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Abstracts

Survivors of traumatic cardiac arrest. M. Azam Majeed. From the University Hospitals Birmingham, Birmingham, UK.

Background: Traumatic cardiac arrest (TCA) carries high mortality and morbidity. Survival is poor. Recent studies suggest the rate of morbidity and mortality due to TCA is approaching the same as that due to any other cause of cardiac arrest. The common causes are head trauma, tension pneumothorax, spinal injuries and hypovolemia. The commonly found rhythm in TCA is pulseless electrical activity (PEA) followed by asystole and then ventricular fibrillation (VF). This study identified survival rates and factors affecting them. **Methods:** A 5-year retrospective database review was conducted to identify trauma patients who had traumatic cardiac arrest. This study was conducted at the University Hospitals Birmingham, England, which is a Level 1 regional trauma centre. The primary outcome measure was survival to hospital discharge. The secondary outcome was to look at the factors affecting survival. **Results:** Forty patients had out-of-hospital cardiac arrest secondary to major trauma. The mean age was 50 years (16–84 years) and the male to female ratio was 32:8. The commonest mechanism involved was road traffic accidents and then falls. The mean injury severity score (ISS) was 37.5 (9–66) and the most commonly injured regions were as follows: chest 70% (28 patients), head 55% (22), face 40% (16), spine 37% (15), abdomen 27% (11) and 15% (6) with pelvic injuries. Ninety-five percent (38 out of 40) of patients received adrenaline and all (100%) patients received CPR. Out of 40, only 60% (24 patients) received blood. The mean length of CPR was 46 minutes (2–90 minutes). Only 55% (22) patients got return of spontaneous circulation on scene and 35% (14) more patients while in the resus room. The commonest rhythm was asystole 78% (31 patients), PEA 18% (7 patients) and then 5% (2 patients) had VF. Only 4 patients (10%) survived to discharge. When we looked at these alive patients they had received CPR for a mean time of 4.5 minutes (2–7 minutes), and their mean age was 39 years (31–48 years). Among these 4 patients, 2 had sustained only rib fractures and lung contusions. One patient had renal contusion and liver laceration. The last patient was a case of drowning. **Conclusion:** The survival rates described are poor but comparable with (or better than) published survival rates for out-of-hospital cardiac arrest of any cause. Patients who have active bleeding on scene leading to hypovolemia have a poor chance of survival. Also, the survivors had a very short time of cardiopulmonary resuscitation. Most of the guidelines suggest a poor chance of survival with longer resuscitation.

All-terrain vehicle serious injuries and death in children and youth: a national survey of Canadian pediatricians. Peter Gill,¹ Thomas McLaughlin,² Daniel Rosenfield,¹ Charlotte Moore-Hepburn,¹ Natalie Yanchar,³ Suzanne Beno.¹ From ¹The Hospital for Sick Children, Toronto, Ont.; the ²BC Children's Hospital, Vancouver, BC.; and the ³Alberta Children's Hospital, Calgary, Alta.

Background: All-terrain vehicles (ATVs) are a leading cause of serious injury in children and youth. Certain Canadian regions have implemented legislation to promote safety, including age restrictions, mandatory training and helmet use. Jurisdictions with more stringent ATV safety legislation have been shown to have reduced injury rates in the short term. We aimed to estimate the burden of ATV-related serious injury and death in Canada and to

identify Canadian physicians' knowledge of ATV-related legislation and health. **Methods:** A one-time survey was distributed to practising pediatricians and pediatric subspecialists participating in the Canadian Paediatric Surveillance Program (CPSP) in October 2016. **Results:** Of 2793 physicians contacted, 904 responded (32.4%). There were 181 reported cases of serious and/or fatal ATV-related injuries, including 6 deaths. Children aged 10–14 years represented the most number of cases ($n = 82$, 45.3%), followed by those aged 15–19 years ($n = 48$, 26.5%) and 5–9 years ($n = 40$, 22.1%). Most cases occurred in July/August (48.3%) and May/June (25.2%), were in males ($n = 133$, 78.2%) and occurred during recreational activity ($n = 139$, 83.2%) or organized racing ($n = 6$, 3.6%). In 99 cases (58.9%), the child was the driver of the ATV. Only two-thirds of respondents (67.5%) knew that ATVs should not carry passengers while under half (42.2%) never discussed ATV safety with their patients. **Conclusion:** ATV-related injuries and deaths in Canadian children remain a serious public health problem. Education of health care practitioners, including pediatricians, is needed to promote safety. Despite efforts to reduce injuries related to ATVs, there remains a significant number of serious injuries and/deaths related to their use.

Early versus late: appropriate timing of venous thromboembolism prophylaxis in traumatic brain injury. Mboutidem Etokakpan. From the Geisinger Health System, Danville, Pa.

Background: Nationwide, venous thromboembolic events (VTEs) remain the leading cause of morbidity and mortality in trauma patients. The incidence of VTE ranges from 300 000 to 1 million in the United States and is as high as 25% in traumatic brain injury (TBI) patients. Currently, there is no standardization on timing of VTE prophylaxis in patients with TBI. As we know, VTE is a time-dependent event, with most occurring early in the hospital course. **Methods:** This was a retrospective cohort study from January 2011 to December 2016. Data were collected from Geisinger Danville and Geisinger Wyoming Valley Trauma Registries. Patients were grouped into those who received early VTE prophylaxis (0–24 hours) versus late (24–72 hours). Patients in the early and late groups underwent propensity score matching. Initial and 24-hour head CT scans were manually reviewed to evaluate for stability of intracranial hemorrhage. **Results:** During the study period, 1167 patients were identified. Following propensity score matching using age, body mass index, trauma centre designation, comorbidities, mechanism, TBI severity and classification of type of TBI, 122 patients were identified in each group. There was no difference in progression of intracranial hemorrhage or number of VTEs. Seven patients had progression of intracranial hemorrhage in the early group versus 13 within the late group ($p = 0.16$). Only 2 patients within the study were diagnosed with VTE, both within the early group. Our secondary outcome data showed there was no difference in length of stay in the intensive care unit, need for intubation or days on the ventilator. **Conclusion:** We found no significant progression of intracranial hemorrhage when starting VTE prophylaxis early. Only 2 patients within our study developed VTEs. Although our study found no difference in the incidence of VTE, it is well established that TBI patients are at high risk of VTE; therefore, once safe, VTE prophylaxis should be started. Based on our small retrospective study it appears safe to start VTE prophylaxis within 24 hours.

The use of a pediatric pre-arrival and pre-department trauma checklist to improve the clinical care in a simulated trauma resuscitation: a randomized trial. *Sberry MacGillivray,¹ Patricia Lee,² Russell Lam,¹ Jonathan Guilfoyle,¹ Jeffrey Lin,¹ Angelo Mikrogianakis,³ Vincent Grant,¹ Adam Cheng.³* From ¹Alberta Health Services, the ²University of Calgary and the ³Alberta Children's Hospital, Calgary, Alta.

Background: The purpose of this study is to determine if the introduction of a pre-arrival and pre-departure trauma checklist will improve clinical performance in a simulated environment. The trauma checklist was developed in response to quality assurance reviews of high-acuity trauma activations. It focuses on pre-arrival preparation and pre-departure review before patient transfer. We conducted a randomized controlled trial assessing the impact of the trauma checklist on time to critical interventions on a simulated pediatric patient. **Methods:** Emergency department teams composed of 2 physicians, 2 nurses and 2 confederate actors were enrolled in our study. In the intervention arm, participants watched a 10-minute educational video modelling the use of the trauma checklist before their simulation scenario and were provided a copy of the checklist. Teams participated in a standardized simulation scenario caring for a severely injured adolescent patient with hemorrhagic shock, respiratory failure and increased intracranial pressure. **Results:** Our primary outcome of interest was time measurement to initiation of key clinical interventions, including intubation, first blood product administration, massive transfusion protocol activation, initiation of hyperosmolar therapy and others. Secondary outcome measures included a trauma task performance score and checklist completion scores. We enrolled 14 multidisciplinary teams ($n = 56$ participants) into our study. There was a statistically significant decrease in median time to initiation of hyperosmolar therapy by teams in the intervention arm compared with the control arm (581 seconds [509–680] v. 884 seconds [588–1144], $p = 0.03$). Time to initiation of other clinical interventions was not statistically significant. There was a trend to higher Advanced Trauma Life Support (ATLS) task performance scores in the intervention group; however, this did not reach statistical significance ($p = 0.09$). Pre-arrival and pre-departure checklist scores were higher in the intervention group (9.0 [9.0–10.0] v. 7.0 [6.0–8.0], $p = 0.17$, and 12.0 [11.5–12.0] v. 7.5 [6.0–8.5], $p = 0.01$). Cognitive workload scores did not show statistical significance across all 7 domains of the NASA-TLX tool. **Conclusion:** Teams using the trauma checklist had significantly higher pre-arrival and pre-departure scores, with a trend to higher trauma task performance scores. However, use of the trauma checklist did not impact the cognitive workload scores of team participants. The impact of this checklist should be studied outside tertiary trauma centres, particularly in trainees and community emergency providers, to assess for benefit and further generalizability

A survey of communication among team members during resuscitation of trauma pediatric patients in a tertiary care centre in North America. *Deepak Choudhary, Jeremy Killion, Sarah Dipalma, Jeremy Walsh.* From the Women and Children's Hospital of Buffalo, Buffalo, NY.

Background: Effective communication is critical in high-risk environments like pediatric emergency resuscitations. At Women and Children's Hospital of Buffalo, during a typical resuscitation

there could be 5 to 15 people in the resuscitation room, each member playing a specific role. Due to the intense situation and number of people, there are chances of errors at multiple levels. The objective of this survey was to bring out these gaps in communication during resuscitation scenarios. **Methods:** Between Dec. 15, 2016, and Sept. 21, 2017, at the end of each trauma event in the pediatric emergency department, a survey was provided to all team members (physician and nonphysicians). The survey gathered information about the team member's knowledge of the patient's age, weight, presentation, medical history, regular medications and allergies, access to vital signs and ETCO₂, laboratory tests and radiological investigations ordered for the patient. The answer options included yes, no and not applicable. **Results:** We received a total of 135 filled surveys. Survey completion rates were 15% for emergency department (ED) attendings, 19% for ED fellows, 44% for ED nurses, 4% for emergency medicine residents, 1.5% for pediatric intensive care unit (PICU) attendings, 1.5% for PICU fellows, 7% for surgery residents, 1% for respiratory therapists, 6% for allied professionals and 1% for pediatric residents. Based on the results of χ^2 analyses, less than half of providers reported having access to patients' allergy information (38%), medication information (25%) and medical history (37%) ($p < 0.001$ for all). Thirteen percent of providers were not aware of the patient's presentation and 31% of providers were not aware of the patient's vital signs. There was no significant difference in team members' awareness of age and weight (aware 56%; not aware 44%). In the given scenario, 49.25% did not have access to the patient's ETCO₂ at all times; 35.82% felt that ETCO₂ was not applicable. Twenty-three percent did not know the medications and fluids ordered for the patient in real time; 5.93% felt that medications and fluids were not applicable. Further, 30.60% did not know the laboratory tests ordered and results for the patient in real time; 3.73% felt that laboratory tests were not applicable. In addition, 29.63% did not know the radiological investigations ordered in real time and results for the patient; 8.89% felt that radiological investigations were not applicable. **Conclusion:** A significant proportion of team members had a poor understanding of the patient's presentation, ongoing resuscitation, laboratories and radiological investigations. Only a few people could gather the medical history and information on regular medications and allergies for the patient. Our survey shows that providers have poor communication during resuscitations. We hope to install large monitors on walls, visible to all participants. We also intend to create a software program that will display all the required information.

Knowledge transfer: implementation of a clinical intervention guide to optimize and harmonize trauma care for patients with rib fractures in the emergency department. *Nathalie Rodrigue, Nancy Tze.* From the McGill University Health Centre, Montréal, Que.

Background: Rib fractures are common trauma injuries and incidence increases with age, resulting in visits to the emergency department. Observing variability in internal practices, the Montreal General Hospital Trauma Program implemented over a year an evidence-based clinical intervention guide to optimize and harmonize trauma care for patients with rib fractures. The guide consists of 3 tools: an interprofessional algorithm including multimodal analgesia for pain relief, a nursing management care guide

and an educational brochure for patients discharged home. **Methods:** Using the knowledge to action framework and following a timetable, barriers and facilitators were identified; the cycle evaluation–feedback–correction–re-evaluation was used, and the guide was adapted to the local context and transformed into a protocol. Guided with indicators, chart audits and patient phone follow-up reviews, the fidelity of the implementation of the new practice as well as the effects of the new practice on patients and on the organization of care and services were evaluated. **Results:** Over 200 clinicians from different professions were trained to the new practice. A total of 197 patients met the inclusion criteria to the protocol. The implementation allowed for a relatively high overall rate of activation of 61%, going as high as 74% when examining the nursing portion of the protocol. The rate of activation also varied between patients discharged home and those admitted, at 43% and 88%, respectively. The discharge pamphlet was given 22% of the time and no patients discharged from the emergency department were readmitted for complications related to rib fractures (i.e., uncontrolled pain, pneumonia). Using a sample of 18 patients, the analysis of the fidelity of the implementation indicated that all 3 nursing interventions (documented pain level, respiratory exercises and mobilizations) were done 78% of the time. Of the patients reached via the phone follow-ups ($n = 37$), 60% reported receiving some to enough information on pain medication and its side effects, 83% took their prescribed medication, 56% were doing their respiratory exercises, and all were mobilizing at least 3 times per 24 hours. As many as 37% reported having unexpected problems since returning home, of which 58% were related to their rib fractures. The main problems were related to pain not being well managed, more severe than expected or interfering with sleep and comfort. The phone follow-ups were positively perceived by patients and were a great opportunity to teach and refer as required. **Conclusion:** The knowledge to action framework was instrumental in guiding this implementation project to its success. Our goal to optimize and harmonize care has been achieved. A large number of patients are now receiving the right multimodal analgesia and the right nursing care to prevent complications. In addition, facilitators and barriers were identified and used to put forward recommendations for future projects, such as adapting the protocol for use on trauma units.

An uncommon case of 100% musculocutaneous nerve rupture and brachial plexus impingement after clavicular fracture. *Shankar Haran.* From the Geelong Hospital, Geelong, Australia.

Background: Brachial plexus palsy in the setting of fragment compression from acute clavicular fracture is rare. We present the only known case in the literature with a musculocutaneous nerve rupture secondary to bony fragment displacement of a clavicular fracture. This case required neurolysis of the lateral cord, dual nerve transfer surgery to treat the musculocutaneous nerve rupture and internal fixation of the clavicle, resulting in an excellent functional recovery. **Methods:** A literature review using Medline and PubMed with search terms including “clavicular fracture” and “brachial plexus injury” OR “brachial plexus impingement” was performed and all articles were reviewed. **Results:** The mechanism of most acute lesions of the brachial plexus is high-energy, blunt traction related to motorbike, car or industrial accidents. Lesions of the brachial plexus due to clavicular

fractures are rare. Reported cases have focused almost exclusively on delayed cases due to nonunion, malunited fragments, direct compression from hypertrophic callous or subclavian pseudoaneurysm. Although compression of the medial and posterior cords has been reported, in the present case the lateral cord was involved. The importance of a thorough neurovascular examination at the time of presentation of the fracture is highlighted by this case. An inability to flex the elbow and altered sensation in the lateral forearm were initially overlooked. If routine neuromuscular testing reveals a neurologic defect, appropriate referral to a nerve centre or brachial plexus unit is required. Nerve conduction studies and electromyography should be undertaken to confirm the clinical suspicion. Axonal discontinuity results in predictable pathological findings and time-related changes that follow the pathophysiology of denervation. Needle electromyogram should only be performed after 3 weeks, after which Wallerian degeneration results in spontaneous electrical discharges. MRI is the investigation of choice for anatomic delineation of neural structures. T_1 -weighted MRI is a reliable tool due to its multiplanar capabilities and superior soft tissue delineation. In this case, MRI revealed clavicular bone fragment causing impingement of the upper part of the brachial plexus at the level of the cords. **Conclusion:** Although rare, direct compression of the brachial plexus by a bone fragment must always be considered in the presence of neurologic deficit, particularly in the presence of significant displacement or comminution of a fracture of the clavicle. Early diagnosis and appropriate treatment with neurolysis, removal of bony fragments and fixation of the fracture as well as appropriate management of the neurologic injury by way of repair or transfer can lead to excellent results.

Head injuries in mixed martial arts: a systematic review. *Joel Lockwood,¹ Liam Frappe,¹ Alum Ackery.²* From the ¹University of Toronto and ²St. Michael's Hospital, Toronto, Ont.

Background: Mixed martial arts (MMA) is an emerging combat sport that is gaining popularity worldwide. Despite MMA's increasing popularity and societal acceptance, it remains a violent sport. Of particular concern are the cumulative neurodegenerative effects of repeated head trauma in MMA, and rigorous academic studies examining head injuries sustained in MMA are lacking. **Methods:** We conducted a comprehensive systematic review of academic databases from 1990 to 2016 for studies of any design that reported acute or chronic head injuries in persons participating in MMA activities. Two reviewers hierarchically assessed articles based on predetermined inclusion and exclusion criteria; included articles were evaluated using the GRADE approach, and evaluated studies based on participant demographics, head injury incidence and prevalence, previous diagnosis of head injury and head injury treatment/rehabilitation. **Results:** The initial database search yielded 472 citations, including 264 unique citations after duplications were removed. Full-text manuscripts were obtained and reviewed for 39 citations. A total of 18 studies ($n = 7587$) were selected for final analysis, based on the predefined eligibility criteria. The studies included in the final analysis were heterogeneous in their design, the population studied and the outcomes measured. We included 13 observational studies, of which 8 were retrospective studies describing injuries and injury patterns sustained in MMA competition, and 5 were prospective longitudinal cohort

studies measuring structural changes on MRI and behaviour. We also included 1 cross-sectional study, 2 survey studies and 2 case reports. All studies were ranked as very low using the GRADE approach. The cohort studies were all assigned a score of 4 (out of a possible 9), using the Newcastle–Ottawa Quality Assessment Scale for cohort studies. **Conclusion:** MMA has experienced a dramatic increase in popularity. However, head injury patterns sustained by participants, injury prevention strategies and long-term sequelae of head injuries sustained in MMA activity remain poorly elucidated. Increased medical oversight and study is required to minimize head injuries sustained in MMA, to ensure that consistent head injury diagnosis, treatment and reporting are used, and to ensure that appropriate return to activity guidelines are developed and enforced.

National Injury Prevention Day in Canada. *Pamela Fuselli,¹ Jane Edwards,² Brandon Batey,² Zabra Hussein,³ Neil Merritt.²* From ¹Parachute, Toronto, Ont.; the ²London Health Sciences Centre, London, Ont.; and ³Trauma Services, Vancouver General Hospital, Vancouver, BC.

Background: The inaugural National Injury Prevention Day (NIPD) in Canada was held July 5, 2017, to shine a spotlight on the issue of preventable injuries — the leading cause of death to Canadians aged 1–44 years. NIPD galvanized communities across the country to “light up” in Parachute green and “Stop the Clock” on preventable injuries. **Methods:** Parachute reached out to have NIPD formally recognized as an observance day by Health Canada. Our communications team submitted requests to various landmarks, such as the CN Tower (Toronto), the Peace Bridge (Fort Erie) and Vancouver City Hall. Parachute developed a social media guide that included a hashtag (#NIPD) and sample tweets and Facebook posts. A broadcast email was sent to partners across the country, including the TAC Injury Prevention Committee, to promote NIPD. **Results:** The response from partners across the country was overwhelming, with a number proposing new landmarks and pursuing approval on behalf of Parachute. Partners contacted us for more information on how to spread the word and share our messaging. A dedicated NIPD webpage was created that provided information on the event and activities. A total of 10 Canadian landmarks participated by lighting up in Parachute green on July 5. These landmarks included the CN Tower, the 3D Toronto sign, the Calgary Tower, the Peace Bridge, London City Hall, the High Level Bridge, Vancouver City Hall, Science World, North Bay City Hall and Caesars Windsor. During the day, Parachute raised its flag at a ceremony at Toronto City Hall in honour of NIPD. Partners supported NIPD through social media, using #NIPD and linking the national initiative to local issues and events. NIPD social and traditional media outreach resulted in 1263 tweets, a total of 4 324 848 social media impressions, 555 people participating, the no. 1 trending topic, 30 traditional media stories and a total of 3 146 106 traditional media impressions. **Conclusion:** The inaugural NIPD was a significant success, galvanizing partners across the country to spread the message of preventable injuries by turning landmarks in Canada green. This national social media initiative was able to link with local partners, injury issues and activities to raise awareness of the burden of injuries in Canada and highlight the work being done to “Stop the Clock” so Canadians can live long lives to the fullest.

Outcomes of nonoperative management of splenic injury: a retrospective cohort from a Level 1 trauma centre in Thailand. *Osaree Akaraborworn, Naruthep Nuchaikeaw, Burapat Sangthong, Kommet Thongkhao.* From the Prince of Songkla University, Thailand.

Background: Nonoperative management (NOM) of splenic injury is standard management for hemodynamically stable patients. However, it may be a challenge in developing countries with limited intensive care resources. This study aimed to review the outcomes of NOM of splenic injury in a Level 1 trauma centre in Thailand. **Methods:** This was a retrospective review from a prospectively collected trauma registry. The enrolled patients had splenic injury and underwent NOM from 2009 to 2016. Failure of NOM was defined as needing an operation on the spleen after NOM. The outcomes of NOM were described and the predictors for failure of NOM were identified. **Results:** Seventy-two splenic injury patients were included in the study. Motorcycle crash was the most common mechanism of injury (56%). The average injury severity score was 20. Fifty-nine patients (89%) were successfully treated with NOM. Six patients underwent embolization (8%) and none of them required operative management. The lengths of stay in successful NOM and failure of NOM were 15 days and 31 days, respectively. From a univariate analysis, hemoperitoneum ≥ 3 regions and initial heart rate ≥ 110 were significantly associated with failure of NOM. Multivariate analysis found hemoperitoneum ≥ 3 regions (OR 14.1, 95% CI 3.2–62.2; $p < 0.001$) was a predictor of failure of NOM. **Conclusion:** NOM of splenic injury could be done successfully in a high-level trauma centre in a developing country. Angioembolization might be helpful to increase the success rate. The amount of hemoperitoneum was a significant predictor of failed NOM.

Prevalence of risky driving behaviours on popular TV series. *Abigail Tien,¹ Lorraine Tremblay,² Peter Chu.²* From ¹Havergal College and the ²Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: Motor vehicle collisions are a leading cause of death in young adults, partly because people in this age group engage in risky driving behaviours. Social media and television can increase the likelihood of risk taking in youth, particularly high-risk sexual activity. However, no studies have looked at social media and risky driving behaviours. The purpose of this study was to determine the prevalence of risky driving behaviours on popular TV series that are commonly watched by young adults. **Methods:** Popular “Driving TV Series” were identified from the “Most Popular TV Shows” list on the IMDb website. Series were randomly selected, from which episodes were streamed and assessed for the presence of any risky driving behaviours. Risky driving behaviours included distracted driving, driving while using a cellphone, driving under the influence and unsafe driving. **Results:** From the 5 “Driving TV Series” selected, 216 episodes were streamed on Netflix. There were 333 identified driving scenes, of which 271 (81.4%) portrayed at least 1 risky driving behaviour. Unsafe driving (not wearing a seat belt) was the most common risky driving behaviour noted, constituting 74.2% of all identified risky driving behaviours. To a lesser degree, distracted driving and

driving while using a cellphone were noted (10.9% and 8.5%, respectively). There were no instances of texting while driving, and driving while intoxicated was also very rare. **Conclusion:** Popular TV series model unsafe driving behaviours. Seat belts are very infrequently used. As well, drivers are often distracted, as they look away from the road to talk to other occupants in the car. Finally, drivers use cellphones while driving. Further study is required, but TV producers should be sensitive to modelling unsafe driving behaviours, particularly if the audience consists largely of young drivers.

Spinoffs from the introduction of ATLS training in the Caribbean. *Jameel Ali,¹ Rasheed Adam,² Henry Bedaysie,² Ian Pierre,³ Sushilla Maharaj,³ Ernest Ali,³ Rosanna Robinson,⁴ Kenneth John,⁵ Grace Herrera Fernandez.⁶* From the ¹University of Toronto, Toronto, Ont.; the ²Port of Spain General Hospital, Port of Spain, Trinidad and Tobago; the ³Society of Surgeons of Trinidad and Tobago, Port of Spain, Trinidad and Tobago; the ⁴San Fernando General Hospital, San Fernando, Trinidad and Tobago; ⁵St. John Ambulance, Toronto, Ont.; and the ⁶San Jose Hospital, San Jose, Costa Rica.

Background: The Advanced Trauma Life Support (ATLS) program introduced in 1986 in Trinidad and Tobago was the first outside North America. We review the impact of the program in the development of trauma education initiatives in the Caribbean. We previously demonstrated a 2-fold trauma patient outcome improvement in a tertiary centre receiving ATLS training but no overall improvement until other programs (e.g., prehospital) based on ATLS principles were introduced later, leading to trauma education programs in the rest of the Caribbean. **Methods:** We assessed trauma education program evolution in Trinidad and Tobago and the Caribbean by reporting on the specific programs introduced into the Caribbean islands by Trinidad and Tobago faculty, outlining these programs in Trinidad, Grenada, Jamaica and Barbados as well as their impact on ambulance system development and training of participants from other islands that do not have their own trauma training programs. The results were grouped according to individual island trauma training program activities. **Results:** Trinidad: coordinated equipped ambulances with communication systems: total of 125 compared with 25 about 10 years ago (national ambulance service, 45; government, 20; regional health, 20; private including Red Cross, 40). ATLS: 94 courses (16–24/course), 2107 trained; nurse auditors, 550. One hundred and fifty ATLS from adjacent islands of Barbados, Guyana, Antigua, Dominica, Bahamas, St. Lucia, Surinam, Curacao and Aruba. PHTLS (Prehospital Trauma Life Support): 62 courses, 1200 trained. TEAM (Trauma Evaluation and Management for medical students) was started in 2001, trained 100–200 per year. RTTDC (Rural Trauma Team Development Course): 2 courses, 30 trained. The introduction of the PHTLS program in Trinidad was associated with a further decrease in trauma mortality compared with the impact of ATLS alone because of demonstrated increased implementation of prehospital and emergency department resuscitative manoeuvres. Grenada (sponsored and funded by St. George's University): ATLS: 19 courses, 330 trained; nurse auditors, 161; also trains physicians from St. Vincent, Africa, India and the Middle East. PHTLS: 17 courses, 240 trained. RTTDC: 4 courses, 48 trained. TEAM

annual for class of over 250; stopped after 5 years and replaced by ITLS. Jamaica: ATLS: Trinidad faculty conducted 9 courses, 2001–2004; trained 169 ATLS physicians; nurse auditors, 72. The course has faltered because of a change in leadership; the course required re-establishment on 2 occasions because of a lack of activity. Barbados: 1994 PHTLS instructor course for 14 instructors and 2009 for 8 instructors. It was stopped because of lack of funding. **Conclusion:** The ATLS course introduced in 1986 in Trinidad and Tobago has had a significant impact on trauma patient outcomes and spawned the development of trauma education programs in other parts of the Caribbean. It has resulted in ambulance system development, prehospital trauma training and nurse and medical student trauma training in the Caribbean. The mainstay of this effort in trauma education is the ATLS faculty of Trinidad and Tobago.

Nonaccidental trauma induced chylothorax in the pediatric population. *Farah Ladak,¹ Ioana Bratu.²* From the ¹University of Alberta Hospital, Edmonton, Alta.; and the ²University of Alberta and Stollery Children's Hospital, Edmonton, Alta.

Background: Chylothorax in the pediatric population is a rare but highly morbid and potentially fatal condition. Though more commonly precipitated by cardiothoracic surgery and penetrating trauma, there are case reports to suggest a distinct association with nonaccidental trauma. At present, management guidelines focus exclusively on the former 2, without direction in the setting of nonaccidental trauma. **Methods:** We present a case and review of the evidence surrounding nonaccidental trauma-induced chylothoraces in the pediatric population. **Results:** After sustaining a fall while being carried down the stairs, an 8 kg (5th percentile) 16-month-old girl presented a day later with tachypnea, paraplegia and complete opacification of the right chest cavity. Prompt chest tube placement drained 300 mL of bloody chyle and led to a marked improvement in her breathing. CT and MRI showed a Chance fracture at T11–T12 with cord contusion myelomalacia, as well as multiple, bilateral rib fractures. She was kept NPO, and TPN was initiated in the first 24 hours. Within 36 hours of admission, her chyle output increased to 1–1.5 L/day (high absolute lymphocyte count) and remained high for a week. Fluid and electrolyte balance were monitored daily. Chest tube drainage slowed to 30 mL/day, such that by day 12 of admission, Lipistart 30 (medium-chain triglyceride diet) NG feeds could be started. By day 17, she switched to a low-fat diet, and by day 21 she was tolerating a regular diet with minimal chest tube output. Her chest tube was removed on day 22. Her paraplegia improved only marginally. She was transferred to a pediatric rehabilitation centre for her spinal cord injury on day 25. Upon review of the literature, 5 cases of nonaccidental trauma induced chylothoraces have been described. In 4 of 5 cases, patients were treated conservatively with prolonged chest tube drainage and fluid/electrolyte/nutritional support. **Conclusion:** Management of pediatric chylothorax in the setting of nonaccidental trauma is determined on a case-by-case basis. This study demonstrates the potential role for a prolonged trial of conservative management, with tolerance for higher levels of chest tube output over a longer period of time. While further study is required to determine the safety and efficacy of this approach, it does prompt investigation into whether chylothoraces following cardiothoracic surgery can be approached the same way.

Provincial implementation of a new field trauma triage protocol in Quebec — outcomes a year later. *Stephanie Leclerc,¹ Lynne Moore,¹ Louis-Philippe Pelletier,² Douglas Eramian,³ Sébastien Gaudreault,⁴ Camille Marcoux,¹ Camylle St-Laurent,¹ Julien Clement.⁵* From ¹Laval University, Québec, Que.; ²Centre intégré de santé et de services sociaux des Laurentides, Saint-Jérôme, Que.; ³Centre hospitalier universitaire de Québec – Hôpital Enfant-Jésus, Québec, Que.; ⁴Centre intégré universitaire de santé et de services sociaux de la Capitale-Nationale Québec, Que.; and ⁵Centre hospitalier universitaire de Québec, Québec, Que.

Background: For decades, trauma prehospital triage in Quebec was a combination of the Prehospital Index and high-velocity impact, which oriented patients toward a network of 59 centres, regardless of level designation. The Institut national d'excellence en santé et en services sociaux concluded in a previous review that the CDC-ACSCOT algorithm would be superior. This algorithm enables the bypass of a lower designation centre in an area. Bypass radius was fixed at 60 minutes. To ensure safety, a fifth box was added to the algorithm. **Methods:** The city of Québec was the first area to implement the new triage protocol. The first 1186 cases were recorded and analyzed. The primary outcome was to prove that the fifth box is unnecessary and will contain mostly minor trauma patients. We considered that less than 5% of major trauma would be sufficient to remove the fifth box. Secondary outcomes were to analyze the proportion of patients in each box and the number of admissions, transfers or discharges. **Results:** A total of 1186 cases were recorded between November 2016 and April 2017. Of those, 558 (47.0%) were in box 5, 527 (44.4%) were in box 4, 51 (4.5%) were in box 3 and 48 (4.0%) were in boxes 1–2. In the fifth box, 470 (84.2%) were minor trauma patients, 83 (14.9%) were nontrauma patients with medical diagnostics and only 5 (0.9%) were major trauma patients, all of them being traumatic brain injuries. Also, 83.2% of the patients were discharged directly from the emergency department (ED), 2.5% were transferred to a Level 1 trauma centre for further evaluation and 57% of these transfers were discharged from the ED after evaluation. The other 14% were hospitalized mostly for minor fractures, minor brain injuries or other medical conditions. In the fourth box, 78.0% were minor traumas, 21.8% were nontraumatic conditions and 0.4% were major traumas; 73.6% were discharged from the ED, 23.9% were hospitalized and 2.5% were transferred. In the third box, 96.2% were minor traumas and 3.8% were major traumas; 75.5% were discharged from the ED, 22.6% were hospitalized and 1.9% were transferred. Boxes 1 and 2 were analyzed together since they are both supposed to identify the sickest trauma patients. In these boxes, 58% were minor trauma patients, 39.6% were major trauma patients and 2.1% were nontrauma-related conditions; 39.6% were discharged from the ED, 45.8% were hospitalized and 14.6% were transferred. **Conclusion:** Implementation of a new province-wide triage protocol based on clinical expertise and recommendation is possible. Safety concerns were addressed by the addition of a temporary fifth box to the algorithm. The results of this study confirm that the addition of a fifth box is unnecessary because it contains less than 1% of major trauma. This study also permitted us to quantify the volume of patients in each box and their disposition after entering the ED.

Creating a national voice for injury prevention. *Brandon Batey,¹ Jane Edwards,¹ Zabra Hussein,² Neil Merritt.¹* From the ¹London Health Sciences Centre, London, Ont., and ²Trauma Services, Vancouver General Hospital, Vancouver, BC.

Background: Regional and national injury prevention (IP) groups exist across Canada; however, no specific group represents trauma hospitals. The mission of the Trauma Association of Canada (TAC) is to reduce the incidence and relieve the burden of injury by bringing together multidisciplinary health care professionals. Although TAC recognizes IP as an important priority, only recently has there been a formalized IP subgroup. Leveraging a collective hospital voice for IP strategies will improve national advocacy for IP. **Methods:** In February 2017 IP stakeholders from across Canada were identified through an email distribution list for the TAC 2017 Conference and invited to attend an inaugural meeting in Vancouver. Following the meeting a TAC-IP working group (TAC-IP WG) was created with the guidance of the TAC Board of Directors, along with a Terms of Reference. The effectiveness of this WG will be evaluated by attendance, membership, consultations and collaborations on national IP strategies. **Results:** Since the inception of the TAC-IP WG in February 2017, 4 teleconference meetings have happened with an average attendance of 60% (8/13 centres, 20 members) representing 13 trauma centres across 7 provinces. These meetings have fostered improved communications among trauma centres, facilitating a national trauma centre voice for IP. July 5 was Parachute's National Injury Prevention Day (NIPD); the TAC-IP WG identified an opportunity to collaborate in aiding Parachute Canada's NIPD, ensuring trauma centres across the country were sharing similar IP messages. All members were made aware of NIPD and many trauma centres participated in NIPD through social media and by commissioning buildings in their communities to "light up" in Parachute green. In addition to a unified approach to national IP work, the TAC-IP WG will advocate for important legislative changes. In September the group was presented with an opportunity to advocate for proposed changes to national building codes in an effort to reduce child falls from windows. The TAC-IP group, with the support of all its members, submitted a letter unifying a trauma centre voice to influence changes to Canada's national building codes. **Conclusion:** With this novel and unified group, injury prevention will continue to be recognized as an integral component of the trauma system while garnering support and funds for important national IP initiatives. Collectively, the TAC-IP WG will advocate for important strategies to improve IP across the country. With many early successes, the group continues to share best practices and lessons learned while working collaboratively on IP strategies to ultimately achieve a goal of zero injuries.

Multiple colonic injuries: for grading and universal management plan. *Yaser Selim.* From the Ministry of Health, Riyadh, Saudi Arabia.

Background: Wounds of the colon and rectum resulting from penetrating or blunt trauma are commonly encountered in civilian and war circumstances. Before World War II, this type of injury was associated with significant mortality and morbidity. Our main objective was to demonstrate the presence of multiple injuries of the colon due to gunshot wounds as a definite clinical

and operative entity and to evaluate its prevalence in clinical practice. **Methods:** This study was conducted in the 6-month period from October 2016 to March 2017 in a general hospital close to the Saudi–Yemeni border in a war zone. The study included 23 patients presenting with gunshot injuries of the abdomen, and the colon was injured in all of them. In this study, patients were managed according to Advanced Trauma Life Support (ATLS) guidelines and sent to the operating room for laparotomy. Full exploration of the abdominal organs and viscera was done. **Results:** Patients ranged in age from 19 to 39 years with a mean of 26.65 ± 4.49 years. The most common part of the colon injured was the left colon (60.9%) followed by the right colon (17.4%), the transverse colon (13.0%) and the cecum (8.7%). Colonic injuries were graded according to the American Association for the Surgery of Trauma scale: grade 1 injuries were seen in 1 patient (4.3%), grade 2 injuries in 6 patients (26.1%), grade 3 injuries in 6 patients (26.1%) and grade 4 injuries in 6 patients (26.1%). Four patients sustained multiple perforations of the colon in a percentage of 17.4, which is significant. **Conclusion:** Multiple injuries of the colon are frequently seen in gunshot injuries due to the use of shotguns. These types of injuries are managed on an individual basis with a wide variety of results, which may be due to the absence of proper grading and management guidelines.

Hospital lengths of stay (LOS) comparison of BC trauma registry (BCTR) hospitals. *Recep Gezer,¹ Jaimini Thakore,² Jennifer McMillan,³ Scott Robinson.²* From ¹Trauma Services BC, the ²Provincial Health Services Authority and the ³BC Trauma Registry, Vancouver, BC.

Background: The purpose of our analysis is to show the impact of episode of care on LOS. We compared BCTR hospitals in their risk-adjusted facility-based and episode of care LOS. We also highlighted the differences in decanting practices among hospitals: where the care is provided within the trauma hospital until the patient is discharged from acute care, versus where the care is provided until the patient is well enough to be transferred to a lower level facility. **Methods:** Different portions of LOS, from the emergency department to acute care to rehabilitation/repatriation were calculated for each patient. For the risk adjustment, we used age, mechanism of injury, body regions injured, transfer status, number of previous admissions within the last year and Elixhauser comorbidities as risk factors. We used hierarchical regression analysis to take between-hospitals variation into account. We also calculated the readmission rates to observe if different decanting practices have any impact on patient outcomes. **Results:** The overall average and median facility-based LOS for BCTR hospitals for the study population were 11.3 days and 7 days, respectively, excluding alternative level of care (ALC), in-hospital rehab and psych days. The overall average and median episode LOS were 15.3 days and 8 days, respectively, excluding ALC days. The average facility-based and episode of care LOS at BCTR facilities combined decreased year over year slightly. When we look into only the facility-based LOS for the care provided within British Columbia's 2 adult Level 1 hospitals, they had almost identical average LOS (13.1 v. 13.3 days). On the other hand, when we compared episode of care, one of the Level 1 hospitals had significantly longer LOS, on average more than 6 days per patient (23.0 v. 16.7 days). Using the facility-based or

episode of care LOS affected the rankings of risk-adjusted LOS comparisons for many hospitals. We also calculated facility-based and episode of care LOS for special cohorts: thoracoabdominal, polytrauma, traumatic brain injury and older (age 65 years and older) patients for individual BCTR hospitals. **Conclusion:** We showed that there were significant differences especially in episode LOS among BCTR hospitals even after taking contributing risk factors into account. While we know that longer LOS costs significantly more to the system, we do not know the implication of shorter LOS. We did not conclude the impact of differences in decanting practices on patient outcomes. Readmission rates showed that it was difficult to draw a correlation between LOS and readmissions.

Acute care surgery, trauma and disaster relief: a clinical exchange between the University of British Columbia and the Red Cross hospital in Mexico City during the September 19th earthquake. *Joseph Margolick,¹ Maria de Los Angeles Mendoza Velez,² Avi Afya,³ Edgar Meza,³ Emilie Joos.¹* From the ¹University of British Columbia, Vancouver, BC; the ²Cruz Roja Hospital and the ³Cruz Roja Mexicana, Mexico City, Mexico.

Background: Experience in global surgery during residency can broaden surgical exposure and foster clinical partnerships at an early career stage. A memorandum of understanding was signed between the Canadian Red Cross, McGill University and the University of British Columbia (UBC) to create an exchange with the Cruz Roja Hospital in Mexico City. Objectives of the rotation included promoting an understanding of international surgery, enhancing surgical skills, using data to improve knowledge and health outcomes access. **Methods:** One general surgery fourth-year resident travelled to Mexico City for the 4-week rotation. All surgical cases and procedures performed were documented. An anonymous, 32-item, Likert-style questionnaire was given to Mexican residents and staff physicians after the exchange to determine attitudes toward international surgery and to assess how best to move forward with a sustainable, bilateral, clinical and research relationship between UBC and the Cruz Roja Hospital. **Results:** Surgical procedures during the rotation included 8 laparotomies, 2 thoracotomies, 2 neck explorations and numerous saphenous cutdowns. Additional surgical procedures included partial finger amputations, extensor tendon repairs, appendectomies, cholecystectomies and diagnostic peritoneal lavages. There was a fairly high number of penetrating trauma cases, including 12 abdominal gunshot wounds, 6 penetrating chest cases and 2 penetrating neck cases. On Sept. 19, 2017, a 7.1 magnitude earthquake struck Mexico City, killing 370 people and injuring over 6000. In the 48 hours immediately following the earthquake, over 300 patients were treated in the emergency department. Most surgical procedures were orthopedic; however, other procedures included a quadriceps fasciotomy and popliteal exploration in addition to numerous resuscitative procedures such as chest tubes. The post-rotation survey of the Mexican staff and residents revealed that the elective was an overwhelmingly positive experience. All participants surveyed felt that it is important to maintain clinical and academic partnerships with hospitals outside of Mexico. Additionally, 100% of participants felt that Mexican residents would benefit from a rotation in Canada and 100% wished to collaborate with Canadian centres on research and clinical care. The

questionnaire demonstrated that 100% of those surveyed believed prior international experience was not important for working at the Cruz Roja but that Advanced Trauma Life Support (ATLS) certification and prior trauma experience were critical. Identified challenges to continuing the exchange were economic in nature, such as transportation and accommodation costs. **Conclusion:** Foundations for a sustainable clinical and academic partnership between UBC and the Cruz Roja Hospital in Mexico City were established. The objectives of broadening surgical exposure and improving understanding of global surgery were met. Data collected demonstrated that Mexican doctors are motivated to continue collaborating academically and clinically with Canadian doctors. Plans are in place for monthly case discussions between trauma teams via Skype and for Mexican residents to complete rotations in Vancouver.

Rollover motor vehicle crashes in New Brunswick: a descriptive study. *Ian Watson, Susan Benjamin, Allison Chisholm, Kate Ellis, Tusbar Pishe.* From the NB Trauma Program, Fredericton, NB.

Background: Anecdotal reports have suggested that patients involved in rollover motor vehicle collisions (MVCs) suffer serious injury. The purpose of this study was to quantify these occurrences and identify characteristics of rollover MVCs in New Brunswick. **Methods:** A retrospective analysis was conducted for which all trauma patients admitted to a Level I, II or III designated trauma centre between Apr. 1, 2014, and Mar. 31, 2015, with a Canadian Triage and Acuity Score of 1, 2 or 3 upon arrival in the emergency department were considered. Injuries resulting from MVCs were included. Descriptive statistics were used to determine the incidence of rollover MVC, the types of vehicles involved and the resulting types of injuries. **Results:** A total of 2345 trauma patients were admitted to hospital within the study period, of whom 409 had been involved in an MVC. After removing cases involving pedestrians, 24.9% of the remaining 382 cases were the result of a rollover. Passenger vehicles represented 42.6% of this subset, while all-terrain vehicles represented 27.7%. Although rollover of light trucks and vans contributed only 11.7% of all MVCs, of those injured in a light truck or van, over half suffered injuries with an injury severity score > 12. **Conclusion:** The findings of this study suggest that those involved in rollover MVCs in light trucks or vans may contribute disproportionately to the burden of injury. Focusing on prevention of light truck and van rollovers may help reduce the burden of injury, and understanding the characteristics of rollover MVCs can help support injury prevention programs. Further study to identify longitudinal trends is warranted.

Does the presence of CT scanning capability in Level 5 trauma centres delay access to definitive care? A retrospective review from New Brunswick's inclusive trauma system. *Ian Watson, Kate Ellis, Allison Chisholm, Tusbar Pishe.* From the NB Trauma Program, Fredericton, NB.

Background: For qualifying trauma cases, an early call from Level 5 designated trauma centres to New Brunswick's Toll Free Trauma Referral System (TFTRS) is recommended. In New Brunswick, 2 Level 5 designated centres have CT imaging capability; the remaining 10 Level 5 designated sites do not. This study's purpose was to determine if significant differences exist in time to

initial call to the TFTRS between level 5 centres with CT capability and those without. **Methods:** A retrospective analysis of all recorded transfer calls to the TFTRS between Apr. 1, 2015, and Aug. 30, 2017, was conducted. Data were available for 312 calls. After excluding calls that were made solely for consultation purposes and those that had incomplete data or extreme outliers, the resulting data consisted of 249 calls: 45 from centres with CT capability and 204 from centres without. Independent *t* tests were used to ascertain if a significant difference existed. **Results:** The mean age was 42.46 years, and the sample was 27.3% female. On the basis of age and sex distribution, the 2 samples were relatively homogeneous. As an injury severity score was not available for all cases, field trauma triage criteria were compared across centres to ensure no significant differences existed in severity between Level 5 centres ($\chi^2 = 2.304$; $p = 0.129$). Hospitals that had CT capability had significantly longer times ($t = -1.68$, $p = 0.04$) to first call than those that did not. The average time to first call in centres with CT capability was 86.60 minutes, whereas time to first call in centres without CT capability was a mean of 60.58 minutes. Among patients seen in CT-capable centres, 35.90% had a CT scan completed before first call to the TFTRS. **Conclusion:** Time to first call to the TFTRS is significantly longer in centres with CT capability, with a large number of cases seen in CT-capable centres receiving a CT before first call. Prior research suggests that trauma patients are best served by ensuring timely access to definitive care. Our study suggests caution in proceeding with CT scans of qualifying trauma patients in Level 5 trauma centres, as doing so may delay access to definitive care.

An evaluation of overtriage in New Brunswick's field trauma triage system. *Susan Benjamin, Ian Watson, Allison Chisholm, Tusbar Pishe.* From the NB Trauma Program, Fredericton, NB.

Background: The NB Trauma Program was established in 2010. Early system changes included field trauma triage (FTT) guidance that enabled the bypass of Level 5 designated trauma centres for patients meeting certain physiologic, anatomic or mechanism of injury characteristics. The purpose of this study was to determine the "overtriage" rate of this bypass population. **Methods:** All emergency medical services (EMS) responses between Apr. 1, 2014, and Mar. 31, 2015, that resulted in application of the FTT guidelines and bypass of a Level 5 trauma centre were extracted from the New Brunswick Trauma Registry (NBTR) and analyzed, including discharge disposition and the requirement for CT scanning among those discharged home. Bypasses based on provider judgment alone were excluded. **Results:** There were 59 qualifying cases; 20 met exclusion criteria. A total of 139 cases were analyzed. Seventy-nine cases (57%) were discharged from the emergency department. Of the discharged population, 33 (42%) required a CT scan before discharge disposition could be determined and 8 additional cases were determined to warrant bypass for other diagnostic or clinical requirements. These results would suggest an acceptable overtriage rate of 27% based on the remaining 38 cases discharged home. **Conclusion:** Caution is warranted when interpreting FTT performance between jurisdictions, as destination guidance between FTT tools varies significantly. Our study provides both a generalizable methodology and a local baseline to measure the specificity of FTT in New Brunswick.

Major trauma and field trauma triage in New Brunswick. Susan Benjamin, Ian Watson, Allison Chisbolm, Tusbar Pisce. From the NB Trauma Program, Fredericton, NB.

Background: A modified field trauma triage (FTT) guideline that provides destination decision guidance was introduced to all Ambulance New Brunswick paramedics in 2011. The province's Level I and II designated trauma centres identify those patients with injury severity scores (ISS) greater than 12. We sought to evaluate whether our provincial FTT guideline was effective in identifying this population and whether paramedics reliably activate the guidelines for qualifying patients. **Methods:** Data for patients with ISS > 12 who were cared for at the province's Level I or II designated trauma centres between Apr. 1, 2014, and Mar. 31, 2015, were extracted from the provincial trauma registry. Patients not arriving by EMS, who presented > 24 hours post-injury, or for whom data capture was incomplete were excluded. The remaining cases were reviewed to determine if the guideline would have identified this population and if a FTT activation actually occurred. **Results:** A total of 218 patients with ISS > 12 received care at the Level 1 or 2 trauma centres. Of this population, 57 cases were removed from analysis. Of the remaining 161 patients, the guideline accurately identified 145 (90%) patients with immediate life threats or bypass qualifying criteria that would have benefited from a FTT activation. Of this 145, there were 90 formal FTT activations (62%). **Conclusion:** New Brunswick's FTT tool was effective in identifying at least 90% of trauma patients with an ISS > 12. There may be an opportunity to ensure sufficient resources are allocated to paramedics to facilitate ideal FTT activation rates.

Building a model for assessing trauma-related mortality in a rural trauma system. Bryn Robinson,¹ Kate Ellis,² Margaret Holland,³ Allison Chisbolm,² Ian Watson.² From the ¹Maritime SPOR SUPPORT Unit, the ²NB Trauma Program and the ³New Brunswick Institute for Research, Data and Training (NB-IRDT), Fredericton, NB.

Background: New Brunswick faces unique challenges in trauma care delivery, in that the population is rapidly aging and has a disproportionately high percentage of older adults. Furthermore, the province is predominantly rural. For trauma programs to be efficacious, an accurate understanding of the population it serves is essential. The present study investigates how to meaningfully communicate trauma mortality in a traditionally under-represented rural setting, without compromising privacy nor losing relevant information for decision-making. **Methods:** In consultation with the Maritime SPOR SUPPORT Unit and the NB Institute for Research, Data and Training, we extracted all deaths with an injury severity score (ISS) > 12 from the NB Trauma Registry that occurred in the province's 2 major trauma centres from 2011 to 2015. We calculated age-specific and standardized death rates (ASMRs) to understand trauma-related mortality in NB, using the 2011 Canadian standard population, and we used a 3-year rolling time period to guard against year-over-year fluctuations. **Results:** There were 941 trauma-related in-hospital deaths that occurred in the 2 major trauma centres from 2011 to 2015. We found that adjusted age-specific death rates at the Level 1 centre were relatively stable between the 2 time periods. For each age

group, the highest rates were found in those patients most severely injured (ISS ≥ 25), especially those aged 75 years of age and older, with a rate of 35.15 per 100 000 in April 2011–March 2014 (decreased to 24.64 per 100 000 in 2012–2015). A similar pattern was found in the Level 2 centre, where those aged 75 years and older had the highest rates of death due to trauma (25.90 per 100 000 for 2011–2014; 17.60 per 100 000 for 2012–2015). Overall, the ASMR for the Level 1 centre was 9.34 per 100 000 in 2011–2014 and 8.29 per 100 000 in 2012–2015. For the Level 2 centre, these rates were 9.87 per 100 000 and 7.19 per 100 000, respectively. There were no significant differences in mortality odds ratios between the Level 1 and Level 2 centres, if patients had an ISS 12–15 (OR 2011–2014 = 0.17, 95% CI 0.02–1.47; OR 2012–2015 = 0.18, 95% CI 0.02–1.67), 16–24 (OR 2011–2014 = 0.52, 95% CI 0.22–1.22; OR 2012–2015 = 0.49, 95% CI 0.19–1.23) or 25 or greater (OR 2011–2014 = 1.23, 95% CI 0.75–2.01). **Conclusion:** As a largely rural province, NB is uniquely positioned to develop and implement methodologies to measure rural system performance, including mortality. While the above results do not account for deaths after discharge from hospital, the current study provides preliminary quantifiable trauma-related mortality rates within 2 NB trauma centres and allows us to compare with trauma systems in Canada. This provides the framework for which trauma mortality can be measured in the rural trauma system setting.

Opportunities for improved management of major trauma presenting to rural and remote community hospitals: a survey of rural physicians in British Columbia. Abdullab Albarrak,¹ David Evans,¹ Ole Olsen,¹ Jude Kornelsen,² Stuart Iglesias.² From ¹Trauma Services, Vancouver General Hospital, and the ²University of British Columbia, Vancouver BC.

Background: Optimized function of rural and remote centres is critical to overall performance of a regionalized trauma system. British Columbia's inclusive trauma system serves 4.6 million dispersed across 945 000 km². Eighty-one of British Columbia's 92 acute care hospitals are Level 4 or 5 centres that transfer forward approximately 25% of the 9000 patients admitted to Level 1–3 centres annually. Rural/remote emergency physicians may provide valuable insight as to the best opportunities for improving outcomes for these challenging patients. **Methods:** Following institutional research ethics approval, we conducted an electronic survey of physicians registered with the Rural Coordination Centre of BC. A committee of key informants oversaw development of a 41-item questionnaire in Fluid Survey exploring practice profile and local perceptions of major trauma care and actionable opportunities for improvement. A 7-point Likert scale was used. After beta-testing with 10 physicians, the survey was conducted over an 8-week period beginning in July 2017. Results were analyzed using descriptive statistics. **Results:** Eighty-eight rural physicians completed the survey. All respondents had College of Family Physicians of Canada (CCFP) certification, with 30% holding additional training in emergency medicine, anesthesia, obstetrics or surgery. Fifty-nine percent were over age 40 and 60% had been in practice more than 10 years. One-third were foreign medical graduates. Locum work was practised by 35%, and 82% reported that they resided in the community where they practised. Nearly 70% of respondents

were from 2 of BC's 5 regional health authorities (Interior Health 49%, Northern Health 30%), and 69% lived in communities of fewer than 10 000 residents. Over 90% of respondents agreed (42% strongly) that there is a need to improve the care of major trauma in the rural setting and that it is possible to do so. Asked to consider 20 factors that might compromise the care of major trauma, timely access to air medical transport was considered most important. The efficiency of the provincial transfer network to facilitate transfers and the capacity of local centres to conduct life- or limb-saving interventions were also major concerns. Most physicians considered their technical skills adequate but felt they could improve their knowledge of trauma management. As regards where improvements could practicably be achieved, improved air transport and inter-facility transfer were again considered most feasible (decision-making, communication, logistical support). Increased ability to provide essential surgical care locally also received strong support. **Conclusion:** A sizeable number of rural practitioners perceived that improved major trauma care is needed and achievable in BC. Despite constant challenges of distance and weather, swifter transfer of patients garnered strongest support as the problem most remediable by reasonable means. Enhancing local capability was also considered reasonably feasible, offering an interesting proposition given the growing interest among GPs in enhanced surgical skills. Further data corroborating these perceptions and elucidating where best to improve services are required.

Rural drivers are more distracted than urban drivers: a roadside study of 25 000 subjects. *David Bracco,¹ Mete Erdogan,² Tarek Razek,¹ Robert Green.³* From ¹McGill University, Montréal, Que.; ²Trauma Nova Scotia and ³Dalhousie University, Halifax, NS.

Background: With the expanded use of smartphones, distracted driving has become a trauma public health issue. The objective of the present study is to evaluate the incidence and geographical disparities in distracted driving in Canada. **Methods:** An iOS-based app was developed to allow volunteer users to observe driver behaviours at the roadside without limitation in space and time. Data were reverse-geocoded through Google Maps API, population densities were computed based on the Canada Post Forward Sorting Area (FSA; first 3 digits of postal code), and population by FSA from Statistics Canada and the area of the FSA was computed from a corresponding shapefile. **Results:** A total of 24 572 drivers were observed. The overall incidence of distracted driving was 9.68%. Men and women were equally distracted while driving, whereas professional drivers were more distracted than drivers in personal vehicles (12.2 v. 9.4, OR 1.33). The incidence of distracted driving ranged from 4.75% in British Columbia, 7.7% in Ontario, 10.0% in Nova Scotia, 11.3% in Quebec and 11.8% in Manitoba to 15.2% in Alberta. There was a strong relationship between population density and distracted driving, with sparsely populated areas having much more distracted driving than urban areas. The incidence of distracted driving decreased from 22% in sparsely populated areas (25 ha/km²) to 6.6% in densely populated areas (100 000 ha/km²). **Conclusion:** Distracted driving is a very frequent behaviour. In Canada, on average 1 out of 10 drivers is actually distracted while driving. There are significant geographical variations in distracted driving across Canada.

Developing an intubation checklist for the pediatric trauma team in the emergency department (ED): a quality improvement project in progress. *Mary Claire Avanis,¹ Maxim Ben-Yakov,¹ Suzanne Beno,¹ Cengiz Karsli,^{1,2} Elaine Ng.^{1,2}* From ¹The Hospital for Sick Children and the ²University of Toronto, Toronto, Ont.

Background: Intubation of pediatric trauma patients at our tertiary pediatric hospital ED poses unique challenges, including the urgency of the situation and unknown comorbidities in potentially unstable patients. Ad hoc teams are inevitable due to shift work and rotating trainees. Post-event surveys suggest an inconsistent approach to airway management and poor communication of intubation plans. We proposed the introduction of an intubation checklist to provide a consistent and safe preparation for intubation and facilitate a shared mental model for the airway management plan. **Methods:** Approval from the Quality Management Department was obtained. A checklist was designed based on NAP4 recommendations, following consultation with key stakeholders. The colour scheme was adjusted according to colour theory. Tabletop discussions, roleplays and interprofessional simulation sessions were conducted before introduction into clinical practice, testing the usability of the checklist in different trauma scenarios. Structured debriefs following simulations provided further insight into the usability and applicability of the checklist, which was modified accordingly. **Results:** The resulting checklist consists of 4 sections: (1) discussion topics before patient arrival, to be completed by the trauma leader and anesthesiologist; (2) preparation for intubation, to be completed by the respiratory therapist and anesthesiologist; (3) time out before intubation; and finally (4) intubation with a post-intubation plan, to be completed by the whole team. Items were prioritized based on their clinical relevance and rate dependent nature (i.e., preparation of medications and calling for senior help). Participants in the simulation stated that the checklist was helpful as a prompt for intubation preparation and promoted communication. The checklist was most useful with strong leadership. **Conclusion:** The proposed trauma intubation checklist facilitated communication and a shared mental model for the intubation plan, including post-event management. Next steps will include promotion by education and observations in real-life situations.

Stress inoculation training as a cognitive tool to enhance health care performance: a systematic review. *Aidan McParland,¹ Mike Lauria,² Anand Swaminathan,³ Christopher Hicks.⁴* From the ¹University of Toronto, Toronto, Ont.; ²Dartmouth College, Hanover, NH; ³Bellevue Hospital, New York, NY; and ⁴St. Michael's Hospital, Toronto, Ont.

Background: Medical error is now the third leading cause of death in the United States. Human performance is vital to delivering high-quality medical care. Various forms of psychological skills training have proven to be effective in enhancing performance in fields outside of medicine with similar cognitive demands, yet have been largely neglected in medical education. Here, we propose a role for stress inoculation training (SIT) as an educational tool to enhance performance in health care providers. **Methods:** An electronic search of Ovid Medline, Web of Science Core Collection, ProQuest and Scopus was conducted. Inclusion criteria included randomized controlled trials investigating an

intervention for enhancing performance using SIT. Outcome measures included recording of various aspects of the type of performance measured and the details of the SIT training received. Screening of articles, data extraction, and summarization were conducted by 2 independent reviewers. **Results:** Our search yielded 431 studies, of which 40 were screened for full-text review. Of those, 10 studies met the inclusion criteria. A total of 930 trainees throughout the 10 studies were enrolled. Four studies were performed in a population of students of varying academic disciplines, 4 studies were composed of military personnel, 1 study was composed of civil servants and 1 study was performed in police officers. None of the studies that met the inclusion criteria investigated this response in a medical population of any kind. A change in performance was noted in 90% (9/10) of studies, and a reduction in anxiety and/or stress was also noted in 90% (9/10) of studies. **Conclusion:** SIT has been shown to serve as an effective cognitive tool to enhance performance in high-acuity environments and to also reduce stress and anxiety. However, stress training has been largely underused in a medical, and specifically a trauma, setting, where health care provider performance is a large predictor of patient outcomes. Here, we propose a path forward for novel research in trauma education through the use of SIT.

Base deficit in penetrating trauma does not always predict blood products transfused in MTP protocols. *Victoria Schlanser, Chih-Yuan Fu, Emily Koeck, Francesco Bajani, James Boron, Andrew Dennis, Hadyn Hollister, Matt Kaminsky, Kristina Kramer, Kevin Luftman, Thomas Messer, Stathis Poulakidas, Fredric Starr, Faran Bokhari.* From the John H. Stroger, Jr. Hospital of Cook County, Chicago, Ill.

Background: Patients with injuries from penetrating trauma often present with complex physiologic derangements. Massive transfusion protocol (MTP) has been used to help correct these deficits. Base deficit (BD) is often used as a guide to management of MTP resuscitation. We sought to investigate if better BD would predict an earlier truncation of MTP in trauma patients who required MTP. **Methods:** A retrospective review of penetrating trauma patients presenting to a Level 1 trauma centre was performed. All patients who required MTP from 2013 to 2016 were included. The initial BD, number of individual blood products (packed red blood cells [pRBCs], fresh frozen plasma [FFP], platelets) and overall outcomes were evaluated. **Results:** The MTP component ratios averaged 2:1 for prick to FFP. The median time to first cooler arrival was 4 minutes. BDs better than 25 did not correlate with number of pRBCs transfused ($p = 0.691$). When patients with BD worse than 25 are also included, there is a trend toward number of pRBCs correlating with worse BD ($p = 0.055$). Number of pRBCs transfused in patients with BDs better than or equal to 25 versus patients with BDs worse than 25 was 13.6 versus 26.0 ($p < 0.001$). While number of units of FFP transfused was not statistically significant, the trend followed the pRBC trend (BD better than or equal 25 v. BD worse than 25; 6.6 v. 11 units, $p = 0.057$). The total time of MTP activation (average pRBCs transfused 13.6 units) for patients with BD better than or equal to 25 did not correlate with survival at times less than 60 minutes ($p = 0.595$) or less than 120 minutes ($p = 0.323$). In a multivariate analysis, trauma and injury severity score, BD and number of units of pRBCs transfused were inde-

pendently significantly correlated with survival ($p < 0.05$). **Conclusion:** BDs and pRBC transfusion requirements are thought to indicate physiologic status. A BD better than 25 in penetrating trauma does not predict the number of pRBC units needed. However, the number of pRBCs needed correlates with survival. Hence, BD should not be used as a correlate for the number of pRBCs required for MTP resuscitation. In addition, when the first cooler arrives rapidly, the total time to complete MTP does not change survival.

Organ donation in trauma patients: a systematic review. *Adam Cameron,¹ Mete Erdogan,² Sara Lanteigne,¹ Alexandra Hetherington,¹ Robert Green.²* From ¹Dalhousie University and ²Trauma Nova Scotia, Halifax, NS.

Background: Organ donation rates are consistently below those needed to meet demands. One strategy to address this shortfall is to improve rates of organ donation among deceased trauma patients. The prevalence of organ donation by deceased trauma patients has not been systematically reviewed. The primary objective of our study was to measure reported rates of organ donation in deceased trauma patients. Our secondary objective was to assess for factors associated with organ donation in these patients. **Methods:** We searched 4 electronic databases (PubMed, EMBASE, Web of Science, Cochrane Library) and the grey literature for publications that reported a conversion rate for a sample of trauma patients. The search was performed in June 2017. There were no limits on publication date or language. The donor conversion rate (DCR) was defined as the number of actual organ donors divided by the number of potential organ donors (PODs), and expressed as a percentage. **Results:** There were 35 articles that met all of our inclusion criteria and were included in the review. Most studies were performed in the United States, with the remaining studies performed in France, the Netherlands, the Philippines, the United Kingdom and Brazil. Study cohorts ranged in size from 25 to 120 512 patients (median 132) and varied in their inclusion criteria. Eleven studies included all types of trauma patients, 8 studies were limited to patients with gunshot wounds to the head and 6 studies were limited to trauma patients who suffered cardiac arrest. There were 6 studies that included only pediatric patients. Conversion rates among individual studies ranged from 3.6% to 85.7%. We calculated an aggregate estimate of 74.2% for the DCR across all studies. However, the sample size of 1 study was considerably larger than that of all other studies and accounted for 97.1% of PODs. Removing this study from the calculation reduced the aggregate estimate of the DCR across studies to 43.6%. Only 7 studies assessed for factors associated with organ donation. Patient-level factors associated with organ donation included higher Revised Trauma Score, lower admission Glasgow Coma Scale score, and receiving thyroid hormone replacement. Institution-level factors associated with organ donation included having catastrophic brain injury guidelines in place and having a trauma surgeon on the hospital's organ donor council. **Conclusion:** Evidence from the published literature suggests there is considerable variation in conversion rates among trauma patients. This variability may be due in part to differences in study populations and in the definitions used for a POD. Few studies have examined factors associated with organ donation in the trauma population; this is an area that warrants further investigation.

Investigation of fibrinogen stability after reconstitution for hemostatic fluid resuscitation on the battlefield. *Henry Peng,¹ Andrew Beckett,² Shawn Rhind,¹ Barto Nascimento.³* From ¹Defence Research and Development Canada – Toronto Research Centre, Toronto, Ont.; ²McGill University, Montréal, Que.; and the ³Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: Canadian Armed Forces adopted fibrinogen concentrate (RiaSTAP) for damage control resuscitation in the far-forward combat setting, given its benefits in reducing blood loss and mortality, and its long storage stability and portability. RiaSTAP should be administered within 8 hours after reconstitution when stored at room temperature. There is a need to investigate the stability and efficacy of RiaSTAP after reconstitution and exposure to the extreme temperatures in which our forces may operate. **Methods:** RiaSTAP was reconstituted as per manufacturer's instructions and stored at specific temperatures (−20°C, 4°C, 22°C, 35°C, 42°C or 50°C) for 4 weeks. Reconstituted RiaSTAP was also oscillated on a rocker at 18 rpm under 22°C and 50°C. The hemostatic function of reconstituted RiaSTAP stored at the various temperatures was measured at different time points using rotational thromboelastometry (ROTEM) performed with RiaSTAP-spiked fibrinogen-deficient plasma, normal plasma and whole blood. Fibrinogen concentrations were measured by commercial ELISA. **Results:** No change to the hemostatic function was observed at −20°C during the study period. At 4°C, a decrease in ROTEM maximum clot firmness (MCF) of RiaSTAP-spiked fibrinogen-deficient plasma at 672 hours indicates that its function begins to degrade, but no obvious changes were seen for normal plasma and whole blood during the study period. At 22°C, a remarkable decrease in the MCF of RiaSTAP-spiked plasma was seen after 168 hours of storage, while a slight reduction in the MCF of spiked blood occurred at 144 hours of storage. Similar decreases over time were observed at 22°C under rocking condition. Storage at 35°C appears to decrease the hemostatic effects of reconstituted RiaSTAP after 8 hours for fibrinogen-deficient plasma and 72 hours for normal plasma and whole blood, while storage at 42°C resulted in further impairment. No coagulation of fibrinogen-deficient plasma occurred when spiked with RiaSTAP stored for ≥ 96 hours at both temperatures. Finally, storage at 50°C for 4 hours resulted in complete loss of hemostatic function. Compared with the hemostatic activity, the fibrinogen concentrations for reconstituted RiaSTAP showed less change over time at the different temperatures. At 22°C and below, there were no clear alterations. There appeared to be a trend toward an overall decline in fibrinogen concentration at 35°C and 42°C. At 50°C little or no fibrinogen was detected by ELISA at ≥ 4 hours. **Conclusion:** The hemostatic function of reconstituted RiaSTAP decreases with increasing storage temperature, especially at 35°C and above. The fibrinogen concentration was not significantly altered at all temperatures for the study period except 50°C, where there was a rapid decline. Sample oscillation did not produce differences in the results. The shelf life of reconstituted RiaSTAP may, therefore, be recommended accordingly when stored at different temperatures and extended to 6 days at room temperature provided that sterility is maintained.

Falls in the bathroom: a mechanism of injury for all ages. *Morgan Schellenberg, Kenji Inaba, Jessica Chen, Jim Bardes, Elizabeth Crow, Lydia Lam, Elizabeth Benjamin, Demetrios Demetriades.* From the LAC+USC Medical Center, Los Angeles, Calif.

Background: Ground-level falls are an important cause of morbidity and mortality. When they occur in the bathroom, there is particular potential for harm given the high density of hard surfaces. Risk factors for this mechanism of injury are not clearly defined by the existing literature. **Methods:** All patients presenting to our high-volume Level 1 trauma centre between January 2008 and May 2015 after a fall in the bathroom as defined by an ICD-9 code of E884.6 were included in this study. Patient demographics, injury characteristics, investigations, procedures and outcomes were collected. Statistical analysis was performed with SPSS. **Results:** A total of 57 patients were included, with a mean age of 44.7 years (range 0–92), of which 42.1% were male ($n = 24$). The pattern of patient age approximated a normal distribution, with most patients in the 41–60 year age range. Common comorbidities included cardiovascular disease ($n = 23$, 40.3%), neuromuscular disorders ($n = 13$, 22.9%) and diabetes ($n = 9$, 15.8%). Ten patients (17.5%) were intoxicated at the time of presentation to hospital. Home medications included antihypertensives ($n = 18$, 31.6%) and anticoagulation ($n = 8$, 14.0%). Investigations performed in the emergency department for workup of potential injury included x-rays ($n = 41$, 71.9%) and CT scans of the head ($n = 20$, 35.1%). The most frequent injuries were contusion/laceration ($n = 45$, 78.9%), fracture ($n = 12$, 21.1%), and traumatic brain injury ($n = 7$, 12.2%). Most patients did not require hospital admission ($n = 46$, 80.7%), although 4 (7.0%) needed care in the intensive care unit and operative intervention (open reduction and internal fixation [$n = 2$, 3.5%] or craniotomy [$n = 2$, 3.5%]). Mortality was low ($n = 1$, 1.8%). Most patients were discharged home ($n = 40$, 70.1%) or to jail ($n = 8$, 14.0%), and infrequently to skilled nursing facilities, rehabilitation or nursing homes ($n = 4$, 7.0%). **Conclusion:** Although falls are typically considered a mechanism of injury for the elderly, all ages are susceptible to falls in the bathroom. The majority of patients are between 41 and 60 years of age. Despite the potential for serious injury, most do not require hospital admission. Risk factors include drugs/alcohol, cardiovascular disease, neuromuscular disorders, diabetes, and home anticoagulation and antihypertensive medications. Efforts to minimize fall risk should be directed toward these individuals.

Impact of maladaptive thinking on the development and persistence of depression and posttraumatic stress disorder (PTSD) symptoms. *Sana Haddad, Lauren Goldberg, Marjan Khanjani, Xingshan Cao, Alyssa Leano, Ben Diplock, Rachel Ebrlich, Alan Dick, Illana Perlman, Willem Mueller, Gili Adler Nevo, Anthony Feinstein, Homer Tien, Janet Ellis.* From the Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: Studies from around the world show that symptoms of PTSD and depression are prevalent in the general population. Unwanted intrusive cognitions and maladaptive thoughts are prominent features of PTSD and depression and interfere with natural recovery after trauma by contributing to avoidance of processing and adaptive recovery behaviours. However, specific

cognitions have yet to be explored. This study examines the relationship between particular maladaptive thoughts and the experience of PTSD and depressive symptoms over time. **Methods:** Participants ($n = 95$) were recruited as part of an ongoing study within 3 days of entering the trauma unit at a large trauma centre. At 1 month, participants completed the Posttraumatic Cognitions Inventory (PTCI), a questionnaire with subscales measuring negative views of the self, negative world views, and self-blame. At 3- and 6-month follow-up, participants completed the PTSD Symptom Scale Interview and Beck Depression Inventory – II, questionnaires assessing the presence/severity of PTSD and depression symptoms. **Results:** At 1-month follow-up, 29.1% of participants reported severe depressive symptoms, as well as 55.4% scoring at or above the PTSD scoring cut-off. At 3-month follow-up, 31.8% of participants reported moderate and severe depressive symptoms, and 50.7% of participants scored at or above the PTSD scoring cut-off. At 6-month follow-up, 31.7% of participants reported moderate/severe depressive symptoms, while 46.1% met diagnostic criteria for PTSD. In addition, 40.2% of participants met diagnostic criteria for PTSD, as assessed by the Structured Clinical Interview for the DSM. PTCI subscales at 1 month were used to predict traumatic and depressive symptoms at 3-month follow-up ($n = 42$) and 6-month follow-up ($n = 35$). Regression analyses revealed a significant positive association between negative views of the self and PTSD symptoms, $b = 6.62$, $p = 0.007$, as well as depressive symptoms, $b = 5.47$, $p = 0.007$, at 3-month follow-up. Negative views of the self marginally predicted traumatic symptoms, $b = 4.67$, $p = 0.084$, at 6-month follow-up. Negative world views were significantly associated with PTSD symptoms at 3-month follow-up, $b = 3.24$, $p = 0.035$, and 6-month follow-up, $b = 3.83$, $p = 0.030$, as well as depressive symptoms at 6-month follow-up, $b = 4.92$, $p = 0.002$. Self-blame was not associated with either PTSD or depressive symptoms at 3- and 6-month follow-up. **Conclusion:** Results suggest that negative views of self at 1 month predict persistent depressive symptoms, and a negative world view at 1 month predicts persistent PTSD symptoms. Identifying specific maladaptive thoughts related to self and the world will help identify those at risk of PTSD and depression and will help with targeted treatment. This study validates the need to address “unhelpful thinking” and facilitate different ways of conceptualizing trauma similar to cognitive processing therapy, an evidence-based trauma-focused psychotherapy.

A “human-proof pointy-end” for a potential trauma pod effector: technical notes on robotically applied hemostatic applied clamp for care under fire: an update. *Andrew Kirkpatrick,¹ Jessica McKee,² Ian McKee,³ Paul McBeth,¹ Naisan Garraway,⁴ David Schneider,⁵ Ian Atkinson,² Chad Ball.¹* From the ¹Foothills Medical Centre and the University of Calgary, Calgary, Alta.; ²Innovative Trauma Care, Edmonton, Alta.; the ³Edmonton Fire Department, Edmonton, Alta.; ⁴Trauma Services, Vancouver General Hospital, Vancouver, BC; and the ⁵Grey Medical Group.

Background: Bleeding to death is the pre-eminent cause of preventable deaths in armed conflicts, constituting a challenge for care providers, especially in tactical medical scenarios. In such environments a human response to the casualty may result in multiple victims, or else extreme psychological distress to comrades

witnessing a brother or sister exsanguinate within earshot or eye-shot. A model low-cost robot was thus constructed and a bomb robot used to assess the practicality and design parameters to construct a versatile hemorrhage-control robot (HCR). **Methods:** A robotic arm was constructed and a bomb disposal robot (UGV) used capable of deploying a wound clamp. The robot featured 4 degrees of freedom and was not mobile. The UVG has 2-way communication, is wirelessly controlled, has a 360° rotating robotic claw and can climb the stairs. Synthetic wounds were used. The iTClamp is a wound clamp that offers immediate wound closure and mechanically assisted direct-pressure tamponade from the purposefully induced wound hematoma. **Results:** Five different end-effectors or “hands” were constructed for the first-phase proof-of-concept (POC) robot arm. The pinwheel “hand” controlled by 2 motors was the most effective. The POC robot was able to grasp, arm, approximate, place and close the iTClamp (from scalp laceration position) in 20/20 attempts. Limitations encountered during this first phase were an inability to adjust the applied force of the robot end-effectors, the inability to remove the iTClamp from the package, the inability to close the iTClamp in the fully open position and the robot’s stationary design. The UVG robot in the second phase had increased force of the robot end-effectors and was wirelessly mobile. The UVG robot was able to move to the simulated laceration, as well as grasp, arm, approximate, place and close the iTClamp, in the regularly open position. The UVG robot was able to complete this task with the simulated laceration in the horizontal and vertical positions. Limitations that still exist from this second phase are the inability to remove the iTClamp from the packaging, proof that a fluid-tight seal was obtained and proof of the ability to apply several iTClamps in series. **Conclusion:** In this first test of concept, 2 different robots were able to demonstrate the first steps toward robotic hemorrhage control. A wound clamp may constitute an existing hemostatic device that could potentially be fitted to every operational robot to render hemorrhage control in human-prohibited environments. Further development and testing is required.

Alcoholism screening and counselling in trauma patients seen at physician offices in the United States (US). *Jumaid Bhatti.* From the Sunnybrook Research Institute, Toronto, Ont.

Background: Trauma leads to 1 in 10 physician office visits in the US. Alcohol is a significant predictor of these injuries. We assessed whether the rates of alcoholism screening and counselling were higher in trauma patients as compared with non-trauma patients in US physician offices. **Methods:** Study data were extracted from the National Ambulatory Care Survey (NAMCS), a nationwide, cross-sectional sample of physician office visits in the US. We focused on NAMCS data from 2014 as they included information on alcoholism screening and counselling. Patients were distinguished as trauma and nontrauma patients by a specific field. We estimated weighted frequencies using SAS software version 9.4. **Results:** Of 45 523 patient visits, 5455 (11.6%) were related to traumatic injuries. A total of 187 patients (0.6%) received alcoholism screening and 178 (0.5%) received alcoholism counselling. About 413 (1.0%) patients in the NAMCS 2014 survey were identified as those with ongoing alcohol misuse problems. In this subgroup, the rate of alcoholism screening was 11.7% ($n = 34$) and alcoholism

counselling was 21.2% ($n = 76$). In the overall sample, a trauma-related patient visit doubled the odds of alcoholism screening (13.4/1000 visits, 95% CI 9.8–16.6) than a nontrauma patient visit (5.6/1000 visits, 95% CI 3.6–7.5). Similarly, a trauma-related patient visit doubled the odds of alcoholism counselling (13.5/1000 visits, 95% CI 10.5–16.3) than a nontrauma visit (3.8/1000 visits, 95% CI 2.5–5.1). In the alcohol misuse subgroup, the trauma-related patient visits led to alcoholism screening 3 times more often than nontrauma patient visits (16.9% v. 6.1%). In the same patients, a trauma patient visit led to alcoholism counselling twice as often as a nontrauma patient visit (27.6% v. 14.2%). **Conclusion:** Trauma-related physician office visits were more likely to result in alcoholism screening and counselling than other visits. There is still a large amount of room for improvements in alcoholism screening and counselling in physician offices to match recommendations from the Institute of Medicine.

Is traumatic brain injury an independent risk factor for problem gambling? A matched case-control study. *Junaid Bhatti.* From the Sunnybrook Research Institute, Toronto, Ont.

Background: We assessed whether traumatic brain injury (TBI) increases the risks of subsequent problem gambling. **Methods:** We conducted a matched case-control analysis of adults in Ontario, Canada. The study included those who self-reported their gambling activities in the Canadian Community Health Survey 2007–2008. Using the Problem Gambling Severity Index, we defined cases as those who were problem gamblers and controls as those who were recreational gamblers. Cases were matched to controls 1:2 using propensity scores based on demographics, prior mental health and reported behaviours. The main predictor was prior TBI. **Results:** Of 30 652 participants, 16 002 (53%) reported gambling activity, of whom 14 910 (49%) were recreational gamblers and 4% ($n = 1092$) were problem gamblers. A total of 1469 respondents (5%) had a prior TBI. Propensity score matching yielded 2038 matched pairs including 1019 cases. The analysis showed a significant association between prior TBI and subsequent problem gambling (odds ratio 1.27, 95% CI 1.07–1.51, $p = 0.007$). The increased risk was mostly apparent in men aged 35 to 64 years diagnosed with substance use. The relative risk of problem gambling in those with 2 or more TBIs equated to an odds ratio of 2.04 (95% CI 1.05–3.99). **Conclusion:** We found that a prior TBI was associated with an increased subsequent risk of problem gambling. Our findings support more awareness, screening and treating such risks among TBI patients.

Assessing the relationship associated with the alcohol withdrawal effect and trauma in alcohol-dependent patients following a traumatic injury; a preliminary study. *Michael Gryciuk,¹ Khatija Ali,¹ Carlos Semprun,² Ghassan Ali,¹ Sandro Rizoli,³ Ilias Ettayebi,¹ Mubannad Alwashb,¹ Tony Zifan Yang,¹ Augusto Camilloti.¹* From ¹St. Michael's Hospital and the University of Toronto, the ²Sunnybrook Health Sciences Centre and ³St. Michael's Hospital, Toronto, Ont.

Background: Alcoholism afflicts 15%–40% of the national trauma population. The literature demonstrates a positive correlation between alcohol intake and traumatic injury variables;

however, it is not known to what extent, if any, the alcohol withdrawal effect is involved. This is due to heterogeneity in human physiology, which makes doing necessary methodological retrospective calculation of blood alcohol concentration (BAC) at the time of injury difficult. With examining the current secondary literature regarding BAC calculations, we have devised a unique method allowing us to answer this important question. **Methods:** This was a prospective cohort study involving 100 trauma patients, of which group 2 ($n = 50$) had a positive BAC upon admission. Eligible patients required completion of the AUDIT questionnaire to determine drinking behaviour. The patients were stratified into 2 population groups based on alcohol status and ratio of deviation (ROD) scoring. The Ethanol(+) group was further stratified into $ROD > 1$ and $ROD < 1$. Variables such as mechanism of injury, injury severity score (ISS) and length of stay (LOS) were collected and statistically analyzed. **Results:** Currently, there is a lack of research on alcohol withdrawal and trauma. This study contributes to the ongoing body of literature in an attempt to establish methodology of assigning a ratio of deviation to stratify alcohol-dependent population groups into over- and under-intake relative to a baseline alcohol dependence and control group, answering a question previously unknown: To what extent, if any, does the alcohol withdrawal effect in alcohol-dependent trauma patients play a role in trauma medicine? Proposed results will show whether alcoholic populations in withdrawal are more prone to certain clinical outcomes such as LOS, ISS, mechanism of injury and other complications that we sought to analyze. A retrospective ROD calculation was derived from various biophysical formulae into 1 clinically relevant equation. ROD is defined as BAC at time of injury over the baseline dependent BAC in the alcoholic trauma populations. Statistical analysis, currently pending, will be presented at the TAC 2018 conference. **Conclusion:** This preliminary study is a contribution to the current literature in trauma medicine, as our approach to answering a previously difficult question can pave the way for others in trauma and substance-use research. This equation can be applied in multidisciplinary aspects of medicine. Our study has implications for injury prevention, cost reduction and the management of alcoholic trauma patients.

Our patients are breathing better — the implementation of a pneumonia diagnostic tool in trauma patients. *Emilie Joos,¹ Zeeshan Rana,² Nasira Lakha,² Angie Brisson.³* From the ¹LAC+USC Medical Center, Los Angeles, Calif.; the ²Vancouver General Hospital, Vancouver, BC.; and ³Vancouver Coastal Health, Vancouver, BC.

Background: Pneumonia is a case-sensitive adverse event and continues to be a frequent complication of hospital care. Presently, at our accredited Level 1 trauma centre, there are inconsistencies in how ventilator-associated pneumonia (VAP) and hospital-acquired pneumonia (HAP) are diagnosed. This has resulted in over-reporting of the complication by our trauma registry. Our aim is to improve the validity and reliability of physician documentation for HAP and VAP among the trauma patient population. **Methods:** The Vancouver General Hospital trauma team collaborated with the Quality and Patient Safety Office to develop a checklist, standardizing the diagnosis of HAPs. Standardized definitions were used, such as the CDC criteria. After consensus was reached, a triplicate form identifying patients with

pneumonias was implemented in the trauma charts. The pilot study will run from October 2017 to January 2018. Rates of HAP and VAP will be compared before and after implementation. **Results:** Prior to the implementation of the pneumonia diagnostic tool, the proportion of patients with pneumonia was 10.2 per 100 discharges, the highest in the province. A preliminary review of our data after 1 month of implementation revealed a rate of 5.5 per 100 discharges. A survey will be completed among physicians, nurses and pharmacists to evaluate the process, to make improvements and to better integrate the checklist into the existing workflow. Furthermore, a chart review will be conducted to audit physician documentation of HAP and VAP and measure validity and reliability of the diagnostic tool. **Conclusion:** The lack of standardized diagnostic criteria for pneumonia has led to inaccurate reporting of this adverse event. We hope that a standardized definition will improve the validity and reliability of physician documentation of HAP and VAP in the trauma patient population. This will, in turn, facilitate the coding of this complication in the trauma registry and ultimately lead to an improvement in outcome measures.

Just pack it! May not be as easy as it sounds without remote guidance. *Jessica McKee,¹ Andrew Kirkpatrick,² Ian McKee,³ Paul McBeth,² Chad Ball.¹* From ¹Innovative Trauma Care, Edmonton, Alta.; the ²Foothills Medical Centre and the University of Calgary, Calgary, Alta; and the ³Edmonton Fire Department, Edmonton, Alta.

Background: Bleeding to death is the pre-eminent cause of potentially preventable death both in military and civilian trauma settings. Tourniquets are standard of care and work well when applied properly. However, for other bleeding wounds first responders are often told to “just pack it” or “hold direct pressure,” assuming that effective packing is an intrinsic skill of any first responder. We sought to scientifically refute or confirm this assumption, and whether a remote mentor aided this “simple” task. **Methods:** Military medics with packing training were randomly assigned to a mentored or nonmentored group. The medics completed a packing scenario using QuikClot Combat Gauze on a commercial wound packing trainer that provides real-time pounds per square inch (PSI) measurement of the force being applied to the source of the bleeding. The participant needs to keep pressure above 5 PSI for at least 90% of the task in order to pass the scenario. Medics were timed and their success was recorded. **Results:** A total of 33 medics participated (16 mentored, 17 nonmentored). Only 5 (15%) of the medics in the study were able to pass the scenario with 90%; of those who passed 80% ($n = 4$) were mentored. While this was not significant ($p = 0.175$), the range of scores speaks to the improvement of mentoring. One of the medics in the mentored group received 100% on the simulation, something not seen in the nonmentored group (highest 91%), while in the nonmentored group the lowest score was 1%, something not seen in the mentored group (lowest 17%). There was no significant difference ($p = 0.123$) between the mentored ($72.1\% \pm 22.1$) versus nonmentored ($58.4\% \pm 28.5$) medics for the grade received on the simulation (90% was considered a pass), despite the mentored medics scoring an average of 14% higher on the simulation. There was also no significant difference ($p = 0.326$) between the time it took mentored (59.9 ± 17.5 seconds) versus nonmentored medics (67.41 ± 25.0 seconds) to complete the wound packing. Of the 28 (85%)

medics who did not pass with at least 90%, almost 70% (67.9%) of those medics thought that they had passed when queried in a post-task questionnaire. The medics who did not pass also rated the difficulty of the packing task with a mean score of 4.5/10 (with 10 being extremely hard). **Conclusion:** Although considered a basic life-saving skill, effective wound packing appears much more difficult than appreciated as the vast majority of otherwise well-trained medics performed unsatisfactorily. Post-test medic self-assessment revealed a performance gap between objective performance and subjective performance. Remote mentoring appeared to improve this performance gap, although the results were nonsignificant with the limited subjects studied. In addition to improved skills teaching, further work on remote oversight and guidance during hemorrhage control should be pursued.

X-rays or whole-body CT in major trauma in the elderly. *M. Azam Majeed.* From the University Hospitals Birmingham, Birmingham, UK.

Background: There is an increasing elderly population within the United Kingdom and hence we are facing more elderly patients with major trauma. If these cases are managed aggressively from the beginning, this leads to increased survival rates. The mortality rates in patients over 65 years of age secondary to falls are highest. Early evaluation and resuscitation of elderly patients improve survival after trauma. Radiology plays a vital role in early diagnosis of elderly patients, and computed tomography (CT) is crucial. **Methods:** This study was designed to find out the common mechanisms of injuries incurred by the elderly and identification by early whole-body CT (WBCT). We undertook a retrospective analysis of the patient notes of patients 65 years and over who presented to the emergency department of University Hospitals Birmingham (UHB) over a 4-year period from 2012 to 2016. Patients younger than 65 years were excluded from the study. UHB is 1 of 3 regional trauma centres. We found the details of the mechanism of injuries and the impact of WBCT in the patient's care. **Results:** A total of 4727 patients were brought in as a major trauma alert over the 4-year period. Among these, 1608 (34%) patients aged 65 years and over were included in the analysis. The mean age was 84 years (range of 65–102 years). The male:female ratio was 60:40. The mean injury severity score was 39.5 (range 4–79). The mechanisms of injuries were as follows: 504 (31%) patients had a fall < 2 m, 456 patients (28%) were in a road traffic accident and 87 patients (5.4%) were stabbed. The areas involved in the injuries were pelvic injuries 28% (452 patients), head injuries 32% (514 patients), spinal injuries 13% (211 patients) and chest injuries 14.4% (223 patients). The most common cause of injury was a fall < 2 m and the most commonly involved region was the head in our patient group. **Conclusion:** Elderly patients with minor head injury and a Glasgow Coma Scale score of 13–15 have a 14% risk for abnormal CT findings. Chest radiographs do not represent about one-half of rib fractures visible at CT. In a study, 4.4% of patients with clinical suspicion for hip fracture had false-negative radiographs. Routine x-rays in the elderly (over 65 years) could have missed more than 50% of injuries and would have led to delayed treatment and a potentially different outcome.

External validation of a clinical decision rule for thoracolumbar spine evaluation. *Katelyn Young, Shannon Brindle, James Dove, Marie Hunsinger, Mohsen Shabahang, Joseph Blansfield,*

Kenneth Widom, Jeffrey Wild. From the Geisinger Medical Center, Danville, Pa.

Background: Though it is well established that a missed thoracolumbar spine fracture (TLF) can result in serious neurologic damage, controversy exists regarding the patient characteristics that should mandate radiographic screening. Recently, the American Association for the Surgery of Trauma (AAST) proposed criteria to identify potential TLF in alert adults without distracting injury. Thus, this study aims to externally validate the sensitivity of the proposed criteria in identifying clinically significant TLF. **Methods:** This was a retrospective review of alert (Glasgow Coma Score 15), stable adults (≥ 18 years) presenting to a single Level 1 trauma centre (Jan. 1, 2011, to Dec. 31, 2016) with blunt TLF. Significant TLF was defined as injury requiring thoracolumbar surgery or orthosis, excluding bracing for comfort. The AAST criteria for thoracolumbar CT imaging was recommended for patients meeting at least 1 of these criteria: not alert/evaluable; tenderness/neurologic deficit; injured in high-risk mechanism (fall, auto v. pedestrian, unenclosed vehicle, collision with rollover/ejection); age ≥ 60 years. **Results:** TLF was found in 714 patients, and 403 of these patients (56.4%) had significant injury. Ninety patients with significant TLF (22.3%) presented without back pain and denied tenderness to palpation. To determine the sensitivity of the AAST criteria to identify significant TLF, the 403 patients with significant injury were evaluated. Ultimately, the criteria found that 397 patients had at least 1 indicator for imaging, revealing a sensitivity of 98.5%. In the 6 remaining patients who failed to meet a single criterion, 4 patients had more than 1 TLF, with L4 representing the most common location. All patients sustained at least 1 vertebral body fracture, totalling 6 endplate fractures and 7 compression fractures. Surgical stabilization was required in 1 patient. With respect to the mechanism of injury for patients failing to meet AAST imaging criteria, 4 patients were injured in motor vehicle collisions (without rollover or ejection) at high speed (≥ 55 miles per hour). Thus, if the criteria were to expand the definition of a high-risk mechanism to include high-speed collisions, the criteria's sensitivity would improve to 99.5%. **Conclusion:** In this new and independent population, the previously derived AAST criteria demonstrated a superior sensitivity compared with most available screening guidelines. Incorporating high-speed motor vehicle crashes without rollover or ejection into the definition of a high-risk mechanism of injury would further improve the sensitivity of the guidelines.

Surgical rib fixation: Does timing of repair affect outcomes?
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Background: Surgical rib fixation (SRF) is gaining acceptance, particularly in the treatment of flail chest. Recently, several small studies have recommended that candidates undergo SRF as soon as life-threatening injuries have been addressed. The present study aims to characterize national trends in the timing of SRF and to examine whether the timing of repair affects outcomes. **Methods:** The National Trauma Data Bank identified patients who sustained blunt trauma between Jan. 1, 2008, and Dec. 31,

2015. Adults (≥ 15 years) with rib fracture(s) were eligible, though individuals who were transferred or had severe brain injury were excluded. Patients were stratified into flail chest and non-flail chest cohorts. Furthermore, patients undergoing SRF were subclassified: early SRF (≤ 72 hours after admission) or delayed SRF (> 72 hours following admission). Cochran–Armitage trend testing and multivariate analysis were used (significance: $p < 0.05$). **Results:** A total of 324 518 patients were studied with 8665 (2.7%) undergoing SRF. Most patients (321 422; 99.0%) had nonflail fractures, with 8198 of these patients undergoing SRF. In these patients, there was a significant trend toward earlier SRF across time (percentage early SRF [range]: 54.9, 63.6%; $p < 0.0001$). Multivariate analysis revealed delayed fixation was associated with increased risk of overall morbidity (OR 2.13, 95% CI 1.87–2.43), including a higher likelihood of tracheostomy (OR 2.26, 95% CI 1.78–2.85), longer hospitalization (HR 0.51, 95% CI 0.49–0.54) and longer duration of mechanical ventilation (HR 0.87, 95% CI 0.83–0.91). Mortality risk, however, was unaffected by the timing of SRF (overall mortality rate: 5.9%). The remaining 3096 patients had flail chest, with 467 (15.1%) undergoing SRF. There was no trend in the timing of SRF (percentage early SRF [range]: 28.6, 55.0%). Longer time to SRF was associated with higher morbidity risk (OR 1.81, 95% CI 1.17–2.80), including longer hospitalization (HR 0.60, 95% CI 0.49–0.73) and longer duration of mechanical ventilation (HR 0.71, 95% CI 0.57–0.87). Mortality was unvaluable in this subgroup (overall mortality rate: 1.1%). **Conclusion:** Regardless of rib fracture pattern, delayed SRF portends higher morbidity in this national sample. These findings support the recommendation to perform SRF as soon as life-threatening injuries have been addressed, ideally within the first 72 hours.

Open abdomen after damage control laparotomy for trauma: Do our quality indicators measure up?
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Background: Open abdomen (OA) following damage control laparotomy (DCL) for trauma is used as a life-saving surgical approach in up to one-third of acute trauma cases. However, DCL and OA are also associated with increased complications and morbidity that may be unaccounted for in current performance measurement programs for adult trauma. Our objective was to evaluate quality indicators used in adult trauma care for measures explicitly related to OA. **Methods:** We performed a scoping review of the literature to assess for use of performance measures that reflect open abdomen in adult trauma care from 2006 to present. We formally searched CINAHL, Medline and PubMed and informally queried content experts. Relevant measures were categorized using a Structure, Process, Outcomes approach, as well as presence in clinical practice guidelines and formal quality improvement data collection systems (e.g., Trauma Quality Improvement Program [TQIP], Agency for Healthcare Research and Quality [AHRQ] patient safety indices). **Results:** Of 2007 articles that were identified, 1548 abstracts and titles were screened and 197 papers were reviewed, resulting in 38 studies for qualitative synthesis. From individual trauma systems, we identified no structure-related measures, 1 direct process-related measure (use of DCL), 3 indirect process measures (return to OR,

therapeutic effect of laparotomy, nutrition status) and 5 indirect outcome-related measures (sepsis, wound infection, abdominal compartment syndrome, anastomotic leak and functional status before v. after surgery in geriatric patients using a modified ALCOVE tool). One national clinical practice guideline recommends DCL and its use as an audit field, but adherence is unclear. In formalized programs, TQIP measures deep space, surgical site infection and wound disruption, but excludes fistula. AHRQ's patient safety indices for postoperative sepsis and metabolic derangement are excluded in emergency surgery. A recent validation study for measures of trauma complications did not include fistula or abdominal compartment syndrome but did include sepsis and anastomotic leak. No direct measures, such as operating room access for planned returns (structure), adherence to indications for DCL or timing of return (process), or rate of failed primary closure (outcome), were identified as ongoing performance measures. **Conclusion:** Current performance measures for adult trauma care do not explicitly reflect the potential impact of open abdomen. There are no structure-related measures and variable use of process and outcome measures that indirectly measure morbidity related to OA. No direct measures for OA were identified in ongoing programs for trauma quality improvement. Future work should systematically measure the impact of OA in trauma to optimize patient care and improve system performance.

Venous access site affects survival in patients with penetrating injuries to the IVC or iliac veins. *John Tierney, Andrew Dennis, Fredric Starr, Faran Bokhari, Kimberly Joseph, Matt Kaminsky.* From the John H. Stroger, Jr. Hospital of Cook County, Chicago, Ill.

Background: Central venous catheters (CVCs) in the femoral, internal jugular (IJ) or subclavian (SC) veins are frequently used in trauma resuscitation. It is unclear if femoral catheters are effective for resuscitating patients with penetrating trauma to the inferior vena cava (IVC) or iliac veins. We reviewed venous access placement during resuscitation in all patients who presented to our institution with penetrating IVC or iliac vein injury. The primary end point was 24-hour survival. **Methods:** Eighteen patients who presented after sustaining penetrating injuries to the IVC or iliac system were identified; patients who presented in cardiac arrest were excluded. Patients were grouped according to initial venous access site for resuscitation (femoral vein v. other site) and survival was compared using Fisher exact tests. Patients who received an initial femoral cordis but were primarily resuscitated through other access were then separated into a third group; survival was compared between the 3 groups. **Results:** Sixteen patients met the inclusion criteria. All had sustained gunshot wounds to the abdomen or pelvis. Ten patients received an initial femoral CVC (group 1) and 6 patients had another form of initial access (IJ, SC, peripheral IV; group 2). Five of 10 patients (50%) with initial femoral lines survived 24 hours, compared with 6/6 patients with other access ($p = 0.09$). Three patients who initially received a femoral line received a subsequent SC or IJ venous catheter during resuscitation or were resuscitated through peripheral IVs instead of the femoral line (group 1b). All 3 of these patients survived. A significant difference was observed between groups 1a (definitive femoral line), 1b (initial femoral line then subsequent additional access) and 2 ($p = 0.01$). Patient age, initial systolic blood pressure, initial heart rate, best Glasgow

Coma Scale score in the resuscitation area, and percent of IVC injuries in each group were similar between groups, but initial base deficit was higher in the definitive femoral line group. **Conclusion:** Our study demonstrates that patients with an IVC or iliac vein injury who are resuscitated through an upper body CVC or peripheral IVs have superior 24-hour survival than patients whose femoral CVC is used as definitive access for resuscitation. Although initial femoral catheter placement did not affect mortality, failure to obtain and use upper body central or large-bore peripheral access early in resuscitation of this patient population was associated with decreased survival.

Play Safe Injury Tracker: developing a solution for tracking injuries in sport organizations. *Brandy Tanenbaum.* From the Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: Injury prevention in sport is possible when the etiology, risk factors and exact mechanisms of injuries are known. A standardized method of data collection is required to capture this kind of information and share it with key stakeholders. Play Safe at Sunnybrook has developed such a tool that uses Web-enabled technology to facilitate easy data capture across sport organizations and provide relevant, real-time data to inform and evaluate intervention strategies. **Methods:** Sunnybrook and its collaborative partners have been developing this platform since 2011. Building on the work of international researchers, the International Olympic Committee and pilot projects at the 2012 Ontario Summer Games and 2013 International Children's Games, Play Safe delivers real-time data collection using cloud technology and standardized injury definitions to support community-, provincial- and national-level sport organizations to begin to understand and manage their injury profiles. Currently, 7 organizations are using Play Safe Injury Tracker. **Results:** Until now, the sport sector and injury researchers have relied exclusively on limited hospital data for insight into sport injury. Hospital data provide limited information on only the most severe sport-related injuries that require an emergency department visit or hospitalization. While hospital data are useful for understanding primary care requirements, they offer none of the necessary information for sport organizations to understand their exact injury profile, causal and contributing factors, severity and type of injuries relative to their sanctioned activities. Play Safe has embarked on a mission to share the need for and reality of online injury data collection with a wide audience of sport organizations in Canada. The number of organizations tracking injury online has increased in the past 6 years, and there is growing interest resulting from pending concussion legislation. In a variety of questionnaires, Play Safe has surveyed user groups to better understand the form and function of online injury data collection. Respondents are in favour of online collection and do not find the number or type of questions to be a deterrent. Organization leaders find it advantageous to gather information online to eliminate the need for paper and maintain better adherence to personal information and privacy requirements. Sport leaders are happy to be able to access useful data. **Conclusion:** Injury data collection is a necessary function of injury prevention. As more organizations are expected to be accountable for the long-term impact of injuries incurred as a result of participation, there is a growing interest in measuring and managing injury differently. Leveraging today's technology, mobile device

accessibility and the liability of organizations to provide a duty of care, injury data collection will continue to evolve and embed itself as a natural part of reporting in sport.

Practice makes perfect: review of in situ simulations at a tertiary trauma centre. *Samuel Jessula, Samuel Minor, Robert Green.* From Dalhousie University, Halifax, NS.

Background: In situ trauma simulations, where simulation is physically integrated in the actual clinical environment, allow the trauma team to practise team dynamics, resuscitation and logistics in a controlled manner. In situ simulations use the same clinical environment, equipment and clinical pathways as a real trauma activation, allowing for the evaluation of parameters not accessible by traditional simulation training that occurs in an isolated learning environment. Errors can be identified and addressed and retested in future simulations. **Methods:** This study was a retrospective review of in situ simulations from Level I trauma centre from 2015 to 2017. Errors were categorized according to the National Patient Safety Agency (NPSA) by 3 independent raters into categories and assigned consequence scores (1–5) and likelihood scores (1–5). A risk score was created as the product of the mean consequence, and likelihood scores, standard deviation (SD) and intraclass correlation (ICC) were calculated. Errors per simulation and simulations required for resolution were also recorded. **Results:** Eight in situ trauma simulations were reviewed. A total of 54 errors were identified, of which 7 were medication-related, 20 were equipment-related, 21 were environment-/staffing-related and 6 were training-related. The mean consequence score assessing potential harm was 2.85 out of 5 (SD 0.75, ICC 28%), classified between minor (2/5) and moderate harm (3/5). The mean likelihood score, assessing the likelihood of potential harm occurring to the patient, was 2.82 out of 5 (SD 0.55, ICC 41%), classified between unlikely (2/5) and possible (3/5). The mean risk score, the product of the consequence and likelihood scores, was 8.42 out of 25 (SD 3.19, ICC 43%). The distribution of risk categories included 1 low risk (1.9%), 23 moderate risk (42.6%), 26 high risk (48.1%) and 4 extreme risk (7.4%). A mean of 6 errors per simulation were identified (SD 3.35) and a median of 2 simulations were required to resolve error (range 1–5). **Conclusion:** In situ simulations successfully identify a wide range of safety issues that are amenable to correction. Latent errors identified are most commonly equipment- or environment-related, which would not be identified with traditional simulation exercises. Most errors identified were of moderate and high risk and required a median of 2 simulations to resolve.

Should we transport pediatric trauma patients by helicopter? A national trauma data bank study. *Mahdi Malekpour, James Dove, Denise Torres, Christopher Coppola, Jeffrey Wild.* From the Geisinger Medical Center, Danville, Pa.

Background: Faster transportation of trauma patients to trauma centres would potentially reduce mortality and morbidity, yet the effectiveness of helicopter transport is being debated. We aimed to study the association between pediatric mode of transport and trauma outcome. **Methods:** Following institutional review board approval, records in the National Trauma Data Bank (NTDB) were reviewed from 2008 to 2012. We included patients younger than 15 years of age in the analysis. Using propensity score-

matched multivariate analysis we studied survival to hospital discharge and discharge disposition in helicopter versus ground modes of transportation. **Results:** Over the 5-year study period, complete data were retrieved in 41 287 Level 1 transports and 14 573 Level 2 transports. Blunt trauma constituted more than 95% of all patients. Helicopter transport to Level 1 trauma centres was associated with a significantly increased survival (OR: 2.07, 95% CI: 1.71–2.5, $p < 0.0001$). A significantly higher survival was also seen with helicopter transport to Level 2 trauma centres (OR: 1.5, 95% CI: 1.11–2.3, $p = 0.01$). Number needed to treat (NNT) for severe traumas (injury severity score > 15) was 20 and 97, respectively, for Level 1 and Level 2 helicopter transports. Helicopter transport to Level 1 trauma centres was associated with a significantly higher rate of discharge to favourable destinations ($p = 0.008$). **Conclusion:** Every 20 helicopter transports versus ground transport saved 1 life in severely injured pediatric trauma patients at Level 1 trauma centres.

Independent predictors of survival after traumatic atlanto-occipital dissociation. *Morgan Schellenberg, Kenji Inaba, Vincent Cheng, Jim Bardes, Patrick Heindel, Kazuhide Matsushima, Elizabeth Benjamin, Demetrios Demetriades.* From the LAC+USC Medical Center, Los Angeles, Calif.

Background: Atlanto-occipital dissociation (AOD), also known as internal decapitation, occurs when the skull base is forcibly separated from the vertebral column at the atlas. The surrounding soft tissues remain intact. Existing studies on AOD consist of small case series only, and risk factors for mortality are unknown. This study examined the epidemiology of patients with AOD and independent predictors of survival after injury. **Methods:** Patients who sustained AOD were identified from the National Trauma Data Bank (2007–2014). Study groups were defined as patients who survived to hospital discharge versus patients who died. Baseline characteristics, injury data, interventions and outcomes were compared between the 2 groups using univariate analysis. Multivariate logistic regression was used to determine independent predictors of survival. **Results:** Over the study period, there were 2394 patients with traumatic AOD. Median age was 35 years (IQR 20–56) and 60% of patients were male. AOD occurred almost exclusively after blunt mechanisms (98%), most commonly motor vehicle collisions (MVCs) (70%). Median injury severity score (ISS) was 27 (IQR 14–43), with 24% mortality. Median time to death was 1197 minutes (IQR 240–4268), approximately 20 hours. Patients who died had a higher ISS (38 v. 22, $p < 0.001$) and were more likely to undergo emergent exploratory laparotomy (16% v. 5%, $p < 0.001$) or thoracotomy (4% v. 1%, $p < 0.001$) than patients who survived. On multivariate regression, independent predictors of survival were higher Glasgow Coma Scale (GCS) score on admission, lower ISS and the absence of concomitant traumatic brain injury. While patients who survived were more likely to undergo neurosurgical intervention on the cervical spine than those who died (37% v. 20%, $p < 0.001$), time to intervention was not predictive of survival. Patients who survived had a median hospital length of stay (LOS) of 5 days (IQR 1–16) and intensive care unit LOS of 1 day (IQR 0–9). Tracheostomy was required in 12% and percutaneous endoscopic gastrostomy (PEG) in 9%. Survivors were most commonly discharged home ($n = 546$, 30%) or to a rehabilitation facility ($n = 341$, 19%). **Conclusion:** Traumatic AOD is not a

uniformly fatal injury, with 76% of patients surviving to hospital discharge. When death occurs, it is typically within the first 20 hours. Lower ISS and higher GCS on admission independently predict survival, while time to neurosurgical intervention does not. Patients who survive have a short hospital stay with infrequent need for tracheostomy/PEG and are commonly discharged home. This study suggests that AOD may not be as devastating as previously considered.

Effect of age on patients with traumatic brain injury — analysis of 7000 patients from a Canadian Level 1 trauma centre. *Gwen Schwartz,¹ Amanda McFarlan,² Ruiwei Jing,¹ Terence Fu,¹ Beate Sander,³ Rob Fowler,¹ Macintyre Burnham,¹ Howard Mount,¹ Mingyao Liu,¹ Sandro Rizoli.²* From the ¹University of Toronto, ²St. Michael's Hospital and the ³University Health Network, Toronto, Ont.

Background: There are global shifts toward an aging population and growing rates of traumatic brain injury (TBI). Consequently, health care systems are faced with increased demand to effectively mobilize acute care resources for rapidly growing older TBI populations. Our study's purpose was to examine effects of advanced age on presentation to hospital, hospital resource utilization and short-term outcomes, including mortality, in a large cohort of TBI patients admitted to a Level 1 trauma centre in Canada. **Methods:** This study was a retrospective analysis of a prospectively collected trauma database at St. Michael's Hospital Trauma Centre in Toronto. Patients were stratified according to age (younger: 18–64 years; older: ≥ 65 years) and injuries (isolated TBI; TBI plus multisystem injuries; no TBI). Descriptive statistics were applied to assess the effects of age on hospital presentation, resource utilization and outcome parameters of interest. Adjusted and unadjusted multivariable logistic regression were used to evaluate independent predictors of in-hospital mortality. **Results:** Of the 7000 patients admitted to hospital between 2008 and 2016, 1883 (27%) were ≥ 65 years old; 1102 (58%) had isolated TBI, 163 (9%) had multisystem plus TBI and 618 (33%) had no TBI. On presentation to hospital, older TBI patients had more comorbidities, were more frequently referred from other hospitals (v. transfer from scene), had falls as the predominant mechanism and suffered more isolated TBI ($p < 0.0001$). Univariable analyses demonstrated age-associated biases on measures of resource utilization with trauma team activations, mechanical ventilation and intracranial pressure monitoring being applied significantly less in older TBI patients ($p < 0.05$). Furthermore, older patients were more likely to be admitted to neurosurgery instead of the trauma service ($p < 0.05$). Older isolated TBI patients had less admission to the intensive care unit (ICU) ($p < 0.0001$), while multisystem plus TBI older patients underwent less operative management and had shorter hospital and ICU length of stay (LOS) ($p < 0.05$). On outcomes, mortality was significantly higher among older patients across all groups ($p < 0.0001$). Compared with younger patients, older TBI survivors were less likely to be discharged home and more to in-patient rehabilitation or another acute care or chronic care facility ($p < 0.0001$). Among those with isolated TBI, significantly more required hospital readmission following discharge ($p < 0.05$). Advanced age, injury severity, comorbidities, admission service patterns and acute care resource utilization predicted TBI-related in-hospital mortality (OR 1.42–13.61, $p < 0.04$), while increased

hospital LOS and surgical management were associated with decreased mortality (OR 0.01–0.7, $p < 0.0006$). **Conclusion:** Advanced age among acute TBI patients affects hospital presentation, resource utilization and short-term outcomes. Older TBI patients presented with more fall-related isolated TBI, comorbidities, and were referred. Surgery, ICU, mechanical ventilation and intracranial pressure monitoring were less frequently used in TBI elders, whose mortality was disproportionately higher, with survivors discharged to a lower level of care. While poorer outcome is expected in older TBI patients, the present study suggests different hospital resource utilization could have a role.

Seven-year outcome of implementation of abusive head trauma prevention (the period of PURPLE crying) in British Columbia. *Ronald Barr,¹ Marilyn Barr,² Fabra Rajabali,³ Claire Humphreys,³ Ian Pike,¹ Rollin Brant,¹ Jean Hlady,¹ Margaret Colbourne,⁴ Michelle Clarke,⁴ Takeo Fujiwara,⁵ Ash Singhal.⁴* From the ¹University of British Columbia and the BC Children's Hospital, Vancouver, BC; the ²National Center on Shaken Baby Syndrome, Farmington, Utah; the ³BC Children's Hospital Research Institute, Vancouver, BC.; the ⁴BC Children's Hospital, Vancouver, BC; and the ⁵Tokyo Medical and Dental University, Tokyo, Japan.

Background: Abusive head trauma is a devastating form of infant abuse, with significant mortality and morbidity. Efforts to reduce the burden of disease are best achieved with prevention efforts, but evaluation of prevention effectiveness is challenging. The current study prospectively evaluates the 7-year outcome of abusive head trauma (AHT) admissions following implementation of a primary, universal prevention program, Period of PURPLE Crying (PPC), composed of 3 prevention doses: parental education, reinforcement and public education. **Methods:** Direct parental education and caregiver reinforcement were provided by a diverse professional group. Training was provided to over 4800 community personnel (pediatricians, family physicians, crisis lines, Aboriginal support workers, early childhood educators) and over 5400 maternity nurses. Public education was provided across multiple traditional media platforms and nontraditional means, and repeated annually. Participation rates were tracked prospectively. AHT hospitalization rates were tracked retrospectively before study commencement and prospectively via 2 surveillance programs. **Results:** At least 86.0% (75 662 out of 87 967) of tracked births received the prevention materials. Through 2015, 95% of patients confirmed receiving the prevention materials from maternity care, 3% from public health, 1% from midwives and the rest from others. Someone other than the mother was present during teaching 80% of the time, most commonly the father. On parent surveys at 2–4 months after birth, 70% of mothers and 51% of fathers had watched the prevention DVD and/or read the prevention booklet. Estimated AHT admission rates per 100 000 person years before and after implementation were prospectively calculated, using the Provincial Child Protection Service case tracking system and an Inflicted Head Injury Surveillance Program developed for this study. In the preimplementation period, AHT admission (< 12 months old) rates averaged 10.9 per 100 000 person years, as expected by historical estimates. Following implementation, admission rates decreased 37% to 6.8 per 100 000 ($p = 0.053$). For < 24-month-

olds, the rate decreased 36% from 6.8 per 100 000 before implementation to 4.4 per 100 000 after implementation ($p = 0.048$). **Conclusion:** This prospective study of a 3-dose prevention program demonstrated, over a 7-year period, a statistically significant 36% reduction in AHT hospitalization in children < 24 months of age. The magnitude of this reduction can be placed in the context of a traditionally low baseline AHT hospitalization rate in our country and province, and the context of rising AHT rates during the period spanning the Great Recession. Parental education programs appear to be effective in reducing AHT admission rates.

Connecting with families and staff: PEDS emerg weekly visits. *Jennifer Lindsay, Brandon Batey, Tania Haidar, Kelly Vogt, Laura Allen, Susan Ready.* From the London Health Sciences Centre, London, Ont.

Background: Annually, the Children's Hospital at London Health Sciences Centre (CH-LHSC) sees approximately 10 000 injury-related pediatric emergency department (ED) visits. Injury prevention (IP) is an integral part of a patient's visit, as a teachable moment exists surrounding an injury. At CH-LHSC IP initiatives are delivered in the ED by nurses; however, with competing priorities, IP delivery by nurses is challenging. The objective of this intervention is to improve IP dissemination and evaluate delivery by dedicated IP staff. **Methods:** Using the strong relationship we have with the ED educator, the IP team (injury prevention specialist and 2 injury project associates) commenced 2-hour weekly visits to the ED in July 2017. The IP team connected with nurses and provided targeted IP education to patients and families. Program effectiveness was assessed over a 2-month period on a variety of indicators: number of family interactions, number of resources taken, number of products given and staff perceptions. **Results:** The IP team made 9 2-hour visits to the ED in July and August. During the visits, 23 patients and/or family members were provided a helmet, educational brochures or paint sheets or had a conversation based on their safety concerns. These visits also facilitated improved communication with staff. On our sixth visit we received a particularly warm welcome upon our arrival to the department, suggesting that staff were expecting our visit and supporting this method for relationship building. In addition to improved relationships, this initiative provides a method for educational materials to be tracked and more promptly refreshed. One of the new resources on car seats, brought to the department during this intervention, saw an average of 2 brochures taken per week, which is the number of brochures taken in total on the other topics over the 9-week period. In 9 weeks, 190 paint sheet packages, which include passive injury prevention messaging, were taken. In terms of equipment, 18 helmets were given by IP staff to patients and siblings in 18 hours (1/hour), compared with 14 helmets given by nurses in 1488 hours (1/106 hours). The themes that have arisen during our intervention include staff relationship building, value seen from families and targeted/individualized IP messaging. **Conclusion:** With weekly IP team visits to the ED, injury prevention messages are being more consistently delivered than with nursing staff alone. As seen with the helmet giveaway program, dedicated IP staff can ensure that targeted IP messaging is delivered. Although weekly visits are a time investment, consistency is necessary to

maximize uptake and will lead to an improved culture of safety. Future work will involve formalizing data collection to better target IP interventions.

Transoceanic telementoring of tube thoracostomy insertion: a randomized trial of telementored versus unmentored insertion of tube thoracostomy by military medical technicians. *Andrew Kirkpatrick,¹ Jessica McKee,² Paul McBeth,¹ Elon Glassberg,³ Scott D'Amours,⁴ Alex Dobron,³ Volker Kock,⁵ Chad Ball,¹ Itamar Netzer.³* From the ¹Foot-hills Medical Centre and University of Calgary, Calgary, Alta.; ²Innovative Trauma Care, Edmonton, Alta.; the ³Israel Defence Forces Medical Corps, Tel Aviv, Israel; the ⁴University of New South Wales, Sydney, Australia; and the ⁵Canadian Forces Medical Services (retired).

Background: Tension pneumothorax (TPT) is a life-threatening post-traumatic condition that is a frequent cause of potentially preventable death. Tube thoracostomy (TT) can obviate death, but it is an invasive procedure that, while life-saving, is fraught with serious complications even in the hands of physicians. We assessed the utility of a remote international virtual network (RIVN) consisting of trauma surgeons and a special force medical technician to remotely guide (mentor) military medical technicians (medics) using wireless informatics. **Methods:** Medics were randomly assigned to insert TT in training mannequins (TraumaMan, Abacus ALS) supervised by RIVN or not. The RIVN consisted of trauma surgeons in Canada and Australia and a technician in Ohio. Medics wore a helmet-mounted wireless camera with a laser pointer to confirm anatomy and 2-way voice communication using commercial software (Skype). Performance was measured through objective task completion (pass/fail), remote mentor opinion (Likert scale 1–5; 1 equals very much and 5 not-at all). **Results:** Fourteen medics attempted TT, 7 mentored using the RIVN and 7 not. The RIVN was functional and surgeons on either side of the globe had real-time communication with the mentees. TT placement was considered safe, successful and secure in 100% of mentored ($n = 7$) procedures, although 2 (29%) received corrective remote guidance. All (100%) of the unmentored attempted and adequately secured the TT and were deemed safe. However, only 71% ($n = 5$) completed the task successfully ($p = 0.46$). When the medics subjectively debriefed, there was no difference between the mentored and nonmentored ($p < 0.99$) when asked if the procedure and simulator were realistic (4 ± 1), or about their confidence in their abilities (3 ± 1). When asked if mentoring increased self-confidence, mentored medics answered 5 ± 0 , when asked if they would feel confident to perform mentored TT in the field they answered 4 ± 1 , and when asked if the mentor helped to make them less anxious they answered 5 ± 1 . When subjectively debriefed, the remote mentors responded that they felt in 100% of the mentored procedures that “yes” they were able to assist the medics (1.86 ± 0.38), and in 71% ($n = 5$) of procedures they felt “yes” they made TT safer (2.29 ± 0.49). In only 1 (14%) of the mentored cases the mentor felt they did “not really” calm the medic (2.29 ± 0.95) and that the video equipment did “not really” help (2.43 ± 0.79). **Conclusion:** Remote mentoring objectively increased the success of effective TT placement and allowed for real-time troubleshooting from thousands of kilometres away with a redundant mentoring capability. Furthermore, remote mentoring was subjectively associated with high levels of

satisfaction and self-reported self confidence in inexperienced operators requested to perform out of scope. Continued evaluation and refinement of telemedical techniques should continue with controlled evaluation in operation settings.

Blunt cardiac injury detection and management: adherence to guidelines and the impact of high-sensitivity troponins at a Canadian trauma centre. *Katherine Aucoin,¹ Angela Coates,² Hisbani Dokainish,¹ Paul Engels.¹* From ¹McMaster University and the ²Hamilton Health Sciences Trauma Program, Hamilton, Ont.

Background: Blunt cardiac injury (BCI) occurs in approximately 2% of all bluntly injured trauma patients. Screening guidelines for BCI were published by the Eastern Association for the Surgery of Trauma (EAST) in 2012 but there are no recent data examining Canadian practices since this publication. Our study examines the screening and investigation practices, including the impact of the transition to high-sensitivity troponins and the outcomes of this injury, at our Level 1 trauma centre. **Methods:** We used data from the Hamilton Health Sciences Trauma Registry, Laboratory Services and Echocardiography Laboratory to compile a retrospective cohort of patients who were diagnosed with BCI and those who were at risk of BCI during the period November 2013 to November 2015, during which our laboratory changed from standard to high-sensitivity troponin testing. We abstracted data on patient demographics, admission, investigations, medications and outcomes using manual chart review as well as electronic records. **Results:** We identified 1572 blunt trauma cases in the Trauma Registry. Maximal Abbreviated Injury Score (MAIS) Chest ≥ 1 defined our “at-risk of BCI” cohort ($n = 661$). In our study, 94% (622/661) had an initial troponin and within 24 hours 51% (316/622) had at minimum a subsequent troponin. Of the 622 patients with at least 1 troponin drawn, 31% (194/622) had either an initial or subsequent troponin positive. A total of 199 patients underwent echocardiography during admission; 81% (161/199) were performed within 7 days and 20% (40/199) had abnormalities. Thirty-nine percent (77/199) never had an elevated troponin and only 57% (114/199) had an echocardiogram ordered. When comparing standard versus high-sensitivity troponin cohorts, no statistical differences were identified, including no difference in the time interval between first and second samples. Twenty-three patients were diagnosed with BCI in the registry. Of these, 87% (20/23) had at least 1 troponin drawn, 3 died in the emergency department and 61% (14/23) had an echocardiogram. Ninety percent (18/20) had a positive troponin within 24 hours, with 14 having the initial troponin positive and 4 having only the second troponin positive. Twenty-six percent (6/23) underwent cardiac interventions (pacemaker, operation, percutaneous coronary intervention) and 4 died. In the MAIS Chest = 0 ($n = 911$) cohort, there were no registry-diagnosed BCIs. Seventy-five percent (685/911) had a minimum of 1 troponin, 3% (25/911) had a positive troponin within 24 hours and 7% (60/911) had an echo within 1 week of admission. **Conclusion:** Our study demonstrates inconsistencies with screening and investigation practices for BCI at our institution when compared with the EAST guidelines. Echocardiography appears to be overused in these patients. We did not find any impact of the implementation of high-sensitivity troponins, although it appears their reduced required interval to exclude BCI is not being used. Cardiac intervention was required in < 1% of those at risk of BCI, which raises questions about the value of BCI screening.

One size doesn't fit all: Impact community event. *Tania Haidar,¹ Brandon Batey,¹ Jane Edwards,¹ Kelly Vogt,¹ Kelley Elliott.²* From the ¹London Health Sciences Centre, London, Ont.; and Lambton Public Health, Lambton, Ont.

Background: The Impact Program (Informing Teens, Preventing Injuries) is an injury prevention strategy targeting grade 11 high school students in London, Ontario, addressing a range of risk-taking behaviours. Impact equips students with the tools necessary to make informed decisions. Partnerships have been critical to the success of the program and continue to be important in reaching students beyond London. We report here on the results of implementing an Impact community event. **Methods:** The Lambton County Safe Roads Committee identified teen driving safety as a priority in their community and recognized Impact as a means to address the issue. Planning stages for this event included identifying all important community stakeholders and engaging students in the entire process. The event involved 3 stages: a mock extrication scene, an Impact presentation with victim speakers, as well as exhibitors. Student perceptions of the event were evaluated with a 5-question survey. **Results:** The first Impact community event was piloted at St. Patrick's Catholic High School in Sarnia, Ontario, to 1300 grade 9 to 12 students. Student involvement in the planning of this large-scale event proved valuable. Recognizing social media is an important medium for teenage communication and having students lead this aspect of the event resulted in increased social media participation. The presence of traditional media captured the magnitude of the day's events. The mock crash scene included a crash car provided by Sarnia Police to demonstrate the consequences of distracted driving. Following the crash scene, the Impact presentation was delivered, along with victim stories from a former patient and family speaker. To conclude the day, the grade 11 and 12 students ($n = 487$, 37%) were encouraged to visit various health services and education stations to discuss topics related to risk-taking behaviours. These stations represented involvement from over 20 community partners. A total of 136 students completed the survey. Results showed that 96% of students felt that the information was useful, and 92% felt it would reduce their risk-taking behaviours. Most respondents (91%) felt very positively about the format of the Impact presentation and 95% of students were satisfied with the Impact presentation. Almost half of the students who completed the survey felt the personal stories were the best part of the event. **Conclusion:** The success of the Impact community event is rooted in the investment in our partnerships and early engagement of students to facilitate a large-scale event with high levels of student participation. Students who attended this event felt it increased their knowledge, changed their attitude toward risk taking and road safety and ultimately would change their behaviour. Expanding the Impact Program in this manner is a feasible solution to reach more students across the region.

Trends of clinical outcomes in patients with a traumatic brain injury in Canada between 2006 and 2012: a multicentre retrospective cohort study. *Delwende Sawadogo, Lynne Moore, Pier-Alexandre Tardif.* From Laval University, Québec, Que.

Background: Traumatic brain injuries (TBI) are the leading cause of death for people < 40 years old. Although the Canadian trauma care system has evolved over the past 10 years, little is known about

the trend of TBI patients' clinical outcomes. The aim of this study was to assess nationwide and provincial trends in mortality, hospital and intensive care unit (ICU) lengths of stay (LOS) and hospital readmissions following a TBI between 2006 and 2012. **Methods:** We conducted a retrospective multicentre cohort study based on TBI admissions across Canadian Level 1 and 2 trauma centres. Data were extracted from the National Trauma Registry linked to other comprehensive databases. All adults (≥ 16 years old) with severe injuries were included. We used multilevel generalized linear models to evaluate the trends of clinical outcomes. Trends were adjusted for physiologic variables and cohort effect. **Results:** Among 40 431 patients admitted for TBI, Ontario patients represented 35.19% of the population, Quebec 25.61%, Alberta 18.02%, British Columbia 13.30%, Nova Scotia 3.58%, Manitoba 3.34% and Newfoundland and Labrador 0.95%. New Brunswick and Saskatchewan were excluded as their codification of injury severity was incompatible with the National Trauma Registry framework. A significant decrease in the risk of mortality was observed nationwide (OR 0.95, 95% CI 0.92–0.98), for Alberta (OR 0.95, 95% CI 0.91–1.00) and in Ontario (OR 0.95, 95% CI 0.92–0.98). No statistically significant trend was observed nationally or by province for the hospital readmission outcome. Hospital LOS decreased significantly in Canada (geometric mean ratio [GMR] 0.98, 95% CI 0.97–0.99), in Ontario (GMR 0.98, 95% CI 0.97–0.99) and in Quebec (GMR 0.96, 95% CI 0.95–0.96). Concerning the ICU LOS, we observed a reduction in Quebec (GMR 0.98, 95% CI 0.97–1.00) and a slight increase in British Columbia (GMR 1.05, 95% CI 1.02–1.07). **Conclusion:** This study pointed out better clinical outcomes in TBI patients across Canada and along the years. It gives evidence of the improvement of trauma care and provides a better understanding of the role of trauma systems on the burden of injuries in Canada. Further research is needed to understand the factors that contributed to this improvement.

A health care improvement initiative to evaluate 6 years of P.A.R.T.Y. program delivery: What do participants think about it? *Sonsbire Figueira.* From the Ottawa Hospital, Ottawa, Ont.

Background: Intentional and unintentional injuries are the leading cause of death for Canadians aged 1–44 years. P.A.R.T.Y. is an in-hospital injury prevention program that aims to prevent traumatic injuries by educating participants on how to recognize risk, make informed choices and identify potential consequences about risky activities and behaviours. The purpose of this quality improvement report is to understand students' perceptions about P.A.R.T.Y. to ameliorate and advance its virtues. **Methods:** This study is a descriptive analysis of participant's perceptions. Students were given a questionnaire to rate the quality of the presentation (1 = poor; 2 = fair; 3 = good; 4 = very good; 5 = excellent), express their level of agreement with a statement and provide their impressions and comments. These post-program questionnaires were categorized using Microsoft Excel and statistically analyzed using the PSPP software. **Results:** A total of 2500 questionnaires from participants of 100 different programs (2008–2015) were assessed. The sex distribution of attendees was 59.6% females (average 16.5 years old) and 40.4% males (average 16.7 years old). The great majority of participants (86.2%) selected the "I completely agree" option regarding injury prevention and decision-making. The higher rating (4.7/5) of presentations was given to the injury survivor's presentation. The

emergency physician and the paramedic presentations followed. The lowest ratings (4.1/5) were given to the sexual assault prevention talk and the visit to the intensive care unit. Most coded comments and impressions fell into 2 categories: "acknowledging learning" and "positive-overall." **Conclusion:** The P.A.R.T.Y. program impacts the decision-making of students when faced with hypothetical scenarios where injury prevention can occur. The average rating of all presentations was "very good," with the injury survivor's presentations consistently rating as "excellent."

Implementation of a regional trauma network in a large and complex regional system. *Sharon Ramagnano,¹ Amanda McFarlan,² Dorothy McDowall.³* From the ¹Sunnybrook Health Sciences Centre, ²St. Michael's Hospital and ³The Hospital for Sick Children, Toronto, Ont.

Background: In Ontario 28.5% of severely injured patients transported to nontrauma centres are ultimately transferred to trauma centres. Three lead trauma hospitals in the Greater Toronto Area (GTA) serve 47 referral hospitals. In 2014, Critical Care Services Ontario (CCSO) began piloting regional trauma networks (RTNs) to address system access, efficiency and quality of care. In 2016, the 3 Level 1 trauma centres began the development of their RTN to address standardization of care, communication and repatriation. **Methods:** The goal of engaging a greater number of centres into the trauma system is to improve quality of care and better align patient needs and system resources. This is a descriptive study of the GTA RTN progress to date analyzing the engagement process and RTN deliverables in the context of a complex trauma system with multiple referral centres with differing capacity, resources and system expectations. **Results:** The RTN leads, representing St. Michael's Hospital, Sunnybrook Health Sciences Centre and The Hospital for Sick Children, identified key partners for inclusion in the process, including but not limited to Toronto Emergency Medical Services (EMS), Ornge air transport services, referral hospital administrative and clinical leads and system leaders. Over time the group has expanded as other key partners were invited to the table (e.g., other regional providers of emergency medical services). Leveraging leadership from lead trauma hospitals (LTHs) as "hubs," the LTHs have engaged with these partners as "spokes" in a coordinated approach to system analysis and change. The RTN has met 3 times. Three working groups (Communication, Standards of Care and Repatriation) have been formed and have added additional membership from our referral communities, further expanding the reach of the network. The working groups were tasked with developing strategies to disseminate best practices, expand quality improvement and education initiatives, examine and enhance transportation and referral practices and address regional challenges as they arise. **Conclusion:** The goal of a regional trauma system is to reduce death and disability following trauma. Engagement of a greater number of centres leads to improvements in patient care and better alignment of resources. The GTA RTN has successfully engaged key opinion leaders and stakeholders. The working groups have successfully expanded network reach and have developed shared objectives, and they have begun the work of developing select standardized documentation, streamlining repatriation strategies and initiating region capacity reviews.

Does trauma team activation influence outcomes in geriatric trauma patients? A retrospective cohort study. *Sonsbire Figueira, Alanna Keenan, Jacinthe Lampron, Heather Knight.* From The Ottawa Hospital, Ottawa, Ont.

Background: Elderly trauma patients are an increasingly important public health concern. Although trauma team activation (TTA) has a positive impact on trauma patients' outcomes, it is less frequently called for patients ≥ 65 years old. The objectives of this study are to compare the rate of TTA upon arrival to the emergency department for patients ≥ 65 years old relative to younger counterparts (< 65 years old) and to compare outcomes for patients who had TTA as compared with those who did not. **Methods:** This was a retrospective analysis of prospectively collected data (April 2012–April 2017) from a Level 1 trauma centre database. Patients included were individuals ≥ 18 years old who had a traumatic injury and injury severity score (ISS) > 12 . A comparative analysis between TTA and no TTA (< 65 years and ≥ 65 years) was conducted. Pearson χ^2 and independent t tests were used for sensitivity measures. **Results:** A total of 2909 participants met the inclusion criteria; 1292 were ≥ 65 years old (45%). The rate of TTA was lower for the > 65 years group (13% v. 40%). Both cohorts (TTA and no TTA) had a higher percentage of males; however, this decreased with age (74% for < 65 years; 60% for ≥ 65 years). The rate of TTA was similar for motor vehicle collisions regardless of age; however, falls triggered fewer TTA. Moreover, within the falls group, TTA were called half as often in the older cohort. No TTA: Despite the fact that ISS was similar for both older and younger groups (21.24 v. 19.67), the ≥ 65 years group had longer intensive care unit (ICU) and total length of stay (LOS). Mortality was 4 times higher (17% v. 5%) in the older cohort; however, time to OR within 24 hours was lower than for their counterparts (17.8 v. 21.5 hours). TTA cohort: ISS and LOS at all levels were similar for both groups; however, mortality was 3 times higher for those ≥ 65 years (31% v. 9%). Older than 65 years: When comparing within the ≥ 65 age group, ISS was almost identical; however, those with TTA had longer total LOS. TTA was associated with more patients going to OR within 24 hours. Despite this, mortality was significantly higher (31% v. 17%) in the TTA cohort. **Conclusion:** Trauma patients ≥ 65 years old triggered fewer TTA. Mortality and total LOS were markedly higher in patients ≥ 65 years old. Additional research is needed to identify whether comorbidities and frailty influence these outcomes. Future considerations may support the need to lower the age criterion for TTA.

The value of digital rectal examination in trauma: a systemic review. *Grabam Wilson,¹ Michael Butler,¹ Shannon Ramsay,² Mete Erdogan,³ Robert Green.¹* From ¹Dalhousie University, Halifax, NS; ²McMaster University, Hamilton, Ont.; and ³Trauma Nova Scotia, Halifax, NS.

Background: The digital rectal examination (DRE) is routinely used in trauma situations to identify injuries to the rectum, urethra, pelvis and spinal cord. The clinical utility of this procedure is widely questioned. A systematic review of the available literature was undertaken to examine the value of the DRE as a diagnostic tool in adult trauma injuries and whether it can be removed from routine use in the trauma setting. **Methods:** Three electronic databases (PubMed, EMBASE, Cochrane Library) were searched from

inception until April 2017 for all articles that used the DRE during the trauma survey. All primary studies that performed a DRE on an adult trauma patient (15 years of age or older) were included. Descriptive statistics were used to assess study characteristics and the number of true positives/true negatives/false positives/false negatives, sensitivity, specificity, positive/negative predictive values and likelihood ratios. **Results:** A total of 15 studies met the inclusion criteria, including 2 retrospective case–control studies, 7 retrospective case series, 1 prospective case–control study and 5 case reports. Studies were published between 1987 and 2016. Overall, there were 2646 DREs performed across the included studies. The diagnostic yield of the DRE varied, with a wide range in the reporting of DRE sensitivity (2%–100%), positive predictive value (27%–77%) and negative predictive value (32.7%–99%). The reporting of DRE specificity was more consistent, ranging from 93% to 99%. **Conclusion:** Despite the DRE being a routine part of the trauma assessment, few studies have assessed the diagnostic and clinical utility of this procedure. Evidence from these studies indicates there is considerable variability in the sensitivity of the DRE for the diagnosis of intestinal injuries, rectal wall and mucosal defects, pelvic fractures, urethral disruptions and spinal cord injuries. There is minimal evidence to support the continued use of the DRE as a screening tool in trauma patients.

Effect of an emergency medicine resident as team leader on outcomes of trauma team activations. *Michael Butler,¹ Robert Green,¹ Mete Erdogan,² Beth Sealy.³* From ¹Dalhousie University, ²Trauma Nova Scotia and the ³NS Trauma Program, Halifax, NS.

Background: Traditionally, a surgeon has served as trauma team leader (TTL). However, this role is increasingly being performed by emergency medicine (EM) physicians. At the Halifax Infirmary, we use a resident trauma team leader (rTTL) under the supervision of a staff traumatologist, a duty shared between EM and surgical residents. Our objective was to compare outcomes between cases led by EM and surgical rTTLs. **Methods:** We conducted a retrospective case–control study of data collected from the Nova Scotia Trauma Registry. Eligible cases were attended to by the trauma team from April 2014 to March 2015. The primary outcome was in-hospital mortality. Secondary outcomes included hospital admission, hospital length of stay (LOS), intensive care unit (ICU) admission, ICU LOS, ventilator requirement, operating room (OR) use and time to OR. Univariate comparisons were made using t tests and Fisher's test. We used logistic and linear regression to adjust for confounding. **Results:** A total of 571 patients were included in the analysis; 179 (31.3%) were managed by an EM resident and the remainder were managed by a surgical resident. There was no statistical difference in mortality or any of the secondary outcomes evaluated on the crude or adjusted estimates. There were 18 patients (10.1%) in the EM group who died compared with 37 (9.4%) deaths in the surgical group. **Conclusion:** There was no difference in any patient outcome between cases managed by an EM rTTL and those managed by surgical rTTLs. These findings support the philosophy that both groups are effective as rTTLs and should be trained in trauma leadership. Further research on introducing the rTTL role into other systems is warranted.

Permissive hypotension versus conventional resuscitation strategies in adult trauma patients with hemorrhagic

injury: a systematic review and meta-analysis of randomized controlled trials. *Alexandre Tran,¹ Jeffrey Yates,² Aaron Lau,³ Jacinthe Lampron,² Maher Matar.²* From the ¹University of Ottawa, Ottawa, Ont.; ²The Ottawa Hospital, Ottawa, Ont.; and ³Vancouver General Hospital, Vancouver, BC.

Background: Aggressive fluid resuscitation in trauma may promote deleterious effects as increased hydrostatic pressure may disrupt and dislodge fresh hemostatic clots. In addition, aggressive resuscitation may result in dilutional coagulopathy and hypothermia. Animal studies have suggested that permissive hypotension maintains appropriate cardiac output and organ perfusion, reduces bleeding and improves mortality. The objective of this review was to assess the efficacy and safety of permissive hypotensive resuscitation in adult trauma patients with hemorrhagic shock. **Methods:** We searched the Medline and EMBASE databases from inception to May 2017 for randomized controlled trials evaluating permissive hypotension versus conventional resuscitation in adult blunt or penetrating trauma patients with hemorrhagic injury. The primary outcome was 30-day or in-hospital mortality. Secondary outcomes included blood product utilization, estimated blood loss and in-hospital complications such as sepsis, coagulopathy or acute kidney injury. Pooling of study data for the primary outcome of mortality was performed with a random-effects model. **Results:** We screened 722 abstracts, from which 5 randomized trials evaluating 1158 patients were included in this review. Blood pressure (BP) targets in the intervention arms varied from systolic BP 50–70 mm Hg or mean arterial pressure (MAP) \geq 50 mm Hg as compared with systolic BP 65–100 mm Hg or MAP \geq 65 in the control arms. Two studies evaluated only patients with penetrating injury, while the remaining 3 evaluated mixed blunt and penetrating injury patients. Four of the 5 trials demonstrated a survival benefit for 30-day or in-hospital mortality when using a permissive hypotension resuscitation strategy, although 3 study findings were not statistically significant due to limitations in sample size. The pooled odds ratio was 0.70 (95% CI 0.53–0.92), suggesting a significant survival benefit for permissive hypotension. Patients with permissive hypotension received fewer blood products and had lower estimated blood loss volumes. Similar rates of sepsis, coagulopathy and acute kidney injury were noted between permissive and conventional resuscitation groups. **Conclusion:** Permissive hypotension may offer a survival benefit over conventional resuscitation for trauma patients with hemorrhagic injury. It may additionally reduce blood loss and blood product utilization. There was no evidence of significant reduction in complications such as sepsis, coagulopathy or acute kidney injury.

PROSPERO registration: CRD42017070526 a clinical prediction model for the early identification of the need for major intervention in patients with traumatic hemorrhage. *Alexandre Tran,¹ Maher Matar,² Jacinthe Lampron,² Ewout Steyerberg,³ Monica Taljaard,⁴ Christian Vaillancourt.²* From the ¹University of Ottawa, Ottawa, Ont.; ²The Ottawa Hospital, Ottawa, Ont.; the ³Leiden University Medical Center, Leiden, the Netherlands; and the ⁴Ottawa Hospital Research Institute, Ottawa, Ont.

Background: The mainstay of treatment for traumatic hemorrhage involves the early recognition of patients at risk of shock in

order to provide timely blood products and hemostatic interventions. This project derives and internally validates a simple clinical prediction score, based on predictors available within the first hour of assessment, in order to identify patients at high risk of requiring major interventions for traumatic hemorrhage, defined as a composite outcome of massive transfusion, embolization and surgery for hemostasis. **Methods:** We created a model based on prespecification of predictors. We conducted a systematic review of prediction models and a survey of Canadian traumatologists to identify candidate predictors. Study findings were reviewed by an adjudication committee for predictor selection. The prespecified model was refined using a cohort of adult patients with major torso trauma at The Ottawa Hospital from September 2014 to 2017. We used a stepdown procedure for simplification and bootstrap resampling for internal validation. **Results:** We included 748 patients of whom 110 required a major intervention. The final multivariable model comprised 5 variables: systolic blood pressure, clinical exam suggestive of hemorrhage, lactate, FAST ultrasound and CT imaging. The c-statistic for the model was 0.953 (naive) and was 0.952 following optimism-correction with bootstrap validation. At a cut-off of 3 points or greater, the simplified score demonstrates 98.2% (95% CI 93.6–99.8) sensitivity and 79.2% (95% CI 76.0–82.3) specificity. The median (Q1–Q3) time to first major intervention was 2.0 (1.0 – 4.0) hours. **Conclusion:** This project utilizes prespecification of predictors in order to minimize reliance on small data sets and reduce potential for over-optimism. Prespecification is based on the best existing knowledge available within the literature and clinical expert community. A simple Canadian Bleeding Score is proposed based on 5 variables in order to systematically identify high-risk bleeding trauma patients and demonstrates excellent sensitivity and specificity for predicting the need for major intervention within 24 hours.

A 2-year review of our damage control patients. What drives the postoperative abdominal complications? *John Kubasiak,¹ John Tierney,¹ Devan Schlund,² Charles Fredericks,³ Fredrick Starr,¹ Andrew Dennis,¹ Matt Kaminsky,¹ Kimberly Joseph,¹ Faran Bokhari.¹* From the ¹John H. Stroger, Jr. Hospital of Cook County, the ²Rush University Medical Center and ³Rush University, Chicago, Ill.

Background: Damage control surgery has revolutionized the treatment of traumatically injured patients. As it is still a relatively new approach, limited information exists on risk factors for developing wound complications after delayed closure of damage control laparotomy. This information would better direct perioperative antibiotic prophylaxis in patients with an open abdomen. We hypothesize that concomitant colon injury increases the risk of wound complications in the setting of a delayed closure. **Methods:** We queried our prospectively collected trauma database for injured patients who underwent damage control laparotomy at a large, urban Level 1 trauma centre between May 2015 and May 2017. Patients who expired within 24 hours were excluded. Patients were grouped by organ injured (stomach, small bowel, colon). The primary outcome was overall wound complications; secondary outcomes included intra-abdominal abscess, interventional radiology drain placement and wound dehiscence. All patients received antibiotics according to national protocols. **Results:** A total of 88 patients met the inclusion criteria. There was no increase in wound complications in patients with stomach

or small bowel injuries. Patients with colon injuries had an increased rate of wound complications (33.3% v. 62.2%, $p = 0.0065$), intra-abdominal abscess (25.5% v. 48.6%, $p = 0.0247$) and wound dehiscence (0.0% v. 29.7%, $p < 0.0001$). The most common pathogens isolated in patients with colon injuries were *Escherichia coli*, nitrobacteria, *Enterococcus* and Gram-positive cocci. **Conclusion:** Patients with colon injuries who undergo damage control laparotomy with delayed closure are at increased risk for infectious and other wound complications. Optimal management may include early re-exploration, broad-spectrum antibiotics or iodine-soaked packing. Further investigation into the optimal antibiotic regimen is required.

Leading the way: an algorithm for blood lead toxicity monitoring in patients with retained missiles. *Nori Bradley,¹ Nicole Jedrzejko,² Matt Kaminsky,³ Naisan Garraway.¹* From ¹Trauma Services, Vancouver General Hospital, Vancouver, BC.; the ²University of British Columbia Postgraduate Residency Program in General Surgery, Vancouver, BC; and ³Cook County Trauma Unit, Chicago, Ill.

Background: Over 115 000 Americans and 7600 Canadians are injured by firearms annually. In Ontario, youth (< 24 years old) sustain 1 firearm injury per day. Over 70% of shootings are nonfatal, leaving potentially 85 000 North Americans with retained missiles. Despite reports that 5% of extra-articular retained missiles (EARMs) result in lead toxicity, a paucity of recommendations for blood lead level (BLL) monitoring exist. Our objective was to develop an evidence-based algorithm for BLL monitoring of retained missiles. **Methods:** We performed a scoping literature review to assess for guidelines and relevant data regarding lead toxicity and EARM. Trauma, orthopedic and occupational literature was assessed as well as governing body guidelines. We formally searched Medline/OVID and PubMed and informally queried content experts. Qualitative data synthesis was performed to identify themes (risk factors) related to lead toxicity from retained missiles. Individual studies were reviewed for discrete data regarding risk factors to guide development of an algorithm. **Results:** Of 225 articles identified, abstract screening and removal of duplicates led to 25 articles that met the inclusion criteria. Most were case reports or small case series. No formal body provided specific recommendations regarding timing or frequency of BLL monitoring for retained missiles; most advised “periodic” assessment. Symptoms of lead toxicity did not correlate with BLL, supporting the need for proactive evaluation. Qualitative data analysis led to the following risk factors for lead toxicity: anatomic location, increased bullet surface area, duration of exposure, high metabolic demand states, and risk of migration. Based on individual study level data, an algorithm to guide practitioners for rational BLL monitoring based on risk factors and assessment triggers is provided. **Conclusion:** Current recommendations for retained missiles fail to provide explicit guidelines regarding timing and/or frequency of BLL monitoring and do not include risk stratification or assessment triggers. Our proposed algorithm may be of benefit to trauma surgeons, family physicians, rehabilitation medicine physicians, toxicologists and any allied health practitioners involved in the follow-up care of trauma patients who have sustained gunshot wounds. Further high-quality research in this area is needed.

Extension of the trauma bypass protocol from 30 to 60 minutes time radius: how to implement a system change.

Matt LeBreton,¹ Jacinthe Lampron,¹ Ivanette Hargreaves,² Mathieu Grenier,³ Stuart Theron,³ Richard Dionne.² From the ¹The Ottawa Hospital, Ottawa, Ont.; the ²Regional Paramedic Program of Eastern Ontario, Ottawa, Ont., and the ³County of Renfrew Paramedic Service, Pembroke, Ont.

Background: It is recognized that prompt definitive trauma care is essential in mortality reduction of trauma patients. With the development of trauma systems, field trauma triage guidelines are in place to guide prehospital personnel to direct trauma patients to the most appropriate trauma centre (TC) for care. This is achieved in bypassing nontrauma hospitals. The goal of this study is to explain how to extend the trauma bypass protocol from 30 to 60 minutes time radius. **Methods:** Meetings took place collaboratively between community hospital representatives, prehospital services and communication personnel to extend the Field Trauma Triage Guidelines time radius from 30 to 60 minutes. A memorandum of understanding was signed by community hospitals and TC administration. Data were prospectively collected in regards to the appropriateness and safety of the 60-minute bypass and shared between the prehospital oversight organization and TC for quality improvement purposes and monitoring of individual trauma cases. **Results:** Starting in January 2016, the project was led by the TC. Prior to amending the regional transport agreement, agreement was achieved between non-TC and prehospital, and all signed a memorandum of agreement. This was followed by an information campaign for diffusion of the change. The system change was launched on May 15, 2017. Prospective data collection is ongoing for quality and audit purposes, and these are preliminary results, excluding patients transported by air ambulance. Trauma cases with transport times between 30 and 60 minutes are reviewed by the prehospital oversight organization and the TC collaboratively. A total of 74 patients arrived at the TC under the 60-minute bypass, including 16 between 30 and 60 minutes of travel time. Their mean age and injury severity score were 48.6 years and 15.4, respectively. Their average transfer time from scene to definitive care was 20 minutes overall and 40 minutes for the 30- to 60-minutes group. The most frequent mechanism was motor vehicle collisions (47.2%, $n = 35$). In addition, systematic feedback is provided to the front-line paramedics who executed the trauma bypass to confirm the appropriateness of the transport decision. It is our hypothesis that data will show a decrease in community hospital transfers, while there will be an increase in “direct from scene” trauma cases to the TC. The hope is to decrease overall time from scene to definitive care. **Conclusion:** Regional initiatives can have a large impact on the transfer time of the patient from scene to definitive care. Within an exclusive trauma system, partnerships between prehospital, non-TC and TC personnel are key to successful implementation of change in a trauma system. Efficiency, collaboration and most importantly a patient centred approach should be paramount during modification of regional trauma policy and protocols.

Inter-hospital variation in resource use intensity for elderly injury admissions: a multicentre cohort study. *Imen Farbat,¹ Lynne Moore,¹ Teegwende Valerie Porgo,¹ Julien Clement.²* From ¹Université Laval and the ²Centre hospitalier universitaire de Québec, Québec, Que.

Background: Injuries are third only to cardiovascular diseases and neuropsychiatric conditions in terms of hospital care expenditure. With the population aging and increased mobility of the elderly, geriatric trauma admissions are increasing exponentially. Decision-makers need data to support appropriate resource use for these patients and to improve injury care efficiency. Our objectives were to assess inter-hospital variation in resource use intensity and identify predictors of high resource use for elderly injury admissions. **Methods:** We conducted a multicentre retrospective cohort study of all elderly (≥ 65 years) patients discharged alive from any of the 57 adult trauma centres of a Canadian provincial integrated trauma system (2013–2016, $n = 30\,537$). Activity-based costing was used to estimate resource use. Intraclass correlation coefficients (ICC) were used to examine inter-hospital variation in resource use and multi-level linear models were used to identify resource use predictors. Analyses were conducted separately for patients admitted with traumatic injuries and fragility fractures. **Results:** Median activity-based costs were Can\$5443 for patients with traumatic injuries ($n = 15\,586$) and Can\$6437 for patients with fragility fractures ($n = 14\,951$). The strongest predictors of resource use intensity for fragility fractures were age (geometric mean ratio [GMR] = 1.13 for ≥ 85 v. 65–74; $p < 0.0001$), number of comorbidities (GMR = 1.08; $p < 0.0001$) and the injury severity score (GMR = 1.06; $p < 0.0001$). Strong predictors of resource use intensity for traumatic injuries were age (GMR = 1.12 for ≥ 85 v. 65–74; $p < 0.0001$), number of comorbidities (GMR = 1.08; $p < 0.0001$), injury severity score (GMR = 1.03; $p < 0.0001$), Glasgow Coma Scale score (GMR = 0.93; $p < 0.0001$), shock (systolic blood pressure < 90 ; GMR = 1.36; $p < 0.0001$) and respiratory rate (GMR = 1.29; $p < 0.0001$). Risk-adjusted resource use intensity varied significantly across trauma centres for elderly trauma admissions (ICC = 0.0603 [0.0545–0.0633]). Greater variation was observed for elderly patients with fragility fractures (ICC = 0.0921 [0.0861–0.0948]) than with traumatic injuries (ICC = 0.0453 [0.0399–0.0488]). The activity centre with the highest inter-hospital variation was the operating room for both patients with fragility fractures (ICC = 0.5180 [0.2657–0.6840]) and patients with traumatic injuries (ICC = 0.4480 [0.2909–0.6943]). **Conclusion:** We observed significant variation in resource use intensity across trauma centres that was not explained by patient acuity, suggesting that there is room for improvement in resource use for injury admissions. We also identified drivers of high resource use that could be used to inform interventions targeting improvements in efficiency. The next step will be to assess whether hospitals with higher resource use intensity have better patient outcomes (mortality, complications and unplanned readmissions).

Minimally invasive approach to low-velocity penetrating extraperitoneal rectal trauma. Tyler Chesney, Fred Brennehan, Shady Ashamalla, Katherine McKendy. From the Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: Traditionally, penetrating rectal trauma was managed with diversion, distal rectal irrigation and presacral drainage. Although the quality of available literature is very low, contemporary guidance recommends proximal diversion for inaccessible extraperitoneal rectal injuries, but recommends against presacral drainage and distal rectal irrigation remains

controversial. Transanal minimally invasive surgery (TAMIS) is a newer technology that allows direct access to visualize, irrigate and reapproximate extraperitoneal rectal injuries and may avoid the need for proximal diversion. **Methods:** We describe 2 clinical cases of low-velocity penetrating extraperitoneal rectal trauma. TAMIS was used to visualize the extraperitoneal rectal injury intraluminally. The injuries were classified by the Rectum Injury Scale (RIS). The injuries were irrigated until clean. Cautery was used to control associated hemorrhage. Finally, barbed locking suture was used to reapproximate the defect to repair the injury. Proximal diversion was not used in either case. Video of the TAMIS procedure is presented. **Results:** Case 1 presented from an assault incident, blunt facial trauma, hematuria and rectal bleeding from transanal penetration with a steel rod. The patient was hemodynamically stable, and Focus Assessment with Sonography in Trauma (FAST) was negative. CT revealed perirectal free air, and cystogram revealed extraperitoneal bladder injury. In the operating room an intraperitoneal bladder injury was identified at laparoscopy with no intraperitoneal rectal injury. TAMIS identified a full-thickness anterior extraperitoneal rectal laceration less than 50% of the circumference (RIS II), suggesting that the patient had a penetrating rectal injury that then penetrated the bladder, causing a through-and-through bladder injury with extraperitoneal and intraperitoneal components. The rectal laceration was repaired using TAMIS as described above. The intraperitoneal bladder injury was repaired laparoscopically with a 2-layer running closure using barbed locking suture. The extraperitoneal bladder injury was treated conventionally with long-term catheterization. Case 2 presented with a stab wound to the right gluteal region. The patient was hemodynamically stable, and FAST was negative. CT revealed perirectal free air and no other injuries. The patient was taken to the operating room for TAMIS. An RIS II full-thickness rectal laceration was identified at the right posterolateral rectum 7 cm from the anal verge. On the opposite rectal wall, there was a smaller 1 cm full-thickness laceration. The rectum was irrigated and both lacerations were closed using barbed suture as described above. Both patients were discharged without complication. **Conclusion:** TAMIS for penetrating rectal trauma in selected cases overcomes disadvantages of transabdominal approaches. Without direct access to the injury, transabdominal approaches can only offer proximal diversion. TAMIS allows direct visualization, assessment, irrigation and closure of extraperitoneal rectal injuries, allowing the option for no diversion. The presented cases display low morbidity and mortality with the benefit of stoma avoidance. TAMIS should be tested in a structured trial to determine if these benefits persist on rigorous examination.

Trauma care for teens: To PEDS or not to PEDS? Scott Assen,¹ Sherry MacGillivray,² Natalie Yanchar.¹ From the ¹University of Calgary and ²Alberta Health Services, Calgary, Alta.

Background: Optimal management of major injury in the adolescent population presents challenges, and the current state of knowledge regarding whether this population should be cared for in pediatric or adult trauma centres is limited. This study sought to collect and interpret quality indicators not currently addressed in the literature, including timely access to care, appropriateness of care,

minimizing morbidities and ensuring appropriate long-term follow-up. **Methods:** A retrospective cohort of all adolescents aged 15–17 years admitted to the region's adult trauma centre (ATC) or pediatric trauma centre (PTC) over 4 years (January 2012–December 2015) with a traumatic brain injury (TBI), solid organ injury or femur fracture was analyzed. Outcomes included mortality, injury severity score, length of stay, readmission rates, use of ionizing radiation, use of blood products, rates of surgery, time to OR and follow-up. Univariate analyses (χ^2) were used for comparisons. **Results:** A total of 123 patients from the ATC and 57 patients from the PTC were compared. Injury patterns differed significantly, with TBI and solid organ injuries accounting for more admissions at the ATC and femur fractures accounting for more admissions at the PTC (66% v. 46%, 32% v. 28%, 16% v. 35%, $p = 0.01$). No difference was found between mortality (3.25% v. 1.75%, $p = 0.57$) or readmission/re-presentation rates (6.50% v. 8.77%, $p = 0.58$). Length of stay was longer at the ATC (median 5 v. 2 days, $p = 0.0009$). CT scans per patient differed significantly, with 2.95 per patient at the ATC versus 0.91 per patient at the PTC ($p < 0.0001$). More red blood cells were transfused per patient at the ATC (1.008 v. 0.035, $p = 0.007$) and the rate of surgery/embolization for solid organ injuries or TBI was 7-fold higher at the ATC (17.5% v. 2.4%, $p = 0.004$). Adolescents with TBI were twice as likely to receive neurocognitive follow-up if admitted to the PTC versus the ATC (90% v. 56%, $p = 0.003$). **Conclusions:** Management patterns vary for adolescents depending on whether they receive care in a pediatric or adult centre, with more judicious use of ionizing radiation and surgical intervention of solid organ injuries, and more complete neurocognitive follow-up of TBIs at the PTC. Patterns of care and quality indicators should be critically evaluated when developing regional triage guidelines for this unique patient population, with the aim of achieving optimal short- and long-term outcomes.

The BIG score and poor discharge outcome in children with traumatic brain injury. *Adrienne Davis, Elana Hochstadter, Abhaya Kulkarni, Paul Wales, Suzanne Schub.* From The Hospital for Sick Children, Toronto, Ont.

Background: Prediction of functional outcome after traumatic brain injury (TBI) is challenging yet important to clinicians, researchers, families and survivors. We examined whether the BIG score (base deficit, international normalized ratio [INR], Glasgow Coma Scale score [GCS]) is associated with poor discharge outcome (functional dependence, coma or brain death, defined by the Pediatric Cerebral Performance Category [PCPC] ≥ 4) in children with TBI, after adjusting for age, injury mechanism, number of systems injured, neurosurgical intervention, early intubation, pupils fixed/dilated, temperature, hypoxia, hypotension-for-age and glucose level. **Methods:** This was a single-centre, retrospective cohort study of 2- to 17-year-old blunt trauma patients sustaining a TBI in 2001–2012. Deaths within 12 hours of injury were excluded. Discharge PCPC scores were determined by trained data abstractors blinded to the BIG using physiotherapy and occupational therapy discharge assessments. We collected the BIG score on emergency department (ED) arrival, plus the aforementioned variables known to impact the PCPC ≥ 4 (primary outcome). Secondary outcomes were hospital length of stay and inpatient rehabilitation disposition. **Results:** Of the 375 study patients, 324 (86%) had multiple system injuries and 8 (2%) had nonaccidental trauma. Mean age was 9.7 ± 4.4 years, injury severity score (ISS) 24.7 ± 9.8 ,

BIG score 10.9 ± 7.0 , and the median PCPC at discharge was 3 (range 1–6). A total of 110/375 (29%) study patients had poor outcome (PCPC ≥ 4) and 177/353 survivors (50%) were discharged to inpatient rehabilitation facilities. Of the 110 children with PCPC ≥ 4 , 3(2.7%) were in coma and 20 (18%) died in hospital. Independent multivariable predictors of PCPC ≥ 4 were the BIG score (OR 2.8, 95% CI 1.77–3.92), neurosurgery requirement (OR 2.7, 95% CI 1.40–5.16), pupils fixed/dilated (OR 4.3, 95% CI 1.49–12.66) and early intubation at the scene or referral hospital (OR 2.1, 95% CI 1.02–4.50). Respective proportions of patients with PCPC ≥ 4 were 2/102 (2%) in those with no multivariable predictor, 8/91 (9%) with 1 predictor, 33/91 (36%) with 2 predictors and 67/91 (74%) with ≥ 3 predictors. The area under the BIG ROC curve was 0.88 (0.84–0.92), compared with 0.79 (0.74–0.84) for the ISS, $p = 0.003$. Using an optimal BIG cut-off of ≤ 8 versus > 8 , sensitivity was 95% (90.0–99.1), specificity 60% (54.1–65.9), positive predictive value 51% (44.1–57.9) and negative predictive value 97% (95.1–97.9). The BIG score was also associated with hospital length of stay ($\beta = 5.9$, 95% CI 5.1–6.8, $p < 0.0001$) and disposition to inpatient rehabilitation (OR 3.1, 95% CI 2.05–4.15). **Conclusion:** The BIG score on ED arrival constitutes an independent predictor of poor functional outcome in children with multisystem blunt trauma and TBI, along with fixed and dilated pupils, need for early intubation and neurosurgery. The BIG score also independently predicts disposition to inpatient rehabilitation and hospital length of stay. Children with no multivariable predictors and those with BIG < 8 have a low probability of poor outcome.

Five-year retrospective review of geriatric major trauma patients in Edmonton, Alberta. *Krista Lai,¹ Vanessa Fawcett,¹ Bonnie Tsang,¹ Sandy Widder.²* From the ¹University of Alberta and the ²University of Alberta Hospital, Edmonton, Alta.

Background: The geriatric population has unique considerations for trauma management due to an increased burden of comorbidities and baseline physiologic changes. Studies have shown that advanced age correlates with increased post-trauma mortality and morbidity. Currently, there are no protocols or guidelines for geriatric trauma in Alberta. This study aims to establish characteristics of geriatric trauma and compare process and outcome indicators between 2 subgroups of geriatric patients based on age. **Methods:** This is a retrospective study of geriatric trauma patients in Edmonton, Alberta, from July 2011 to July 2016. Inclusion criteria were injury severity score (ISS) ≥ 12 and age 65 years and older. Patients were identified and data extracted from the Alberta Trauma Registry. Demographic data as well as process and outcome indicators were collected. Subgroup analysis comparing those aged 60–79 years (old) and 80 years or older (very old) was then performed. **Results:** From the database, 1548 patients meeting the criteria were identified with 61% (940) being male and 39% (610) classified as very old (age 80 years or older). Falls accounted for 69% of presenting mechanisms, followed by motor vehicle collisions (17%), pedestrian trauma (4%), recreation-related (3%) and assault (1%). Close to one-third of patients were transferred from the periphery to 1 of the 2 trauma centres in the study. The mean ISS was 22. When divided into old and very old subgroups, the average ISS was 23 and 22, respectively. The trauma team was activated for 3% of all patients and there was no significant difference in under-activation rate between the old and very old groups. Patients spent an average of 7 hours in the emergency department, with the very

old group spending approximately 1 hour more than the old group ($p < 0.05$). The mean length of stay for the whole group was 18 days and 23% were admitted to the intensive care unit (27% of the old compared with 15% of the very old). Although overall mortality was 20%, there was a difference between the old (26%) and the very old (15%). Nearly half of the population were discharged home; however, this number decreased to 29% when considering only the very old group, with the remaining discharged to long-term care and other acute care or rehab facilities. **Conclusion:** This study did not show differences in process indicators between the old and very old geriatric trauma populations, other than a longer emergency department length of stay. However, in-hospital mortality was higher for the very old group and they were far less likely to be discharged home, with resultant implications for patient quality of life and health care resources. These results may guide improvements in triage and management of geriatric trauma in our setting.

Intensity of resource use following traumatic brain injury: a multicentre cohort study. *Coralie Assy, Lynne Moore, Valerie Porgo.* From Université Laval, Québec, Que.

Background: In 2000–2001, the total direct cost for traumatic brain injury (TBI) was estimated at \$152 million. The lack of patient-level data on resource use for TBI patients in universal health care systems has hampered attempts to improve efficiency for TBI care. The objective of this study was to describe inter-provider variations in resource use intensity for TBI patients and to identify patient-level predictors of resource use intensity. **Methods:** We conducted a cohort study based on adults (≥ 16 years) admitted to any of the 57 adult trauma centres in Quebec (2014–2016, $n = 4952$) following TBI. We estimated resource use with activity-based costs and evaluated inter-provider variations with adjusted intraclass correlation coefficients (ICC) and 95% confidence intervals (CI). We identified predictors of resource use intensity using a hierarchical linear model. **Results:** The median activity-based cost per admission was \$5929 (Quartile 1–Quartile 3: \$3255–\$11 422). We observed significant variation in resource use intensity across hospitals that was not explained by patient case mix (ICC 0.058, 95% CI 0.042–0.068). Inter-hospital variation was higher for the operating room (ICC 0.253, 95% CI 0.140–0.365) and paramedical services (ICC 0.149, 95% CI 0.112–0.186), for severe TBI (Glasgow Coma Scale [GCS] 3–8; ICC 0.225, 95% CI 0.144–0.306) and patients aged < 65 years (ICC 0.096, 95% CI 0.081–0.170). Resource use intensity increased with increasing age, number of comorbidities and injury severity ($p < 0.0001$). Adjusted mean resource use was 35% higher for patients in shock on arrival, twice as high for patients in a coma (GCS ≤ 8) and 63% higher for patients with penetrating injuries compared with those involved in a motor vehicle collision ($p < 0.0001$). **Conclusion:** We have highlighted important inter-provider variations in resource use for TBI patients for the operating room and paramedical services. We have also identified high-resource use patient groups that should be targeted to increase efficiency and improve resource allocation for TBI care. Future studies should examine the influence of resource use intensity on clinically important outcomes including mortality and morbidity.

The importance of alcohol screening in geriatric trauma patients. *Barto Nascimento,¹ Edward Passos,² Junaid Bhatti,³*

Rachel Strauss,¹ Selma Alqattan,¹ Barbara Haas,¹ Sandro Rizoli.⁴ From the ¹Sunnybrook Health Sciences Centre, Toronto, Ont.; ²McMaster University, Hamilton, Ont.; the ³Sunnybrook Research Institute, Toronto, Ont.; and ⁴St. Michael's Hospital, Toronto, Ont.

Background: Alcohol use is a well-recognized risk factor for injuries. In addition, alcohol consumption may be associated with mental health issues such as depression in the elderly. However, there is a paucity of data on the significance of alcohol screening in the geriatric trauma population. This study aimed to determine the incidence of positive alcohol screening; its association with mental health issues; in-hospital processes of care and their outcomes in geriatric trauma patients. **Methods:** This was a retrospective review of geriatric (≥ 65 years) trauma patients admitted to a Level 1 trauma centre between January 2005 and December 2015. Positive alcohol screening was defined by blood alcohol concentration (BAC) ≥ 2 mmol/L on trauma centre arrival. Demographics and medications before injury; BAC results; processes of care, such as alcohol intervention; and outcome data were analyzed. χ^2 and Fisher exact test were used to compare categorical data. **Results:** During the study period, 12 439 trauma patients were admitted to the hospital. Out of 12 439, 2119 (17%) were ≥ 65 years. Of these, 1959 had BAC measured and were included in the analysis. One hundred and thirty-nine had positive BAC (median 30 mmol/L, IQR 12–44) on admission. Out of these, 91% lived independently before injury. Seventy percent of positive BAC patients presented to the hospital following falls, and the incidence of falls had a 3-fold increase during the study period. Among positive BAC patients, 31% had a history of alcohol abuse/alcoholism, 23% had a previous diagnosis of depression and 26% were on antidepressant, antipsychotic or tranquilizing medications before injury. The rate of suicide or self-harm was 9% in this cohort. Alcohol intervention was performed in 38% of the cases. Positive BAC patients had higher mortality rates than their negative BAC counterparts (27% v. 20%, $p = 0.05$, respectively). As compared with pre-injury living situation, only 39% of positive BAC patients were discharged home independently (91% v. 39%, $p < 0.01$). **Conclusion:** Alcohol abuse/alcoholism and depression are common among geriatric trauma patients presenting to the hospital with positive blood alcohol screening. This population carries significant mortality rates and unique challenges with respect to underlying psychiatric issues. Gaps in care specifically addressing alcohol and potentially underlying mental health issues were identified. The roles of addition medicine, psychiatric interventions, allied health professionals and injury prevention for alcohol-associated injuries in the geriatric trauma population should be examined.

Management of blunt hollow viscus injury: an urgent but not emergent surgical disease. *Kristina Kramer, Chih-Yuan Fu, James Boron, Matt Kaminsky, Victoria Schlanser, Fredrick Starr, Statbis Poulakidas, Thomas Messer, Emily Koeck, Andrew Dennis, Hadyn Hollister, Francesco Bajani, Kevin Luftman, Faran Bokhari.* From the John H. Stroger, Jr. Hospital of Cook County, Chicago, Ill.

Background: Blunt hollow viscus injury (BHVI) is an uncommon diagnosis, occurring in less than 1% of trauma patients. Early physical exam findings are nonspecific. Cross-sectional

imaging techniques are notoriously inaccurate for identifying BHVI. The optimal timing for intervention in these patients is poorly defined by small studies, as are the consequences of delayed operative intervention. We endeavour to delineate the management of BHVI using a large and broadly applicable population from the National Trauma Data Bank. **Methods:** The National Trauma Data Bank was queried from 2007 to 2015. Blunt trauma patients with gastrointestinal tract injuries who underwent an abdominal operation were included. Patients with missing data and those undergoing laparotomy beyond 120 hours were excluded. Patient demographics, time from admission to laparotomy, complications, length of stay (LOS) and mortality were collected. A multivariate analysis was carried out to identify factors independently associated with increased mortality. **Results:** A total of 38 219 patients were included. The mean age was 36 years and 63.9% were male. The mean time to laparotomy was 10.5 hours. The overall complication rate was 56.1% and the mortality rate 12.7%. Patients who died in the first 2 hours from admission were excluded from further analysis, leaving 24 260 patients. Factors independently associated with mortality were lower systolic blood pressure (SBP) and Glasgow Coma Scale score (GCS) on arrival, higher injury severity score (ISS), more comorbidities and longer time to operation. The average time to operation for survivors was 14.9 hours compared with 19.4 hours for nonsurvivors ($p = 0.027$). Mortality rate increased by 0.2% per hour of delay to operative intervention. Patients who received their operation beyond 20 hours had longer intensive care unit (ICU) LOS (4.9 v. 10.2 days, $p < 0.001$), hospital LOS (13.1 v. 20.4, $p < 0.001$), more ventilator days (2.4 v. 5.9, $p < 0.001$) and a higher complication rate (50.9% v. 65.9%, $p < 0.001$). A total of 13 278 patients suffered complications. Factors independently associated with complications were older age, lower SBP and GCS on arrival, higher ISS, more comorbidities and longer time to operation. The complication rate increased by 1.1% for every hour of delay to operative intervention. Hospital and ICU LOS both increased with increasing time to operation. Other factors associated with increased LOS were age, SBP and GCS on arrival and comorbidities. **Conclusion:** In patients who suffer BHVI, mortality increased by 0.2% for every hour delay to operation, and complications increased by 1.1% per hour. Longer time to operation is associated with longer hospital and ICU LOS. These data suggest that the current practice of close observation is reasonable to identify patients with BHVI. However, it is important to consider the small but significant increase in complications and mortality for each hour that definitive surgical management is delayed.

Alcohol testing in trauma team activation patients in a Canadian tertiary trauma centre. *Robert Green,¹ Mete Erdogan,¹ Nelofar Kureshi,² Saleema Karim,³ John Tallon,⁴ Mark Asbridge.⁵* From ¹Trauma Nova Scotia, Halifax, NS; ²Dalhousie University and QEII Health Sciences Centre, Halifax, NS; the ³University of Arkansas for Medical Sciences, Little Rock, Ark.; ⁴British Columbia Emergency Health Services, Vancouver, BC; and ⁵Dalhousie University, Halifax, NS.

Background: Although alcohol screening is an essential requirement of Level 1 trauma centre accreditation, the actual rates of compliance with mandatory testing for alcohol in trauma patients are seldom reported. The purpose of this study was to determine

the prevalence of blood alcohol concentration (BAC) testing in patients requiring trauma team activation (for whom blood alcohol testing was mandatory) and elucidate patient, injury and system-level factors associated with BAC testing. **Methods:** This was an 11-year retrospective study of all major trauma patients presenting to a tertiary (Level 1) trauma centre in Halifax, Nova Scotia. Trends in BAC testing over time and across patient and injury characteristics were described. Multivariable logistic regression examined patient, injury and system-level factors associated with testing. **Results:** Overall, 61.4% (1415/2306) of major trauma patients presenting to the trauma centre received BAC testing despite the existence of a mandatory testing protocol. Rates of BAC testing rose steadily over the study period, from 33% in 2000 to 85% in 2010. Testing varied considerably across patient, injury and system-level characteristics. Key factors associated with testing were male gender, younger age, Glasgow Coma Scale score < 9 at the scene, direct transportation to hospital, and presentation between midnight and 9 am, or on the weekend. **Conclusion:** At this tertiary trauma centre with a policy of empirical alcohol testing for trauma team activations, BAC testing rates varied significantly over the 11-year study period and distinct factors were associated with alcohol testing in major trauma patients. These findings should inform clinical testing policies to help improve empiric testing and optimize the use of appropriate, evidenced-based interventions for patients with alcohol-related problems.

Factors associated with organ donation by trauma patients in Nova Scotia. *Alexandra Hetherington,¹ Mete Erdogan,² Adam Cameron,¹ Sara Lanteigne,¹ Stephen Beed,³ Robert Green.²* From the ¹Dalhousie University, ²Trauma Nova Scotia and the ³QEII Health Sciences Centre, Halifax, NS.

Background: Trauma patients represent a significant pool of potential organ donors (PODs), and previous research suggests that this population is underutilized for organ donation (OD). Our objective was to assess factors associated with OD in the trauma population. **Methods:** We retrospectively analyzed OD in Nova Scotia over a 7-year period (2009–2016) using data from the Nova Scotia Trauma Registry (NSTR) and Nova Scotia Legacy of Life Donor Registry. All trauma patients who died in hospital were included. Multiple logistic regression was used to assess factors associated with donation. We also evaluated characteristics, donation types and reasons for nondonation among trauma PODs. **Results:** There were 689 trauma-related deaths in all hospitals in Nova Scotia during the study period, of which 39.8% (274/689) met the NSTR definition of a POD. Data on OD was available for 108 of these patients who were referred to the Legacy of Life program, with successful donation in 44.4% (48/108) of cases. Donation was associated with younger age (OR 0.97, 95% CI 0.95–0.99) and lower Glasgow Coma Scale score at the scene (OR 0.76, 95% CI 0.66–0.88). Odds of donation were increased with air transport compared with land ambulance (OR 8.27, 95% CI 2.07–33.08) and injury within Halifax Regional Municipality (HRM) compared with injury outside HRM (OR 4.64, 95% CI 1.42–15.10). Among 60 referred PODs who did not donate, family refusal of consent was the most common reason (28/60; 46.7%). **Conclusion:** Younger age, greater severity of injury and shorter time to tertiary care were associated with OD in trauma patients.

Base deficit does not predict mortality in penetrating trauma patients who receive massive transfusion protocol. *Emily Koeck, Victoria Schlanser, Justin Mis, Chib-Yuan Fu, Kristina Kramer, Kevin Luftman, Hadyn Hollister, Stathis Poulakidas, James Boron, Thomas Messer, Matt Kaminsky, Andrew Dennis, Fredric Starr, Faran Bokhari.* From the John H. Stroger, Jr. Hospital of Cook County, Chicago, Ill.

Background: Trauma resuscitation research has established base deficit as a simple early predictor of survival. This is validated in the pre- and post-damage control resuscitation (DCR) eras. The prognostic value of base deficit and other initial resuscitation parameters has not been evaluated in patients with penetrating trauma who receive massive transfusion protocol (MTP). **Methods:** We performed a retrospective review of prospectively collected data on penetrating trauma patients who presented to an urban Level 1 trauma centre from 2013 to 2016 and received MTP. Data collected included demographics, initial vital signs, injury severity score (ISS), trauma and injury severity score (TRISS), base deficit, pH, and chemistry, hematology and coagulation profiles. The primary outcome was survival. **Results:** A total of 203 patients were included in the study. Univariate analysis revealed many significant differences between survivors and nonsurvivors, including systolic blood pressure (97 v. 62, $p < 0.001$), pulse (97 v. 62, $p = 0.003$), Glasgow Coma Scale score (13 v. 8, $p < 0.001$), respiratory rate (21 v. 15, $p < 0.001$), ISS (17.2 v. 22.5, $p = 0.015$), TRISS (88 v. 53, $p < 0.001$), base deficit (-10 v. -17, $p < 0.001$), pH (7.248 v. 7.031, $p < 0.001$), bicarbonate (17.3 v. 15, $p = 0.004$), hemoglobin (11.3 v. 9.1, $p < 0.001$), hematocrit (34.7 v. 28, $p < 0.001$), platelets (211.3 v. 155.9, $p < 0.001$), partial thromboplastin time (PTT) (31 v. 69, $p = 0.01$) and international normalized ratio (INR) (1.5 v. 2.3, $p < 0.001$). On multivariate analysis, only TRISS was predictive of survival ($p = 0.006$). pH trended toward, but did not reach, significance ($p = 0.055$). Base deficit was not predictive of survival ($p = 0.533$). **Conclusion:** Despite significant differences in assessed variables between survivors and nonsurvivors, only TRISS was predictive of survival in penetrating trauma patients receiving MTP. Base deficit, predictive in the general trauma population, is not predictive of survival in this population. This calls into question whether trauma research performed in the general population, primarily blunt, can be extrapolated to the penetrating population. More research is needed to determine predictive factors for survival in penetrating patients receiving MTP.

Organ donation by trauma and nontrauma patients in a Canadian province: a retrospective analysis. *Sara Lanteigne,¹ Mete Erdogan,² Alexandra Hetherington,¹ Adam Cameron,¹ Stephen Beed,³ Robert Green.²* From ¹Dalhousie University, ²Trauma Nova Scotia and the ³QEII Health Sciences Centre, Halifax, NS.

Background: Trauma victims represent a large pool of potential organ donors (PODs). Our objective was to describe organ donation (OD) by trauma and nontrauma patients in Nova Scotia. **Methods:** This was a retrospective cohort study of all major trauma patients in the Nova Scotia Trauma Registry who were injured between April 1, 2009, and March 31, 2016, and died in-hospital, as well as all PODs captured in the Nova Scotia

Legacy of Life Donor Registry over the same period. We compared patient characteristics, described OD by trauma and nontrauma PODs, calculated conversion rates and evaluated reasons for nondonation in PODs. **Results:** Overall, 940 patients were included in the analysis, of which 689 were trauma patients. Trauma victims accounted for 37% (48/129) of organ donors. Of all trauma-related deaths in provincial hospitals, 40% (274/689) were identified as PODs and 7% (48/689) successfully donated organs. Only 39% (108/274) of these patients were referred to the Legacy of Life program for OD. Conversion rates were 44% (48/108) in trauma patients and 32% (81/251) in nontrauma patients. Donation after circulatory death occurred in 17% of trauma cases and 16% of nontrauma cases. Family refusal (28/60; 47%) and medical unsuitability (18/60; 30%) were the most common reasons for nondonation in trauma patients. **Conclusion:** Although conversion rates were higher in trauma patients, we identified a large number of trauma PODs who were not referred for OD. Further work is required to improve OD within the trauma population.

Inter-hospital variation in surgical care intensity for trauma admissions: a multicentre cohort study. *Marie-Pier Patton,¹ Lynne Moore,¹ Inen Farbat,¹ Julien Clement.²* From ¹Université Laval and the ²Centre hospitalier universitaire de Québec, Québec, Que.

Background: Surgical procedures are frequent among patients admitted for injuries. Guidelines and recommendations are increasingly moving away from surgical management toward less invasive procedures but there is a knowledge gap on how these recommendations are influencing practice. To identify opportunities for improving care quality, we must evaluate unjustified variation in surgical practices. The objectives of this study are to (1) evaluate the inter-hospital variation in the intensity of surgical procedures and (2) identify predictors of surgical intensity. **Methods:** We conducted a multicentre cohort study of adults admitted for major trauma to any of the 57 trauma centres in the province of Quebec from 2006 to 2016 ($n = 31\,779$). Surgical intensity was measured by the number of procedures during the 24, 48 and 72 hours following admission. We used multilevel Poisson models to identify predictors and the covariance parameter to assess inter-hospital variation. **Results:** During the first 24 hours following admission, 27 886 surgical procedures were performed, of which 9746 were orthopedic surgeries, 4282 neurosurgeries and 986 general surgeries. We found that 21.75% of patients with orthopedic injuries, 18.76% of patients with traumatic brain injuries and 9.23% of patients with thoracoabdominal injuries had at least one orthopedic, neurologic and general surgical procedure, respectively. Overall, there is significant inter-hospital variation in the intensity of surgical care (covariance parameter: 0.17 with 95% CI: 0.11–0.30). The surgical specialties with the most important inter-hospital variation were orthopedic surgeries (covariance parameter: 0.27 with 95% CI: 0.15–0.62) and general surgeries (covariance parameter: 0.13 with 95% CI: 0.07–0.40). The intensity of surgical care increased with the severity of injuries (risk ratio [RR] 2.31 for injury severity score 16–24 v. 12–15, 95% CI 1.96–2.74) and decreased with age (RR 0.70 for patients aged 65–75 years v. 16–54 years, 95% CI 0.60–0.82) and the level of trauma centres (RR 0.32 Level 4 v. Level 1,

95% CI 0.17–0.59). Similar results have been observed by surgical specialties. Overall, there is a significant decrease in surgical care intensity across the years. **Conclusion:** We observed significant variation in surgical intensity across trauma centres that was not justified by differences in patient case mix. These results suggest that there may be room for improvement in the quality of in-hospital injury care. Future research aims to assess the correlation between surgical intensity and clinical outcomes.

Repeat CT imaging increases detection of pseudoaneurysms in patients with high-grade solid organ injury following abdominal trauma and improves patient outcomes. *Hidy Girgis, Phil Vourtzoumis, Andrew Beckett, Dan Deckelbaum, Paola Fata, Kosar Khwaja, Tarek Razek, Jeremy Grushka.* From McGill University, Montréal, Que.

Background: Abdominal trauma can be complicated by the development of delayed pseudoaneurysms. Early intervention reduces the risk of rupture, increases organ salvage and potentially decrease mortality. The objective of this study is to examine the utility and timing of repeat CT imaging for the detection of latent pseudoaneurysms in patients with injury to the spleen, liver or kidney after abdominal trauma. This is particularly significant with the recent shift toward nonoperative management of these patients. **Methods:** A total of 170 patients with high-grade (American Association for the Surgery of Trauma [AAST] grade 3 or higher) solid organ injury after abdominal trauma were identified from the trauma registry at the Montreal General Hospital during 2013–2016. A retrospective chart review was completed to examine age, sex, mechanism of injury, injury severity score (ISS), AAST injury grade, timing of initial and repeat CT imaging, initial management, repeat CT imaging and symptomatology. CT scans and radiologist interpretations were also reviewed. **Results:** One hundred and seventy patients had 192 solid organ injuries. Sixty-nine cases were excluded for several reasons: 7 died intraoperatively, 16 did not have repeat imaging, 29 had splenectomies and 2 had nephrectomies that did not require repeat CT imaging, and 15 had incomplete charting. The average age was 39.8 years (16–98), 74% were male, 91.9% had blunt trauma and 8.1% had penetrating trauma. The average ISS was 23.8 in patients without pseudoaneurysms and 19.3 in those who subsequently developed pseudoaneurysms. Organ injuries were 25.2% kidney, 42.3% spleen and 32.5% liver. The management was 57.7% nonoperative, 30.9% had angioembolization and 11.4% went to the operating room. Ninety-eight cases had initial scans at the Montreal General Hospital (MGH), 15 were transfers and 10 had initial exploratory laparotomies; the latter 2 groups did not have initial times or scans, respectively. The average time to repeat CT scans of the MGH group was 98.4 hours; 54% were within 72 hours. The average time for the latter 2 groups was estimated to be 89 hours. We found that 17.1% of patients had pseudoaneurysms detected on repeat CT imaging, 1.6% were negative on arteriogram and 15.4% with true pseudoaneurysms. Of these, 84.2% were detected within 72 hours, 31.6% were symptomatic and 78.9% underwent angioembolization. **Conclusion:** In patients with high-grade solid organ injury following abdominal trauma, repeat CT imaging detected delayed formation of pseudoaneurysms in 15.4% of patients. Most patients were asymptomatic and required angioembolization. Repeat CT imaging within 72 hours identified

84.2% of cases. Overall, these results suggest that repeat imaging within 72 hours could increase detection of and decrease complications of pseudoaneurysms in patients with traumatic high-grade solid organ injury.

Thromboelastometry derivative parameters are associated with 24-hour transfusion and early mortality in severely injured patients. *J. Carolina Gomez-Builes, Sandro Rizoli.* From St. Michael's Hospital, Toronto, Ont.

Background: Thrombin generation (TG) is pivotal for an adequate hemostatic response. Thromboelastometry (TEM), a point-of-care coagulation test, estimates the first derivative of the clot growth velocity curve (V-curve), a surrogate to TG. TEM V-curve describes the maximum speed of clot formation (MaxV), the time to reach MaxV (MaxV-t) and the AUC. We aimed to determine whether TEM V-curve parameters are associated with 24-hour transfusion and early mortality in severely injured patients and to describe characteristics associated with derivative parameters. **Methods:** We conducted a retrospective cohort study of severely injured patients. Demographic data including mortality, conventional coagulation tests, admission TEM and the 24-hour total amount of blood products transfused were collected. A linear regression model examined the effect of the V-curve parameters and 24-hour transfusion, adjusting for confounders. With a logistic regression model, we assessed the effect of MaxV in early mortality, adjusting for age, abbreviated injury severity (AIS) head, injury severity score (ISS) and base excess (BE). **Results:** A total of 550 patients were included with median ISS 19 (IQR 14, 26) and a median age of 43 years (IQR 27, 60). The maximum speed of clot formation (MaxV) was associated with the number of units of blood product transfused in 24 hours of injury; for every unit decrease in MaxV (mm/min) there was an average increase of 0.7 U transfused in 24 hours (95% CI 0.29–1.13, $p < 0.0001$) after adjusting systolic pressure (SBP), temperature, ISS, BE, hemoglobin (HB), INR, fibrinogen, activated partial thromboplastin time (aPTT) and platelet levels at admission, and the other V-curve parameters (MaxV-t, AUC). Other parameters affecting 24-hour blood transfusion were SBP (95% CI 0.42–0.85, $p < 0.0001$), AUC (95% CI 0.02–0.71, $p = 0.037$), BE (95% CI 0.87–2.29, $p < 0.0001$). In a logistic regression model, MaxV was independently associated with 24-hour mortality (OR 1.3 for every 1 mm/min decrease, 95% CI 1.12–1.51, $p = 0.0005$). Also, age (OR 1.19 for every 5-year increase; 95% CI 1.05–1.36; $p = 0.0068$), traumatic brain injury severity (OR 1.74 for every 1 AIS point increase; 95% CI 1.21–2.5; $p = 0.0027$) and BE (OR 0.88 for every 1 mEq/L increase; 95% CI 0.81–0.96; $p = 0.0033$) were associated with 24-hour mortality. **Conclusion:** Our study is among the first to demonstrate an association between the TEM derivative parameters and clinical outcomes in trauma. Reductions in MaxV were associated with increased 24-hour transfusion requirements and early mortality, underscoring the importance of the velocity of clot growth to assess the hemostatic potential after injury and provide adequate and timely hemostatic strategies. Future studies incorporating the derivative parameters in transfusion algorithms are warranted.

Hemorrhage control in penetrating cardiac injury: a new device put to the test in the Advanced Trauma Operative Management (ATOM) course. *Joao Rezende-Neto,¹ Joice Inglez,²*

Jameel Ali,³ *Sandro Rizoli*.⁴ From the ¹University of Toronto and St. Michael's Hospital, Toronto, Ont.; the ²Universidade Federal de Minas Gerais, Belo Horizonte, Brazil; the ³University of Toronto, Toronto, Ont.; and ⁴St. Michael's Hospital, Toronto, Ont.

Background: Massive bleeding is the main cause of death in penetrating cardiac injuries. We recently developed a new device to temporize bleeding from these injuries. To further understand the usefulness of the device we put it to the test by less experienced physicians. **Methods:** General surgery residents (PGY 4) participating in the ACS-Committee of Trauma's Advanced Trauma Operative Management (ATOM) course tested the device. Each participant received a 1-minute explanation on the use of the device and was allowed to handle it for 30 seconds. Subsequently, a standardized injury (1.5 cm) was created in the right ventricle of a swine used during the course. The device was handed to the participant to control the bleeding. A questionnaire was completed after the procedure. **Results:** There were 20 participants. Nineteen of them felt that the device effectively controlled the bleeding and all participants considered the device easy to use. Sixteen of the 20 participants had seen a cardiac injury previously in a patient. Seven of the 20 participants had previously attempted temporary hemorrhage control in a human heart. Only 3 of the 20 participants had ever sutured a human heart and 11 had sutured an animal heart before. Eleven of the 20 participants had concerns about the device; 6 of those participants were concerned about removing the device before suturing the injury and 5 had concerns regarding the construction material used in the prototype. When asked if they would use the device if it were approved by Health Canada, 18 of the 20 participants responded yes; 1 responded that they would use staples and the other 1 would use suture repair instead. **Conclusion:** The new device is easy to use and effectively controls bleeding in penetrating cardiac injuries regardless of the level of experience of the physician. Improvements are warranted in the making of the device to facilitate removal before suture.

Occult injury in geriatric patients with fall from own height: detection with pan-computed tomography (PAN-SCAN) of trauma patients. *Thana Boonsinsukh, Andrew Beckett, Dan Deckelbaum, Paola Fata, Kosar Khwaja, Tarek Razek, Jeremy Grushka.* From McGill University, Montréal, Que.

Background: The routine use of trauma PAN-SCAN is useful in detecting injury in patients with major high-energy blunt trauma. However, it remains unclear whether this screening tool would be beneficial in patients with low-energy mechanisms such as a fall from own height (FFOH). Geriatric patients are at high risk for FFOH and are at risk for increased morbidity from delayed recognition of injuries. Our objective was to determine the utility of routine PAN-SCAN in geriatric patients with FFOH. **Methods:** A 2-year retrospective analysis of patients admitted to an academic Level 1 trauma centre was performed. Inclusion criteria were as follows: age > 65 years, hospital admission for FFOH and PAN-SCAN. Injuries identified on initial trauma survey were compared with those identified with PAN-SCAN. The primary outcome was any injury detected by initial examination compared with PAN-SCAN. The secondary outcome was incidental finding from PAN-SCAN. Occult injury was defined as injuries identified by PAN-SCAN without clinical evidence of injury on the initial examination. **Results:** A total of 130 patients

were identified. The median age was 83 years (IQR 77–88); 50% were male. The median injury severity score was 11 (IQR 9–21). The most common injury identified was rib fractures and the second most common was head injury. Thirty-one (23.8%) patients required an operation or other surgical intervention. Twenty (15.4%) of the patients died. PAN-SCAN found occult traumatic injuries in 17 (13%) of the patients. Seventy-five (57.7%) patients had nontraumatic incidental findings on PAN-SCAN. Six patients (4.6%) were found to have a malignant tumour by PAN-SCAN and required surgery. **Conclusion:** Although most additional injuries detected by PAN-SCAN did not require surgical intervention, the patients did require hospital admission, close monitoring and intensive follow-up. Moreover, PAN-SCAN provided a benefit by diagnosing incidental non-trauma-associated disease that required further treatment. Therefore, routine PAN-SCAN might be useful in geriatric patients with FFOH until better clinical decision rules are available.

Evaluating replacement therapy for hypofibrinogenemia in trauma. *Barto Nascimento,¹ Andrew Beckett,² Homer Tien,¹ Sandro Rizoli,³ Shawn Rhind,⁴ Henry Peng.⁴* From the ¹Sunnybrook Health Sciences Centre, Toronto, Ont.; ²McGill University, Montréal, Que.; ³St. Michael's Hospital, Toronto, Ont.; and ⁴Defence Research and Development Canada – Toronto Research Centre, Toronto, Ont.

Background: Early hypofibrinogenemia has been associated with increased transfusion needs and mortality in trauma. Accordingly, there has been growing interest in early fibrinogen replacement therapies. However, the efficacy of early administration of exogenous fibrinogen remains poorly understood. Taking advantage of our recently completed randomized trial on fibrinogen concentrate (the FiiRST trial), we used functional fibrinogen assays on thromboelastography (TEG) and rotational thromboelastometry (ROTEM) to evaluate the response to replacement therapy and its correlation with Clauss fibrinogen levels in trauma. **Methods:** This was a post-hoc analysis of the FiiRST trial. The trial enrolled hypotensive trauma patients in need of blood transfusion. Placebo or fibrinogen concentrate was administered within 1 hour of arrival. Response to therapy was evaluated after 1 hour by TEG maximum amplitude (MA), ROTEM maximum clot firmness (MCF) and Clauss fibrinogen. Correction of hypofibrinogenemia between groups was compared using the Fisher exact test; *t* tests and linear regression were used for coagulation variables. ROC curve analysis was used for prediction of hypofibrinogenemia. **Results:** Forty-five patients were randomized and included in this analysis. Overall, 32% were coagulopathic by INR \geq 1.2 on presentation. Admission hypofibrinogenemia (plasma fibrinogen level < 2 g/L) occurred in 56% of all patients. In the placebo group, 80% developed hypofibrinogenemia by 2 hours of hospital admission as opposed to 17% following replacement at 2 hours of admission ($p < 0.01$). Clauss fibrinogen level was higher in the replacement group (2.9 g/L \pm 0.7 v. 1.6 g/L \pm 0.5; $p < 0.01$) 1 hour following fibrinogen concentration infusion. MA and MCF significantly improved after fibrinogen concentration administration from baseline and when compared with placebo at 2 hours of hospital arrival (1 hour following replacement). MCF had the best ROC (0.96 [0.9–1.0]) for the prediction of critical fibrinogen level (< 1 g/L) and the highest correlation with Clauss fibrinogen assay ($\rho = 0.87$; $p < 0.01$). MA and MCF had better predictive value for

both massive and plasma transfusions compared with Clauss fibrinogen. **Conclusion:** If untreated, 80% of hypotensive trauma patients, requiring any blood transfusion, will develop hypofibrinogenemia by 2 hours of hospital arrival. Our findings demonstrate that administration of exogenous fibrinogen improved clot strength when evaluated by functional fibrinogen assays on TEG and ROTEM. These tests can be regarded as useful tools when evaluating and guiding fibrinogen replacement in trauma. The effect of fibrinogen replacement therapy on clinical outcomes should be examined.

Improving task performance in pediatric trauma resuscitation. *Genevieve Ernst,¹ Tania Principi.²* From the ¹BC Children's Hospital and the University of British Columbia, Vancouver, BC; and ²The Hospital For Sick Children, Toronto, Ont.

Background: At the Hospital for Sick Children (HSC), pediatric-specific Advanced Trauma Life Support (ATLS) tasks are commonly omitted or delayed. Standardizing our approach to trauma patients could improve the timing of critical tasks and provide a shared conceptual framework for the trauma team. Checklists as cognitive aids in trauma have been shown to improve task performance without increasing cognitive load. This quality improvement project aimed to develop a checklist-based trauma tool to aid in task completion during emergency department resuscitations. **Methods:** Current state analysis at HSC included retrospective chart audits to describe baseline ped-ATLS task performance during trauma team activations (TTAs), stakeholder interviews and tabletop as well as in situ process mapping from June 2016 to May 2017. The resuscitation tool was developed using the Model for Improvement. Iterative changes to a tool prototype were made based on direct observations and team feedback during trauma resuscitation in both simulated and clinical environments at our Level 1 pediatric trauma centre. **Results:** Prior to tool implementation, the median length of stay (LOS) in the trauma bay for TTAs was 54 minutes and ranged from 36 to 93 minutes ($n = 16$). On average, it took 13 minutes to record a patient temperature after arrival, ranging from 3 to 25 minutes ($n = 7$). Tetanus immunization status was not verified in 56% of patients ($n = 27$), 75% of girls over 8 years old did not have a pregnancy test before CT imaging ($n = 8$), 81% of patients over 12 years of age did not undergo toxicology screening ($n = 16$) and 29% of children with open fractures did not receive antibiotic prophylaxis in the trauma bay ($n = 16$). Three distinct parts of trauma team resuscitation that would benefit from a unified cognitive aid were identified: pre-arrival preparedness, critical resuscitation steps during the primary and secondary surveys, and preparation for transfer to definitive care. LOS in the trauma bay was monitored using a run chart and use of the Pediatric Trauma Resuscitation Tool by the trauma team leader did not prolong LOS in the trauma bay during the development process. **Conclusion:** We developed a Pediatric Trauma Resuscitation Tool with an emphasis on key evaluation and management tasks frequently missed in our setting, rather than basic ATLS survey steps. Involvement of end users in tool development will hopefully promote sustainability. The tool is currently being implemented at HSC, and we aim for the tool to be used in 90% of TTAs by July 1, 2018.

Do not delay! TBI patients need early VTE prophylaxis. *Lu Yin.* From the University of British Columbia, Vancouver, BC.

Background: The rate of venous thromboembolism (VTE) in traumatic brain injury (TBI) patients is as high as 20%–30%. Delaying VTE prophylaxis has been shown to double or triple the risk of VTE. The purposes of this study are to review the rate of VTE in polytrauma patients with or without TBI at Vancouver General Hospital, evaluate if the delay in VTE prophylaxis impacts this rate and define a high-risk population in whom an early VTE prophylaxis protocol can be implemented. **Methods:** A retrospective study of polytrauma patients with and without TBI from January 2012 to March 2016 was conducted to compare the rates of deep venous thrombosis (DVT) and pulmonary embolism (PE). Data were collected from the Vancouver General Hospital (VGH) Trauma Registry and patients' charts were reviewed to determine the time for thromboprophylaxis start, the severity of the TBI and the extend of PE. **Results:** A total of 1716 patients with TBI and 4536 patients without TBI were included over the 4-year period. In TBI patients, the rate of DVT was 2.1% (36 patients) and PE was 1.8% (31 patients) compared with non-TBI patients in whom the rate of DVT was 0.8% (45 patients) and PE was 1.4% (63 patients). We defined delay in VTE prophylaxis as started more than 72 hours after admission. Overall, half the patients in the TBI group had delayed VTE prophylaxis, as opposed to 18.5% in the non-TBI group. In the TBI group, 80.6% of patients with DVT and 45.2% of patients with PE had delay in VTE prophylaxis. In the non-TBI group, 11.1% of patients with DVT and 7.9% of patients with PE had delay in VTE prophylaxis. The TBI group was further stratified into low risk and high risk, based on the modified Berne–Norwood criteria. In the high-risk TBI group, 48 patients had VTE, and the majority (75%) had delayed VTE prophylaxis. In the low-risk TBI group, 6 patients had VTE and half of them (50%) had delayed VTE prophylaxis. **Conclusion:** TBI patients have a higher incidence of VTE. Furthermore, a delay in VTE prophylaxis is associated with an increased risk for VTE. These results reflect the absence of standard of care for VTE prophylaxis in TBI patients and stress the necessity to implement an early VTE prophylaxis protocol in these patients. More objective measures of hypercoagulability in TBI patients, such as thromboelastometry, could be evaluated in the future to help risk-stratify these patients.

Mentored versus nonmentored military medics compared in the application of the iTClamp to a simulated wound without prior training: a potential option for just-in-time hemorrhage control. *Jessica McKee,¹ Andrew Kirkpatrick,² Ian McKee,³ Paul McBeth,² Chad Ball.²* From ¹Innovative Trauma Care, Edmonton, Alta.; the ²Foothills Medical Centre and the University of Calgary, Calgary, Alta; and the ³Edmonton Fire Department, Edmonton, Alta.

Background: Strategies to stop external bleeding consist of manual pressure, pressure dressings, gauze packing with or without hemostatic ingredients, or the use of tourniquets. The iTClamp is a relatively new wound-clamp (WC) alternative to stop external bleeding. It can be placed in different anatomic regions: scalp, neck, upper and lower limbs, axillary and inguinal regions. We examined the ability of military medics without any prior WC exposure to apply the WC with and without telementored oversight. **Methods:** Military medics were randomly assigned to mentoring or nonmentored. Mentoring was from an experienced subject-matter expert using a head-mounted camera and 2-way

voice communication. All medics completed a bleeding-control scenario designed for the iTClamp, on a bleeding simulator with objective blood loss metrics. As no medic had prior WC exposure, nonmentored medics were given a 30-second safety briefing, while mentored medics had none. Objective outcomes were time to task completion and success in arresting bleeding. **Results:** A total of 33 medics participated (16 mentored, 17 non-mentored) in the study. Medics were tasked to apply an iTClamp to a simulated bleed. The simulator used extrudes pulsatile red water from a simulated wound on an arm. When clamped off properly, no more external bleeding (red water) is visible. When not clamped off properly (no fluid-tight seal), external bleeding (red water) will still be flowing from the wound. All of the medics (100%) in each allocated arm were able to successfully apply the iTClamp to the simulated wound so that no more bleeding (red water) was present. There were no iatrogenic injuries and all clamps were safely applied. There was, however, a significant difference in application time ($p < 0.001$) between the mentored (40.4 ± 12.0 seconds) and nonmentored (15.2 ± 10.3 seconds) medics. However, discounting the 30-second safety briefing the nonmentored medics received to each of their application times obviated any significant difference ($p = 0.231$) between the times of the mentored and nonmentored medics. On a post-task questionnaire, medics were asked how difficult they found the iTClamp application. Medics rated the difficulty of the wound clamping as 1.7/10 (with 10 being extremely hard). **Conclusion:** The WC appeared to be an easily acquired technique that was effective in controlling simulated extremity exsanguination. In this scenario, telementoring, while very feasible, did not obviously improve the ability of medics to quickly learn and perform the required intervention. There are several limitations to the study and future research should focus on comparing live mentoring to an instruction card instead of a 30-second briefing, and evaluating end user preferences and stress levels.

Introduction of ROTEM is associated with unchanged blood product and increased fibrinogen usage — a single-institution review. *Philip Dawe,¹ Naisan Garraway,¹ Angie Brisson,² Emilie Joos.³* From ¹Trauma Services, Vancouver General Hospital, ²Vancouver Coastal Health and the ³University of British Columbia, Vancouver, BC.

Background: Rotational thromboelastometry (ROTEM) is a blood test that measures in vitro clot strength as a surrogate for a patient's ability to form clot in vivo. ROTEM use has been shown to decrease blood product usage but has not had any effect on mortality. Our ROTEM device was introduced in November 2016 and is centralized in the hematology laboratory with online "real-time" results available to clinicians, allowing for time-sensitive decisions about blood product therapy in resuscitation for trauma. **Methods:** A single-centre retrospective analysis of blood product usage in the emergency department (ED) was done comparing blood usage in Trauma Exsanguination Protocol (TEP) patients in the 12 months before introduction of ROTEM (pre-ROTEM group) to the 12 months following introduction of ROTEM (ROTEM-era group). A

similar comparison was made between the pre-ROTEM group and in those patients where ROTEM was actually used (ROTEM-used group). **Results:** In the pre-ROTEM group, there were 23 TEPs initiated. In the ROTEM era, there were 41 TEPs, in which 31 used ROTEM (76% compliance). Average blood product usage was as follows: (pre-ROTEM/ROTEM era/ROTEM used) 7.7/7.9/9.0 units packed red blood cells (PRBCs) ($p = 0.98; 0.65$), 5.1/4.4/5.3 units fresh frozen plasma (FFP) ($p = 0.71; 0.93$), 1.6/1.3/1.6 doses of platelets ($p = 0.67; 0.91$), 0.4/0.2/0.2 doses of Cryo ($p = 0.25; 0.31$) and 0.2/0.8/0.9 doses of fibrinogen ($p < 0.01; < 0.002$). **Conclusion:** In this relatively small sample size, the introduction of ROTEM at our institution was associated with unchanged PRBCs, FFP, platelet and cryoprecipitate usage and increased fibrinogen usage whether ROTEM was actually used or not. The compliance rate with use of ROTEM during TEPs was 76% in the first year after its introduction. Cases where ROTEM was used had a trend toward more blood product and more fibrinogen usage.

Integration of a regional trauma system: a need for front-line performance metrics. *Lori Milton,¹ Morad Hameed.²* From ¹Interior Health, Kelowna, BC; and ²Trauma Services, Vancouver General Hospital, Vancouver, BC.

Background: A trauma system functions within a geographical region with clear boundaries and designated care centres within those boundaries that have an accredited skill level with appropriate resources across disciplines. Even in established regional systems of trauma care, performance metrics of variability in practice between referring and referral hospitals, access to support and referral, and extent of integration are infrequently or incompletely measured. **Methods:** This study is a literature review and environmental scan of established performance measures reflecting integration in terms of standardization of practice and access to referral regional trauma systems. A heuristic approach is used to identify potential integration performance measures in front-line settings. **Results:** There are few validated metrics specifically dedicated to front-line experiences of providers in referring hospitals within integrated regional trauma systems. A heuristic approach to identifying potential measures reveals several themes. Assessment of adherence to regional guidelines, access to teleconsultation, timeliness of initiation of referral, timeliness to transfer for time-dependent injuries, provider awareness of regional protocols, clarity of regional protocols, provider satisfaction, closed-loop communication between referring and referral centres, and access to data are all potential opportunities for the development of metrics of regional integration. **Conclusion:** Even in established regional trauma systems, there is a potential disconnect between policy and clinical implementation of clinical protocols, especially as they pertain to acute trauma care and urgent transfer of critically injured patients to definitive care. Measures of knowledge and successful implementation of clinical practice guidelines and transfer protocols may be useful in ensuring that policy translates to seamless coordination of trauma care at the front-lines at all levels.