCENTS FATALITY RATE IN ASIANS WITH HYPERFIBRINOLYSIS AFTER MAJOR TRAUMA: A REPORT FROM A LEVEL I TRAUMA CENTER IN ASIA CALLING FOR AN EARLY AGGRESSIVE APPROACH.

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**Introduction:** Hemorrhage remains the leading cause of death after trauma worldwide. Coagulopathy after severe hemorrhage is common and leads to complicated bleeding control which increases mortality and blood transfusions. Recent studies from Western countries have identified the coagulopathy is associated with hyperfibrinolysis (HF). This study was designed to determine the incidence of HF after trauma in an Asian population and its outcomes.

**Methods:** A case-control study was conducted. All adult trauma patients presented directly to our institution, a level I trauma center in Thailand, and met major trauma activation criteria were reviewed. Patients who were transferred and resuscitated from outside hospitals were excluded from the study. Blood for coagulation studies was drawn on arrival. HF was determined by rotational thromboelastometry (ROTEM), a viscoelastic hemostatic test. The patient characteristics, transfusion requirements, and mortality were reviewed.

**Results:** During the two-year study period, a total of 2,368 adult trauma patients were admitted with 353 patients met severe trauma activation criteria. Forty-three patients had full data sets of ROTEM and were the study population. The average age was  $36.0 \pm 14.0$  years old. Forty-one (95.4%) of the patients were male. The median Injury Severity Score was 25 (14-33). Blunt trauma was the majority of injury mechanism (79.1%). HF was identified in two patients (4.7%). The overall mortality rate was 32.6%. One hundred percent mortality rate was observed in the HF group while the group that did not exhibit HF on arrival (non-HF group) showed 29.3% mortality rate. Blood product requirements and mortality rate between the 2 groups was shown (Table 1).

<b>Table 1. Blood product requirements and mortality rate between HF group and non-HF group</b>		
<b>Blood product</b>	<b>HF group (n=2)</b>	<b>Non-HF group (n=41)</b>
Packed red cells (units)	$13.0 \pm 7.0$	$5.5 \pm 7.4$
Fresh frozen plasma (mL)	$2,046.5 \pm 1,116.5$	$1,269.4 \pm 1,819.4$
Platelet concentration (units)	$11.0 \pm 15.6$	$3.5 \pm 6.5$
Mortality rate (%)	100.0	29.3

**Conclusion:** Hyperfibrinolysis rarely occurred in Asian population with severe trauma. However, patients that exhibited hyperfibrinolysis have extremely high mortality rate and need massive amount of blood transfusion. Further study to address this coagulation disturbance is substantially warranted.

## CLINICAL EVALUATION OF A NOVEL COAGULOPATHY DEVICE

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**Introduction:** Thrombelastography (TEG) provides viscoelastic information on the clotting processes in real-time. It is currently applied in trauma patients who are at risk of bleeding or who are being transferred to theatres when it is vital to analyse and understand their coagulopathy. Trauma patients, in particular, are at risk of changes to coagulopathy due to massive haemorrhage, body temperature and infusion of blood products. TEG analysis is not a substitute for ANTT and INR measurements, but the analysis time is considerably quicker than comparable laboratory tests and does provide guidance and information pre-transfusion in “at risk” patients. Current TEG instruments are large and relatively immobile but the data the technique provides, is useful in early-trauma resuscitation and providing information on coagulation pathways in bleeding trauma patients. We tested a novel portable viscoelastic measuring device (CoaguScan Biosensor) and compared it to a Haemonetics TEG 5000 analyser.

**Methods:** 20 Consecutive trauma patients were selected (convenience sampling) based upon their suitability to need a TEG. A routine TEG was taken for patient care, and the remainder of this sample that would normally go to waste was used for the CoaguScan Biosensor. All adult trauma patients were included (age 18 and above), and patients were recruited using a nominated consultee if unable to consent at the time of the study. These results were anonymised prior to data analysis and 12 healthy volunteers were used as a comparator. Clinicians requesting the TEG were blinded to the Biosensor results.

**Results:** Results compared were: initial viscosity, blood viscosity, maximum amplitude, R-time (time to detect the clot), and overall raw traces. The CoaguScan Biosensor showed comparable results to that of the TEG 5000, despite the biosensor being an early pre-production model. The positive correlation potentially demonstrates that the Biosensor may be used to measure and observe coagulopathy, and that this could be calibrated to the results of the TEG for Clinicians to direct care. The Biosensor showed a significant difference in Maximum Amplitude – giving an indication that the biosensor may be more sensitive to this measurement than the TEG 5000. It also identified a hyperfibrinolysis in trauma patients where the TEG 5000 stated there was normal, suggesting potential for detecting Acute Coagulopathy of Trauma. Comparison against the TEG 5000 was challenging as the biosensor was configured to mimic the manual steps associated with the TEG, but the biosensor had a much smaller sample size. This study was limited by a small sample size and a device that is in early stages of development and therefore more prone to user error.

**Conclusion:** Further work validation and calibrating the device on both healthy volunteers and abnormal samples is currently being undertaken to further understand the results produced and to show comparability to the current TEG and ROTEM devices. Following calibration, a large multi-centre study, taking samples from trauma patients at point of injury and throughout the patient pathway will be completed. The benefit of a portable device, with rapid diagnosis of coagulopathy in trauma – particularly early on the in the patient pathway is currently unknown – a device such as this indicate on how to direct care using early coagulopathy results.

### TEG IN TRAUMA PATIENTS: EVERY MINUTE COUNTS

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**Introduction:** Thromboelastography (TEG) has become an integral part of the management of trauma patients. However, optimal protocols to incorporate TEG into routine trauma protocols have not been determined. We hypothesize a correlation between early TEG use and survival in patients with severe hemorrhage.

**Methods:** A retrospective review of consecutive adult patients who received massive transfusion protocol (MTP) at a Level I Trauma Center was performed from 4/2017-2/2018. Patient demographics, Injury Severity Score (ISS), blood product usage, and mortality were recorded. Patients were stratified into 2 groups based on length of time before TEG was ordered (TEG-L,  $\geq 120$  min and TEG-S  $\leq 120$  min). Patient outcomes were analyzed with a t test for univariate analysis.

**Results:** A total of 91 patients were identified and 56.0% of these patients had TEG level measured. Average time for trauma surgeons to order TEG was 381.4 min with a range of 22-7226 min. There was no difference in baseline patient demographics between TEG-L and TEG-S patients. The TEG-S group had decreased ICU LOS (8.6  $\pm 1.8$  vs. 22.6  $\pm 3.8$ ,  $p=0.0031$ ) and decreased deaths (14.2% vs 47.8%,  $p=0.0135$ ).

Table 1. Demographics and outcomes for trauma patients with massive hemorrhage stratified by length of time for trauma surgeon to order TEG.

Variable	Short TEG N=23	Long TEG N=28	p value
Age, avg yrs (SEM)	38.0 (3.1)	34.0 (2.6)	0.32
Male gender, n (%)	20 (87.0)	19 (67.9)	0.18
Penetrating trauma, n (%)	15 (65.2)	17 (60.7)	0.78
ISS, avg (SEM)	25.5 (2.8)	20.0 (1.1)	0.06
ED SBP, avg (SEM)	113.7 (7.7)	104.9 (3.7)	0.28
GCS, avg (SEM)	8.9 (1.0)	11.0 (1.0)	0.15
<b>Outcomes</b>			
PRBCs in 24 hrs, avg (SEM)	16.8 (3.9)	12.7 (2.5)	0.22
FFP in 24 hrs, avg (SEM)	14.0 (3.2)	10.2 (2.1)	0.31
Platelets in 24 hrs, avg (SEM)	2.1 (0.1)	2.0 (0.3)	0.82
Crystalloids, avg (SEM)	2852.3 (386.0)	2840.0 (294.2)	1.0
Hospital LOS, avg (SEM)	16.4 (3.8)	22.6 (2.8)	0.19
ICU LOS, avg (SEM)	8.6 (1.8)	22.6 (3.8)	0.0031
Ventilator days, avg (SEM)	5.8 (1.3)	11.0 (2.3)	0.15
Death, n (%)	4 (14.2)	11 (47.8)	0.0135

**Conclusion:** This analysis demonstrated a survival benefit in severe hemorrhage patients with early use of TEG. Institutions should adopt quality measures to review proper early use of TEG in patients with severe hemorrhage. Prospective validation is needed in order to better understand this TEG time-survival correlation.

**Evaluation of Factors Affecting Clinical Outcomes in Patients with Penetrating Cardiac Injuries by Cortopunzante Weapon. 5 Years Experience in a Level 1 Complexity Institution in Colombia.**

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**Introduction:** The behavior of assault injuries with a short stabbing weapon as a cause of death has been described from 1980 to 2016 by the Global Burden Of Disease with a sustained trend in young population between 15 to 55 years of age, with a peak persistent towards 25 years. The injuries caused by sharps in the thorax are related to a high mortality despite the early interventions carried out by the pre-hospital care staff and even in the emergency room of hospitals around the world, despite the advances in the area of care in trauma, the implementation of programs such as ATLS and the use of portable ultrasound images, up to 90% of patients may die before reaching the emergency service. The objective of the following study was to describe the different factors that affect clinical outcomes in patients with wounds caused by a sharp weapon in the thorax.

**Methods:** Observational descriptive study of patients admitted to the emergency department with a diagnosis of penetrating cardiac lesion, clinical, paraclinical, imaging findings were evaluated, patients were followed, central tendency measures were calculated, statistical confidence tests were applied as Chi<sup>2</sup>, Wilcoxon test, Fisher test.

**Results:** The majority of patients belong to the male sex [86%]; the average age was  $30.6 \pm 9.75$  years, 98% of penetrating injuries were located within the area. At the time of admission to the emergency department, the average Systolic Blood Pressure (SBP) was 79.4 mmHg and the heart rate (HR) was 100 beats per minute; the average of the Shock Index (SI) was 1.9. Admission to the Intensive Care Unit was required by 21 (42%) of the patients and 36 (72%) required the use of Hemocomponents during the hospital stay. The average hospital stay was  $7.5 \pm 6.1$  days. The location of the cardiac lesions were 60% of cases in the right ventricle, 18% in the left ventricle, 12% in the right atrium, 6% in the pericardial sac and 4% in the left atrium. The left anterolateral thoracotomy was the most frequent technique of surgical approach. The average size of the cardiac lesions was 19.2 mm. Hospital mortality was 14%. The diagnostic method of cardiac injury was by Surgery in 62%.

**Conclusion:** Despite advances in pre-hospital care, diagnostic modalities and resuscitation strategies, PCLs remain highly lethal. A clinical suspicion focused on the early recognition of the unstable patient with lesion in the precordial area allows decision-making aimed at imaging diagnosis or immediate surgical diagnosis.

## **MASS-CASUALTY IN A LEVEL 2 TRAUMA CENTER: ARE WE REALLY PREPARED?**

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**Introduction:** On the 1st of October, 2017 in Las Vegas, Nevada, a crowd of over 22,000 people at a country music festival was fired upon by an individual using a semi-automatic converted to automatic rifle from an elevated position at the Mandalay Bay Hotel and Casino. This resulted in approximately 60 fatalities and over 500 injuries. The majority of those who were injured were treated at one of two major trauma centers in the city.

**Methods and Results:** Sunrise Hospital and Medical Center received and treated 221 of those patients. Of those, 16 were triaged to category black and later pronounced deceased, over 95 underwent surgery in the first 24 hours, and an unknown number were treated for minor injuries and left the hospital without being registered. Through the combined efforts of the trauma surgeons, residents, and registered nurses, non-trauma surgeons, anesthesiologists and nurse anesthetists, physician assistants, nurse practitioners, and support staff of all levels, the above was accomplished and with only two additional mortalities occurring after the first 24 hours.

**Conclusion:** Routine training for mass casualty incidents (MCI) and other disasters is part of the curriculum for most trauma centers. However, no amount of preparation would be considered adequate for one of such a large scale as that which occurred on October 1st. Sunrise Hospital periodically performs mock trauma scenarios in order to keep its staff ready in the event of such situations, but these are usually limited to motor vehicle collisions and associated blunt trauma. Those performing their duties during the MCI at Sunrise will attest that the patients were treated properly with remarkable speed and efficiency, and although strained for personnel and resources at times, the compensatory efforts made were successful. Part of this can be explained by the nature of the trauma seen in Las Vegas routinely. In 2017, there were 408 cases of penetrating trauma treated at Sunrise Hospital, including 316 caused by firearms. These numbers and experience translate into familiarity, comfort, and skill in treating this type of pathology that would make the outcomes and statistics of this MCI otherwise unachievable. There is a wide variation in the types of trauma that are seen at different trauma centers across the United States, with many seeing blunt trauma disproportionately. Many surgical residency programs send their trainees to larger academic centers in order to fulfill their trauma training requirements and gain a more broad perspective in the field. In light of recent events and the realization of certain deficiencies, it would be of great benefit to expand on this concept, and examine the possibility of developing further cross-program integration or exchanges for MCI routine training and continuing medical education for all trauma healthcare providers. This would create a network of well-prepared community trauma centers, better prepared to serve their regions and alleviate a portion of burden on the more high-volume academic centers.

**Education in trauma: An educational alternative that promotes injury prevention.**

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UNIVERSITARIA NAVARRA

**Introduction:** As trauma is a public health problem, different programs have been designed to prevent injuries. The aim of this study was to evaluate the effectiveness of an educational model that measures the adolescents' attitudes towards the rules of road safety, alcohol and road accidents in Colombia.

**Methods:** A pedagogical model evaluating the effect of road safety education and adolescents' attitudes towards and experiences of alcohol and road accidents in Colombia was created. After the education concluded, this educational process is analyzed by its impact on adolescents' behavior. The educational program included 160 adolescents with the mean age being 17.5 years.

**Results:** The test results indicated that before the educational program 80% of adolescents did not use a safety element when driving, while after the educational program the percentage of no helmet use among adolescents decreased from 72.5% to 24.3% ( $p = 0.0001$ ) and driving a vehicle under the state of drunkenness from 49.3% to 8.1% ( $p = 0.0001$ ).

**Conclusion:** An educational model aimed at preventing injuries caused by traffic accidents is shown to be effective in generating changes in adolescents' customs of and attitudes towards alcohol and road safety standards in Colombia

## **PSYCHOLOGICAL DISTRESS AFTER TRAUMA: A PROSPECTIVE COHORT STUDY**

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**Introduction:** Psychological distress is a general term to describe a state of emotional suffering that interferes with the level of functioning, and could be characterized by symptoms of posttraumatic stress (PTSS), and symptoms of depression and anxiety. This study aimed to (1) describe the prevalence of psychological distress within one year after injury in a clinical trauma population (2) determine risk factors for this poor outcome and (3) develop prediction models for poor psychological outcome 6 months and 1 year after trauma.

**Methods:** This is a multicenter prospective observational cohort study. All adult trauma patients admitted to ten hospitals (N=9774) were asked to complete a questionnaire at 1 week, and 1, 3, 6 and 12 months after injury. The Hospital Anxiety and Depression Scale (HADS) was used to screen for anxiety and depressive disorders and the Impact of Event Scale (IES) was used to assess symptoms of posttraumatic stress disorder (PTSD). Potential predictors were assessed in univariable logistic regression, with psychological distress as outcome. Psychological distress was defined as: HADS $\geq$ 8 or IES $\geq$ 35. All risk factors with a  $p < 0.2$  were included in multivariable model. The model performances were assessed with the discrimination (Area Under the Curve), Nagelkerke R-square ( $R^2$ ) and graphically with calibration curves.

**Results:** A total of 4883 patients (46%) completed at least one questionnaire in the follow-up period of one year after trauma. Prevalence rates of psychological distress is higher in women than in men. Patients with a low injury severity score also suffered from psychological distress. Overall, the prevalence of anxiety and depressive symptoms decreased during the follow up period. The highest prevalence of PTSS was found in female trauma patients with low injury severity. Risk factors for poor psychological outcome are female gender, low educational level, low injury severity, pre injury presence of anxiety and depression, and low functional capacity index.

**Conclusion:** Prevalence of psychological distress is high among female trauma survivors. This study provides possible tools for early diagnosis and screening of poor psychological outcome after trauma. Further research is needed to externally validate these findings.

## EFFECTS OF TRAUMA CENTER ON MORTALITY AT A REGIONAL CITY IN JAPAN: A POPULATION BASED STUDY

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**Introduction:** Although trauma centers have been reported to be effective on mortality of trauma patients, their effects on mortality in a region have not been thoroughly investigated. In our medical district (about 500,000 of population), emergency medical center (EMC) and trauma center (TC) was established for the first time in April 2010, and October 2011 respectively in only one university hospital (UH), and cooperated with each other for trauma patients. The objective of this study is to clarify the effects of the centers on the mortality at a population-level.

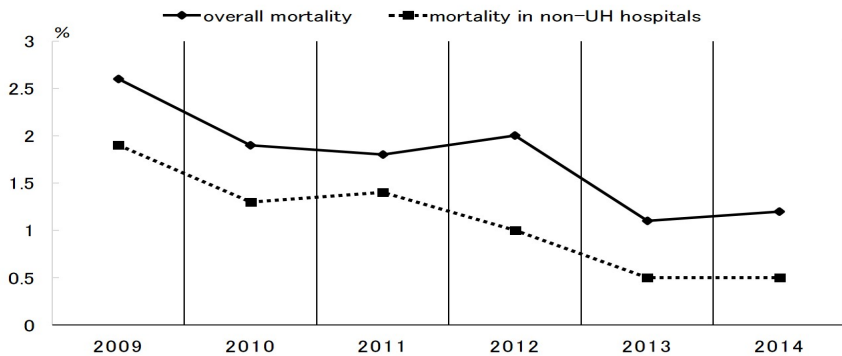
**Methods:** Standardized regional data form were used for this retrospective study. The data have been collected for all patients taken to hospitals by ambulance, and included prehospital information, and both of diagnosis and outcome one week after injury. The analysis was performed during fiscal years from 2009 to 2014. Trauma patients were extracted from the codes of trauma such as “traumatic intracranial hemorrhage”, “spinal cord injury”, “cardiovascular and lung injury”, “abdominal organ injury”, “pelvic fracture”, “proximal femur fracture”, “severe multiple trauma”, and “other fractures”.

**Results:** There were total 122, 306 patients transported in the region during 6 years, and collection rate of the records was 92.6% (n=113,254). Out of them, 11,788 (10.4%) were trauma patients directly transported from the scene and used for analysis.

Number of trauma patients, median age, and the time from call to hospital increased during the period (Table). Rate of patients transported to UH increased from 4.2% at 2009 to 7.5% at 2012 after establishment of trauma center. Mortality in UH decreased from 18.6% (2009) to 10.9% (2014), and that in non-UH hospitals also decreased from 1.9% to 0.5% (Figure). As a result, the overall mortality in the region improved from 2.6% to 1.2% despite of population aging and the increased time from call to hospital (Figure).

Fiscal year	2009	2010	2011	2012	2013	2014
All patients	18371	20199	20197	20895	21260	21384
Collection rate % (n)	90.8 (16679)	90.0 (18176)	91.7 (18529)	91.9 (19196)	95.2 (20241)	95.6 (20433)
Trauma patients	1992	2301	2302	2322	2557	2624
Direct transport	1658	1912	1851	1978	2163	2226
Age (median)	75	76	78	77	78	79
Call to hospital (median)	33.0	33.5	35.0	36.0	37.0	37.0

**Conclusion:** The establishment of EMC and TC resulted in the increase in a number of patients transported to UH, and the improvement of mortality at a population level. The centers may have contributed to trauma care in the region by intensification of severe trauma patients.





## PSYCHOLOGICAL DEVELOPMENTS 28 YEARS AFTER MULTIPLE TRAUMA

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**Introduction:** The impact of polytrauma on long-term quality of life is poorly investigated. Potential effects are based on type and severity of the injury, but also on the psychological consequences of the trauma itself as well as long-term consequences. Trauma can decrease quality of life and increase socio-economic burden. We have previously shown long-term development of post-traumatic stress disorder and depression. In this study, we examined other long-term psychological developments in multiple injured patients.

**Methods:** More than 20 years after trauma, 637 patients enrolled in our polytrauma database who suffered trauma dating from January 1, 1973 to December 31, 1990 received a questionnaire that included self-assessment of posttraumatic psychological developments. This questionnaire included questions modified from or based on: Short Form 12 Health Survey (SF-12) Diagnostic criteria of PTSD from the Diagnostic and Statistical Manual of Mental Disorders (DSM IV) of the American Psychiatric Association (APA) HADS (Hospital Anxiety and Depression Scale) and the Clinical Anxiety Scale (CAS) as found in the Present State Examination (PSE, Wing, Cooper and Sartorius 1974) An internally devised question set to evaluate potential positive psychological developments

**Inclusion criteria:** patients who were enrolled in the database and returned the questionnaire.

**Exclusion criteria:** patients with severe head injuries or patients who could not fill out the questionnaire even with assistance.

**Results:** This study evaluated 337 completed questionnaires from 637 patients more than 20 years after trauma. Of these patients, 34.9% experienced or witnessed additional trauma, potentially amplifying psychological effects of the initial injury. Ten patients (3.0%) suffer from symptoms of PTSD. Further, 4.1% of patients reported symptoms of anxiety and nearly half (48.2%) show symptoms of depression. However, we also identified effects that were considered as positive by this population. The most common positive development was a sense of improved trust in others (42.0%) during times of need. Nearly one-third of patients (31.4%) accepted or learned to cope with personal shortcomings. More than half of patients (52.7%) developed a new appreciation for health and vitality. Nearly one in five patients (17.8%) developed faith or strengthened their religious beliefs.

**Conclusion:** Multiple injured patients risk developing multiple psychological effects including PTSD, anxiety, or depression. However, patients can also experience different psychological developments. As clinicians we must keep these effects in mind, offering psychiatric consultation where needed, while fostering and supporting potential positive developments.

## **TRAUMA, TREATMENT AND REHABILITATION: A PATIENTS' PERSPECTIVE**

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**Introduction:** Qualitative research that focusses on the process of treatment and rehabilitation in relation to psychological factors after trauma is lacking. Using focus groups, the aim was to explore patients' experiences with the trauma, treatment and rehabilitation.

**Methods:** Trauma patients, treated in the shock room of the Elisabeth-TweeSteden Hospital, The Netherlands, participated in a focus group. Purposive sampling was used. Exclusion criteria were younger than 18 years old, severe traumatic brain injury, dementia, insufficient knowledge of the Dutch language. The interviews were recorded, transcribed verbatim and analyzed using coding technique open, axial and selective coding.

**Results:** Six focus groups were held before data saturation was reached. Then, no new information was found during the discussion. In total, 134 patients were invited, 28 (21%) agreed to participate (Age median: 59.5; min. 18 – max. 84). Main reasons to decline were fear that the discussion would be too confronting or patients experienced no problems regarding the trauma or treatment. Participants reported difficulties on physical (no recovery to pre-trauma level), psychological (fear of dying or for permanent limitations, symptoms of posttraumatic stress disorder, cognitive dysfunction), social (impact on relatives and social support) and environmental domains (satisfaction with care). Good communication regarding recovery is imperative, whereas clarity about the injury and expectations regarding recovery and future perspectives needs to be explained. Good communication seems to be related to surrendering to care and reduced feelings of helplessness and loss of control.

**Conclusion:** This is the first study that explored patients' experiences with the trauma, treatment and rehabilitation. Our findings illustrate the need for awareness and knowledge in health care providers about the consequences on several domains. Improvement in care can be accomplished after awareness, improved adjustment in communication and a multidisciplinary team is created. Professionals with the knowledge of consequences after trauma can better anticipate on patients' need.

## APPLYING THE 5-PILLAR MATRIX TO THE DECADE OF ACTION FOR ROAD SAFETY IN QATAR: IDENTIFYING GAPS AND PRIORITIES

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**Introduction:** Road traffic injuries [RTIs] are the leading cause of death in Qatar; consequently, the country has participated in the Decade of Action for Road Safety [DoARS] coordinated by the United Nations Road Safety Collaboration, since 2011. Its goal is to reduce the number of road traffic deaths and injuries by 50% by 2020, by implementing activities, in the areas of road safety management, safer roads, safer vehicles, safer road users and post-crash response, the 5-Pillars. This study evaluated the DoARS initiatives and programs implemented in Qatar, to identify areas for future prioritization and focus.

**Methods:** Data, on completed or ongoing road safety initiatives for the years 2011-16, was collected from the key stakeholders, governmental and non-governmental, involved in road safety. This data was analyzed in the 5-Pillar Matrix, created, based on the DoARS Action Plan [Table 1].

Table 1: Five Pillars DoARS<sup>1</sup> Matrix [Abridged], 2011 to 2016, Qatar.  
 Traffic Department, Ministry of Interior, National Traffic Safety Committee, Ministry of Public Works, Ministry of Public Health and Hamad Medical Corporation  
<sup>1</sup>Based on UNRSR, DoARS Road Safety Action Plan

Activity	Pillar 1: Road safety management [4/5]	Pillar 2: Safer roads & mobility [5/5]	Pillar 3: Safer vehicles [0/7]	Pillar 4: Safer road users [4/8]	Pillar 5: Post-crash response [6/7]
1	Establish a lead agency	Promote road safety ownership & accountability	Apply UN motor vehicle safety regulations	Road safety awareness & social marketing campaigns	Develop prehospital care systems
2	Develop a national strategy	Promoting the needs of all road users	Use new car assessment programs	Speed limits & rules	Develop hospital trauma care systems
3	Set realistic & long-term targets based on national traffic crash data	Safe operation, maintenance & improvement of existing road infrastructure	New motor vehicles are equipped with seat-belts & anchorages	Drink-driving laws & evidence-based standards & rules	Provide early rehabilitation & support to injured patients.
4	Ensure that funding is sufficient for activities	Promote the development of safe new infrastructure	Universal deployment of Electronic Stability Control & Anti-Lock Braking Systems	Standards & rules for motorcycle helmets	Establishment of appropriate road user insurance schemes
5	Establish & support data systems	Encourage capacity building & knowledge transfer	Incentivize motor vehicles that provide high levels of road user protection	Standards & rules for seat-belts & child restraints to reduce crash injuries	Crash investigation & an effective legal response to road deaths & injuries
6		Encourage research & development in safer roads & mobility	Pedestrian protection regulations & safety technologies	Standards & rules for commercial freight & transport vehicles, & other public & private vehicle fleets	Encouragement & incentives for employers to hire & retain people with disabilities.
7			Fleets with vehicles that offer advanced safety technologies & high levels of occupant protection.	Policies & practices to reduce work-related road traffic injuries in the public, private & informal sectors	Encourage research & development into improving post-crash response.
8				Establishment of Graduated Driver Licensing systems for novice drivers.	
DoARS Compliance	80%	100%	0%	50%	86%

Non-compliance with indicators are shown in *italics*. Compliance with indicators is shown in **bold**.

**Results:** Pillars 2 [Safer Roads] and 5 [Post-Crash Response] met most of the DoARS indicators, 100% and 86% respectively, while Pillar 3 [Safer Vehicles] complied with none. Previously non-existent, legislative and policy indicators were the least likely to be completed. Systems, programs and laws that were already existent in 2011 and involving road engineering or healthcare systems were more likely to be in compliance with DoARS indicators.

**Conclusion:** To build on the initial gains of DoARS, Qatar must go beyond activities and programs that were already existent in 2011. It must prioritize proven interventions that make vehicles and road users safer; i.e. more stringent vehicle safety standards and graduated driver licensing for novice drivers.

## **ROLE OF REVISED TRAUMA SCORE AND KAMPALA TRAUMA SCORE IN LOW AND MIDDLE INCOME COUNTRIES - ASSESSING FEASIBILITY, ACCURACY AND UTILITY IN RURAL INDIA**

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**Introduction:** Annually, trauma causes more than 5.8 million deaths worldwide, with low and middle income countries (LMICs) accounting for the vast majority of these deaths. While predictors of mortality have long been studied and validated in high-income countries (HICs), risk predictors such as the Injury Severity Score (ISS) are of low utility in resource poor settings. As a result, both the Revised Trauma Score (RTS) and Kampala Trauma Score (KTS) have been developed and tested in LMICs, largely in urban areas. We aimed to validate RTS and KTS as predictors of mortality as well as disposition from a trauma department in rural western India.

**Methods:** Retrospective analysis of prospectively collected trauma registry data at a 550 bed tertiary care hospital serving a rural catchment area of 11,300 sq km of Gujarat, India was conducted. Patients presenting to the emergency room with all mechanisms of injury between September 1, 2017 to February 12, 2018 were included. Patients pronounced 'dead on arrival' were excluded. Primary outcome was in-hospital mortality. Secondary outcome was disposition from the trauma department (treated and discharged vs hospitalized). RTS and KTS were evaluated as predictors of in-hospital mortality by using logistic regression models. The sensitivity and specificity of each score was assessed using the area under the receiver operating curve (ROC). Pearson's  $\chi^2$  goodness of fit test was performed to assess the above mentioned associations.

**Results:** Of 1601 patients included in the trauma registry, 479 had enough data points recorded to calculate both the RTS and the KTS. Missing respiratory rate was the most common reason for inability to calculate these measures. Of these, 71% were males, median age was 32 (IQR 19.5 - 44.5) years and the most common cause of injury was road traffic accidents (54%, 258/479), followed by falls (23%, 110/479). 33 patients died in the hospital. 47% patients required inpatient admission, 29% patients were treated and discharged from the trauma department, and 20% left against medical advice. Logistic regressions revealed that both RTS [OR 0.39, 95% CI 0.28 - 0.55,  $p < 0.001$ ] and KTS [OR 0.41, 95% CI 0.27 - 0.62,  $p < 0.001$ ] were strong predictors of in-hospital mortality. Both the scores demonstrated adequate level of fit based on the Pearson's  $\chi^2$  goodness-of-fit test ( $\chi^2 < 0.0001$ ). The area under the curve (AUC) for RTS (0.766) and KTS (0.783) were similar ( $p = 0.78$ ). For patients with RTS  $< 4.5$ , the probability of in-hospital death was  $> 25\%$  in our cohort. Additionally, both the scores were significant predictors of requiring hospitalization (RTS: OR 0.18, 95% CI 0.04 - 0.74,  $p = 0.018$ ; KTS: OR 0.10, 95% CI 0.06 - 0.17,  $p < 0.0001$ ). Only 3% (8/268) patients discharged directly from the trauma department required readmission within 30 days.

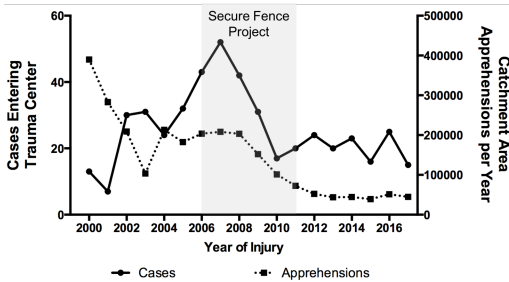
**Conclusion:** In rural LMIC settings when ISS is impractical to calculate, less resource intensive scoring systems such as RTS and KTS perform equally well as significant predictors of mortality. Both scores can also be utilized to predict safe and successful discharge directly from the trauma department. This can further guide the clinical practice in LMICs where resources are sparse and need to be rationed. However, to maximize utility of these measures in the future, it will be important to encourage full recording of key data such as respiratory rate that preclude such calculations.

## AN 18-YEAR ANALYSIS OF BORDER FENCE INJURIES

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**Introduction:** The southwest portion of the US-Mexico border remains the greatest contributing sector to national border apprehensions. Policy increasing the length and height of the fence has previously affected the number and severity of intentional border jump or fall cases seen at US border trauma centers. The Secure Fence Act of 2006 which increased the height, length and reinforcement of the area border fence was more than 99% complete by 2011. We hypothesized that policy and economic changes significantly affected numbers and severity of intentional border jump or fall cases seen over an 18-year period.

**Methods:** We performed a time-trend study using the Trauma Registry at a US Level 1 Trauma Center covering a portion of the US-Mexico border. Age, sex, injury severity score (ISS), and injured body regions for patients admitted after a border jump or fall from 2000 through 2017 were analyzed. The number of apprehensions in the Trauma Center's catchment border regions per year were obtained from US Customs and Border Protection data.



**Results:** A total of 465 admissions were coded as border jump or fall injuries. 72% were male with an average age of  $33.0 \pm 9.6$  years. There was a significant decrease in the number of border jump or fall patients admitted from 43 in 2006 to 20 in 2011. This trend correlated with a decrease in apprehensions within the region but also an increase in

the number of body regions affected per patient. Since 2011, the number of cases and apprehensions has remained stable. ISS also remained stable over the 18-year analysis with an overall average of 8.33. The highest mean ISS of 11.8 occurred in 2011, and the lowest mean ISS of 4.7 occurred in 2015.

**Conclusion:** During this 18-year period, the number of border jump or fall cases at the US-Mexico border has decreased and stabilized after completion of the Secure Fence Act. The overall ISS of border crossing jump or fall cases has remained unchanged but the number of body regions affected per patient has increased.

## **“INTEGRATION” IS THE KEY FACTOR TO DEVELOP PREHOSPITAL TRAUMA CARE SYSTEM IN THE LEAST DEVELOPING COUNTRIES**

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**Introduction:** Road traffic accidents (RTAs) is a global issue, and all countries are aimed to achieve SDGs 3.6, half deaths and injuries from RTAs. In fact, in most of the developing countries, the number of RTA deaths and injuries expected to rise. Emergency medical service (EMS) is one of the key factor to minimize the damage of RTAs. However, building a nationwide EMS is extremely challenging, especially in the least developing countries (LDCs). Lao People’s Democratic Republic (Laos) is no exception.

**Methods:** Laos is one of the LDCs, which faces the rapid increase of RTAs. There is no public EMS existed and little is known about the trauma care system, especially about the prehospital settings. From January to February 2018, we have conducted an observational study in the capital Vientiane. We focused on visualizing the current prehospital settings and proposing the action plans for strengthening the capacity of post-crash response.

**Results:** In Vientiane, 8 private non-profit sectors are running the ambulance services. Since 2007, different ambulance services have been developed one after another. Today, due to the “disintegration” of services, the overlap calls and arrival of several ambulances at once were observed at the injury sites. The quality gap among services are evident, including transfer time and prehospital care treatment. We found most of the severe RTAs occur out of the town, but most of the stations where ambulance stands were located middle of the town. After our survey, we have set the 25 action plans to strengthen the trauma care system, including the establishment of a universal access number and command & control center.

**Conclusion:** There are many developing countries where private sectors run the ambulance services. “Disintegrated” prehospital trauma care system could cause transfer delay and the quality gap. Achieving a universal access number and command & control center in the early development stage are necessary.

## THE CHALLENGING AND STRATEGIES FOR TRAUMA CARE IN CHINA

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**Introduction:** Trauma is one of the biggest public health problems in the world, as well as in China. In order to understand the current pitfalls in dealing with trauma care in China and to find out the solution, a survey was carried out between January 2010 and December 2014. Based on the success of the Advanced Trauma Life Support course and Primary Trauma Care course, a trauma-training program was propelled in China.

**Methods:** The authors and their colleagues surveyed 30 hospitals located in different parts of China, including 15 tertiary hospitals, 22 secondary hospitals, and 4 primary hospitals. A Standard Operating Procedure was established in advance and was used for face-to-face interviews and field surveys, with the primary objective of whether a trauma patient was admitted to a specific division, such as acute surgery and trauma surgery. Field survey covered both the hospital settings and the layout of the emergency departments, including hospital profiles, infrastructure for trauma care, trauma care capacity and pre-hospital response capacity.

**Results:** The study found that there were specialized trauma care facilities in 11 tertiary hospitals (73.33%), 4 secondary hospitals (36.36%) and 3 primary hospitals (75.00%). The common adverse aspects included: External factors – less desirably regulated operation of local EMS system, lack of effective inter-hospital transfers, no mandatory setups for trauma care required by legislation, no specialty such as the trauma surgery in the promotion system, the time-consuming training and the expanding scope of trauma care. Internal factors - the restrained development of trauma surgery, the less efficient operation of trauma care facilities, the lower time-sensitive management of the multiple trauma patients approached by intra-hospital consulting regime, the less satisfactory spatial accessibility among different interacting functional units, and confusing standard protocol with unnecessary patient transfers. Other findings include that the unique path for trauma care was less taken into consideration in tertiary hospitals, the care of traumatic brain injury or major thoracic trauma is less satisfied, traffic is poor, first-aid setups were far behind, long distance away from emergent department and insufficient storage of blood products, no resuscitation room for trauma patients in ED and prolonged pre-operative time. In June 2016, a panel of trauma committee experts from the Chinese Medical Doctor Association initiated a training course on trauma care with independent intellectual property right. In June 2017, 21 courses were organized.

**Conclusion:** Strategies for improving trauma care system in China include, at the national level - establishing and improving regulations and standards for designated trauma centers, setting up the “trauma/acute care” as a new discipline in medical colleges or universities, strengthening injury and trauma care capacity by certificated trauma training program; at the hospital level – reorganizing trauma team and trauma division at different levels of hospitals, establishing a trauma resuscitation area in ED and for improving “hardware” for ED and pre-hospital care facilities.

**Key words:** Challenging and strategies; Trauma care; China

## **A COMPARATIVE STUDY ON BOARDING OF MEDICAL STAFF OF HELICOPTER EMERGENCY MEDICAL SERVICE (HEMS) AND THE TRAUMA DEATH RATE: FOCUSING ON THE LOCAL REGIONAL TRAUMA CENTER**

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**Introduction:** The importance of rapid transfer to designated regional trauma centers for the good outcome of severely traumatized patients cannot be emphasized enough. To this end, helicopters for emergency medical care have been established in most developed countries today, but there is still controversy about the proper boarding personnel to provide professional prehospital care during the air transportation. The purpose of this study was to compare the outcomes in traumatic patients with trauma surgeons on board with outcomes in those with paramedics on board during transportation flights to the regional trauma centers by helicopter.

**Methods:** Among the patients who were transferred to the two regional trauma centers from January 2012 to December 2017, adult blunt patients who were referred to the 'air transportation' as a means of transfer in the trauma database system were included. The information on the transfer was taken from the 'EMERGENCY MEDICAL SERVICE REPORT' prepared by the EMTs and the electronic medical records of the trauma center were used. Trauma Team Staffed HEMS (TTS-HEMS) and EMT-HEMS (Emergency Medical Technicians HEMS) were compared. The trauma and injury severity score (TRISS), the injury severity score (ISS) and the revised trauma score (RTS) were used to classify the trauma patients. Z statistics and W statistics were calculated to compare the predicted survival rate with the actual survival rate of the study population.

**Results:** A total of 662 trauma patients were transferred to the regional trauma center using HEMS. A total of 435 adult patients were included in the analysis except for pediatric, penetrating, drowning, hanging, Dead on Arrival (DOA) and Dead in Emergency Department (DIED). Of these, 327 (75.2%) were TTS-HEMS and 108 (24.8%) were EMT-HEMS. The TTS-HEMS was 266 subjects (81.3%) who exceeded the ISS 15 compared with the EMT-HEMS 44 subjects (40.7%) were statistically significant. During the transfer, TTS-HEMS could be treated with endotracheal intubation, transfusion, and thoracotomy + open cardiac massage, but EMT-HEMS could only perform basic treatment based on basic life support (BLS). When the predicted survival rate was calculated using TRISS, the actual survival rate of overall HEMS (Z statistic = 4.40,  $p < 0.001$ , W statistic = 3.77) and TTS-HEMS (Z statistic = 3.69,  $p < 0.001$ , W statistic = 3.79) were statistically significantly higher than the predicted survival rate. The actual survival rate of TTS-HEMS was statistically significantly higher than the predicted survival rate in the subgroup of the severely injured patient ( $ISS \geq 25$ ) (Z statistic = 3.56,  $p < 0.001$ , W statistic = 18.44). In the subgroup of mild ( $ISS < 15$ ) and moderate ( $16 \leq ISS < 24$ ), there were no statistically significant difference between actual survival and predicted survival.

**Conclusion:** As a result of analyzing HEMS conducted for adult blunt trauma patients, when trauma team staff participated in the transfer, the actual survival rate was higher than the predicted by TRISS despite the high severity. Improvement in treatment result was not confirmed when boarding only by EMT.



## **A QUALITY OF LIFE STUDY COMPARING PATIENT'S OUTCOME OF SURGICAL INTERVENTION FOR RIB FRACTURES: A PRELIMINARY, PROSPECTIVE, COHORT STUDY IN TAIWAN**

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**Introduction:** Traumatic rib fracture is the most common cause of chest injury. For so many years, most of patients were treated with non-operative methods such as pain control or rib brace. Recently, surgical intervention for rib fixation becomes more and more adopted as a treatment modality because of its effects on lessening pain scale and shortening length of stays (LOS). Despite all the abundant literature related to the rib fractures, there are still very few investigations using Quality of life (QoL) measurement to compare the outcomes of patients with rib fractures. Therefore, the goal of the present study is to compare the subjective outcomes of these patients measured by QoL instruments and their timing and possibility of return to work.

**Methods:** Since July, 2017 we started a prospective, cohort study of rib fractures in three major hospitals of northern Taiwan using Short-form 36 (SF-36) and Work Quality Index (WQI) to measure the quality of life among these patients after admission. Patients of rib fractures in these three hospitals were asked their willingness to join our study and to have surgery or not. We performed several screw-plate systems for rib fixation. For the operative groups, we collected the results of these two questionnaires at 5 time points (Pre-operative, Post-operative, 1 months, 3 months and 6 months). If patients chose not to have surgery, the first two interviews will be conducted as within 3 days of admission and 1~2 day before discharge.

**Results:** Up to now, we have recruited 21 patients in this multi-centered QoL study. There are slightly more patients (12/21, 57.14%) chose to have surgery. The average age of these patients are 61.9 years old and the gender of study patients is predominantly male (16/21, 76.2%). The majority of patients have been admitted to ICU (16/21, 76.2%) and the average length of stay (LOS) in ICU is 4.75 days. The total LOS of these patients is 8.8 days. The average number of fractured ribs in these patients are 5.57 ribs. To show the comparative effects of surgery, we found younger patients are more inclined to have rib fixation (average: 55.2 years old in operative group vs 70.8 years old in non-operative group,  $p < 0.001$ ). The surgical patients have slightly longer LOS (9.25 days in operative group vs 8.22 days in non-operative group). In terms of QoL results, the most significant finding is except pain scale, most physical, emotional and social limitations are decreased in operative groups and the effects become stronger until 1 ~ 3 months. The chance of return to work, measured by WQI, showed that there are 6 patients already back to work. Among those already back to work at 1 month of follow-up, most patients are in surgical group (5/6, 83.36%).

**Conclusion:** Our study is the first study to show that rib fixation has better effects on helping patient recovery, both in QoL and work quality. Beyond traditional pain score measurements and physiological parameters such as pulmonary function test and lung volume, the results of this study encourage more patients to have surgery to improve the quality of life and their ability to return to work. Further study of larger scales should be done to investigate the economic impacts on the society after rib fixation.

## CLINICAL SIGNIFICANCE OF ULTRASOUND IN PATIENTS WITH PENETRATING CHEST TRAUMA

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**Introduction:** Treatment of patients with penetrating chest trauma depends on accuracy and velocity of examination. Focused assessment with sonography for trauma (FAST), computed tomography and pericardial window are used as diagnostic tools.

**Methods:** Patients with open wound admitted to level 1 trauma center from 1<sup>st</sup> of January to 31<sup>st</sup> of December 2016 were included in retrospective non-randomized study. Heart injury was suggested if the wound was located in the “precardial box”. Findings of ultrasonography of pericardium were taken into account only in such cases. Patients in extremes were excluded from the survey. Any amount of fluid in the pleural cavities, or discrepancy between pericardium and heart more than 5 mm in diastole was considered as a positive result. The results of FAST were controlled by follow-up observation, CT or operation. Chest X-ray was also performed. Local wound exploration and suturing was fulfilled after preoperative examinations. Depending on intensity of intrapleural bleeding in the patients with penetratin wound, suturing with tube thoracostomy, VATS, or thoracotomy was performed. The presence of hemothorax and hemopericardium, which was detected by FAST preoperatively, was confirmed or disproved during surgery. All patients were admitted to hospital for observation. Chest X-ray, ultrasound examination of pleural cavities and echocardiography were repeated when necessary. Sensitivity, specificity, positive and negative predictive value and their 95% confidence interval were calculated.

**Results:** The relationship between FAST and intraoperative findings was explored in 547 patients with chest wound, of which 155 had one in the “precardial box”, and are presented in the tables 1 and 2. Sensitivity, specificity, negative and positive predictive value of ultrasound results are presented in table 3.

Table 1. The relationship between FAST of the pleural cavities and real hemothorax.

Hemothorax US result	during operation	
	Yes	No
Yes	111	7
No	63	366

Table 2. The relationship between FAST of pericardial cavity and real hemopericardium.

Hemopericardium US result	during operation	
	Yes	No
Yes	11	7
No	7	130

Table 3. Sensitivity, specificity and predictive value of FAST.

US	Sens. %, (95% CI*)	Spec. %, (95% CI)	NPV %, (95% CI)	PPV %, (95% CI)
Pleural cavities (n=547)	63,8 (59,7-67,9)	98,1 (97,0-99,2)	85,3 (82,3-88,3)	94,1 (92,1-96,1)
Pericardium (n=155)	61,1 (53,4-68,8)	94,9 (91,4-98,4)	94,9 (91,4-98,4)	61,1 (53,4-68,8)

Se\*95%CI

- 95% confidence interval, NPV - negative predictive value, PPV - positive predictive value, sensitivity, specificity and predictive value of FAST.

**Conclusion:** Positive result of FAST in patients with open injuries clearly indicates a penetrating character of the wounds. A negative ultrasound result does not exclude serious internal organ injuries, and therefore such patients require further observation and instrumental investigations.

## PENETRATING CARDIAC INJURIES IN THE 21<sup>ST</sup> CENTURY: HAS SURVIVAL IMPROVED?

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**Introduction:** Penetrating cardiac injuries (PCI) are often fatal despite rapid pre-hospital care. Although many studies have identified risk factors for mortality, few studies have included non-transported field mortalities, and none published in the 21<sup>st</sup> century. This study analyzes penetrating cardiac injuries including hospital and coroner reports in the current era.

**Methods:** 17-years of records were reviewed, including trauma center (TC) registry, medical records, and coroner reports from 2000-2016. Identified PCI was graded using the AAST cardiac organ injury score (COIS). Subjects were divided into three groups: field deaths, hospital deaths, and survived to hospital discharge. The primary outcome is survival to hospital discharge overall and among those transported to the hospital.

**Results:** During the study period, 834 patients were identified, and after excluding 243 for inadequate data, 591 PCI patients were analyzed. Mean age was  $38.1 \pm 17.5$  years, and survivors (n=66) were significantly younger than field deaths (n=359) (32.6 vs. 41.1,  $p < 0.001$ ). Stab wounds (n=173) had improved survival compared to gunshot wounds (n=470) (26.6% vs. 4.3%,  $p < 0.001$ ). COIS grades 4 to 6 (n=602) had lower survival than grades 1 to 3 (n=41) (8.3% vs. 39.0%,  $p < 0.001$ ). Survivors (n=66) had lower median COIS than patients who died in hospital (n=218) (4 vs. 5,  $p < 0.001$ ). Single chamber PCI had higher survival than multiple chamber PCI (13% vs. 5%,  $p = 0.004$ ) (Table 1). Of single chamber injuries, the left ventricle is the most injured (n=177), and right ventricle PCI has the highest survival ( $p < 0.001$ ). Of field deaths, left ventricular injuries had the greatest single chamber mortality (60%), equalling multi-chamber PCI (60%). Overall and hospital survival are similar to previous reports from Campbell et. al and Rhee et. al, who reported overall survival of 2.9% and 19.3% and hospital survival of 50% and 42.7% (Table 2).

**Conclusion:** Survival to both TC evaluation and hospital discharge following PCI is influenced by many factors including age, mechanism, anatomic site, and grade. Despite advances in trauma care, survival has not appreciably improved.

Table 1

	Total	Field Death	Hospital Death	Surv to Hosp Disch	p-value†
OVERALL	591	313 (53%)	212 (36%)	66 (11%)	
Pericardial Injury	18	2 (11%)	7 (39%)	9 (50%)	<0.001‡
Left Ventricle	177	106 (60%)	60 (34%)	11 (6%)	<0.001°
Right Ventricle	119	43 (36%)	46 (39%)	30 (25%)	<0.001°
Left Atrium	29	17 (59%)	10 (34%)	2 (7%)	0.335°
Right Atrium	48	26 (54%)	18 (38%)	4 (8%)	0.34°
Single Chamber	373	192 (51%)	134 (36%)	47 (13%)	0.004‡
Multiple Chambers	200	119 (60%)	71 (35%)	10 (5%)	
2 Chambers	161	89 (55%)	63 (39%)	9 (6%)	0.015°
3 or 4 Chambers	39	30 (77%)	8 (21%)	1 (2%)	0.063°

Table 2

	Campbell et. al	Rhee et. al	Current Study
Total Patients	1198	212	591
Field Deaths	1128 (94%)	116 (55%)	313 (53%)
Hospital Deaths	35 (3%)	55 (26%)	212 (36%)
Survived	35 (3%)	41 (19%)	66 (11%)

†Comparing survivors vs. hospital+field deaths, for each row

‡Chi-square vs. all other PCI

°Chi-square vs. all other single-chamber PCI

¶Chi-square vs. all other PCI excluding pericardial injuries (n=573)

‡Chi-square vs. single chamber PCI

## **PREDICTORS FOR RETAINED HEMOTHORAX AMONG PATIENTS WITH PENETRATING THORACIC INJURIES**

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**Introduction:** Tube thoracostomy (TT) is the most common procedure for thoracic trauma. Retained hemothorax (RH) is a frequent complication in patients requiring a TT after penetrating trauma. It is associated with higher risk of empyema, prolonged length of stay and increasing costs. Risk factors of RH have been poorly studied in subjects with TT after penetrating chest trauma (PCT). We aimed to investigate clinical predictors of retained hemothorax among patients with penetrating thoracic injuries.

**Methods:** We conducted an observational study of 324 patients with PCT who required a TT within the first 48 hours from injury. Patients admitted to the emergency department in shock, who required an emergent or urgent thoracotomy, or those who were transferred or died within 48 hours after the injury, were excluded. Demographics, injury characteristics, and clinical and surgical information were prospectively collected during hospitalization. Retained hemothorax was defined as blood in the pleural cavity observed on X-ray or computed tomography scan that could not be drained through the TT and required surgical intervention (thoracotomy or video-assisted thoracoscopy). Predictors for RH were assessed using stepwise logistic regressions.

**Results:** Retained hemothorax was observed in 41 (12.6%) patients. The final regression model indicated that total drainage greater than 750mL (odds ratio [OR], 2.00; 95% confidence interval [CI], 1.41-2.81) and changing tube procedures (OR, 4.62; 95%CI, 1.68-12.7) were independent risk factor of retained hemothorax. Patients who underwent laparotomies were at lower risk of developing retained hemothorax (OR, 0.05; 95%CI, 0.00-0.47). Injury severity, delay in the TT insertion and the requirement of two or more chest tubes were not independent predictors of RH.

**Conclusion:** In patients with PCT, emphasis on continuous quantification of pleural drainage and proper chest tube placement are important factors for reducing the risk of RH. Improved pain management and chest physiotherapy after abdominal surgery may in part explain the reduced risk of RH after laparotomy.

## A STUDY OF POST-OPERATIVE COMPLICATIONS IN AN EMERGENCY GENERAL SURGERY FIRM IN 2017

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**Introduction:** The aim of this study was to provide a basic statistical assessment of the post-operative complications within a 30-day period of a local emergency general surgery firm using the Clavien-Dindo classification. The data collected pertains to all surgeries performed by this surgical firm over the course of 2017.

**Methods:** Trainees working in this firm were responsible for data collection. Every patient who underwent emergency surgery during the calendar year of 2017 had the following details collected - the presence or absence of a complication in the 30-day post-operative period, the type of complication and description of complication along with the grade of the complication (see Fig 1.) and the total number of complications for any given patient were documented. Patients who underwent intermediate to major surgery were followed up at outpatients and were specifically asked for the occurrence of complications from the point of discharge up until the outpatient appointment. With one centralised national hospital - the people who were discharged and subsequently experienced considerable or major complications invariably represented back to hospital via the A&E department. Some patients kept in touch giving verbal feedback and the rest were contacted and asked for any post-operative complications after discharge within this 30-day period.

I	Any deviation from the normal postoperative course without need of intervention beyond the administration of antiemetics, antipyretics, analgesics, diuretics, electrolytes and physiotherapy.
II	Complications requiring pharmacological treatment with other medicines beyond the ones used for the complications of degree I.
III	Complications requiring surgical, endoscopic or radiological intervention
	IIIa Without general anaesthesia   IIIb Under general anaesthesia
IV	Life-threatening complication requiring admission to ITU
	IVa Single organ dysfunction (including dialysis)   IVb Multi-organ dysfunction
V	Death

Fig.1 - Severity Scale of Complications of Clavien-Dindo Classification

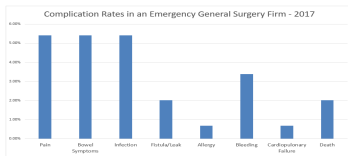


Figure 1. Complication rates for 2017 year of 2017

**Results:** A total of 148 emergency surgeries were performed by this surgical firm in 2017. Of these 148 cases – 29 patients experienced post-operative complications within the first 30 days after their procedure. This equated to a complication rate of 19.59%. 24 of the 29 patients experienced just one complication, whilst the other five patients

experienced two complications from the same procedure. Thus, giving a total of 34 complications for all the surgeries performed by this firm in 2017. The most common complications were abdominal pain, nausea & vomiting, and wound infection. There were 8 complications for each of these 3 categories. Post-operative bleeding occurred in 5 cases with fistulas or leak of an anastomosis occurring in 3 cases. Death of a patient occurred in 3 instances once as a result of post-operative bleeding from the site of anastomosis after a Whipple's procedure, the 2nd occurred subsequent to post-operative bleeding from a peptic ulcer and in the 3rd case occurred in an instance of faecal peritonitis as a result of anastomotic failure after a Roux-en-Y bypass for a patient with pancreatic malignancy.

**Conclusion:** The Clavien-Dindo classification proved to be simple, efficient and useful in analysing post-operative outcomes. The results of this study prove that despite that the vast proportion of emergency cases in a predominantly elderly cohort at times going laparoscopic or minimally invasive surgery – the complication rates were similar to other foreign studies who had younger cohorts undergoing elective surgery.

## COMPLICATION RATES IN EMERGENT VERSUS DELAYED SURGICAL INTERVENTION FOR ACUTE CHOLECYSTITIS – A RETROSPECTIVE REVIEW

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**Introduction:** The last several years have seen considerable enthusiasm endorsing the adoption of clinical pathways recommending early cholecystectomy for patients presenting with complicated gallstone disease. We evaluated the differences between “Emergent” (operation performed on the initial hospital admission) versus “Delayed” (operation scheduled for and performed at a later date) for acute cholecystitis over a 7.5-year period.

**Methods:** Patients who underwent cholecystectomy for acute cholecystitis from June 2010 to December 2017 were identified using our tertiary referral center’s acute care surgery registry and operative logs. Their cases were reviewed retrospectively from electronic medical records. Comparisons were analyzed with chi-square testing.

**Results:** Three hundred twenty-nine patients with acute cholecystitis were treated surgically on their initial encounter. Conversely, 107 patients presenting with acute cholecystitis were initially treated non-operatively and underwent a delayed cholecystectomy. There were 77 (23.4%) Emergent patients that developed intra- or post-op complications (including 7 deaths) and 13 (12.1%) complicated cases in the Delayed group (no deaths). In addition to deaths, the complications identified include common bile duct injuries, bile leaks, retained stones, abscesses, and reoperation for hemorrhage. The difference in complication rates between the Emergent group (23.4%) and the Delayed group (12.1%) was statistically significant ( $p=0.012$ ,  $\chi^2$ ).

**Conclusion:** Our observations of significant surgical complications in patients undergoing early cholecystectomy for acute cholecystitis support a selective approach to surgery for complicated gallstone disease. Efforts should be made to identify patients at greatest risk for perioperative complications, especially death.

## **DOES THE "HALO EFFECT" OF TRAUMA CENTER DESIGNATION EXTEND TO SEVERE POSTPARTUM HEMORRHAGE? A FOUR YEAR RETROSPECTIVE REVIEW OF LEVEL 1 TRAUMA CENTERS IN AMERICA**

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**Introduction:** High quality trauma services have been shown to improve outcomes of trauma patients. This “halo effect” has been shown to extend to patients with nontrauma surgical conditions such as ruptured abdominal aortic aneurysms. However, it remains unclear if this benefit is generalizable to other populations. We hypothesize that the discrepancy in outcomes in prior studies is related to the populations studied; specifically, that the “halo effect” of trauma centers encompasses noninjured patients in hemorrhagic shock. The aim of this study is to assess the impact of level 1 trauma center designation on outcomes for patients with severe postpartum hemorrhage (PPH).

**Methods:** The Nationwide Inpatient Sample for years 2008 to 2011 was reviewed. Patients with severe PPH were identified with a diagnosis code for postpartum hemorrhage requiring transfusion, hysterectomy, or surgical repair of the uterus. Trauma patients and patients transferred from other institutions were excluded. Hospitals were dichotomized into level 1 trauma centers (TC) versus non-level 1 trauma centers (NTC) by linking the American Hospital Association Annual Survey. Hospital and patient level covariates were evaluated including the Obstetric Comorbidity Index (OCI), a validated index used to predict maternal end-organ damage and mortality. Primary outcomes were end-organ injury or death. Multivariate logistic regression analysis was performed and potential confounders were included if univariate analysis showed  $p < 0.10$ .

**Results:** 11,135 patients were admitted with a diagnosis of severe PPH. The majority were hospitalized at NTC rather than TC (71.4% vs. 28.6%). Patients at NTC were younger, more likely to be white, admitted electively, insured, and healthier at baseline with a lower mean OCI (1.3 vs. 1.7;  $p < 0.0001$ ). Patients at TC had higher rates of preeclampsia, congenital heart disease, sickle cell disease, multiple gestation, systemic lupus erythematosus, human immunodeficiency virus, placenta previa, hypertension, previous cesarean delivery, asthma, and diabetes mellitus. Overall inpatient mortality was less than 1% with no statistical difference between rates at NTC and TC. There was also no significant difference in rates of organ failure. However, after adjustment for differences in OCI, race, emergency admission status, patients at NTC had a significantly higher risk of respiratory failure (OR, 1.27; 95% CI, 1.01-1.59). The overall risk of either end organ failure or death, although not significantly different, was higher at NTC (OR, 1.11; 95% CI, 0.95-1.3).

**Conclusion:** We have found that in the care of patients with severe postpartum hemorrhage, level 1 trauma centers care for patients with an overall higher maternal comorbidity index. When adjusted for this and other confounders, patients at TC had improved respiratory outcomes. These patients also tended to have a lower, though not statistically significant, risk of acute maternal end-organ injury when compared to patients at NTC. These findings suggest that improvements in the care of patients at trauma centers may be transferable to non-trauma patients, and achievement of trauma center designation may indirectly improve the level of care provided to patients with severe PPH.

## **SURGICAL RESCUE IN A MAJOR HIGH VOLUME URBAN EMERGENCY GENERAL SURGERY (EGS) SERVICE USING AN ELECTRONIC AUTOMATIC EMERGENCY GENERAL SURGERY REGISTRY**

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**Introduction:** Postoperative mortality is impacted by the speed and proper interventions implemented by an acute care surgeon to “rescue” complicated patients from death. Failure to rescue has been recently regarded as an important indicator of patient’s safety and quality care. In our high surgical volume and low resources institution where there is no option to hire registrars to feed databases, an electronic Emergency General Surgery registry was recently developed to automatically capture in-hospital information and outcomes from the Electronic Medical Record (EMR).

**Objective:** The aim of this study is to describe the incidence of “surgical rescue” and outcomes of the complicated EGS patients at an inner city 1000 beds university major referral center.

**Methods:** A prospective electronic captured EGS (demographic, primary EGS coding, surgical procedures, surgical and outcomes) was used to screen for acute EGS surgical complications of operative procedures from June to July 2017 at a large urban academic medical center in a tertiary care facility. During morning rounds, emergency general surgeons prospectively identified, classified and included surgical complications in an online application that was also automatically captured in the electronic EGS registry. Surgical chart reviewers of complicated patients confirmed and validated the captured data. Only surgical complications requiring surgical procedure in the operating room were included.

**Results:** We identified 496 patients (55 years old  $\pm$  20; 57% female) who underwent to 524 EGS surgical procedures. Most common procedures were: laparoscopic cholecystectomy (25.6%), appendectomy (18.5%), drainage of intraabdominal collection (14.6%), and abdominal exploration (7%). for peritonitis or ischemia Thirteen patients of the 496 patients (2.6%) required “surgical rescue” defined as patients who were immediately intervened after identifying a surgical complication mainly for uncontrolled sepsis (43%) and anastomotic leaks (30%). The most common surgical intervention was source control of the infection (50%), bowel resection or intestinal repair (15%), and bleeding control (15%). Surgical rescue failure rate (inability to prevent death after development of a surgical complication) was 15.4%. Hospital length of stay, need for critical care and in-hospital mortality was higher in the surgical rescue patients compared to those without surgical complications.

**Conclusion:** Surgical failure to rescue rate was higher than similar high volume EGS services recently described. The development and implementation of an electronic automatic captured EGS registry database in our academic medical served to build best practices for “surgical rescue” and to drive quality improvement programs.



## **ESTIMATING THE ECONOMIC BURDEN OF ENTERIC FISTULA AFTER DAMAGE-CONTROL LAPAROTOMIES: A SYSTEMATIC REVIEW AND META-ANALYSIS**

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**Introduction:** Enteric fistula (EF) are a known complication after damage-control laparotomy (DCL) for severe traumatic injury. However, the total economic burden of EF in the United States is unknown. Defining the economic burden of fistula development is needed to provide the foundation for future research, advocacy, and education efforts.

**Methods:** This analysis combined a systematic review of data from the Agency for Healthcare Research and Quality's Healthcare Cost and Utilization Project (HCUP) with a meta-analysis of data from a Level 1 trauma center and a literature review from the PubMed and MEDLINE databases, covering January 1, 2000 through December 31, 2017. We selected data from HCUP by primary diagnosis ICD-9CM codes to determine an annual number of emergent laparotomies in the United States. Since the most recent HCUP data available to us was collected in 2014, we updated its figures to 2017, assuming that the proportion of laparotomy procedures to the U.S. population remained consistent over the three-year period. We then used ratios created from our meta-analysis of past medical studies to determine the number of specific types of laparotomies and their complications, specifically fistula development. Intensive care unit (ICU) and hospital lengths of stay (LOS) for DCL patients with and without fistula were analyzed to generate baseline costs. We then conducted an 80-hospital survey of direct charges for ICU and general ward stays, in conjunction with a ratio of professional to facility charges for patients with an Injury Severity Score  $\geq 18$ , to determine the excess per-patient charges incurred by DCL patients with fistula. Applying those excess charges to the likely annual nationwide number of fistula developed, we then calculated the total economic burden of fistula development.

**Results:** There were between 13,526 and 19,938 emergent laparotomies in 2017. Of these, between 4,427 and 6,525 (or 32.7%) represented DCL. A fistula complication was likely to have arisen in 322 to 474 (or 7.3%) of these DCL cases. We estimate that the facility and professional charges required to treat DCL patients with EF was \$309,150 versus \$69,929 without EF, and the excess per-patient cost for EF treatment was \$239,211. Nationally, we assess that the total economic burden of enterocutaneous and enteroatmospheric fistula after damage-control laparotomies to be between \$77 million to \$113 million.

**Conclusion:** This analysis fills a knowledge gap in the study of fistula development after DCL. The economic burden of fistula is substantial and significant in the United States.

## **Rhabdomyolysis and acute kidney injury in blunt trauma patients**

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**Introduction:** Rhabdomyolysis (RB), which is a decomposition of skeletal muscles, is common in blunt trauma patients. RB can result in acute kidney injury (AKI) and sometimes it can be life-threatening. The aim of our study is to identify predictors of RB induced AKI from the initial patient information and parameters.

**Methods:** We retrospectively analyzed 727 blunt trauma patients admitted to a single tertiary hospital from January 2014 through December 2017. Patients who had chronic kidney disease previously diagnosed were excluded from the study. RB was defined as a creatine kinase (CK) level equal or greater than 1,000 U/L. The diagnosis of AKI was based on RIFLE criteria.

**Results:** The overall incidence of RB and AKI were 30.4 % (n = 221) and 12.2 % (n = 89), respectively. According to the univariate analysis, peak CK ( $p = 0.045$ ), initial hemoglobin ( $p = 0.010$ ), serum pH ( $p = 0.001$ ), base excess ( $p = 0.001$ ), lactate ( $p = 0.008$ ), calcium ( $p = 0.001$ ), magnesium ( $p = 0.021$ ), ISS score ( $p = 0.016$ ), and ISS of extremity ( $p = 0.017$ ) were showed to be associated with RB induced AKI. And lactate appeared to be related to needs for RRT among RB associated AKI patients ( $p = 0.003$ ). In multivariate analysis initial base excess (Odds ratio (OR) 0.862; 95 % confidence interval (CI) 0.775 - 0.959;  $p = 0.006$ ) and initial serum calcium level (OR 0.563; 95% CI 0.373 - 0.849;  $p = 0.006$ ) were shown to be associated independently with RB induced AKI.

**Conclusion:** Serum CK level is used diagnose RB, but it does not predict RB induced AKI. Low base excess and low serum calcium levels are independently associated with RB induced AKI. And serum lactate level seems to be associated with RRT in RB induced AKI patients.

## NEUROENTERIC AXIS MODULATES THE INTESTINAL CIRCULATION AFTER TRAUMA/HEMORRHAGIC SHOCK

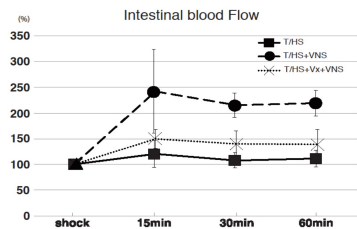
Masayuki Yagi MD, Koji Morishita MD, Ph.D., Akinori Ueno Ph.D., Junichi Aiboshi MD, Ph.D., Hajime Nakamura BS, Hiroya Akabori MD, Ph.D., Mitsuaki Kojima MD, Ph.D., Atsushi Senda MD, Yasuhiro Otomo MD, Ph.D., Tokyo Medical And Dental University

**Introduction:** Gut barrier breakdown causes an intestinal inflammatory response generating the inflammatory mediators. Electrical vagus nerve stimulation (VNS) is known to prevent gut damage in animal models of trauma/hemorrhagic shock (T/HS) by altering the gut inflammatory response to acute injury, independent of the spleen. However, its effect on detailed electrophysiological function of the vagus nerve (VN) to the gut is unknown. Therefore, the aims of this study were: 1) to investigate the action potential of VN induced by VNS, 2) to evaluate the influence of evoked neural activity on the systemic circulation and intestinal blood flow (IBF), 3) to determine whether VNS improve the gut damage after T/HS.

**Methods:** 1) Male Sprague Dawley rats were anesthetized by isoflurane, and cervical and abdominal VN was exposed. One pair of bipolar electrodes were attached the cervical VN to stimulate the VN (square wave, 5V, 5Hz, 20min), and other two pairs of bipolar electrodes to the abdominal VN to measure the VN action potential. After the each VNS, the action potential was detected by threshold processing of band-pass-filtered (200-1000 Hz) recording from the abdominal VN. The mean arterial pressure (MAP) and heart rate (HR) were measured simultaneously. 2) Rats were randomly assigned to undergo T/HS, T/HS+VNS, or T/HS+Vagotomy (Vx)+VNS. The rats underwent the T/HS (MAP 25 mmHg for 30min) without fluid resuscitation and then received cervical VNS. A separate cohort of animals was subjected to abdominal Vx to disrupt the neuroenteric axis. The IBF was measured by laser Doppler flowmetry. The gut was harvested to evaluate the gut injury.

**Results:** 1) The action potential was identified around the time point of  $40 \pm 12$  msec after each stimulus of VN in the normal condition. 2) VNS caused an approximately 3.2-fold increase in the IBF in comparison to shock phase ( $p < 0.05$ ). Abdominal Vx eliminated the effect of VNS on the IBF ( $p < 0.05$ ). The BP and HR were decreased for several seconds immediately after VNS, but the BP then rapidly increased from 25.2 mmHg to 52.1 (34.2-62.8 mmHg) and the HR showed a slight increase. 3) Performing VNS is tend to protect T/HS induced gut injury (MPO activity).

**Conclusion:** VNS causes VN action potential and improves the T/HS-induced IBF impairment. VNS may have a therapeutic impact on acute gut injury after T/HS.



## **INCIDENCE OF ACUTE RESPIRATORY DISTRESS SYNDROME AND ASSOCIATED MORTALITY IN A POLYTRAUMA POPULATION**

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Invited Discussant:

### **Introduction**

The incidence of Adult Respiratory Distress Syndrome (ARDS) has decreased in the last decades by improvement in trauma and critical care. However, it still remains a major cause of morbidity and mortality. This study investigated the current incidence of ARDS and its relation to mortality in polytrauma patients.

### **Methods**

A 4-year prospective study included consecutive trauma patients admitted to a Level-1 Trauma Center ICU. Isolated head injuries, drowning, asphyxiation and burns were excluded. Demographics, ISS, physiologic parameters, resuscitation parameters, Denver Multiple Organ Failure (MOF) scores and ARDS data according to Berlin criteria were prospectively collected. Only severe ARDS ( $\text{PaO}_2/\text{FiO}_2$  ratio < 100) was included in analysis. Data are presented as median (IQR),  $p < 0.05$  was considered significant.

### **Results**

222 patients were included. Median age was 47 (28-60) years, 169 males (76%), ISS was 29 (22-37), 212 (95%) patients had blunt injuries. Forty-two patients (19%) died, 36 due to brain and/or spinal cord injuries (86%). Twenty-eight patients (13%) developed severe ARDS. Median time to ARDS onset was 2 (1-4) days after injury. Median duration of ARDS was 1 (1-2) day. Only 3 patients (11%) had ARDS for more than 3 consecutive days. No patient died of ARDS. Four patients who developed ARDS later died of CNS related injuries. Patients who developed ARDS had lower ISS (28 vs. 29,  $p=0.04$ ) lower  $\text{PaO}_2$  in ED (182 vs. 223 mmHg,  $p=0.005$ ), and lower saturation in ICU (97 vs. 98%,  $p=0.002$ ). Further, they stayed longer on the ventilator (12 vs. 6 days,  $p=0.000$ ), longer in ICU (16 vs. 7 days,  $p=0.000$ ) and in hospital (31 vs. 21 days,  $p=0.000$ ) and developed more often Multiple Organ Dysfunction Syndrome (MODS 71% vs. 20%,  $p=0.000$ ). There was however no difference in mortality between both groups (14% in ARDS vs. 20% in non-ARDS,  $p=0.61$ ).

### **Conclusion**

In this polytrauma population mortality was predominantly caused by brain injury. Although ARDS was still present in severely injured polytrauma patients, no patient died of ARDS. Its presentation was only early onset, and during a short time period.

**DISRUPT THE COUPLING BETWEEN IL-1R1 AND NECROSOME PROTECT THE HEMIN-EVOKED NEURON CELL DEATH AFTER ICH**

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Invited Discussant:

**Background and Purposes-** Accumulated evidence suggests that hemin—a breakdown product of hemoglobin plays a pivotal role in inflammatory injury in hemorrhagic stroke through TLR2-TLR4 signal pathway. However, no significant improvement has been found when blocking the TLR2-TLR4 signaling pathway. Hence, further detail mechanism of how hemin triggers neuron cell death directly following ICH is waiting to explore. As preclinical studies and animal researches have demonstrated the recombinant IL-1 receptor antagonist (IL-1RA) improves clinical outcome in stroke, we here investigated the mechanism of how IL-1RA exerts protection in hemin induced neuronal necrosis after ICH.

**Methods-** ICH model was induced by hemin injection in C57BL/6 mice and IL-1R1<sup>-/-</sup> mice. We also used primary cultured neurons to assess hemin induced cell death. IL-1RA was administrated 1h before hemin application in cultures. Co-IP, immunoblot, immunofluorescence immunostaining, neurological deficit scores and brain water content were used to study the mechanisms of IL-1R1 neuroprotective effects both in vitro and in vivo.

**Results-** Free hemin that released from hemoglobin mediated neuronal cell death directly by assemble of necrosome complex. The activated necrosome further translocated to the cell membrane to disrupt the membrane integrity, and then induce neuron cell death. This phenomenon was driven by IL-1R1 as IL-1R1 can form a complex with necrosome both in vivo and in vitro. After treatment with IL-1RA, the expression of necrosome had been depressed, and its translocation also been blocked. In addition increased neuron survival had been gained when the interaction between IL-1R1 and receptor interacting protein 1/3 (RIP1/RIP3) has been disrupted. Additionally, our results showed that the IL-1R1 deficient mice presented less expression of HO-1 induced by hemin, and lower concentrations of necrosome components including RIP1, RIP3 and MLKL compared with control mice after ICH. Furthermore, the neurological deficit scores, brain water content and inflammatory response were also reduced in the IL-1R1 deficient mice after ICH.

**Conclusions-** Functional inhibition of the interaction between IL-1R1 and necrosome can improve neuron survival and promote the recovery of brain function in the model of ICH. Targeting IL-1R1/RIP1/RIP3 assemble could be a promising therapeutic strategy for ICH.

**STUDY OF SERUM COPPER LEVELS IN CONSERVATIVELY MANAGED HEAD INJURY PATIENTS WITH SPECIAL REFERENCE TO ITS SEVERITY AND OUTCOME.**

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**Introduction:** Head injury is most common cause of death and disability in mechanically injured patients. Trace metals like copper is known to have its impact in traumatic brain injury. This study was conducted to observe impact of serum copper levels in traumatic brain injury and its correlation with severity and outcome.

**Methods:** It is a prospective cohort study. Blood samples were collected within eight hours of injury and serum copper was estimated by atomic absorption spectrophotometer after its complete digestion by microwave digester. Patients were subsequently followed up clinically with repeat serum copper estimation on day 5 and day 10. Levels in cases and controls as well as that in moderate and severe head injury patients on day 0, day 5 and day 10 were compared using paired t-test. The  $p$ -value $<0.05$  was considered as significant. All analysis was carried out by using SPSS 24.0 version.

**Results:** The results are presented in mean $\pm$ sd. Serum copper levels were found to be significantly low in patients of severe head injury ( $p<0.001$ ). Patients with persistent low levels of serum copper had poor recovery in GCS ( $P<0.05$ )

**Conclusion:** Study showed primary evidence of a relationship between severity and serum copper levels in traumatic brain injury patients. Association of persistent low level with poor outcome opens new area of research to study recovery pattern with additive therapy of copper in severe head injury patients.

**IMPACT OF THE RESUSCITATIVE ENDOVASCULAR BALLOON OCCLUSION OF THE AORTA (REBOA) ON MORTALITY IN PENETRATING TRAUMA PATIENTS: A PROPENSITY SCORE ANALYSIS.**

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**Introduction:** The use of endovascular balloon occlusion of the aorta (REBOA) as an ancillary method in damage control resuscitation (DCR) for trauma has been reported mostly on blunt injuries. Information on penetrating trauma is limited and the effect on mortality is not known. We compared in-hospital mortality between penetrating trauma patients managed with and without REBOA, adjusted by a propensity score.

**Methods:** In a retrospective cohort study, patients 16 years or older with penetrating trauma, requiring DCR and emergent surgery, and treated between 2014 and 2017, were included. The decision to use or not REBOA during emergent surgery was based on individual surgeon opinion. A propensity score (PS) was built adjusting for age, clinical signs on admission (systolic blood pressure, cardiac rate, Glasgow coma scale), severe trauma in thorax and abdomen, and the presence of non-compressive torso hemorrhage. PS attempted to approximate the conditions of random assignment of REBOA for treatment, in patients who had a similar distribution of covariates. Main analysis compared mortality between patients with and without REBOA. Final logistic regression for mortality was adjusted for the number of red blood cells (RBC) transfused within the first six hours after admission, injury severity score (ISS), and quintiles of PS.

**Results:** Inclusion criteria were met by 345 patients; 28 of them (8.1%) were treated with REBOA. Crude mortality rates were 17.8% (5 patients) in REBOA group and 15.4% (49 patients) in control group ( $p=0.785$ ). After controlling for RBC transfused, ISS, and PS, the odds of death in REBOA group was 78% lower than in the control group (odds ratio [OR] 0.22, 95% confidence interval [95%CI] 0.05-0.84,  $p=0.028$ ). This regression model demonstrated excellent discrimination (area under the curve of 0.81) and adequate calibration ( $p=0.097$ ).

**Conclusion:** After adjustment for an anatomic score (ISS), a physiologic indicator of blood loss (number of RBC transfused), and quintiles of PS, the use of REBOA showed a significant reduction in the odds of mortality, compared with no REBOA use. It suggests that, in selected penetrating trauma patients who are suffering severe injuries and physiologic exhaustion, the use of REBOA might add to the survival, as an adjuvant of DCR protocols.

## INTERPERSONAL VIOLENCE AND MORTALITY IN PEACETIME SUB-SAHARAN AFRICA

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**Introduction:** Trauma is a leading cause of death and disability worldwide. Interpersonal violence has often been overlooked as a significant cause of traumatic injury and mortality. We hypothesized characteristics differed between victims of interpersonal violence and unintentional injuries in Sub-Saharan. We also sought to identify factors associated with mortality.

**Methods:** We compared characteristics of all injured patients in the trauma registry at Kamuzu Central Hospital, Lilongwe, Malawi, from 2009 through 2016. Multivariable Poisson regression was used to identify factors associated with inpatient mortality after interpersonal violence.

**Results:** Of 109,422 trauma patients, 26,829 (24.5%) were victims of interpersonal violence. Compared to unintentional injuries, alcohol was more frequently used by assault victims (15.7% vs 2.9%,  $p < 0.001$ ), women comprised fewer assault victims (20.7% vs 29.8%,  $p < 0.001$ ), and assaulted patients were older (median 27yrs vs 21yrs,  $p < 0.001$ ). Most assaults involved penetrating injuries (45.8%). In multivariable analysis, truncal injuries (iRR 7.14, 95%CI 3.74, 13.67) head injuries (iRR 4.36, 95%CI 2.41, 7.90),  $\geq 3$  injured body locations (iRR 2.54, 95%CI 1.71, 3.76), penetrating injuries (iRR 3.52, 95%CI 1.96, 6.34) and blunt tool injuries (iRR 2.27, 95%CI 1.23, 4.18) were associated with increased mortality (Table). For every increased decade of age, mortality risk increased by 17% (iRR 1.17, 95%CI 1.02, 1.33). Women had lower mortality (iRR 0.43, 95%CI 0.24, 0.78).

**Conclusion:** Even in peace times, interpersonal violence accounts for a large percentage of Malawi's trauma burden. Significant risk factors for mortality are penetrating and blunt tool injuries to the torso, thus improving surgical capacity is essential to reducing homicides.

Characteristics	Patients n (%)	iRR	95% CI	p-value
Extremity injury	7,178 (27)	ref	---	---
Head injury	15,153 (57)	4.36	2.41 – 7.91	< 0.001
Torso injury	4,248 (16)	7.15	3.74 – 13.67	< 0.001
1 injured body regions	15,606 (57)	ref	---	---
2 injured body regions	8,855 (33)	1.37	0.97 – 1.93	0.07
$\geq 3$ injured body regions	2,797 (10)	2.54	1.71 – 3.76	< 0.001
Punches and kicks	2,691 (21)	ref	---	---
Blunt tool	4,255 (33)	2.27	1.22 – 4.18	0.009
Penetrating tool	5,862 (46)	3.53	1.96 – 6.34	< 0.001



## **THE SPECTRUM OF INJURIES RESULTING FROM GUNSHOT WOUNDS IN CAR HIJACKING: A SOUTH AFRICAN EXPERIENCE**

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**Introduction:** Car hijacking is aggravated robbery of a vehicle from the driver that usually involves the use of a firearm. South Africa has the highest rate in the world. However, there is little literature on the spectrum of GSW (gunshot wounds) sustained by victims of car hijacking.

**Methods:** A retrospective review was conducted over the 8-year period from January 2010 to January 2018 at a Major Trauma Centre in South Africa. All patients who sustained GSW following a carjacking incident were included.

**Results:** 101 patients were identified (74% male, mean age: 34 years). The mean time from injury to arrival was 7 hrs (rural district: 10 hrs, urban district, 4 hrs,  $p < 0.001$ ). Seventy-five percent (75/101) of all patients sustained GSW to multiple body regions, while the remaining 25% (25/101) were confined to a single body region. The most common region involved was the chest (48) followed by the abdomen (46) and neck (34). 62% of patients required one or more operative intervention. The most common procedure was laparotomy (28), followed by peripheral vascular exploration (20) and neck (14) exploration. Eighteen percent require intensive care admission, the mean length of hospital stay was 8 days. The overall morbidity was 13% (16/101) and the overall mortality was 18% (18/101).

**Conclusion:** The majority of victims sustained multi-regional GSWs and two-third require surgery, with a high mortality. Trans-axial GSW of the torso is common and can be challenging to manage.

## **CORRELATION BETWEEN QUALITY AUDIT FILTERS AND SEVERITY OF TRAUMA**

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**Introduction:** trauma is a frequent problem, which often requires prompt diagnosis and treatment. The stress and the complexity present in some cases create a situation in which errors are more likely to occur. Trauma audit filters were proposed as variables able to identify opportunities to improve patient's care. However, the role of audit filters as adequate tools for quality improvement programs has been recently questioned. The objective of this study was to assess the correlation between the most frequently used audit filters (AF) and the severity of trauma.

**Methods:** We carried out a retrospective analysis of the trauma registry data, including adult patients admitted from 2014 to 2015. Severity of the trauma was assessed by *Abbreviated Injury Scale (AIS)*, *Revised Trauma Score (RTS)*, *Injury Severity Score (ISS)* e *TRISS*. We selected ten AF frequently used in quality improvement programs: F1: Acute subdural hematoma drained after 4 hs. of admission. F2: transfer a patient with GCS<8 without a definitive airway. F3: tracheal reintubation <48 hs. of planned extubation. F4: time between admission and laparotomy > 60 min. in unstable patients. F5: unplanned reoperation. F6: laparotomy after 4 hs. of admission. F7: no fixation of femur diaphysis fracture. F8: nonoperative management of abdominal GSW. F9: time between admission and operative treatment of open tibial fracture greater than 6 hs. F10: operation after 24hs. of admission. We compared trauma indexes between patients with and without AF. We used chi-square and Fisher's exact tests, considering  $p<0.05$  as significant.

**Results:** 663 patients were included, with mean age of  $39 \pm 9$  years. Mean RTS, ISS and TRISS were, respectively,  $6.7 \pm 1.4$ ;  $6.8 \pm 11.3$  e  $0.90 \pm 0.20$ . AF were present in 39 patients (5.9%), including 10 of the 498 patients with ISS<10 (2.0%), 3 of the 26 with ISS between 10 and 15 (11.5%), 14 of the 63 with ISS between 16 and 25 (16.9%) and 12 of the 43 with ISS>25 (27.9%) ( $p<0.05$ ). In patients sustaining severe injuries in head, thorax, abdomen and extremities, AF were, respectively, 21, 16, 17 and 9 times more frequent.

**Conclusion:** These data show a correlation between AF and trauma severity. This might indicate that the more severe is the trauma, the higher is the risk for mistakes.

**MORBIDITY, MORTALITY AND HEALTHCARE COST DUE TO INJURY FROM VENOMOUS AND NON-VENOMOUS ANIMALS IN THE UNITED STATES: 5-YEAR ANALYSIS OF THE NATIONAL EMERGENCY DEPARTMENT SAMPLE**

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**Introduction:** Injuries due to encounters with animals can be serious, but are often discussed anecdotally or only for isolated types of encounters. The burden of animal-related injuries is currently unexplored. We sought to characterize animal-related injuries on U.S. emergency departments (ED) to determine the impact of these types of injuries.

**Methods:** All ED encounters with the diagnosis code corresponding to an animal-related injury were identified using ICD-9-CM codes from the 2010-2014 National Emergency Department Sample (NEDS). The primary outcome was mortality; secondary outcomes included costs and inpatient admission. Survey methodology was applied to univariate and multivariate analyses. Weighted numbers are presented.

**Results:** A total of 6,457,534 ED visits resulting from animal-related injuries were identified, averaging 1,291,507 visits annually. This corresponded to 19 animal-related injuries per 10,000 patient-ED visits per year. Common animal-related injuries were associated with bites from non-venomous arthropods (n=2,648,880; 41%), followed by dogs (n=1,660,878; 26%), and envenomation from hornets, wasps or bees (n=813,649; 13%). A total of 210,516 patients (3%) were admitted. Inpatient admission was the most common for those who sustained bites from venomous snakes or lizards (24%, N=10,332). Death was infrequent, occurring in 1,162 patients (0.02% of all ED presentations). The greatest number of deaths were due to bites from non-venomous arthropods (24% of deaths, n=278). Rat bites proved the most lethal (6.5 deaths per 10,000 bites), followed by bites from venomous snakes or lizards (6.4 deaths per 10,000 bites). Dog bites resulted in fatality 6.1 times in 10,000 bites. Factors associated with increasing odds of death were age>65 years (OR 7.0, P<0.001) and ISS>15 (OR 39.9, P<0.001); female sex was associated with decreased odds of death (OR 0.6, P<0.001). Total healthcare cost due to animal encounters was 5.7 billion dollars (95% confidence interval: 5.4-6.5 billion dollars) over the 5-year time period.

**Conclusion:** The morbidity, mortality, and healthcare cost due to animal encounters in the United States is considerable. Often overlooked, this particular mechanism of injury warrants further public health prevention efforts.

## **DIAGNOSIS AND TREATMENT OF BLUNT ADRENAL GLAND TRAUMA**

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**Introduction:** Frequency of blunt adrenal gland injury (AGI) is less than 1%.

**Methods:** 32 patients with AGI were included in a prospective study. There were 26 men (81.3%) and 6 women (18.7%) 30±12.9 years old with ISS of 22.7±13.6. 28 (87.5%) were delivered to the hospital through 1.3±1 hour after injury, 4 (12.5%) were transferred from 10 till 96 hours. All patients performed FAST during resuscitation. Intensive bleeding from liver or spleen in 10 patients were the indication for urgent laparotomy. One patient performed left thoracotomy and then laparotomy. One of the four transferred performed laparotomy at Level 2 trauma center. Thus 12 victims (37.5%) performed urgent laparotomy, 20 (62.5%) were treated without operation. US of the abdominal cavity and the abdominal CT with intravenous contrast enhancement were performed. In case of conservative treatment US and CT have been repeated.

**Results:** Thirty victims were found to have right AGI, 1 - left and 1 - both. The V degree of AGI was found in 30 victims, IV and III – in one. Most often, the right kidney (10), liver and right kidney (5), liver (3) were damaged with the adrenal gland. AGI hadn't any clinical picture and was found only during US or CT. No one AGI was identified during laparotomy. AGI was found by US in 27 victims (84.4%). Direct US sign was the appearance of oval hypoechoic mass with a clear border and size less than 50x40 mm without blood flow. AGI suggested when injury of right kidney, liver segment VII and right perirenal hematoma were identified. The more indirect signs had been found, the more likely AGI was. The accuracy of US diagnosis of AGI increased with repeated trials a day from the time of injury. An important difference of AGI from tumor was gradual regression of US signs and return to a normal picture in the fourth week. AGI was found by CT in 31 patients (96.9%). An oval high density mass with clear borders less than 57x31 mm was found. On the 3rd day the gland became heterogeneous due to the appearance of low-density areas. By the 14th day adrenal gland density became normal. Only the absence of contrast medium accumulation allowed to recognise AGI from tumor. The AGI size decreased from the third week and the structure and size became normal to 1.5-2 months. Bleeding from the adrenal gland in all cases stopped spontaneously. Clinical manifestations of adrenal insufficiency wasn't observed. Thirty one victims recovered, one died from severe traumatic brain injury.

**Conclusion:** Blunt adrenal gland injury had no characteristic clinical picture, however, clearly revealed by US and CT. Conservative therapy was effective in all cases.

### **Damage Control Indication for Severe Blunt Trauma Injuries in Japan**

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**Introduction:** There are many arguments regarding the criteria for damage control surgery (DCS). Previously, we analyzed the data from Japan Trauma Data Bank (JTDB) and created a score for damage control surgery (Damage Control Indication Detecting score; DECIDE score), comprised of body temperature, Glasgow Coma Scale (GCS) and type of injury (blunt or penetrating). Considering trauma in Japan is mostly blunt injuries, as gun-shot wounds are seldom in Japan, we sought for a new criterion for DCS focusing on blunt injuries.

**Methods:** Retrospective data from JTDB from 2004-2014 were used to analyze blunt trauma patients who were FAST positive and underwent emergency laparotomy. We excluded burn victim patients and patients with ISS=75. Primarily, we performed a baseline characteristic analysis between the DCS group and non-DCS group. Then, we performed a logistic regression analysis and created a prediction score for damage control surgery.

**Results:** Of the 159157 registered trauma patients, 1934 blunt trauma patients who were FAST positive and underwent emergency laparotomy were extracted. We compared the 364 patients that underwent DCS (DCS group) to the 1570 patients who underwent typical laparotomy (non-DCS group). Blood pressure, body temperature, GCS, blood transfusion rate, Injury Severity Score, time to surgery, and mortality rate were significantly different between the groups. Then, we performed a logistic regression analysis, with DCS as the dependent variable, and age, gender, head AIS, ISS, GCS, body temperature, and blood pressure as the independent variables. Blood pressure, GCS, and body temperature were independent risk factors for DCS. Following the analysis, we categorized the risk variables, and created the DCS prediction score comprised of body temperature (0-2 points), blood pressure (0-1 point) and Glasgow Coma Scale (0-3 points) with a maximum of six points. From this score, we performed a receiver operating characteristic (ROC) analysis. Area under the ROC curve was 0.704, and cut-off value of three points showed sensitivity of 68% and specificity of 63%. Furthermore, we used the data from JTDB 2015 to validate our score. The proposed score showed legitimate sensitivity and specificity for Damage Control Surgery as well as mortality.

**Conclusion:** Blood pressure, body temperature, and GCS could be utilized as a legitimate indicator for damage control surgery in Japan.

## **OUTCOMES OF BLUNT ABDOMINAL TRAUMA PATIENTS WITH A FALSE-NEGATIVE FAST SCANNING IN A LEVEL I TRAUMA CENTER**

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**Introduction:** Focused assessment with sonography for trauma (FAST), is the initial diagnostic modality of choice for the assessment of blunt abdominal trauma and was adopted in the Advanced Trauma Life Support (ATLS) protocol by American College of Surgeons. Despite widespread use, there are ongoing debates regarding the accuracy of FAST and the interpretation of false-negative results. Here we determine whether negative FAST studies can rule out abdominal injuries.

**Methods:** A retrospective study was carried out between October 2008 and October 2013 on 11,924 patients admitted to our Level I Trauma Center who received a FAST examination. Free fluid in RUQ, LUQ or pelvis was considered "positive FAST." Abdominal CT and/or exploratory laparotomy were considered gold standard confirmation of free fluid. True positive (TP) FAST was defined as positive FAST and presence of free fluid with abdominal CT or surgery. False negative (FN) FAST was absence of free fluid with FAST but presence of free fluid found during abdominal CT or surgery. Multivariable modeling was used to compare TP and FN FAST results and outcomes of FN FAST patients.

**Results:** The study population comprised 9973 patients that sustained blunt abdominal trauma, the majority of them being male (72.4%). Mean age was 38.5 years, median hospital LOS was 9.52 days, injury severity score (ISS) was 11.9 and 7,767 (79.47%) cases were discharged home without any sequela. FAST positive (+), FAST negative (-), and FAST undetermined were; 358 (3.6%), 9172 (93.8%) and 242 (2.47%), respectively. FN FAST was 312 (3.4%) of total FAST (-) patients, and TP FAST group was 319 (89.1%) of total FAST (+) patients. Sensitivity was 50.55% (95% CI [46.58%-54.52%]) and specificity was 99.56% (95% CI [99.40%-99.69%]). True LOS was increased for FN FAST by a factor of 2 ( $p < 0.0001$ ), but hospital LOS, ICU days, morbidity, and discharge status were similar between TP and FN.

**Conclusion:** FAST has a low sensitivity (50.5%) for evaluation of blunt abdominal trauma, and FN FAST results in prolonged LOS due to additional imaging methods and/or serial abdominal examinations. Although FAST (+) predicts abdominal injury, FAST (-) does not exclude abdominal injury.

## **HOLLOW VISCOUS ORGAN INJURY IN BLUNT ABDOMINAL TRAUMA- CHALLENGES IN TRAUMA BAY**

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**Introduction:** Trauma is fast becoming the leading cause of mortality and morbidity in the young population of the globe. Amongst all the causes of trauma like road traffic incidence, falls and penetrating injuries, trauma surgeons tend to broadly categorize trauma in two broad categories – blunt injuries and penetrating injuries. Most of the victims, who suffer from multiple injuries, experience both types of mechanism of injury and land up in the trauma bay. But by far, blunt injuries are more common than penetrating forces. Blunt injury abdomen are challenging in both, presentation and management. It is also quite challenging to understand and reconstruct the event in reference to the mechanism of injury to predict intraabdominal injuries.

**Methods:** Total 824 patients with blunt injury abdomen were admitted to the department of trauma surgery, KGMU, UP, Lucknow, India. A retrospective observational study was conducted in regard to the mechanism of injury, presentation and operative findings.

**Results:** 326 patients were managed by surgical intervention and 499 patients by nonoperative measures. Out of 326 patients, who landed in OR, 96 patients of solid visceral organ injuries were treated. 227 patients presented with hollow visceral injuries and only 128 patients required early operative management. 99 patients with blunt abdominal trauma presented late, either in our department or were transferred from other hospitals.

**Conclusion:** We studied the basic mechanism of injuries and presentation of the patients, and concluded that hollow viscous injuries may delay in presentation, symptomatically. We called this delay as the lucid interval of presentation. The varied mechanism involved in blunt abdominal trauma may obstruct the reconstruction of events. These may masquerade or even hide symptom of intra-abdominal injuries, which may present late. Patients may attend the trauma bay late and even land up in shock, which becomes challenging to manage. The overuse of antibiotics and analgesics may keep an operative patient out of OR and initial protocol management may tilt towards non-operative management. Late bowel perforations and mesenteric tear leading to gangrene of bowel segments may delay symptomatic presentation. Injuries to urinary bladder, gall bladder, previously undetected ovarian cyst, mesenteric cyst, and gravid uterus etc may present late in course of blunt abdominal trauma, and a high index of suspicion and serial clinical and radiological examination are the keys for successful management of these patients. The patients who presented late had a prolonged hospital stay and high incidence of morbidity and mortality.

**EVALUATION OF THE SELECTIVE USE OF CONTRAST-ENHANCED  
COMPUTED TOMOGRAPHY IN CLOSED ABDOMINAL TRAUMA**

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SOROCABA

In order to reduce the dose of radiation and contrast-induced nephropathy, we suggest the use of contrast-free Computer Tomography (CT) as the initial evaluation form, and selective indication of intravenous (iv) and oral contrast.

We retrospectively evaluated 86 exams of patients attended in the ER with a history of closed abdominal trauma who underwent tomography in the current protocol, noncontrast phase, phase with iv contrast and late phase.

We evaluated the noncontrast phase of these exams and then suggested the use of contrast, so that we could evaluate all CTs in the following phases.

As a result we had 86 exams, 12(14%) which had indication to use contrast ev and 8(0,09%) to use oral contrast (6 (0,07%) had indication to ev and oral contrast). The main doubt in these exams was hollow viscera lesion and pancreatic lesions.

Of the 76(88%) CT scans that did not require contrast, only one presented a discrepant diagnosis, however did not compromise the patient's clinical follow-up.

The emergency CT plays an important role in the assessment of blunt abdominal trauma, despite the need for prospective multicenter and randomized studies, in this retrospective study with protocol of evaluation using contrast selectively, the evaluation without contrast presented a great result, and safety. Although CTs with contrast can facilitate the representation of lesions of solid and hollow viscera, CTs without contrast can detect serious lesions effectively, also reducing radiation and possible complications of intravenous contrast.



## **DETERMINANTS OF EMERGENCY DEPARTMENT DISCHARGE DISPOSITION OF PATIENTS WITH TRAUMATIC BRAIN INJURY IN A TERTIARY CARE HOSPITAL OF UGANDA**

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**Introduction:** Traumatic brain injuries (TBI) are common causes of emergency department visits and hospital admissions due to trauma in Kampala, Uganda. Patients with different causes of TBI have different clinical presentation and severity of injury. The objective of this study was to determine the predictors of Emergency Department (ED) discharge disposition with reference to patient and injury characteristics. The outcome consists of four categories: Discharged home, Admitted, Died, and Others including referred or went against medical advice.

**Methods:** This prospective study was conducted at Mulago National Referral Hospital, Kampala, Uganda from May 2016-July 2017. Patients of all age groups presenting to ED with TBI were followed-up till ED disposition or within 24 hours of ED arrival, whichever comes first. Patient demographics, external causes of injury, TBI characteristics, injury severity (Kampala trauma score: KTS; Revised trauma score: RTS) and discharge disposition from ED was noted. TBI cases were grouped into mild, moderate and severe categories based on Glasgow Coma Scale (GCS). We used multinomial logistic regression model to calculate conditional odds ratio of admission, death and other disposition compared to discharged home as a reference category.

**Results:** There were 3,944 patients were included in the study. Proportion of males was 84.7% and that of females was 15.3%. Mean age was 28.50 (SD:14.22). Patients had closed head injury in 62.9% cases and open head injury in another 36.3% The cause of TBI was road traffic injury in 58.8% cases, and intentional injuries in 28.7% cases. There was no significant difference between four discharge categories with respect to age, sex, mode of arrival, cause of TBI, area of residence, place of injury, type of head injury, and RTS ( $p > 0.05$ ), but there were statistically significant differences ( $p < 0.05$ ) between four discharge categories for number of serious injuries, GCS on arrival, change in GCS, and KTS. In multinomial logistic regression model, after adjusting for other variables—type of head injury, GCS on arrival, KTS and change in GCS were significant predictors for admission and death in ED, whereas mode of arrival, improvement in GCS, and KTS were significant predictors in others category including referred or left against medical advice.

**Conclusion:** The conditional odds ratios for Emergency department disposition are differentially affected by injury characteristics and are largely dependent on KTS, and change in Glasgow Coma Scale during ED stay. TBI patient characteristics have no impact on ED disposition in a tertiary care hospital of Kampala.

## **ROUTINE SERIAL CT OF THE HEAD AND HOURLY NEUROLOGIC EXAMINATIONS ARE UNNECESSARY IN PATIENTS WITH MINOR TRAUMATIC BRAIN INJURY**

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**Introduction:** The clinical presentation of mild traumatic brain injury (TBI), defined as initial GCS > 13, is frequent in patients presenting with blunt trauma, and is often evaluated by computed tomography of the head (CTH). Positive findings on CTH can trigger a cascade of events including serial CTH, monitoring in an ICU setting, and prolonged hospitalization, all intended to identify patients that might require neurosurgical intervention, although the frequency of such intervention is low. We hypothesize that positive findings on CTH in patients with GCS > 13 portend minimal risk, and that serial CTH and ICU-level monitoring are unnecessary, adding substantial cost of care without benefit.

**Methods:** We reviewed all adult trauma patients (age > 17 years) admitted to a single urban level I trauma center between 1/1/2016 and 12/31/16. Patients with an ICD10 code for traumatic subarachnoid hemorrhage (SAH: chosen as a marker for positive CTH) and initial GCS > 13 were identified as the study group, and medical records were reviewed. Data collected included age, sex, mechanism of injury, admission GCS score, length of stay and discharge disposition. Timing and results of CTH studies, serial evaluations of GCS, and need for neurosurgical intervention were also collected.

**Results:** The study group consisted of 135 patients, who underwent a total of 311 CTH. 24 patients had one CTH, 63 patients had 2, 35 patients had 3 and 13 patients  $\geq$  4 CTH. Average ICU length of stay was 2.4 days for patients having 1 or 2 CTH, and 5.6 days for those having more than 2 CTH. Four patients (3%) required craniotomy, all of whom had either epidural hematoma (EDH) or subdural hematoma (SDH) in addition to SAH. One craniotomy was done immediately for a large EDH, and the other 3 were done in delayed fashion for acute-on-chronic SDH. No patient had specific intervention driven by findings on serial CTH, nor did any patient have specific intervention driven by clinical neurologic deterioration over the course of a single hour.

**Conclusion:** In our study population of patients with GCS > 13 and positive CTH, as identified by the presence of traumatic SAH, neurosurgical intervention was required in only 3%, all of whom had large EDH or SDH identified on the initial CTH. No specific interventions were driven by findings on serial CTH, or by changes in GCS over the course of a single hour. These findings demonstrate that more than 170 repeat CTH yielded no actionable findings, and could have been avoided. Furthermore, patients the study group utilized a total of more than 450 ICU days, at a cost more than double that of care in the step-down unit. Based on our data, patients with presenting GCS > 13 and positive CTH do not require routine serial CTH or routine admission to the ICU. Adoption of this approach will result in substantial savings while maintaining quality care.

## Development of a Pseudo Encryption Tool to Share Unique Patient Identifiers Between Institutions to Facilitate Trauma/Emergency Medicine Epidemiologic Research Within Metro Region

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**Introduction:** Local and national safeguards limit sharing of personal health information (PHI), to protect patient privacy. We encountered challenges in attempting to study recidivism of penetrating trauma across an urban metropolitan area secondary to HIPPA and state privacy laws. We sought to develop an IRB-approved mechanism whereby different trauma centers could identify patients who received care at more than one metro area trauma center.

**Methods:** An Excel formula was developed to create a unique identifier for each subject. This identifier had to be sufficiently specific to avoid duplication, incorporate alphanumeric data, be configurable at each site, and provide a de-encryption pathway. The Excel file stipulated columns for name (last, first, MI) and date of birth (month, dd, yyyy). Parsing functions were used to extract one or more characters from each column. The parsed alphanumeric terms were compiled into a shared “encrypted identifier”.

**Results:** The Figure shows an example of a sample input: John Smith, 22 Jan 1979 (First, Last, Day, Month, Year) is transformed and compiled into the unique identifier JhS018Ja. Additional elements could be added to improve specificity or further obfuscate the identity. The approach was reviewed and approved by the IRB at all institutions and by corporate compliance officers.

Patient Identifier Input area, ENTER INFO HERE				
Alpha	Alpha	Number	Alpha	Number
John	Smith	22	January	1979
All investigating sites need to input data points in the same format				

Parsing Formula Area, DO NOT EDIT/CHANGE					
FNFI	LNFI	LNLI	BYL3	BMF2	
J	S	h	979	Ja	
Parsing formulas can be adjusted to select any number of characters from either the left or right side of the source cell					

Identifier Output Area, DO NOT EDIT
JhS979Ja
This output can be any combination. Currently: FNFI, LNLI, LNFI, BYL3, BMF2

**Conclusion:** A simple, spreadsheet based algorithm was developed to allow disparate trauma centers to share unique anonymous patient identifiers that allowed us to expand the scope of trauma research across health care systems to more completely understand injury within the entire metro area. Such a tool will help to facilitate trauma epidemiologic studies.

## **A COMPARATIVE ANALYSIS OF THE FINDINGS OF POST-MORTEM CT SCAN AND TRADITIONAL AUTOPSY IN TRAUMATIC DEATHS: IS TECHNOLOGY MUTUALLY COMPLEMENTING OR EXCLUSIVE?**

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**Background:** Postmortem examination is indispensable to ascertain the cause of an unnatural death. The increasing use of modern-day radiology for postmortem examination has opened a new arena in overcoming the difficulties of traditional autopsy. There are conflicting reports regarding superiority of one modality of the postmortem over other.

**Objective:** To compare the findings of postmortem CT scan and traditional autopsy in the victims of traumatic deaths and to analyze whether postmortem CT can be used to replace traditional autopsy.

**Methods:** All patients with history of trauma that were declared dead on arrival in Emergency Department were subjected to full body CT scan. An experienced Radiologist reported the findings of CT scan. Subsequently a forensic expert subjected the patients to traditional autopsy. The physician who performed autopsy was blinded to the findings of CT scan and vice versa. An individual who was not part of the Radiology or Forensic team entered the findings of CT scan and autopsy in a pre-designed Performa. An unbiased assessor finally compared the findings of the two modalities and analyzed the results. McNemar test was used to ascertain the level of significance between the findings reported by the two modalities considering p value of 0.05 as significant. The agreement or disagreement on cause of death reported by the two modalities was also assessed.

**Results:** 95% of the deceased were males. The mean age was 35 yrs. CT was superior in picking up bony injuries, air containing lesions, hemothorax and hemoperitoneum. Autopsy was more sensitive for soft tissue and solid visceral injuries. Both modalities were equally helpful in identifying extremity fractures. There was no statistically significant agreement on cause of death by both modalities.

**Conclusion:** Postmortem CT scan is promising in reporting injuries in traumatic deaths and can significantly complement the conventional autopsy. However, at present it cannot be considered as a replacement for traditional autopsy.

## TUBE THORACOSTOMY FOR THE TRAUMA PATIENT; IT'S NOT JUST ABOUT SIZE

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**Introduction:** Recent studies have challenged the dogma of using large chest tubes for trauma, and the 10th edition of ATLS is *now* even suggesting against this practice. However, none of these studies have accounted for the *suction power* used in the context of tube size; and, their conclusions have focused only on long term outcomes, and not on *immediate* considerations that may determine if the patient will live or if they will die (*i.e.* <24hour mortality was excluded from these early studies). The most decisive decision for the trauma surgeon to make under these conditions is whether a thoracotomy is indicated or not, and is based on whether the initial chest tube output/flow rate is higher than 20mL/kg or >200mL/hr for 4 consecutive hours. This standard of care was established using flow rates from *large* tube thoracostomies connected to a pleurovac set at -20cm H<sub>2</sub>O (14.7mmHg). Our hypothesis is that variation of suction power may affect the flow rate, and that this deviation from established standards may have significant therapeutic ramifications.

**Methods:** Flow rates of a uniform volume of solution (200mL water) were measured using different size thoracostomy tubes (10F, 20F, 40F) and different suction powers (200mmHg, 100mmHg, 40mmHg, 20mmHg).

**Results:** SD:200mmHg-->14.77100mmHg-->23.48 40mmHg-->42.09 20mmHg-->68.01 Tube Size mmHg mL/Sec

10	200	13.54
	100	8.52
	40	4.75
	20	2.97
20	200	30.19
	100	20.88
	40	14.45
	20	9.31
40	200	52.63
	100	28.05
	40	17.94
	20	12.17

**Conclusion:** In all cases, the entire study volume of solution was *eventually* evacuated irrespective of tube size or suction power; *this finding is in line with earlier studies that showed no difference in tube size with respect to long term outcomes (ie. retained hemothorax for incomplete evacuation).* On the other hand though, the variation in flow rates between different size tubes changes significantly, with increasing suction power; suction power is a variable that has not been accounted for by any of the earlier studies. This variation is particularly important at the suction power that mimics a conventional pleurovac (-20mmH<sub>2</sub>O/14.7mmHg). Timing, and indication for a thoracotomy can be dramatically affected by this variation in flow rate. Moreover, slower flow rates may lead to increase viscosity of solution (hemothorax forming clot), a factor not specifically addressed by our study. To this end, we advocate reserving caution moving away from time honored dogma of using large chest tubes for the trauma patient.

## THE TEAM (TRAUMA EVALUATION AND MANAGEMENT COURSE - MEDICAL STUDENT KNOWLEDGE GAINS AND RETENTION IN THE USA VS GHANA

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**Introduction:** Trauma and injury are significant contributors to the global burden of disease, with 5 million deaths and 250 million disability-adjusted life years lost in 2015. This burden is disproportionately borne by low and middle income countries (LMICs). Solutions are complex, but one area for improvement is basic trauma education. The American College of Surgeons has developed the TEAM (Trauma Evaluation and Management) Course as an introduction to trauma care for medical students. We hypothesized that the TEAM course would be an effective educational program in LMICs and result in increased knowledge gains and retention similar to students in high-income countries (HICs).

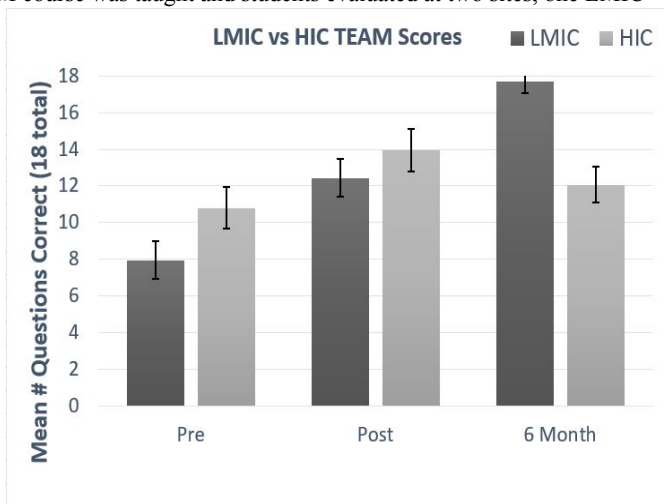
**Methods:** The TEAM course was taught and students evaluated at two sites, one LMIC

and one HIC, after obtaining approval from the HIC Institutional Review Board and medical school dean. Participation was optional for all students and results were blinded. The course was administered by a single educator for all sessions. Tests were given before and after the course, and again six months later.

**Results:** A total of

62 LMIC and 52 HIC students participated in the course and completed testing. Demographics for the two groups were similar. LMIC students started with a relative knowledge deficit, scoring lower on both pre- and post-course tests than HIC students, but gained more knowledge during the initial teaching session. After 6 months the LMIC students continued to improve, while the HIC students' knowledge had regressed.

**Conclusion:** The TEAM course is a useful tool to provide the basic principles of trauma care to students in LMICs, and should be expanded. Further study is needed to determine the impact of TEAM education on patient care in LMICs.



## VARIED TRAINING EXPERIENCE AMONG 2-YEAR FELLOWSHIP CANDIDATES: EXPERIENCE MAY NOT EQUATE TO SELF-PERCEIVED COMPETENCE

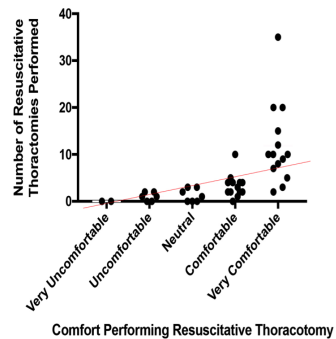
Richard C. Maduka BS, Sarah A. Moore MD, Patrick M. Reilly MD, Jon Morris MD, Mark J. Seamon MD, Daniel Holena MD, Lewis J. Kaplan MD, Niels D. Martin MD, University of Pennsylvania

**Introduction:** Fundamental training in trauma & surgical critical care is an integral component of general surgery residency and the critical base experience for the added educational qualifications of fellowship. We hypothesize that variations in clinical exposure exist and that perceived confidence will correlate with clinical experience.

**Methods:** With IRB approval and in a double-blinded fashion, all interviewees to a large, urban, academic, level one trauma, critical care, & emergency surgery fellowship were offered a 70-question survey. The survey focused on past clinical exposure and their perceived confidence in key areas relevant to fellowship. Experience was assessed via absolute numbers and confidence via a 5-point Likert scale; data is reported using descriptive statistics and linear regression.

**Results:** Forty-two of 44 completed the survey (95.5% response rate). 81% had exposure to a Level 1 trauma center during training. Experience and comfort varied greatly between procedures (**TABLE**) and experience did correlate with self-perceived confidence in most procedures including resuscitative thoracotomy (**FIGURE**). However, the experience necessary to result in confidence was minimal, for cricothyroidotomy, 86% of respondents had done  $\leq 2$ , but only 26% were uncomfortable with the procedure.

Procedures	Mean Number Performed (SD)	Mean Comfort (SD) [5 = Very Comfortable]
Recognizing Multiple Etiologies of Delirium and Coma		4.53 (0.61)
Treatment of Multiple Etiologies of Delirium and Coma		4.14 (0.65)
Performing a Brain Death Exam		3.71 (0.84)
Leading End of Life / Goals of Care Discussions		4.52 (0.63)
Independently Performing a Sternalotomy	5.81 (10.94)	3.77 (1.10)
Identifying the Phrenic Nerve in the Chest		3.8 (0.86)
Exploring the Carotid Sheath		3.35 (0.96)
Performing a Resuscitative Thoracotomy	5.33 (6.95)	3.74 (1.21)
Open Cardiac Repair	1.48 (2.07)	
Interpreting Swan-Ganz Catheter Wave Forms and Pressures	2.74 (2.11)	3.19 (0.99)
Hemodynamic Assessment with Bedside Ultrasound		2.90 (1.10)
Arterial Catheter Placement	3.19 (10.67)	4.69 (0.68)
Central Venous Catheter Placement		4.95 (0.21)
Dialysis Access Catheter Placement		4.83 (0.38)
Pulmonary Artery Catheter Placement		2.83 (1.13)
Basic Ventilator Management (Initiation, Maintenance, and Weaning)		4.45 (0.74)
Advanced Ventilator Techniques (e.g. ARDSnet and APRV)		3.64 (0.89)
Preventing Ventilator Associated Adverse Events		3.9 (0.79)
Treating Ventilator Associated Adverse Events		3.98 (0.71)
Performing Bag Valve Mask Ventilation for Airway Management		4.67 (0.57)
Placing Supraglottic Airways for Airway Management		3.81 (1.06)
Performing Intubation for Airway Management		3.77 (1.23)
Placing Cricothyrotomies for Airway Management		3.29 (1.02)
Performing Bronchoscopy		4.52 (0.80)
Placing Percutaneous Endoscopic Gastrostomy Tubes		4.24 (1.08)
Performing a Pringle Maneuver	2.76 (3.70)	3.4 (1.08)
Packing a Major Liver Laceration	4.64 (5.10)	3.69 (1.00)
Managing Acute Kidney Injury		4.50 (0.59)
Performing Pre-Peritoneal Packing of the Pelvis for Hematoma	0.9 (1.05)	2.86 (1.12)
Gaining Access to the Major Vascular Structures of the Retroperitoneum		2.83 (1.01)
Gaining Supra-Celiac Control of the Aorta	2.10 (3.69)	2.69 (1.02)
Open Abdominal Aortic Procedures	3.52 (5.01)	
Performing Vascular Anastomoses With Suture S-0	29.74 (26.79)	3.79 (0.92)
The Concept of Vascular Clamping		3.39 (0.94)
Steroid Use in Critical Care		3.43 (0.74)
The Components and Process of Massive Transfusion	16.24 (17.25)	4.14 (0.52)
Demonstrating Antibiotic Stewardship		4.14 (0.65)
Management of Most Surgical Infectious Diseases and Infectious Complications		4.53 (0.65)
Management of Sepsis Shock		4.57 (0.50)



**Conclusion:** Large variations in both experience and comfort within relevant training domains exists amongst 2-year fellowship interviewees. Importantly, domains with little experience did not impede applicants from reporting comfort with those skills. These disparate findings may inform fellowship program directors on curriculum development and appropriate training support structures.

## **COGNITIVE AND TEAM WORK RESUSCITATION SKILLS PERFORMANCE OF MEDICAL STUDENTS WITH THE TEAM® COURSE**

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Monique N. Drago edD, Ronald Stewart\* MD, Hospital Universitario Mederi

**Introduction:** Trauma Evaluation and Management®(TEAM®) is an abbreviated version of the American College of Surgeons (ACS) Advanced Trauma Life Support® (ATLS®) course that introduces the concepts of trauma assessment and management. Errors in teamwork, leadership, and communication skills have been identified as major factor in adverse clinical events. Improvements in these areas are therefore of particular interest. The aim of this study is to evaluate immediate retention in knowledge, communication and team resuscitation skills performance using the team approach in medical students taking the TEAM course in Bogota, Colombia

**Methods:** The TEAM (3<sup>rd</sup> edition) format used for our course was: ATLS 10<sup>th</sup> Edition team approach initial assessment video demonstration, a 90-minute slide presentation, a series of clinical trauma case scenarios for small-group discussion, and skills sessions in 2 trauma simulation scenarios using the team approach. We performed an observational pre- and post- intervention comparison study of the effects the TEAM course had on cognitive and teamwork resuscitation skills performance. Cognitive skills were assessed by a 20-multiple-choice questionnaire with a pre and post-test assessment. Team clinical assessment and management skills performance was evaluated using checklist rating of critical decision making and overall performance evaluation in 2 trauma simulation scenarios. The effectiveness of the group during these simulated scenarios in the behaviors of assistance, communication, and situation assessment was evaluated by 2 independent raters using the Standardized Assessment for Evaluation of Team Skills (SAFE-TeamS) method.

**Results:** A TEAM course was conducted in November 2015 for 92 medical students in Bogota, Colombia. Participants displayed a significant improvement in cognitive skills ( $p < 0.001$ ) on the post course evaluation. The 16-team groups demonstrated a significant improvement in their checklist rating of critical decision making ( $p=0.01$ ), and overall teamwork performance evaluation ( $p= 0.006$ ) between training and test trauma simulation scenario. The group's team performance as measured by the SAFE-TeamS method improved, but was not statistically significant ( $p=0.12$ ).

**Conclusions:** Trauma Evaluation and Management course improves trauma didactic knowledge. Teamwork behaviors and resuscitation skills performance needs further study with a larger sample size. Trauma education and teamwork training as can be done with the ACS TEAM course is a critical component for trauma and safety care improvement worldwide.



**The impact of International trauma rotation at Tygerberg hospital in South Africa;  
Comparison of surgical volume in an urban trauma center in Tokyo**

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**Introduction:** International rotation will get a chance of operations which surgeon rarely experienced in own country. The author has rotated in six months at Tygerberg hospital (TB) in South Africa. The purpose of this study was to compare the volume between our trauma center in Tokyo and TB in South Africa.

**Methods:** We conducted the retrospective chart review at our trauma center in Tokyo and compare the surgical volume which he experienced in TB for six months and the number of operations which he joined in Tokyo for fifteen months.

**Results:** The number of operations he joined in TB for six months was 175, and 151 of them were for trauma cases. The number of urgent trauma operations was 102 (68%), and that of penetrating and blunt injuries, GSW and Stab injuries were 85 (83%), 17 (17%), 46 (45%) and 39 (38%) respectively. Cardiac or large vessel injuries were 40 cases including 2 cardiac, 2 aortic, 5 subclavian artery, 6 iliac vessels, and 8 inferior vena cava injuries.

The number of operations for trauma cases he joined in Tokyo for fifteen months was 49, and the urgent operations were 27 (55%). Ten (37%) were penetrating injury and 17 (63%) as the result of blunt trauma.

The number of urgent trauma operations he could experience in South Africa for six months was approximately same as the number for five years at the one of the biggest trauma center in Tokyo, especially penetrating cases were for ten years.

The number of operations for trauma cases he joined in Tokyo for fifteen months was 49, and the urgent operations were 27 (55%). Ten (37%) were penetrating injury and 17 (63%) as the result of blunt trauma.

The number of urgent trauma operations he could experience in South Africa for six months was approximately same as the number for five years at the one of the biggest trauma center in Tokyo, especially penetrating cases were for ten years.

**Conclusion:** The international rotation in South Africa has impacted on learning for trauma surgery, especially for penetrating injuries. It has resulted in a private negotiation but not through a systematic and sophisticated organization. The personal reference by the surgical society should be necessary to rotate in foreign facility.

## ATLS 20 YERS - FROM HONG KONG TO MAINLAND CHINA

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**Introduction:** ATLS® was introduced into Hong Kong in 1997. In September 2016, 136 courses were given to students and 13 courses for instructors were organized, as well as 2100 doctors received ATLS® training. The setup of a new hospital managed by both Hong Kong and Shenzhen provided the possibility and opportunity to bring ATLS® into mainland China. However, language barrier has previously been a major obstacle against the promulgation of ATLS® into mainland China. How to set up an appropriate training area is also another big issue to deal with.

**Methods:** With the support and approval of the American College of Surgeons, ATLS® textbook was allowed to be translated into Chinese by a team from Shenzhen. Since September 2013, 20 ATLS® Providers from Shenzhen have been approved to attend English courses in Hong Kong, of which seven of these candidates have successfully achieved Instructor status. These Instructors are Putonghua-speakers who are now charged with the task of conducting the ATLS® courses in mainland China, based on the translated 9<sup>th</sup> Edition ATLS® Student Manual and other teaching materials. A multi-party group was formed and regular meetings were arranged to organize things in the future. A new surgical skills training center was designed and built to provide accurate preparation for ATLS® training purpose. Funding for this surgical skills training center was donated by philanthropists from Hong Kong. The training equipment list was purchased in Hong Kong and sent to Shenzhen. Chinese ATLS® instructors were trained in Hong Kong with a Singapore educator. A joint and transitional Chinese ATLS® course was organized in Hong Kong before the first Chinese ATLS® course held in Shenzhen, China.

**Results:** The Chinese ATLS® student manual was published in August 2016. The new surgical skills training center was completed and opened for ATLS® training. An ATLS® instructor group with mixed doctors from Hong Kong and Shenzhen was established to teach the first Chinese ATLS® course from September 26-28, 2016. An instructor course was also organized in December 2016 with the same educator from Singapore. In September 2017, a total of 6 courses were organized for students, with 80 doctors coming from across mainland China receiving ATLS® training and another 9 doctors receiving their instructor qualifications.

**Conclusion:** It is highly recommended that ATLS® courses be taught to doctors in mainland China who are involved in the management of trauma patients, as evidenced by the strong documented positive impact of ATLS® courses on cognitive knowledge, practical skills and critical decision making. The introduction of ATLS® into mainland China is, hopefully, a step to help develop a structured trauma service for the benefit of people in China.

**Key words:** ATLS® training; mainland China; Trauma education

## **RIB FRACTURES IN THE ELDERLY: PHYSIOLOGY TRUMPS ANATOMY**

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**Introduction:** Rib fractures in elderly patients are associated with substantial pulmonary morbidity and mortality; predicting which patients are at highest risk for late complications remains a dilemma. Most existing predictive models use anatomic, physiologic or laboratory parameters in isolation. The RibScore is an example of an anatomic only model that uses radiographs to assess severity of the fractures. In a single institution with a relatively young patient population, RibScore performed well. We hypothesized that in elderly patients, where frailty is a major driver of adverse outcomes, a purely anatomic model will underperform models that take into account physiologic and laboratory variables.

**Methods:** This is a retrospective chart review of adult trauma patients admitted from January 2014 to June 2017 at an academic level 1 trauma center. A total of 466 patients were identified with a blunt mechanism and  $\geq 1$  rib fractures by computed tomography scan. Patient care was driven by a protocol for initial disposition, pain management and pulmonary hygiene. Variables indicating adverse pulmonary outcomes included pneumonia, ventilator days, and tracheostomy. We examined three models for their ability to predict adverse outcomes: (1) Ribscore, (2) Modified Frailty Index (mFI), and (3) initial PaCO<sub>2</sub>. Receiver operating characteristics (ROC) and area under the curve (AUC) were used to compare each approach. Logistic regression was used to identify independent predictors of adverse outcome.

**Results:** Fifty seven percent of the population was  $\geq 55$  years of age, and comprised our elderly cohort. Thirteen percent developed one or more pulmonary complications. Increased RibScore, mFI, and initial PaCO<sub>2</sub> were each statistically associated with risk. ROC AUC analysis of individual models predicted complications with the following concordance statistic (CS): Anatomic only (RibScore) yielded a CS of 0.79 (95% CI 0.69, 0.89)  $p < 0.001$ ; Physiologic only (mFI) yielded a CS of 0.83 (95% CI 0.75, 0.91)  $p < 0.001$ ; and Laboratory only (initial PaCO<sub>2</sub>) yielded a CS of 0.88 (95% CI 0.80, 0.95)  $p < 0.001$ . A PaCO<sub>2</sub> threshold of 45 mm Hg yielded the highest sensitivity and specificity. The initial PaCO<sub>2</sub> had the highest discriminative ability of the three individual models. When examining independent predictors of developing complications, the initial PaCO<sub>2</sub> and mFI resulted in an adjusted odds ratio of 1.11 (95% CI 1.05, 1.18,  $p < 0.001$ ) and 30.66 (2.35, 36.79,  $p 0.008$ ) respectively. When the models were combined, a CS of 0.85 (95% CI 0.74, 0.91),  $p < 0.001$  resulted for anatomic and physiologic; 0.88 (95% CI 0.80, 0.96)  $p < 0.001$  for anatomic and laboratory; and 0.89 (95% CI 0.82, 0.96)  $p < 0.001$  for physiologic and laboratory. Combining all three models yielded the best performance with a CS of 0.90 (95% CI 0.81, 0.97)  $p < 0.001$ .

**Conclusion:** An anatomic score (RibScore) can predict adverse outcomes in elderly patients with rib fractures. However, models based on mFI and PaCO<sub>2</sub> individually outperform the RibScore. A combination of all three models yields the highest discriminative ability. This combined approach should be used in assessing the overall severity of the injury, the prediction of complications, and the intensity of interventions in the elderly.

## **TREATMENT OF SEVERELY INJURED PATIENTS - SMALL IMPACT, BIG DEAL. ELDERLY PATIENTS AFTER LOW-ENERGY TRAUMA AND LIFE-THREATENING CONSEQUENCES**

Orkun Özkurtul MD, Johannes K. Fakler MD, Christoph Josten MD, Ph.D., University Of Leipzig

**Introduction:** Due to demographic developments, the proportion of elderly patients among severely injured with an ISS  $\geq 25$  is becoming increasingly important. Their treatment is particularly challenging for trauma surgeons, not only because of the increased risk of mortality. The complex medication and the constantly growing mobility of the elderly is an additional risk. Moreover, the biomechanical and physiological effects of trauma in patients  $> 59$  years of age differs fundamentally from those in younger patients  $< 60$  years. The aim of our study was to investigate the differences in the trauma mechanism, treatment and therapy of this population compared to younger patients.

**Methods:** We carried out a retrospective evaluation from our own prospectively recorded data set of the trauma register of the German Trauma Society DGU® for the years 2010-2015. Included in the study were polytrauma patients with ISS  $> 25$ , over 16 years of age and low energy trauma. A fall below 3m was defined as a low-energy trauma. All patients who died in the trauma bay were excluded. A poor outcome was defined as a Glasgow Outcome Scale (GOS) of 1-3 points. Descriptive data were recorded in addition to injury severity ISS, AIS, hospital stay, outcome, ITS and ventilation duration as well as dismissal in care facilities and domesticity. We conducted a subgroup analysis with patients  $> 59$  vs.  $< 60$  years. Statistical evaluation was carried out via univariate analysis and the significance test for subgroup analyses via t-test.

**Results:** Out of 1200 patients in our database, a total of 69 (6%) patients with ISS  $\geq 25$  and low energy trauma were included, of whom 55  $\geq 60$  years were and 14  $< 60$  years old, respectively. In the group of  $< 60$ -year-olds, the mean ISS was  $28.27 \pm 7.5$  (range 25-75) and  $29.43 \pm 5$  (range 25-38) in the younger group. Elderly patients had a 5 times higher incidence of severe injuries despite minor trauma than younger patients and had a significantly worse outcome with 54.5% to 36.4% ( $p=0.05$ ). Only 9 patients  $\geq 60$  years of age were discharged home, 14 (25.5%) older patients have died.

**Conclusion:** Patients in old age suffer 5 times more severe injuries with an ISS  $\geq 25$  than younger patients, despite low kinetic energy. For the treating colleague, knowledge of the effects of age-related physiological changes and the associated vulnerability of the musculoskeletal system is crucial. Only then a comprehensive treatment concept can be created and resources targeted. Despite established networks and interdisciplinary cooperation, the severely injured is and remains a major challenge for trauma surgeons.

## TRAFFIC ACCIDENTS FOR GERIATRIC PEDESTRIAN IN JAPAN

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**Introduction:** Walking is strongly recommended as a health promotion strategy for elderly people. Traffic accidents in geriatric population are increasing rapidly in our aging society. The purpose of this study was to describe injured body regions among the elderly pedestrians compared with young population and the fatal injuries among them with the sample of Japan Trauma Data Bank (JTDB).

**Methods:** We extracted data of pedestrian injuries from the JTDB2016. Those with complete data of Age, ISS, Max AIS of 9 body region, and mortality were analyzed. The subjects were divided into two groups by age: Young group(YG) was defined as the age from 15 to 64 and old group(OG) as more than 65. We also conducted subgroup analysis for old group to compare between the survived and dead. Mann-Whitney's U test was used for non-parametrical analysis.

**Results:** In YG, 5883 subjects were extracted and median ISS(IQR) was 16(9-25). In OG for 6197, median ISS(IQR) was 20(10-30) ( $p < 0.001$ ). Median Max AIS in OG was greater than that of YG in all body region except surface region. On subgroup analysis for OG, Median(IQR) of Max AISs compared death to survive were 4(4-5) vs. 3(3-4) ( $p < 0.001$ ) in head, 4(3-4) vs. 3(3-4) ( $p < 0.001$ ) in chest, 3(2-4) vs. 2(2-3) ( $p < 0.001$ ) in abdomen.

**Conclusion:** Geriatric pedestrian sustained severer injuries than young generation. For older population, severer head, chest and abdomen were associated with death. Reducing injury severity, possibly by pedestrian protection devices, may reduce pedestrian mortality in the case of vehicle-pedestrian collisions. Reducing injury severity, possibly by pedestrian protection devices, may reduce pedestrian mortality in the case of vehicle-pedestrian collisions.

		15yo-65yo				65+				p	survive-				survive+				p
		n	Median	1 IQR	3 IQR	n	Median	1 IQR	3 IQR		n	Median	1 IQR	3 IQR	n	Median	1 IQR	3 IQR	
Max AIS	Head	3585	3	2	4	4221	4	3	4	0	1202	4	4	5	2828	3	3	4	0.000
	Neck	1469	1	1	2	1423	1	1	2	0.002	275	2	1	2	1075	1	1	2	0.053
	Face	36	1	1	1	21	2	1	3	0.013	8	2	1.25	3	13	1	1	3	0.374
	Chest	1962	3	3	4	2334	3	3	4	0.032	755	4	3	4	1481	3	3	4	0.000
	Abd.	870	2	2	3	767	3	2	3	0.000	288	3	2	4	451	2	2	3	0.000
	Spine	1043	2	2	3	1038	2	2	3	0.001	262	2	2	3	720	2	2	3	0.173
	Upper Ext	1568	2	1	2	1912	2	1	2	0.000	394	2	1	2	1408	2	1	2	0.573
Lower Ext	2991	2	2	3	3578	3	2	3	0.000	868	3	2	5	2522	3	2	3	0.000	
	Surface	438	1	1	1	296	1	1	1	0.257	66	1	1	1	212	1	1	1	0.127
	ISS	5557	16	9	25	5976	20	10	30		1402	34	25	43	4247	17	10	25	

## COMPARATIVE ASSESSMENT OF IN-HOSPITAL TRAUMA MORTALITY AT AN INDIAN TRAUMA CENTER WITH IN-HOSPITAL TRAUMA MORTALITY AT A LEVEL 1 TRAUMA CENTER IN THE UNITED STATES

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**Background:** In India, a trauma-related death occurs every 1.9 minutes. While Trauma Center infrastructures have been developed to provide definitive trauma care, formal performance improvement initiatives remain in the early stages at both the national and individual hospital level. As an initial benchmarking exercise, we compared registry-based mortality data from the Jai Prakash Narayan Apex Trauma Centre (JPNATC) in New Delhi, India and Michigan Medicine in Ann Arbor, Michigan

**Methods:** Retrospective data was collected over four months from September 2015 to December 2015 as a part of the Australia–India Systems Collaborations (AITSC) project in the JPNATC-AIIMS New Delhi, India. For comparison, consecutive admissions from the University of Michigan’s Trauma Registry for 2015 were abstracted. Data were managed Excel and SAS (Version 9.4, Cary NC). Univariate and bivariate descriptive statistics were generated for the following variables: age, gender, mechanism of injury, emergency department vital signs, GCS score, Injury Severity Score, ICU days, operative status, and mortality. Mortality was evaluated based on gender, mechanism of injury, GCS score, ISS, and destination. Statistical significance was considered at an alpha level of 0.05. Proportions were compared with a two sample Z-test for categorical and ordinal variables.

**Results:** A total of 1,505 patients were included in this study. Differences in population and patterns of mortality were apparent between the two systems. Patients in India were younger and overwhelmingly male. The most common cause of injury seen at JPNATC was motor vehicle accidents, which accounted for 56.4% of the injuries, followed by falls at 25.4%. Falls were more commonly seen in the US. Initial overall mean GCS was lower (12.9 vs. 14.4,  $p < 0.05$ ), mean ISS was lower (8.96 vs 10.46,  $p < 0.05$ ) and RTS was lower (7.289 v 7.59,  $p < 0.05$ ). As expected, the overall mortality was higher at JPNATC compared to Michigan Medicine (3.3%,  $P < 0.05$ ). Mortality differences were not distributed evenly across all categories of injury; outsized differences were identified in minor brain injury (GCS 13-15, OR death 5.02,  $p < .0001$ ) and in patients with even mild - moderate injury (ISS 0 -15, ISS 16-24, OR death 8.12, 12.77 respectively,  $p < 0.0001$ ).

**Conclusions:** Trauma care in India is still in a fragile state of development, and the societal burden remains high. We have shown that shared trauma performance improvement efforts can identify areas where interventions from a mature system could have impact in the Indian system. Specifically, further examination of potential opportunities for improvement in moderate injury and mild TBI between institutions may have mortality benefit. This work supports the ongoing importance of collaborative registry and performance improvement efforts in India.

Mortality(%)				
	MM	AIIMS	Mortality Ratio (AIIMS/MM)	p-value
Gender				
Male	3.89	12.32	3.17	<0.0001
GCS Score				
3-8	16.56	36.99	2.23	0.0007
9-12	12.5	17.65	1.41	0.6431
13-15	0.99	4.97	5.02	<0.0001
ISS, %				
0-15	1.18	9.58	8.12	<0.0001
16-24	1.45	18.52	12.77	<0.0001
25-75	26.09	25	0.96	0.9197

## **PREHOSPITAL CARE IN INDIA: THE NEED OF THE HOUR**

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**Introduction:** India is a developing country and although our potential as a budding superpower seems irrefutable, we lag far behind when it comes to prehospital care. The availability of trained personnel and prehospital ambulance services, as well as the time taken to attend to the injured are severely compromised.

**Methods:** At a Level - I Trauma centre in New Delhi, We did a retrospective review of 2413 severely injured patients who presented to the hospital between January 2017 and June 2017. We also conducted a questionnaire-based interview of ambulance drivers (n=95).

**Results:** We found that majority of them were in the 3<sup>rd</sup> decade of life (24%). Interestingly, we noticed that 22% of them were children under 10 years of age, with fall from height contributing 84% injuries in this age group. The mechanism of injury was predominantly RTI (42%), closely followed by fall from height (37%). The average time to presentation was around 3 hours for these patients, with only 15% of them reaching within the golden hour. And among the 27% referred patients, only 15% reached the hospital within first 3 hours. Only 4% had an access to (or) preferred to use an ambulance to get to the hospital, and 63% had made it to the hospital by themselves or with the help of a relative via a private means of transit to the hospital. This established the fact about the non-availability of ambulances and the long response time. Most of the ambulances in the capital were patient transport ambulances. Very few of these ambulances had any kind of paramedic support (n=9), and even fewer ambulance drivers received any kind of formal pre-hospital training (n=7). An average ambulance in the country is usually a vehicle which can accommodate a driver, the patient and at most a couple of his/her relatives. Apart from a very few, that are part of elite hospitals or private owned hospitals, most ambulances lack a cervical collar, backboard, intravenous cannulas, and/or resuscitative fluids. Some even lack a proper first aid kit. When enquired about the delay, most ambulance drivers quoted the traffic and the lack of awareness among the general public as the reason behind the same. They also said that the “on-scene” time was practically near zero as they had no paramedic support. We also noted that the ambulances usually take the patient to the nearest hospital and the absence of field triage protocols result in some patients landing in centers which are under-equipped for patient care. Most patients had to pay for their transfer.

**Conclusion:** If the prehospital phase is delayed to such an extent in the capital of the country, one has to question the availability and the time taken at peripheral centers. India spends only 3% of its Gross Domestic Product (GDP) on healthcare. With such limited spending and the lack of government insurance cover for the poor and the needy, the future of healthcare in the country looks bleak. For a country which is looking to lock horns with the super giants of the world, it is not only necessary but also prudent to increase their outlay on healthcare services. There is a pressing need to formulate goals and work towards bringing about a change in the healthcare system which, at the moment, is in shambles.

**ULTRASOUND-GUIDED CANNULATION VIA THE RIGHT  
BRACHIOCEPHALIC VEIN IN ADULT PATIENT: AN  
OVERLOOKED APPROACH STILL**

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**Introduction:** Central venous catheter (CVC) insertion is a challenging and high risk procedure. Ultrasound (US) guided cannulation increases the success rate and reduces procedural-related complications. The internal jugular vein (IJV) and subclavian vein (SCV) is the most frequent site for US-guided CVC insertion. In recent years, a new approach has been suggested, consisting of cannulation of the brachiocephalic veins (BCV) from the supraclavicular area, which could offer advantages in neonates and infants. But it is rarely reported in adult patients. The aim of this study was to evaluate the safety and efficacy of US-guided supraclavicular right brachiocephalic vein (BCV) cannulations in adult patients.

**Methods:** Between January 2014 and December 2016, 536 adult patients requiring central venous catheterization underwent ultrasound-guided right BCV cannulation. The puncture success rate and catheters indwelling procedure-related complications were analyzed.

**Results:** The technical success rate was 100% (536/536). The right BCV was successfully punctured on the first attempt in 522 patients (97.4%). The mean operation time was  $9.26 \pm 5.34$  minutes (range of 6-15 minutes). The mean length of catheter introduction was  $9.57 \pm 5.53$  cm (range of 9-15 cm). The complications rate of puncture was 0.56%: three arterial punctures were reported with self-limiting hematoma. Only one case of pneumothorax (PNX) was identified, and no chest drainage was required. The incidence of postprocedure complications was 0.93% (5/536), including catheter-related infection in two, thrombosis in three. The average insertion duration was  $10.68 \pm 3.77$  (3-28) days.

**Conclusion:** This supraclavicular, in-plane, US-guided cannulation of the right BCV seems to be an effective and safe method to insert central venous catheters in adult patients. It can provide another option of catheter access for the clinical performance of central venous catheterization.



## INTER-HOSPITAL VARIATIONS IN RESOURCE USE INTENSITY IN INJURY DEATHS: A MULTICENTER COHORT STUDY

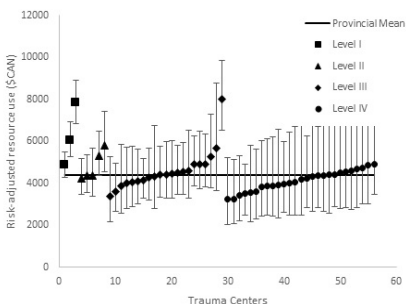
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**Introduction:** Injury represents the first cause of life years lost and is second only to cardiovascular diseases in terms of acute care costs. Our group has previously shown significant variation in withdrawal of life-sustaining therapies for traumatic brain injury across Canadian trauma centers (Turgeon et al. CMAJ 2011). The intensity of care associated with death following injury is however, unknown. We aimed to evaluate inter-hospital variations in resource use intensity for injury deaths across trauma centers in an inclusive, mature Canadian trauma system.

**Methods:** We conducted a multicenter, retrospective cohort study including deaths following admission for injury to any of the 57 trauma centers in a Canadian trauma system between 2014 and 2016. We used data from a trauma registry linked to hospital discharge and hospital costing databases. Resource use intensity was measured by activity-based costs according to Canadian guidelines for the economic evaluation of health technologies and GRADE recommendations, whereby units of resource use were multiplied by unit costs. We used multilevel log-linear regression to calculate median activity-based costs adjusted for age, comorbidities, physiological status on arrival, injury type and severity and transfer. Inter-hospital variations in resource use intensity were measured using intraclass correlation coefficients (ICC) with 95% confidence intervals. Analyses were performed globally and by time to death (48h, 72h, 7 days), age (<65, ≥65 years) and injury type.

**Results:** We identified 2055 injury deaths among whom 12% died within 48h of arrival, 21% within 72h, and 44% within 7 days. Median activity-based costs were \$4710 (quartiles 1 and 3: 1932-10,296). We observed significant inter-hospital variation in resource use intensity (ICC=7.3% [4.1-8.8], Figure 1). Mean risk-adjusted activity-based costs varied from \$4863 to \$7812 across level I trauma centers. Variations were still significant when we restricted analyses to deaths within 48h (ICC=10.6% [3.3-17.1]), within 72h (ICC=9.4% [5.8-12.7]) and within 7 days (ICC=7.9% [5.9-10.1]). Variation was higher for traumatic brain injuries (ICC=9.3% [5.1-12.4]) than overall and higher for patients aged <65 years (ICC=12.9% [3.1-19.1]) than for ≥65 years (ICC=6.2% [3.7-7.7]).

**Conclusion:** We observed significant variations in resource use intensity for injury deaths across trauma centers even after adjustment for patient case mix. These variations were greater in traumatic brain injury and younger patients. Results may reflect variations in decisions to withdraw life-sustaining therapies. Our group is currently working on improving the shared decision-making process in this population.



## **UNPRECEDENTED SURGE ON BLOOD BANK DURING LARGEST MASS SHOOTING IN UNITED STATES' HISTORY**

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**Introduction:** The most deadly mass shooting in modern U.S. history occurred in Las Vegas, Nevada on October 1, 2017, where 58 people were killed and 851 were injured at an outdoor concert. Bleeding is responsible for the majority of trauma deaths occurring within the first 24 hours, which has prompted public awareness programs like “Stop the Bleed Campaign.” Additionally, severely injured patients experiencing hemorrhagic shock often require massive transfusion. Earlier transfusion with higher blood products ratios (FFP:Platelets:RBC), defined as damage control resuscitation (DCR), has been associated with improved outcomes. (PROPPR trial). The surge for blood products at our level 2 trauma center during this unprecedented event has prompted further investigation into our blood product utilization. We aim to identify limiting factors in blood product transfusion and the feasibility of balanced resuscitation during a mass casualty event (MCE).

**Methods:** This is a review analysis of blood product utilization for all victims of the MCE at our institution. After obtaining approval from our IRB, we collected data for age, blood products administered, timing of transfusion, injury severity score (ISS), length of stay (LOS) and mortality. The total inventory of blood product within our blood bank and steps to transfusion were reviewed. Additionally, our team met with blood bank staff to address barriers and successes during this unanticipated event.

**Results:** We identified 23 patients who presented to our institution and required blood product transfusion. A total of 105 units of fresh frozen plasma, 174 units of platelets, 226 units of packed red blood cells, and 15 units cryoprecipitate were utilized during the MCE. We observed the most demand on the blood bank during the first 24 hours following admission; 100 units of FFP, 156 units of platelets, 198 units of pRBC were used during this timeframe. This represented 95.2% of all FFP, 89.7% of all platelets, and 87.6% of all pRBC utilized during the MCE. Of the 23 patients requiring transfusion, we further identified 11 patients who placed the highest demand on the blood bank. This subset of patients utilized 92.2% of total blood product used during the MCE, had an average ISS of 23.3, an average LOS of 21.25 and a transfusion ratio of 1:1.6:2. The mortality rate was 36.4 percent.

**Conclusion:** Clinical knowledge, supply constraints and logistical details play crucial roles if blood product provision is to be managed effectively. Events such as provider recognition, patient identification, inventory, restocking, product preparation and delivery, and teamwork impact component resuscitation during the surge for blood product. A major difficulty in trying to learn useful lessons from past incidents is a scarcity of clinical data. Our data suggests that balanced resuscitation is feasible and that centers should not deviate from this practice if restocking strategies are possible. Protocols must be developed and centers must prepare for MCE to mitigate inefficient usage of blood components during a mass shooting event.

## **SHOCK INDEX AS A MORTALITY PREDICTOR IN A EMERGENCY RESUSCITATION IN TRAUMA PATIENTS**

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**Introduction:** Trauma is considered a public health problem, different scores are using for predicting mortality. The aim of this study was to evaluate whether the shock index, given by the formula  $SI = \text{heart rate} / \text{systolic blood pressure (HR/SBP)}$ , is useful for predicting mortality at 24 in trauma patients admitted to the emergency department of a university hospital in Colombia.

**Methods:** We evaluated shock index (SI) at admission and generating a dichotomous variable with two groups: Group A ( $SI < 0.9$ ) and Group B ( $SI > 0.9$ ). we evaluated the initial type of resuscitation used (colloids, crislatolides and blood). Bivariate and Multivariate analyses were used. For evaluated the correlation between shock index and the type of resuscitation the discriminatory power of the score, its accuracy and precision was assessed by logistic regression and as the area under the receiver operating characteristic curve. Shapiro Wilks, chi2 and Wilcoxon test were used

**Results:** 900 patients were analyzed, 57.22% (515) had  $SI < 0.9$ , and 42.78% (385)  $SI > 0.9$ . The mean age for groups A and B was 32.4 and 35.4 respectively. Injury Severity Score mean was 5.8 and 16.3 ( $p=0.001$ ) respectively. Mortality at 24 hours after injury for  $SI > 0.9$  group was 24.9 % in blood resuscitation and 75.09% in Crystalloid Resuscitation ( $p = 0.001$ ).

**Conclusion:** An initial shock index greater than 0.9 implies a worse prognosis 24 hours after injury. shock index allows evaluating the effectiveness of resuscitation in emergency department in a university hospital in Colombia, Shock index is a quick and applicable score.

## **TRAUMATIC LARYNGOTRACHEAL INJURIES – 7 YEAR EXPERIENCE FROM A LEVEL I TRAUMA CENTRE**

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**Introduction:** Laryngotracheal (LT) trauma is a potentially devastating injury that requires a high index of suspicion and prompt intervention to maximize survival and aerodigestive outcomes. Traumatic laryngotracheal injuries can be classified as external or internal, and due to blunt or penetrating mechanisms. Due to the protection offered by surrounding bony structures and numerous soft tissue suspensions, injuries to the laryngotracheal apparatus are considered infrequent. Respiration, phonation, and airway protection are all at risk following laryngeal injuries that potentially compromise the structural or neurologic integrity of the apparatus.

**Methods:** The study design was of a retrospective cohort of all patients with traumatic laryngo-tracheal injuries presenting to a level-I trauma centre in India between January 2011 and June 2017.

**Results:** A total of 48 patients presented to our centre with traumatic LT injuries over the 7 year time period. Majority of them were males (87.5%) and 50% patients in the 3<sup>rd</sup> decade of life, with mean age of 30.7 years and range between 7-70 years. Penetrating injury accounted to 62.5% patients, out of which 40% were self-inflicted. 44% patients were referred from other hospitals, of which 42% presented after 24 hours of injury. Of all the primary patients, only 8 presented within the golden hour of trauma. Of the 48 patients, 13 were referred intubated, 13 needed immediate airway intervention at our centre. 85% patients had partial LT injury. 25 patients had associated injuries, with 7 having vascular injury, 11 with aero-digestive tract injuries. 19 patients underwent primary repair alone, 16 underwent primary repair with tracheostomy, 3 patients had a tracheostomy done, and 8 were managed non-operatively. We had a mortality of 4%, both patients due to other causes.

**Conclusion:** Although rare, blunt and penetrating trauma to the soft tissue structures of the neck is associated with high morbidity. Many of these injuries require operative intervention, and awareness of the injury with complete, prompt work-up and evaluation are important in order to implement timely, appropriate management. The management of LT traumatic injury continues to evolve, knowledge of current practices allows trauma surgeons to help guide surgical and interventional treatments.

## **AVOIDING UNNECESSARY LAPAROTOMY IN SELECTED BLUNT AND PENETRATING TRAUMA PATIENTS: TIME FOR A PARADIGM SHIFT TOWARDS LAPAROSCOPIC MANAGEMENT**

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**Introduction:** Despite being routine in elective procedures, laparoscopy is still limited in the emergency setting. The surgical community still struggles to incorporate laparoscopy in the management of trauma patients due to various limitations, including lack of technical skills, resources, and scarce evidence of safety and feasibility. However, laparoscopy has shown benefits in selected patients. The main objective of this study is to analyze the value of laparoscopy in avoiding unnecessary exploratory laparotomies. As a second outcome, evaluate the safety of the procedures, measured by complication and missed injury rates.

**Methods:** Retrospective chart review of consecutive blunt and penetrating trauma patients admitted from March 2010 to March 2018. We included all patients who were initially managed by laparoscopy. Demographic, clinical, intra and postoperative data were analyzed. Laparoscopy was divided in negative (no injuries found), positive, and therapeutic (injuries managed only with laparoscopy). Complications were depicted using Clavien-Dindo classification.

**Results:** Complete data was obtained in 128 cases. One hundred and five were male (82%), mean age was 32 years-old. Blunt mechanism was present in 58 cases (45%) and the median ISS was 13 (4-50). Out of the 70 penetrating traumas, with the median ISS of 13 (1-29), 51 were due to stab wounds. Firearm injury was present in 19 (15%) of the studied population. The most common indications for laparoscopy in blunt trauma were free fluid with no solid organ injuries in 33 cases (57%) followed by persistent abdominal pain (12%) and diaphragmatic hernia (10%). In penetrating trauma, thoracoabdominal injury (49%) and suspected peritoneal violation (19%) were the main indications for laparoscopy. Of the laparoscopic procedures, 86 were positive, of which 42 (49%) were therapeutic. Main therapeutic procedures were diaphragmatic repair (50%), hollow viscus suture (26%), and solid organ hemostasis (14%). Thirty-four (26%) were negative laparoscopies. Twenty-four patients had laparotomies. Of those, 13 (54%) had small midline incisions for intestinal suture or resection, with no cavity re-exploration. Main reasons for the 11 conversions to exploratory laparotomy were moderate hemoperitoneum (45%) and technical difficulties (36%). There were 8 Clavien  $\geq 3$  complications. A single case of missed injury (main pancreatic duct) was associated with a Clavien 3a complication (percutaneous drainage of fistula). Two patients died (1,5%) due to septic complications. Unnecessary exploratory laparotomies were avoided in 91% of the patients.

**Conclusion:** Laparoscopic management of trauma patients is feasible and safe in selected blunt and penetrating patients. Complication and missed injury rates were low. Unnecessary exploratory laparotomies, and their early and late complications, were avoided in 91% of the cases.

## THE ADDITIONAL VALUE OF FOLLOW-UP TESTS IN THE ASSESSMENT OF SPLENIC FUNCTION AFTER BLUNT SPLENIC INJURY IN PEDIATRIC TRAUMA PATIENTS

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**Introduction:** Splenectomy used to be the main treatment modality for blunt splenic injury (BSI). Nowadays, even patients with high grade BSI are preferably treated using spleen preserving treatments (SPT). It is assumed that patients with low grade BSI treated with SPT have a good splenic function after recovery. However, there is no consensus on splenic function after high grade BSI. In several institutions, asplenic/hyposplenic infection prevention protocol will be executed in all patients who had SPT after high grade BSI, where other institutions evaluate splenic function first. Scintigraphy is believed to be the best flow/activity test to approximate splenic functionality. The aim of the study was to analyze whether spleen injury grade is associated with diminished splenic function. Secondly, we aimed to evaluate whether splenic function testing is necessary in pediatric patients after BSI.

**Methods:** A retrospective study was performed in our level I trauma center from January 1998 to January 2018. In our institution patients with BSI grade IV of V are assumed hyposplenic and will receive a splenic function test. We included all patients with a minimum follow-up test period of 5 days. All tests were analyzed by the radiology specialist. For each patient we furthermore collected clinical data, including the date of trauma, gender, age, mechanism of injury, Abbreviated Injury Score (AIS) of splenic injury and Injury Severity Score (ISS).

**Results:** During the 20 year inclusion period we included 33 patients consisted of 23 male and 10 female, with a median (IQR) age of 11,8 (7,3 – 13,5). Median ISS was 16,0 (13 – 30,5) and the median spleen AIS was 4 (3 – 4). Non-operative management was used in 26 patients, angio-embolization in five patients and two patients were treated with surgical mesh technique. The median follow-up time of all performed tests was 59 (22 – 75) days. A total of 20 patients (61%) had a grade IV or V splenic injury. Scintigraphy was utilized to test most patients. After testing, a total of 32 out of 33 patients had an adequate splenic function, including all angio-embolization patients. Only one patient with a grade II splenic injury after surgical mesh technique showed no splenic function.

**Conclusion:** So in conclusion, even high grade splenic injuries show adequate splenic function in the follow-up of pediatric trauma patients after BSI. Therefore routine diagnostic follow-up by scintigraphy is not necessary in this specific patient group.

## **SURGICAL OUTCOMES IN PANCREATIC TRAUMA: A 10-YEAR INSTITUTIONAL REVIEW**

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**Introduction:** The use of damage control laparotomy following abdominal trauma has been well documented, however, the clinical outcomes following damage control laparotomy in patients with pancreatic injury has not been well studied. The aim of this study is to compare the clinical outcomes of patients who underwent damage control laparotomy (DCL) or single surgery (SS) for their pancreatic injury.

**Methods:** A retrospective review (2006-2016) of patients who presented to an urban Level 1 Trauma Center with a diagnosis of pancreatic injury, either from a blunt or penetrating mechanism, was performed. All patients who had operative intervention to the pancreas (debridement, resection, or repair) were included. Non-operative patients or patients who did not have a procedure to the pancreas were excluded. Post-surgical outcomes were compared between groups. A  $p \leq 0.05$  was considered significant.

**Results:** During the study period, 111 patients were found to have a pancreatic injury (blunt  $n=72$ ; penetrating  $n=39$ ); 85 (77%) had a laparotomy, and 26 (23%) were non-operatively managed and excluded. Of the 85 patients in this series who underwent exploratory laparotomy for intra-abdominal injury, 44 patients (52%) had operative intervention involving the pancreas. Of these 44 patients, 24 (55%; blunt  $n=10$ ; penetrating  $n=14$ ) had a damage control laparotomy procedure while the remaining 20 (45%; blunt  $n=12$ ; penetrating  $n=8$ ) had a single surgery with primary closure. There was no difference between the groups in terms of age, race, mechanism of injury, grade of injury, or anatomic location of injury (all  $p > 0.05$ ). The damage control surgery group had a higher ISS (22 vs 15), abdominal AIS (3.5 vs 2.4), more ventilator days (8.4 vs 2.7), longer ICU LOS (14.5 vs 7.4), and more blood products transfused [PRBC (22 vs 5.1), FFP (18.1 vs 3.3), PLT (2.2 vs .4)] than the single surgery group (all  $p \leq 0.05$ ). There was no difference in mortality or post-surgical pancreatic complications ( $p > 0.05$ ) between the damage control and single surgery groups.

**Conclusion:** Patients with a pancreatic injury, from either a blunt or penetrating mechanism, who required damage control laparotomy were more severely injured than those who did not require damage control surgery. There were no differences in mortality or pancreas related post-surgical complication rates between these two groups. Damage control techniques allow the management of more severely injured patients with pancreatic trauma without increases in mortality or complications.

## **HYPOVOLEMIC SHOCK IN THE VIEW OF COMPUTED TOMOGRAPHY - IS THERE A PLACE FOR THESE SIGNS?**

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**Introduction:** The presence of tomographic (CT) signs indicative of hypovolemic shock (CTSH) in children has been reported in the medical literature for some time, however these possible signs for the adult are still not well studied. In order to contribute to the tomographic evaluation of patients with blunt abdominal trauma on the presence of shock, we retrospectively studied the ct and hypothesized that these findings may be representative of a clinical state of hypoperfusion.

**Methods:** We retrospectively reviewed 46 patients with adult blunt abdominal trauma treated at our emergency unit (ERU) with a Severity of Injury Index (ISS) greater than 15 and a systolic blood pressure lower than 90 mm Hg and submitted to thoracoabdominal CT during a period of 24 months, demographic and clinical data of the registered patient were also analyzed. All the reports of the CT scans were evaluated by the radiology service and after evaluation of the medical records a new discussion with the radiologists was made.

**Results:** 32 patients (69%) of our sample had signs of hypovolemic shock, and the average number of signs per patient was 4. The most common findings in patients with CTSH were the presence of free peritoneal fluid, increased uptake and / or dilatation of the small intestine, flattened inferior vena cava (IVC) and flattened renal veins. VCI and flattened renal vein as well as active contrast extravasation were found in patients presenting with low hemoglobin and greater need for transfusion. Another analysis identified dilatation of the small intestine and splenic injury may be factors associated with mortality and a greater chance of laparotomy.

**Conclusion:** CTSH can correlate with clinical hypoperfusion in patients with closed trauma and still provide important prognostic and therapeutic implications. The presence of CTSH in patients with closed trauma should call for immediate attention and may require rapid intervention. Despite the small study with retrospective design, we can warn that trauma surgeons should seek to understand these signs and consequently include them in the evaluation of patients with closed abdominal trauma as to the decision making mainly regarding the surgical conduct



## **NON-OPERATIVE MANAGEMENT IN ABDOMINAL PENETRATING INJURIES - WHERE DOES THE PROTOCOL LIE**

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**Introduction:** Penetrating trauma is fast becoming the leading cause of trauma due to intentional harm, as a result of increased use of weapons and firearm. According to WHO report, there is increased use of firearm weapon all over the world. The war zone of the globe is already reeling under the pressure of such patients. These patients occupy maximum numbers of beds in the hospitals and challenge the trauma system in that part of the world. Even the free gun licensing in the U.S.A. and other countries also have increased the incidence of firearm injuries. India has a strict law of firearm licensing but is still has an increasing trend in firearm and other penetrating injuries, maybe due to more number of illegal and country-made weapons. Terrorism also is a challenge and causes severe injuries due to penetrating injuries. Patients with abdominal penetrating injuries occupy the maximum number of beds in trauma surgery department and OR are kept busy with the operative intervention of these patients.

**Methods:** This is a retrospective observational study conducted in the department of trauma surgery KGMU, U.P. Lucknow, India from December 2016 to February 2017. Total 252 patients with firearm injury abdomen were admitted to trauma surgery department.

**Results:** Out of these 252 patients, 230 patients were operated and landed in OR after primary survey, resuscitation, and investigations. 22 patients were in grey zone and had no positive radiological or clinical finding to justify immediate surgery. Out of 22 patients who were initially managed by non-operative measures, 10 had stab injuries and 12 had firearm injuries. Out of 12 firearm injuries patients, 5 had pallet (shotgun) injuries and 7 had bullet injuries. Out of the total of 22 patients of penetrating abdominal trauma 3 patients of stab wound injuries and 4 patients of firearm injuries (2 pallet injuries and 2 bullet injuries) were operated after 48 hours of the Admission and had late signs and symptoms. While 7 patients with stab injuries and 8 patients of the firearm injury abdomen (3 pallets and 5 bullet injuries), patients were managed by non-operative management.

**Conclusion:** The penetrating abdominal injuries are challenging and drama involved with these patients, tempt the trauma surgeon to the role the patient to OR. But a good serial clinical examination, radiological examination, and other investigations may prevent unnecessary laparotomies and reduced mortality and morbidity. The dictum of penetrating injuries of the abdomen are managed in OR, stays challenged for our institution.

## **LOOKING AT THE OTHER SIDE OF THE COIN: USING VISCOELASTIC METHODS (ROTEM TO HOLD BLOOD TRANSFUSIONS IN TRAUMA PATIENTS**

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**Introduction:** Hemorrhage and coagulopathy are a major cause of death and morbidity in trauma. Exams using viscoelastic characteristics of the clot have been introduced more recently to guide blood product transfusions in these patients. The objective of this study was to assess the importance of ROTEM parameters as a tool to hold transfusions in trauma patients.

**Methods:** Retrospective analysis of the trauma registry data in a period of 12 months, starting in November, 2014, including all adult patients that had a ROTEM test upon hospital arrival. We used the ROTEM cut-offs parameters (Extem CT, Extem A10, Extem MCF, Extem CFT, Extem ML, Extem Angle, FibtemA10 and Fibtem MCF), as defined by the manufacturer, to assign patients into one of two groups: "normal" or "abnormal". The variable "normal ROTEM" (NL ROTEM) was created to identify patients in whom all ROTEM parameters were normal. The two groups were compared regarding the use of blood products in 2x2 tables. Negative predictive values (NPV) for blood products transfusion were calculated. The utilization of blood products was assessed regarding the type and the volume of transfusion. These analyses were repeated in subgroups of patients with ISS>15, as well as, with systolic blood pressure (SBP) lower than 90mmHg on admission. Chi square and Fisher's exact tests were used for statistical analysis, considering  $p<0.05$  as significant

**Results:** 793 patients fulfilled the inclusion criteria. Blunt trauma accounted for 80.2% of the admissions (73.5% were male). Median age was 42 y.o. (range 15-96). Forty six patients (5.8%) were admitted with SBP lower than 100 mmHg, and 161 (20.3%) sustained a AIS head higher than 2. Median ISS was 9 (2-19) and 269 patients sustained an ISS>15 (33.9%). At least one unit of blood products was transfused in the first 24 hours in 92 (11.6%) cases and NL ROTEM was observed 604 (76.2%) patients. The NL ROTEM NPV in predicting the transfusion of: any blood product (BBP), plasma (FFP), platelets (PLT) and massive transfusion (MT) were, respectively, 94.7%, 98.3%, 98.8% and 99.7%. Regarding patients with ISS>15, the NL ROTEM NPV in predicting the transfusion of: BBP, FFP, PLT and MT were, respectively, 83.8%, 92.5%, 96.3% and 98.8%. In the subgroup of patients admitted with SBP<90 mmHg, NL ROTEM predicted 14/15 (93.3%) cases in which MT did not happen.

**Conclusion:** There is evidence that NL ROTEM is able do identify patients who will not need BBP transfusions in the first 24 hs. after trauma, even in subgroups of patients sustaining severe injuries and hemodynamic instability.

## **PREDICTION OF PATIENTS WITH MAJOR TRAUMA REQUIRING MASSIVE BLOOD TRANSFUSION : A COMPARISON OF ABC, TASH, PWH, SI SCORES**

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**Introduction:** Several scoring systems that predict the need of massive transfusion (MT) in trauma patients have been proposed. The aim of this single center retrospective study was to validate the accuracy of existing scoring systems in Korean trauma patients.

**Methods:** Among trauma patients who were admitted to a regional trauma center between January 1, 2014 and December 31, 2016, those who were  $\geq 13$  of age, with injury severity score over 15, and who had received  $\geq 1$  RBC units during initial 24 h were included. Previously developed scores [Assessment of Blood Consumption (ABC), Trauma-Associated Severe Hemorrhage (TASH), Prince of Wales Hospital (PWH), and shock index (SI)] were calculated for each patient according to the published methods. Performance of each scoring system to predict the need of MT was compared using area under the receiver operator curve (AUROC). MT was defined as (1)  $\geq 1$  RBC unit within 2 h and (2)  $\geq 5$  RBC units or death from hemorrhage within 4h.

**Results:** Among the 562 patients who met the inclusion criteria, 176 (31.3%) patients were classified as MT patients. According to multivariate logistic regression, initial systolic blood pressure, heart rate, Glasgow coma score, and free abdominal fluid were associated with MT. When receiver operator curve of ABC, TASH, PWH, and SI were plotted, all four scoring systems were good predictors of MT with AUROC of 0.828, 0.844, 0.866 and 0.811, respectively. When previously reported cut-off values were applied, ABC, TASH, PWH scores showed high specificity (93.8%, 96.8%, and 93.4% respectively), but low sensitivities (50.6%, 31.8%, and 49.1% respectively).

**Conclusion:** ABC, TASH, PWH, and SI showed comparable capabilities in predicting MT in Korean trauma patients. However, previously proposed cut-off values of ABC, TASH, and PWH were skewed towards higher specificity leading to low sensitivity and high false negative rate.

**ASSOCIATION OF THE TIME INTERVAL FROM HOSPITAL ARRIVAL TO CT SCANNING WITH MORTALITY AMONG ADULT TRAUMA PATIENTS WITH PREHOSPITAL SHOCK ON SCENE; A NATIONWIDE HOSPITAL-BASED REGISTRY IN JAPAN**

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**Introduction:** In recent years, the implementation of computed tomography (CT) scanning has become faster and provided physicians various information on patients. Therefore, in treatments of trauma patients, CT scanning is absolutely necessary. However, the appropriate timing of CT scanning is still unknown among trauma patients with shock vital. The purpose of this study was to assess the relationship between the time from hospital arrival to CT scanning and mortality among adult trauma patients with prehospital shock on scene.

**Methods:** We used data from the Japan Trauma Data Bank, in which 256 institutions of all over Japan have been involved since 2008 through 2015. Adult trauma patients with prehospital shock vital on scene were included in our study. Patients who were transferred to another hospital, and traumatic cardiac arrest on hospital arrival were excluded, and they were divided into the following three groups according to the time interval from hospital arrival to CT scanning; immediate scanning group of 0-29 mins, intermediate scanning group of 30-59 mins, late scanning group of more than 60 mins. We analyzed separately the head injury patients (Abbreviated Injury Scale of head  $\geq 3$ ) and trunk injury patients (Abbreviated Injury Scale of chest or abdomen  $\geq 3$ ). Primary outcome was mortality on discharge. Multivariable logistic regression adjusting for age, sex, day of week, Injury Severity Score, Glasgow Coma Scale on hospital arrival, shock on arrival, focused assessment with sonography for trauma (FAST), and the time interval from finding to hospital arrival was performed to test the association between CT scan timing and mortality by the type of injury (head or trunk).

**Results:** A total of 23,988 patients were included. Of them, the immediate group were 10066 (42%), the intermediate group were 9753 (40.6%), and the late group were 4169 (17.4%). Among head injury patients, mortality gradually increased from 25.3% to 30.4% as CT scan timing delayed (p for trend =0.02). The adjusted odds ratio of the late group for mortality after adjusting for potential confounders was 1.28 (95% confidence interval, 1.04-1.57) compared with the immediate group. Among trunk injury patients, mortality gradually increased from 13.1% to 21.0% as CT scan timing delayed (p for trend <0.001). The adjusted odds ratio of the late group for mortality was 1.37 (95% confidence interval, 1.12-1.67).

**Conclusion:** Among adult trauma patients with shock on scene, delayed CT scan timing was associated with increased mortality on discharge.

**IS THERE A MORTALITY  
DIFFERENCE IN TRAUMA PATIENTS REPATRIATED TO NON-TRAUMA  
CENTERS? PILOT DATA FROM AN EAST MULTI-CENETR TRIAL**

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**Introduction:** The Committee on Trauma has pledged towards 'Zero Preventable Deaths' in U.S. trauma systems. The feasibility of this mission with the trauma patient that is repatriated to a non-trauma center is the focus of an ongoing multi-center study sponsored by EAST (eastern association for the surgery of trauma). The impetus to transfer patients to non-trauma centers is predicated on the Affordable Care Act; health plans require repatriation of these patients to their assigned medical centers, many of which are not designated trauma centers.

**Methods:** Multicenter data is being collected to track 90-day mortality rates of trauma patients transferred to non-trauma center. A 1:1 match of independent variables including age, gender, Injury Severity Scale (ISS), Trauma Injury Severity Scale (TRISS) is used to compare death rates to expected mortality.

**Results:** To date, we have 9 patients enrolled. 90 day mortality = 4.9% for transferred patients. Expected mortality = 4.1%

**Conclusion:** Preliminary data does not suggest a mortality difference in repatriated trauma patients who receive their secondary care at non-trauma centers, if they received their initial care at a designated trauma center.

**TRIBULATIONS OF CONDUCTING RANDOMIZED CONTROLLED TRIALS  
IN COLOMBIA: THE EXPERIENCE FROM THE CELTA TRIAL  
(HYPERTONIC SALINE FOR EARLY ABDOMINAL FASCIAL CLOSURE  
AFTER EMERGENT LAPAROTOMY IN TRAUMA PATIENTS)**

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**Introduction:** A randomized controlled trial (RCT) evaluating the effect of hypertonic solutions (HS) for abdominal fascial closure (AFC) after damage control laparotomy (DCL) in trauma patients was proposed and started to recruit patients since November of 2015. We described our experience on conducting a RCT in Colombia and provided preliminary data.

**Methods:** Since November 2015, trauma patients who require DCL were randomized to 50mL/hour of HS during the next 70 hours following laparotomy plus standard fluid resuscitation, or standard fluid resuscitation alone. Sample size was calculated on 400 patients in a multicenter fashion. However, the National Institute of Food and Drug Monitoring (INVIMA) implemented on May 2016 a new regulation and required an insurance that increased dramatically the costs of conduction of the trial, discouraging other settings, and limiting our ability to conduct the trial in our hospital. Labels were not open for this preliminary data analysis.

**Results:** From our hospital and during November 2015–December 2017, we were able to recruit 35 patients. Mean age was 33.6 years (standard deviation [SD], 13.2); 31 were males (88.6%). Mechanism of injury was penetrating in 29 patients (82.8%). Mean injury severity score was 26 (SD, 11.1). Mean fluid balance at day 4 were 803cc (SD, 1248) and -137cc (SD, 1732) for each group ( $p=0.109$ ). Between groups, AFC was achieved in 14 patients (77.7%) and in 15 patients (93.7%), respectively ( $p=0.340$ ).

**Conclusion:** Regulatory barriers and budget limitations exist for the conduction of trauma trials in Colombia. This preliminary data analysis demonstrated nonsignificant trends towards differences in fluid balance at day four and AFC rates, when we compare the study groups. To date, there has been no need to open labels for safety reasons. Question remains whether results will favor the intervention group after other centers helps us to finishing the trial and we are able to open the study labels.

## **THE FEASIBILITY OF TELEPHONE-ADMINISTERED INTERVIEWS TO EVALUATE LONG-TERM OUTCOMES OF TRAUMA PATIENTS IN SUB-SAHARAN AFRICA**

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**Introduction:** Accurate measurements of the long-term functional outcomes of trauma patients in low-income countries are crucial to evaluate the quality of trauma care and inform advocacy efforts. In sub-Saharan Africa, most long-term functional outcomes data are collected from clinic follow-up visits, which can introduce significant sampling bias since both the healthiest and most significantly disabled patients may be less likely to return to clinic. Mobile phone service is rapidly expanding in sub-Saharan Africa, and 70% of the population now has mobile phone coverage. In light of this growing technology, we sought to determine whether structured, telephone-administered interviews are a feasible means of collecting long-term functional outcomes data about trauma patients in sub-Saharan Africa.

**Methods:** We piloted a telephone-administered interview tool based on the Extended Glasgow Outcomes Scale (GOSE). Using departmental logbooks and trauma registries in two academic medical centers in an East African metropolis, 400 consecutive patients presenting with injuries were identified retrospectively. Patient telephone numbers and demographic and injury data were collected from clinical charts. When a telephone number was available, patients or their caretakers were contacted and interviewed about their functional status six months after their injuries.

**Results:** Of 400 patients, we were able to contact 189 patients or their caretakers, and 186 of those contacted were willing to complete the interview with allowing us to calculate a GOSE score (97%). Language barriers and patient refusal to participate were not significant barriers. At six months, 142 patients had made a good recovery (77%), 5 had made a moderate recovery (3%), 31 were severely disabled (17%), and 7 had died (4%). Of those who we were unable to contact, 70% did not have a phone number recorded and 30% had numbers that were not answered or were out of service.

**Conclusion:** This pilot study demonstrates that structured, GOSE-based, telephone-administered interviews are a feasible means of collecting long-term functional outcomes data about trauma patients in sub-Saharan Africa when a reliable telephone number has been recorded. Because patient follow-up is limited in this setting, this research methodology provides a valuable new means of collecting patient data following hospital discharge. These data are essential for understanding the true burden of injury in this context, where almost a quarter of trauma victims had significant persistent disability at six months. Future prospective studies using telephone-administered interviews should emphasize accurate telephone number collection prior to hospital discharge.

## A PROSPECTIVE ANALYSIS OF SHORT AND MID-TERM KNOWLEDGE RETENTION AFTER AN ULTRA-SHORT ULTRASOUND COURSE FOR MEDICAL STUDENTS.

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**Introduction:** Point-of-care ultrasound is becoming an invaluable tool in emergency surgery and is already considered as the new stethoscope by some authors. Ultrasound techniques may be taught early for medical students. FAST represents a simple exam that might be used to teach important aspects of ultrasound imaging. We sought to investigate knowledge retention on short- and mid-term after an ultra-short FAST course for medical students. As a secondary outcome, we pursued to find what the students consider as barriers to participate in ultrasound courses.

**Methods:** This prospective study involved medical students enrolled to the FAST course of the Sao Paulo State Trauma Leagues Symposium, and included those who responded to a pre-course (PRT) questionnaire. The same 8-question form was presented 1 week (1POT) and 3 months (3POT) after the course. The course duration was 50 minutes and involved theoretical explanations and hands-on training. Correct responses obtained from the questionnaires were compared to assess knowledge gain with the course after 1 week, and the retention after 3 months. Statistical analysis was performed using Chi-square and Fisher's Exact tests, and a  $p < 0.005$  was considered significant.

**Results:** Fifty-two students participated in the course. Thirty-seven answered the pre-course questionnaire (PRT) and were included in the analysis. Response rates to 1POT and 3POT were 47% and 32%, respectively. No student had previously participated in an ultrasound course. Comparison between PRT and 1POT showed that there was significant knowledge retention for 6 of the 8 questions (Table 1). Comparison in Table 2 showed that the acquired knowledge was retained, despite small reduction in correct answers. Regarding the barriers for undergoing an ultrasound course, students reported costs (65%), concerns about being released from routine activities (38%), course location (38%), and time spent in the course (24%) as the main factors.

**Conclusion:** this data show that even an ultra-short FAST course can effectively impact theoretical knowledge retention in medical students. Efforts should be made to disseminate this knowledge early during medical education. This should be made by customized courses with low costs, short duration, in accessible places and with previous consent from the university directors.

Table 1. Comparison between PRT and 1POT responses.

	PRT (n= 37)	1POT (n = 18)	p-value
Q1. Basic ultrasound functionality	26 (70%)	15 (83%)	0,346
Q2. Transducer choice	28 (78%)	15 (83%)	0,731
Q3. FAST steps	27 (73%)	18 (100%)	<b>0,021</b>
Q4. E-FAST windows	10 (27%)	13 (72%)	<b>0,001 *</b>
Q5. Ultrasound vs. Chest X-ray	6 (17%)	10 (55%)	<b>0,004</b>
Q6. Free Fluid Identification	8 (22%)	12 (66%)	<b>0,001 *</b>
Q7. Hepatorenal evaluation	8 (22%)	13 (72%)	<b>&lt;0,001 *</b>
Q8. Pericardial evaluation	2 (6%)	12 (66%)	<b>&lt;0,001</b>

Table 2. Comparison between PRT and 1POT responses.

	1POT (n = 18)	3POT (n= 12)	p-value
Q1. Basic ultrasound functionality	15 (83%)	10 (83%)	0,999
Q2. Transducer choice	15 (83%)	10 (83%)	0,999
Q3. FAST steps	18 (100%)	10 (83%)	0,152
Q4. E-FAST windows	13 (72%)	8 (66%)	0,999
Q5. Ultrasound vs. Chest X-ray	10 (55%)	7 (58%)	0,999
Q6. Free Fluid Identification	12 (66%)	5 (41%)	0,119 *
Q7. Hepatorenal evaluation	13 (72%)	5 (41%)	0,094 *
Q8. Pericardial evaluation	12 (66%)	6 (50%)	0,361 *



## **PREPARED TO CARE: AN EXPLORATION OF CONTINUING EDUCATION TRENDS OF NURSES CARING FOR INJURED CHILDREN**

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**Introduction:** The significance of nursing competence in the care of pediatric trauma patients has been well documented (AAP, 2016). Continuing education for trauma nurses is an important component of maintaining competence yet there is significant variability in the resources used to support this goal. The purpose of this current study was to explore the types of educational programs and requirements that members of the Society of Trauma Nurses (STN) must complete to work in verified/ designated trauma centers. Trauma nursing education requirements by state and selected countries (Canada and Norway) are also presented.

**Methods:** A descriptive non-experimental research design was utilized to describe the educational programs that members of the Society of Trauma Nurses (STN) must complete to work in verified/designated trauma centers. An invitation to participate in this study was sent to all (2990) members of STN during May 2017. Participants completed a 15-question survey instrument that included questions about demographics, pediatric trauma educational programs required/offered by their employer, and feedback about pediatric trauma nursing education.

**Results:** A total of 265 responses were included in this current study. Most participants worked at community hospitals (n= 78; 30%) followed by those working at children's hospitals within larger medical centers (n=45; 17%) and free-standing children's hospitals (n=45; 17%). Most worked in an adult trauma centers with county/ state verification/ designation as an adult trauma center (n=68; 26%) or an ACS verified adult trauma center (n=62; 23%). Two international member responses were received. Most participants were trauma program managers/coordinators (n=131) and a wide-variety of other nursing roles were represented. Most participants reported (n=186; 70%) that their verifying/ designating agency required trauma nursing education to support their trauma center. Trauma Nurse Core Curriculum (TNCC) was the most popular educational course required by members' employers (n=208; 79%) followed by Pediatric Advanced Life Support (n=194; 73%) and Emergency Nursing Pediatric Course (ENPC) (n=101; 38%). Course in Advanced Trauma Nursing (n=2) and International Trauma Life Support (ITLS) Pediatric (n=1) and ITLS Provider (n=1) were least common. Participants provided feedback about challenges accessing pediatric-specific trauma nursing education; operational and budgetary limitations of requiring pediatric trauma continuing education that is not required by trauma verifying/designating organizations; limited pediatric trauma content in established trauma courses offered by professional nursing organizations; and suggestions to include additional content about non-accidental trauma in pediatric trauma nursing education offerings.

**Conclusion:** While there is strong support for continuing education in pediatric trauma nursing for all nurses who care for injured children, there is a lack of consensus with regards to standards in programming, content and the amount of time that should be spent in learning activities. Many hospitals continue to expend resources in developing programs for their own institution often due to the limitations related to not being able to endorse a program because it is not mandated by a verifying/designating agency. In addition to high-quality programming developed by professional nursing organizations, some regional and state trauma systems have developed continuing education programs for nurses that include evidenced-based pediatric content that could also serve as a model.

## ESTABLISHMENT OF TRAUMA SYSTEM FRAMEWORK IN SHENZHEN, CHINA

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**Introduction:** The trauma triage in Shenzhen is currently sending trauma patients to the nearest hospital, and has caused some major trauma patients to be sent to hospitals where they do not have appropriate resources and capacity for treatment. The study performed in 2016 showed patients who are considered to have suffered a major trauma, from scene to hospital, as 8.5% were taken to a teaching hospital, 13.6% to a regional hospital, 42.6% to a community hospital and 35.3% to a private hospital.

**Methods:** A geographical analysis of traumatic accidents happened in Shenzhen in 2014 and the results showed that trauma patients were highly clustered. A multi-party group was formed to discuss the feasibility and rationality of designated hospitals for trauma patients based on traumatic accidents location, hospital location, hospital level, previous trauma patient volume and trauma care resources. The recommendation of the regional trauma centers among these hospitals will depend on hard and soft criteria.

**Results:** A consensus has been formed that trauma patients need to be sent to designated hospitals. 22 hospitals were designed to be trauma care hospitals that cover the entire population throughout the Shenzhen area. Five trauma networks were suggested to be established and five hospitals were designed to be regional trauma centers that are expected to meet all the hard and soft criteria by December 31, 2018.

**Conclusion:** The rationale behind the Shenzhen Trauma System Framework is to ensure that the right patient goes to the right hospital at the right time, to receive the right care under the right organization, in order to achieve the right result. This framework will provide experiences for other parties in China to refer to, and it may provide a model for other parties in China to follow as well, in the near future.

**Key words:** Geographical Analysis; Designation; Trauma Center

## **WORLD TRAUMA EDUCATION: HEMORRHAGE CONTROL TRAINING FOR HEALTHCARE PROVIDERS IN INDIA**

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**Introduction:** Hemorrhage remains a major cause of death around the world. Eighty percent of trauma patients in India do not receive medical care within the first hour. The etiology of these poor outcomes is multifactorial. To date, there has only been one documented first-responder civilian training course for basic trauma care in India. The first Stop the Bleed (StB) course was recently offered to a group of medical providers in India.

**Methods:** A cross-sectional survey of 101 participants who attended a StB training in Puttaparthi and Bangalore, India was performed. Ninety-six participants were healthcare providers and five were laypersons, ages 19 to 75 y.o. Pre- and post-training questionnaires were collected from each participant (5-point Likert scale). Data from the five laypersons was excluded, along with that of eight healthcare providers whose questionnaires were incomplete. In total, 88 healthcare providers' pre- and post-training questionnaires were included in the analysis. Training time was distributed evenly between didactic and skills sessions. Three bleeding control skills were presented: wound compression, wound packing, and tourniquet application.

**Results:** Among participants, 88.6% had previously taken a CPR or first-aid training course. Only 23.9% reported receiving bleeding control training. The 88 healthcare providers consisted of nine resident physicians (10.2%), 24 attending physicians (27.3%), and 55 nurses (62.5%). Participants who reported feeling "extremely confident" responding to an emergency medical situation rose from 68.2% prior to StB training to 94.3% post-training. Regarding hemorrhage control abilities, 37.5% felt extremely confident before the training, compared to 95.5% after the training. For wound packing and tourniquet application, 44.3% and 53.4%, respectively, felt extremely confident pre-training, followed by 97.7% for both skills post-training. Importantly, 90.9% of StB trainees felt comfortable teaching newly acquired hemorrhage control skills, as all of the physicians and nurses who completed this course were certified as StB instructors. The training was well received, with 96.6% stating they would recommend the course to others. When evaluating instructional equipment, 95.5% and 94.3% of participants stated that confidence in their wound packing and tourniquet skills would improve with a more realistic mannequin. Additionally, seven trainees requested supplementary videos or real-life scenarios/case discussions where these skills could be used. Lastly, three participants suggested translation of this program into local languages.

**Conclusion:** To our knowledge, this is the first StB training in India. Disparities in access to care, long transport times, and insufficient numbers of prehospital personnel contribute to the nation's significant trauma burden. Dissemination of these critical lifesaving skills into this region and the resulting civilian interventions will increase the number of trauma patients who survive long enough to reach a trauma center. Much more work is needed to match the training required for the large population. Additionally, considerations should be given to translating the course into local languages to increase program reach.

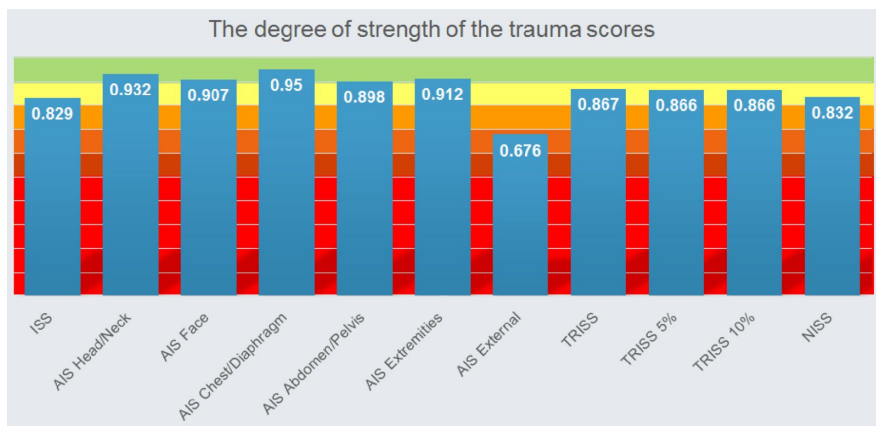
## Assessment Of Polytraumatized Patients According To The Berlin Definition: Does The Addition Of Physiological Data Really Improve Interobserver Reliability?

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**Introduction:** Several new definitions for categorizing the severely injured as the Berlin Definition have been defined. Here, severely injured patients are selected by additive physiological parameters and by the general Abbreviated Injury Scale (AIS)-based assessment. However, all definitions should conform to a AIS severity coding applied by an expert. We examined the dependence of individual coding on defining injury severity in general and in identifying polytrauma according to several definitions.

**Methods:** We investigated the interobserver reliability (IR) between several trauma-scoring systems (AIS, Injury Severity Score [ISS], New ISS [NISS], and The Trauma and Injury Severity Score [TRISS]) for identifying polytrauma using several cutoff levels (ISS <sup>3</sup>16, <sup>3</sup>18, <sup>3</sup>20, and the Berlin Definition). Three hundred and nineteen patients were included for analyzing IR of trauma scores, with 187 for polytrauma definitions. IR for scoring was assessed by intraclass correlation coefficient Cronbach's alpha (ICC) and Cohen's kappa for the polytrauma definitions.

**Results:** IR showed good agreement ( $\geq 0.80$ ) with ISS, NISS, maximum AIS of each body region (MAIS; with the exception of MAISexternal), and TRISS. IR for identifying polytrauma according to the relevant definitions showed moderate agreement ( $< 0.60$ ) in the ISS cutoff categories (ISS <sup>3</sup>16, <sup>3</sup>18, and <sup>3</sup>20), while the Berlin Definition demonstrated a correlation of  $> 0.81$ .



**Conclusion:** Compared with the ISS-based definitions of polytrauma, the Berlin Definition proved less dependent on the individual rater. This underlines the need to redefine the selection of severely injured patients. Using the Berlin Definition for identifying polytrauma could improve the comparability of patient data across studies, in trauma center benchmarking, and in quality assurance.

## **PHYSICIAN BASED ON-SCENE AIRWAY MANAGEMENT IN SEVERELY INJURED PATIENTS AND IN-HOSPITAL CONSEQUENCES - IS THE MISPLACED INTUBATION AN UNDERESTIMATED DANGER IN TRAUMA MANAGEMENT?**

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**Introduction:** Establishing and maintaining an adequate airway by endotracheal intubation (ETI) is an essential component of advanced trauma life support (ATLS®) to ensure best possible oxygenation and ventilation. Orotracheal intubation remains the gold standard for securing a definitive airway in trauma care. When performed in the out-of-hospital environment special attention has to be paid to cervical spine protection, the risk of aspiration and possible sideeffects of analgesia and sedation. The aim of our study was to determine the influence of airway management associated problems on neurological outcome after out-of-hospital intervention by EMS physicians in patients suffering from severe and multiple injuries and the consequences for the trauma leader.

**Methods:** In this retrospective study (01/2011-12/2013), all patients admitted to the trauma room of a level I trauma center were analyzed consecutively. The subgroup of patients with advanced airway management in the out-of-hospital setting by EMS physician as inclusion criteria were investigated in detail. The incidence of unrecognized esophageal misplaced tube, endobronchial intubation and massive aspiration of stomach content were recorded as airway associated problems. The neurological outcome at hospital discharge was evaluated using the Glasgow Outcome Scale (GOS).

**Results:** During the study period 1,176 patients were admitted. Out of these, 151 patients received advanced airway management in the out-of-hospital setting. Airway associated problems were identified in 12 cases (8%). Esophageal intubation was recorded in 5 patients (3%) and other problems were identified in 5%. Airway associated problems was significant associated with vegetative state or severe disability (GOS 2/3) in 36,3%.

**Conclusion:** Out-of-hospital airway management problems may contribute to the neurological outcome of severe and multiple injured patients. Intensive and routine trauma and airway management trainings seem to be a prerequisite for successful trauma management. The trauma leader should consider airway associated pitfalls. Trauma room checklists may be a useful tool for avoiding life-threatening mistakes.

**DEVELOPMENT OF TRAUMA LEVEL PREDICTION MODELS UTILIZING EMS VITAL SIGNS TO REDUCE OVER- AND UNDERTRIAGE RATES FOR PENETRATING WOUNDS AND ELDERLY FALLS**

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**Introduction:** The process to determine the triage activation level can be difficult and inaccurate, resulting in excessive overtriage (OT) and undertriage (UT) rates. This study focuses on the development of trauma activation prediction models using field data to accurately predict trauma activation level and achieve triage rates that are consistently within The American College of Surgeons (ACS) recommended ranges.

**Methods:** We utilized the 2014 National Trauma Data Bank (NTDB) to create a binary regression equation for each injury type under study (geriatric patients with blunt injury from falling while standing (GF), and patients with penetrating wounds (i.e., gunshot and stab wounds)). The 2014 trauma data was randomized and divided into halves, where the first half of the data for each injury type was used to generate the prediction model, and the second half of the 2014 data, 2013, and 2015 NTDB data was used for model verification. The binary regression equations were generated from vital signs collected by EMS. Patients with any incomplete vital sign values or values outside required ranges were removed from the data set. A Cribari Grid with an  $ISS \geq 15$  was used to determine appropriateness of activation level. Chi-square analysis was utilized to determine significant differences between OT, UT, and accuracy predictions.

**Results:** Using our triage models, we were able to obtain an UT rate of less than 4% and an OT rate of less than 40% for GF, an UT rate less than 4% and OT of less than 50% for patients suffering from gunshot wounds (GSW), and an UT rate less than 25% for patients suffering stab wounds.

Fall from Standing for Patients 65 Years and Older (GF)				
Data Set Year	Sample Size	Overtriage % (95% CI)	Undertriage % (95% CI)	Accuracy % (95% CI)
2014 Model	13125	37.03 (36.20, 37.86)	3.51 (3.20, 3.84)	59.46 (58.61, 60.30)
2014 Validation	13134	36.37 (35.55, 37.20)	3.43 (3.12, 3.75)	60.20 (59.36, 61.04)
2013	25821	36.47 (35.88, 37.06)	3.95 (3.72, 4.20)	59.58 (58.98, 60.18)
2015	40700	37.75 (37.28, 38.22)	3.23 (3.06, 3.41)	59.02 (58.54, 59.50)
Gunshot Penetrating Wounds (GSW)				
Data Set Year	Sample Size	Overtriage % (95% CI)	Undertriage % (95% CI)	Accuracy % (95% CI)
2014 Model	4253	46.77 (45.26, 48.28)	3.50 (2.97, 4.10)	49.73 (48.22, 51.24)
2014 Validation	4403	44.79 (43.31, 46.27)	3.84 (3.29, 4.45)	51.37 (49.89, 52.86)
2013	10134	44.29 (43.32, 45.26)	3.95 (3.58, 4.34)	51.77 (50.79, 52.74)
2015	13650	44.42 (43.58, 45.26)	3.46 (3.16, 3.78)	52.12 (51.28, 52.96)
Stab Penetrating Wounds (SW)				
Data Set Year	Sample Size	Overtriage % (95% CI)	Undertriage % (95% CI)	Accuracy % (95% CI)
2014 Model	4532	20.63 (19.46, 21.84)	3.49 (2.97, 4.06)	75.88 (74.61, 77.12)
2014 Validation	4476	21.36 (20.17, 22.59)	3.93 (3.38, 4.54)	74.71 (73.41, 75.98)
2013	9892	21.81 (21.00, 22.63)	3.67 (3.31, 4.06)	74.52 (73.65, 75.38)
2015	13044	21.76 (21.05, 22.48)	3.63 (3.31, 3.96)	74.62 (73.86, 75.36)

For GF, the UT rate for GF patients in 2013 was significantly different ( $p=0.002$ ) from the 2014 Validation and 2015 data, and the OT rate for 2015 was significantly different from the 2013 and 2014 Validation data ( $p<0.001$ ). For GSW, there were no significant differences for UT rates ( $p=0.201$ ), but the OT rate for the 2014 Model was significantly different from the 2013 and 2015 data ( $p=0.037$ ). For stab wounds, there were no significant differences for UT ( $p=0.712$ ) or OT ( $p=0.381$ ) rates.

**Conclusion:** Our developed trauma level prediction models enable health providers to predict trauma activation levels that result in over- and undertriage rates that fall in line with the recommended ranges by ACS.

## THE STATE OF PRE-HOSPITAL CARE AND AMBULANCE UTILIZATION IN RURAL GUJARAT, INDIA

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**Introduction:** Low and Middle income countries (LMICs) like India are going through rapid urbanization and have high injury associated mortality rates. Lack of infrastructure and resources has led to poor prioritization of pre-hospital care and 'Golden Hour'. In Gujarat, despite the recent implementation of a state sponsored ambulance service, its direct impact on outcomes in trauma patients has never been studied. We aimed to investigate the utilization of this ambulance service amongst trauma patients and its impact on mortality in rural western India.

**Methods:** Retrospective analysis of prospectively collected trauma registry data at an only tertiary care hospital serving a rural catchment area of 11,300 sq km in state of Gujarat, India was conducted between September 1, 2017 and January 15, 2018. Basic patient demographics, injury related details, pre-hospital data points and mortality were compared between patients arriving in an ambulance vs other modes of transport. Multivariable logistic regression models were used to determine the impact of mode of transport on patient mortality.

**Results:** Of 1,117 patients, majority (74%) were males, and mean age was 33.6 years ( $\pm$  17.9). Only 364 (33%) patients utilized the ambulance service. Most patients (68%) were brought in either by their relatives or the bystanders in a private vehicle. Patients arriving by ambulance vs private vehicles were similar in age, gender, and time of injury. However, patients arriving in ambulance had lower overall revised trauma score (RTS) suggesting more severe injuries (7.47 vs 7.76,  $p < 0.001$ ). The median ambulance response time was 17.5 minutes. Patients using ambulances had longer transport times (55 mins vs 45 mins,  $p = 0.023$ ). Patients arriving  $>60$  minutes had significantly higher mortality compared to shorter transport times (OR 9.17, 95% CI 2.12 - 39.71,  $p = 0.003$ ). Despite the existing capabilities, the quality of basic pre-hospital care was poor especially for the critically injured patients. Zero endotracheal intubations were performed en route when necessary (GCS  $< 8$ ), and 0 cervical spines were protected when indicated. Consequently, the adjusted mortality rate (by age, cause of injury and RTS) amongst patients transported in the ambulances was no better than in patients arriving by other modes of transport (aOR 1.92, 95% CI 0.50 - 7.38,  $p = 0.338$ ). 319 (28%) patients initially went to the other hospitals which had inadequate capabilities to treat the sustained injuries and were eventually transferred to our hospital. For these inappropriately triaged patients, the median duration from the time of injury to definitive care was longer (160 vs 45 minutes,  $p < 0.001$ ). Additionally, these patients had higher adjusted mortality rates (by age and cause of injury) [aOR 3.15, 95% CI 1.33 - 7.47,  $p = 0.009$ ].

**Conclusion:** The use of ambulance by trauma patients in rural Gujarat remains poor. Ambulance transport is not associated with lower mortality, but on the contrary appears to take longer than private vehicles. Inappropriate triage in the field is common and is associated with increased mortality. Significant improvement in pre-hospital training and triage protocols may improve patient outcomes associated with ambulance transport of trauma patients in rural Gujarat.

## EMERGENT TRAUMA LAPAROTOMY WITH OR WITHOUT THORACOTOMY IN THE EMERGENCY DEPARTMENT: RISKS AND BENEFITS.

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**Introduction:** Different from the level I trauma centers in the United States or other western countries, trauma centers in Japan don't mandate to have one operating room (OR) and one OR team to be available for 24 hours/7 days for emergent trauma surgery. Therefore, our emergency department (ED) in the advanced trauma center have trauma resuscitation rooms with OR set-up which allow surgeons to perform trauma laparotomy/thoracotomy without transferring patients to the OR. This study was conducted to assess the risks and benefits of this practice pattern.

**Methods:** Patients who underwent emergent trauma surgery by our acute care surgery group (4/2013 – 12/2017) were reviewed. Patients' demographics, injury severity score (ISS), location of surgery, type of surgery, time from admission to surgery, vital signs (at the scene, on admission, and prior to surgery), preoperative interventions, transfusions, postoperative outcomes, and in-hospital mortality were recorded. For patients who underwent surgery in the ED, risk factors associated with the in-hospital mortality were analyzed.

**Results:** There were 121 patients who met inclusion criteria. There were 64 patients (53%, 64/121) who underwent surgery in the ED and 57 patients (47%, 54/121) in the OR. The mean ISS was higher in the ED group than OR group (31.0±16.1 vs 13.9±10.1, p=0.04). Patients who underwent surgery within 90 minutes from admission were more frequent in the ED group than the OR group (72%, 46/64 vs 35%, 20/57, p<0.01). The in-hospital mortality rate was 36% (23/64) in the ED group; whereas, there were no mortality in the OR group (p<0.01). Outcomes of 59 patients in the ED who had signs of life on admission were shown on Table 1. Blunt trauma and shock (systolic blood pressure [SBP] < 90 mmHg) were more common in patients who died than who survived. Time from admission to surgery were not different between who died and who survived. Patients who died received more transfusions of red blood cells (RBCs) and platelets than patients who survived. Among patients who died, there were 12 patients (67%, 12/18) who were not shock on admission and 7 patients (50%, 7/18) who developed shock after induction of anesthesia. All patients (100%, 5/5) who underwent laparotomy followed by thoracotomy died in the ED. All patients (100%, 5/5) who needed the placement of resuscitative endovascular balloon occlusion of aorta (REBOA) died. Twelve patients (67%, 12/18) died in the ED following surgery. Among patients who survived, 30 patients (73%, 30/41) were not shock prior to surgery (Table 1).

**Conclusion:** Emergent trauma surgeries in the ED were associated with shorter time from admission to surgery, higher ISS, larger amount of transfusions, and higher mortality compared to surgeries in the OR. There were some concerns regarding pre- and intra-operative anesthetic management in surgeries in the ED. Patients who died in the ED following surgery might not be survivable regardless of the timing of surgery nor the place of surgery. Patients who were not shock prior to surgery could have been brought to the OR. Further study is warranted to assess the safety of this practice pattern.

**Table 1:** Outcomes patients with signs of life on admission and who underwent emergent trauma surgery in the ED (N=59)

	Survived (N=41)	Died (N=18)	P value
Age, years, mean±SD	47.1±22.8	41.7±18.8	0.39
Injury Severity Score, mean±SD	22.8±13.4	38.6±15.0	0.68
Blunt trauma	20 (49%)	17 (94%)	<0.01
Time from admission to surgery > 90 minutes	28 (68%)	13 (72%)	0.78
Shock (SBP <90mmHg) at scene	9 (22%)	6 (33%)	0.52
Shock (SBP <90mmHg) on admission	8 (20%)	6 (33%)	0.32
Shock (<90mmHg) prior to surgery	11 (27%)	11 (61%)	0.02
Shock after the induction of anesthesia	11 (27%)	9 (50%)	0.13
Preoperative REBOA placement	0	5 (28%)	<0.01
Type of surgery: Laparotomy	18 (44%)	4 (22%)	0.15
Type of surgery: Thoracotomy	1 (2%)	1 (2%)	0.52
Type of surgery: Laparotomy then thoracotomy	0	5 (28%)	<0.01
Type of surgery: Thoracotomy then laparotomy	1 (2%)	1 (6%)	0.52
Type of surgery: Retroperitoneal pelvic packing	2 (5%)	5 (28%)	<0.01
Type of surgery: Others	19 (46%)	2 (11%)	0.02
Transfusion of RBCs within 24 hours, units, mean±SD	8.8±12.9	27.2±21.6	0.02
Transfusion of FFPs within 24 hours, units, mean±SD	8.8±12.5	16.6±16.3	0.10
Transfusion of Platelets within 24 hours, units, mean±SD	8.2±12.7	14.7±17.2	0.02