

Canadian Journal
of **Surgery**

Journal canadien
de **chirurgie**

Vol. 60 (3 Suppl 2) June/juin 2017
DOI: 10.1503/cjs.005617

Trauma 2017

**Trauma Association of Canada
Annual Scientific Meeting**

**Fairmont Vancouver Hotel
Vancouver, British Columbia**

Feb. 23–24, 2017

Abstracts

Process mapping as a framework for performance improvement in emergency general surgery. *Kristin DeGirolamo¹, Karan D'souza², Jacques Zhang², Barb Drake², Markus Zurberg², Morad Hameed², Emilie Joos¹.* From the ¹University of British Columbia, Vancouver, BC; and ²Trauma Services, Vancouver General Hospital, Vancouver, BC.

Background: Emergency general surgery conditions are often thought of as being too acute and unpredictable for the development of standardized approaches to quality improvement (QI). However, process mapping, a concept that has been applied extensively in manufacturing, has been used to understand opportunities for improvement in complex health care processes. This study uses process mapping to deconstruct the surgical care of patients presenting to emergency general surgery (EGS) services with acute small bowel obstruction (SBO). **Methods:** The American College of Surgeons Emergency General Surgery Quality Improvement Program (EQIP) pilot database was used to identify patients presenting to a single, large teaching hospital over a 1-year period (Mar. 1, 2015, to Mar. 1, 2016) for the nonoperative or operative management of SBO. The EQIP database and chart and electronic health records were used to create process maps for each patient. These maps were evaluated to identify important process issues and areas for improvement. **Results:** Eighty-seven patients with SBO (34 operative, 53 nonoperative) were identified. Three were excluded for not being admitting to general surgery. Operative SBO had a complication rate of 32%. The processes of care from the time of presentation to the time of follow-up were highly elaborate and variable in terms of duration; however, the sequences of care were found to be consistent. Data visualization strategies were used to identify bottlenecks in care and demonstrated substantial variability in terms of operating room access. **Conclusion:** Complication rates in the operative care of SBO are high and represent an important QI opportunity in general surgery. Process mapping can identify common themes, even in acute care, and suggest specific performance improvement measures. At our centre, we are directing plan-do-study-act (PDSA) cycles and developing standardized orders and approaches based on process map inputs.

Remote transatlantic mentored telemedical support during trauma resuscitation and prolonged field care. *Andrew Kirkpatrick¹, Itamar Netzer¹, Paul McBeth¹, David Hoppenstein¹, Jessica Mckee², Vivian McAlister³.* From the ¹Departments of Surgery and Critical Care Medicine, Foothills Medical Centre and University of Calgary, Calgary, Alta.; ²Innovative Trauma Care, Calgary, Alta.; and the ³Department of Surgery, Western University, London, Ont.

Background: Informatic technologies (IT) are increasingly being deployed with first responders in austere and extreme environments, potentially facilitating remotely telementored (RTM) medical care. As both the utility and potential scope of such RTM care is unknown, we conducted an evaluation of concept during a simulated medical catastrophe requiring resuscitation and prolonged field care (PFC) between Canada and a naval facility in Israel. **Methods:** Two surgeons in Calgary, Alta., provided virtual RTM guidance to a military emergency medical technician (EMT) onboard a naval vessel in Haifa, Israel, to

oversee and mentor a simulator catastrophic injury. The surgeons were connected via off-the-shelf GoToMeeting software to the resuscitation bay of the Israeli facility, which permitted multiple separate video feeds and audiovisual participants. An advanced-skills EMT wore a heads-up video cam and had 2-way communication with the remote mentors. **Results:** The remote mentors were able to easily view the resuscitation and to guide the EMT to sequentially conduct a step-by-step resuscitation according to the Advanced Trauma Life Support Guidelines. The head-mounted webcam was much easier to use than stationary cameras to document the actual technical procedures performed. The remote mentors were successfully able to observe. Further, during the PFC stage the remote mentors successfully deduced the cause of an acute respiratory failure remotely. Nonetheless, the EMT felt constrained in time and scope by the RTM examination. **Conclusion:** The investigators concluded that a head-mounted webcam was more desirable than a stationary camera. It is likely that telementoring will be enhanced by tele-ultrasound. A shared checklist would be desirable at the beginning of an RTM procedure, in which common jargon should be determined ahead of time. Finally, a set of rules should be drafted for when and how to seek telementoring in the field, involving being situationally aware.

Resilient despite experiences of childhood trauma. *Monica Hinton.* From the Department of National Defence, Ottawa, Ont.

Background: In Canada, the number of those who have experienced childhood sexual abuse is substantial. Research suggests that exposure to this type of childhood trauma is associated with a range of adverse consequences. Studies also report how a range of factors influence determinants of resilience despite childhood sexual abuse. The purpose of my qualitative grounded theory research was to uncover what participants believed fostered their resilience despite trauma. **Methods:** Participants were recruited through a university-wide distribution email, through word of mouth, via flyers posted at grocery stores and during my presentations at trauma conferences where I discussed my research. Ten self-identified resilient volunteers were interviewed (semistructured in-depth tape-recorded interviews), and the data were analyzed using grounded theory, which included open, axial and selective coding. **Results:** The chosen central phenomenon was the perception that participants' experiences of childhood sexual abuse were traumatic, and 3 categories of strategies used to address this phenomenon were identified. These categories included regulating the traumatic experience, enlisting important individuals/pets and spirituality. Comparisons between participants showed that many of the same strategies were used to remain resilient, including humour, self-preservation, imagination, choice and "unhealthy" strategies (e.g., addiction, self-harm, risky behaviours). The results indicate that there are degrees of resiliency. Resiliency is a process, and each participant moved beyond periods of using unhealthy strategies in regulating their experiences. **Conclusion:** If clinicians consider that their patients' behaviour may be a detour along their journey toward resiliency, they may assess, diagnose and treat differently those who have experienced childhood trauma. A clinical focus on strengths is a unique and important way of working with our patients.

Predictors of change in functional outcome at 6 months and 12 months after severe injury: a retrospective cohort study. *Ting Hway Wong¹, Nivedita Nadkarni², Ming Terk Chiu³, Yi Chiong¹.* From the ¹Singapore General Hospital, Singapore; ²Duke-National University of Singapore, Singapore; ³Tan Tock Seng Hospital, Singapore.

Background: There is increasing focus on quality of life and long-term survival for trauma patients. Although there are several quality of life scores in use in trauma patients, there are few studies tracking the longitudinal improvement or worsening of functional outcome over time. The goal of our study was to compare the Glasgow Outcome Scale–Extended (GOSE) at 6 months and 12 months in blunt trauma survivors with an injury severity score (ISS) of more than 15. **Methods:** Using the Singapore National Trauma Registry 2011–2013, patients with 6-month GOSE and 12-month GOSE scores were analyzed. They were grouped into patients with the same score at 6 months and 12 months, an improvement in score, and a worse score at 12 months. Ordinal regression was used to identify risk factors for improved score. Patients with missing scores at either 6 months or 12 months were excluded. **Results:** A total of 478 patients were identified: 174 patients had a better GOSE score at 12 months than at 6 months, 233 patients stayed the same, and 71 patients had a worse GOSE score at 12 months than at 6 months. On univariate ordinal regression, the following variables were associated with same or better function at 12 months than at 6 months: male sex, being employed pre-injury, thoracic Abbreviated Injury Scale (AIS) score of 3 or more, anatomic polytrauma (AIS of 3 or more in 2 or more body regions), road traffic injury mechanism, and receiving transfusions of blood components other than packed cells or whole blood (other blood transfusions). Older age, low fall, Charlson comorbidity score of 2 or more, new ISS, head and neck AIS of 3 or more, and undergoing a neurosurgical procedure were predictors of worse function at 12 months compared with 6 months. ISS, revised trauma score, red cell transfusions and other surgical procedures were not significant predictors on univariate or multivariate analysis. When stepwise multivariable ordinal regression was performed, age (OR 0.99, 95% CI 0.98–0.99, $p = 0.01$), Charlson score of 2 or more (OR 0.50, 95% CI 0.28–0.90, $p = 0.02$) and undergoing a neurosurgical operation (0.54, 95% CI 0.35–0.83, $p < 0.01$) were predictors of worsening function, whereas male sex (OR 1.40, 95% CI 0.94–2.09, $p = 0.10$) and other blood transfusion (OR 2.55, 95% CI 0.72–9.05, $p = 0.15$) predicted improved function at 12 months. **Conclusion:** Patients suffering a head injury severe enough to require neurosurgery were more likely to experience a deterioration in outcome at 12 months. The decline in function for older patients and those with significant comorbidities was likely due to chronic disease. Male patients and patients who received other blood products were more likely to experience functional improvement over time, likely representing patients with high-velocity polytrauma requiring longer recovery time but with good rehabilitation potential.

The physiology component of the trauma triage tool has the highest positive predictive value. *M. Azam Majeed.* From the University Hospital, Birmingham, UK.

Background: Injuries are a major cause of morbidity and mortality in both developing and industrialized regions. Injury severity

scores (ISS) are simply a way to describe and quantify the severity of traumatic injury and provide some sense of the probability of survival of the victims. The ISS is a widely accepted method of measuring the severity of traumatic injury. **Methods:** A retrospective database analysis of major trauma patients presenting to Queen Elizabeth Hospital Birmingham (QEHB) during the period January 2013 to January 2014 was performed. All major trauma patients (trauma triage tool [TTT]-positive) presenting to QEHB during this period were included. The patients who were TTT-negative were excluded. Data were coded and entered in an Excel file, and statistical analysis was done using the Statistical Package for Social Science (SPSS) version 16.0. **Results:** In total, 694 trauma patients presented during the study period. Only 597 patients met the inclusion criteria and were included in the study. The majority of our sample was male (70.7%), with a mean age of 53 years. About one-third of these patients had been involved in motor vehicle collisions. Approximately 60% of the study group had been alerted in as major trauma cases. Of the 597 trauma patients, 316 patients were identified as major trauma cases (true positive cases) and had an estimated ISS higher than 15 (positive predictive value [PPV] 0.529, 95% CI 0.49–0.57, $p < 0.001$). The TTT consists of 4 components: vital signs, anatomy, mechanism of injury and special conditions. The vital signs component had the highest PPV at 0.79 (95% CI 0.73–0.85), followed by mechanism of injury (PPV 0.618, 95% CI 0.55–0.69), anatomy (PPV 0.523, 95% CI 0.46–0.69) and special conditions (PPV 0.448, 95% CI 0.39–0.51). **Conclusion:** Within the pre-hospital management of seriously injured trauma patients the accuracy of the field triage is of utmost importance. Clinicians depend on the prehospital information to activate the resources. Hence the greater the PPV of the TTT, the better the trauma team remix can be planned. Our results suggest the correlation of abnormal physiologic parameters with high probability of an ISS above 15.

Prolonged on-scene times have a negative impact on major trauma patients' outcomes. *M. Azam Majeed¹, Decaro Vittorio², Indervir Bharij².* From the ¹University Hospital Birmingham, UK; and the ²National Health Service, UK.

Background: Despite compelling evidence for better outcomes with a shorter prehospital time in trauma patients, there continues to be debate surrounding different approaches used on the scene. This study aims to assess the impact of on-scene time on morbidity and mortality for major trauma patients. **Methods:** A retrospective analysis for patients presenting to a major trauma centre in the UK in 2014–2015 was performed. A complete set of prehospital times was defined as call-time, time-on-scene, time-left-scene and time-at-destination. Remaining prehospital time was defined as the sum of call-time to time-on-scene and time-left-scene to time-at-destination. Demographic characteristics, injury severity score (ISS), length of stay (LOS), mortality and rapid sequence induction (RSI) were analyzed. **Results:** In total, 363 of 494 patients (median age 52 [range 13–101] years, 275 male, 88 female) had a complete set of prehospital times. Median on-scene time was 39 minutes (range 6 minutes to 2 hours 13 minutes), and median remaining prehospital time was 28 minutes (range 2 minutes to 2 hours 14 minutes). Median ISS was 16 (range 1–75), and median LOS was 14 days (range 2–128 days). Forty-two patients died, 53 underwent RSI and

14 received advanced life support. For every hour spent on the scene there was a 70% increase in LOS (95% CI 31%–123%) after correcting for age, ISS and remaining prehospital time ($p < 0.001$). The OR for mortality was 3.19 (95% CI 1.17–8.68) with every hour spent on the scene after correcting for age, ISS and remaining prehospital time ($p = 0.023$). **Conclusion:** A longer on-scene time negatively affects morbidity and mortality for polytrauma patients. We advocate the “scoop and run” approach.

A national survey of thromboprophylaxis strategies in high-risk trauma patients. *R. Mason Curtis, Kelly Vogt, William Leeper, Amol Mujoomdar, Stewart Kribs, Neil Parry, Ian Ball.* From the London Health Sciences Centre and Western University, London, Ont.

Background: The risk of venous thromboembolism (VTE) is high in trauma patients, and VTE prophylaxis with chemical anticoagulation has become the standard of care. Select patients are at high risk for VTE and are unable to receive chemical anticoagulation owing to their injuries. These patients have been defined by the Eastern Association for the Surgery of Trauma, who advocate the use of retrievable inferior vena cava filters (rIVCF). Contemporary use of these devices among Canadian trauma centres is unknown. **Methods:** An online survey questionnaire was distributed to 16 Canadian tertiary care trauma centre directors. This survey was hosted on the REDCap platform and analyzed with REDCap software. **Results:** The survey response rate was 88%. Fifty percent of our surveyed centres see more than 650 severe (injury severity score > 12) trauma patients annually. All responders prefer low molecular-weight heparin for VTE prophylaxis over other modalities. When chemical anticoagulation was contraindicated, a pneumatic compression device was the first-line therapy in 79% of centres, and rIVCF was the first-line therapy in 21% of centres. Sixty-five percent of responders agreed that the risk of rIVCF outweighs its benefit; however, 86% supported the need for future research in the Canadian trauma population, and 64% agreed that sufficient clinical equipoise exists to support randomization for a prospective clinical trial. **Conclusion:** The goal of our survey was to better understand current Canadian practices regarding VTE prophylaxis in this challenging patient population. This investigation of Canadian trauma directors has identified notable practice variation regarding rIVCF use for primary prophylaxis and underscores the need for further investigation of their use in trauma patients.

The rise and fall of bicycle helmet compliance in Montreal from 2011 to 2016. *Jules Eustache¹, David Bracco¹, Tara Grenier².* From ¹McGill University, Montreal, Que.; and ²McGill University Health Centre, Montreal, Que.

Background: A helmet is a valuable protection device for cyclists. Despite numerous advertising campaigns, bicycle helmet wearing compliance remains low in Montreal. The objective of the present study was to observe the evolution of helmet use among cyclists in Montreal from 2011 to 2016. **Methods:** During the summers of 2011 (paper data collection) and 2013, 2014, and 2016 (iPhone app), bicycle helmet compliance was observed in various locations on the island of Montreal. **Results:** A total of

43 452 cyclists were logged by 37 observers in 4521 different locations on the island of Montreal. Bicycle helmet compliance increased until 2014 and then decreased in 2016. Personal cyclists' helmet compliance increased by $1.2 \pm 0.2\%$ per year ($p < 0.001$ for trend), whereas shared bike users did not increase their helmet rate significantly: $0.28 \pm 0.36\%$ per year ($p = \text{NS}$). The slow increase in helmet adoption remained after correction for the suburb and postal codes. Women tended to have 8%–11% greater helmet compliance than men each year, and weekday riders were more often compliant than weekend riders. **Conclusion:** There was a slow increase in helmet compliance among cyclists in Montreal, followed by a drop in compliance in 2016. Despite many campaigns and advertising by numerous agencies, the overall compliance remains low. Shared bike riders have a very poor helmet use rate despite 70% being locals.

Quality improvement education in trauma: identifying the challenges and opportunities to enhance systems-based practice and learning. *Lesley Gotlib Conn¹, Avery Nathens², Charlene Soobiah¹, Homer Tien², Barbara Haas².* From the ¹Sunnybrook Research Institute, Toronto, Ont.; and the ²Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: Learning about quality improvement (QI) is highly prioritized in medical education. Currently, we lack consensus on the optimal approach for delivering QI education during surgical residency. Academic trauma programs appear ideally suited for informal learning through direct exposure to QI processes (trauma registries, external benchmarking); however, whether these processes translate into educational opportunities for trainees is unknown. We sought to explore how trauma program physicians and trainees perceive informal QI learning within their daily practice. **Methods:** Ethnographic data were collected at a level I trauma centre from April 2015 to February 2016 using interviews and observational methods. Semistructured interviews were conducted with trauma program staff physicians and surgical trainees. Physician specialty areas included general surgery, anesthesiology and emergency medicine. Interview data were triangulated with field observations during monthly morbidity and mortality rounds (M&Ms) and morning handover. Transcripts were coded and analyzed iteratively and inductively using a thematic analysis approach. **Results:** Seventeen interviews and 27 observations were conducted. Routine QI participation and education were viewed as integral to the roles and responsibilities of interviewed physicians and trainees; however, as participant groups they described discrepant experiences with informal QI education. Staff physicians perceived QI teaching to be ubiquitous in their daily practice and described patient care scenarios they leveraged for teaching QI. The M&Ms were seen by staff physicians as effective for teaching decision-making around patient complications and deaths, but they were not considered the appropriate forum for learning about systems issues. Surgical trainees defined QI learning as reviewing complications and deaths, surgical decision-making and process improvements. Most trainees expected to learn about QI in M&Ms and did not identify other scenarios where they were acquiring QI knowledge or skills. Trainees found M&Ms ineffective for achieving QI learning owing to poor staff attendance and case selection. As a result, some trainees felt there was no QI learning in trauma. Trainees

also perceived themselves to be poorly positioned to contribute to QI initiatives to enhance their learning because of their transient status and the tendency for QI to happen by staff behind the scenes. **Conclusion:** Trauma surgery training programs are ideal for informal QI education and offer surgical trainees many opportunities to learn about QI through specific skills, such as handover and guideline use. However, staff physicians teach but do not emphasize QI principles in daily practice, leaving residents poorly equipped to recognize and articulate these principles. Opportunities to support informal QI education exist and should be considered to enhance trainees' knowledge and competency in systems-based practice and improvements.

Models of care for traumatically injured patients at British Columbia's trauma centres: variability and sustainability. *Benjamin Tuyp¹, Kasra Hassani², Joe Haegert¹, Lisa Constable¹.* From the ¹Royal Columbian Hospital, New Westminster, BC; and ²Fraser Health, Surrey, BC.

Background: Modern trauma systems utilize a network of hospitals interconnected and stratified by resource availability and staffed by experienced trauma providers in order to ensure optimal care for the injured patient. However, the model of care — the manner by which patients are admitted, overseen and handed over — is an overlooked but equally significant determinant of patient outcomes. Very little is known regarding the design, variety and distribution of care models for trauma patients within a provincial trauma system. **Methods:** A questionnaire was developed in consultation with regional and provincial trauma directors in order to elucidate the models of care operating within British Columbia's (BC's) trauma network as well as their pattern of distribution and the perceived sustainability of each. Surveys were distributed to the trauma directors at BC's 10 adult trauma centres and followed-up with semi-structured interviews to further clarify responses. **Results:** Three different models of caring for admitted trauma patients exist within BC: the "admitting trauma service," the "on-call consultant" and the novel "short-stay trauma unit." Admitting trauma services were staffed by a multidisciplinary team tasked exclusively with the care of injured patients throughout their hospital stay. On-call consultants assisted with the initial hours of trauma resuscitation in the emergency department before transferring patients to a nontrauma medical or surgical service. The short-stay trauma unit site employed on-call consultants who also oversaw a subset of trauma patients admitted to the 48-hour short-stay trauma ward. All level I trauma centres (2 of 2) used the admitting trauma service model, and all level II centres (3 of 3) employed an on-call consultant. Level III centres relied on admitting trauma services (2 of 5), on-call consultants (2 of 5) and short-stay trauma units (1 of 5). Only half (5 of 10) of BC's trauma centres' medical directors believed their current model of care was sustainable in its existing form, with significant discordance depending on the type of model currently in situ. All of the admitting trauma service (4 of 4) and short-stay trauma unit (1 of 1) sites believed they were sustainable beyond 5 years' time. On the contrary, none of the on-call consultant facilities (0 of 5) believed they were sustainable. The most commonly cited barriers to program sustainability were inadequate compensation (6 of 10), limited access to hospital resources (6 of 10) and difficulty recruiting medical staff (2 of 10). **Conclusion:**

Three distinct models of care coexist within BC's trauma system. The distribution of models is not correlated with accreditation level, and many sites remain unsatisfied with the sustainability of their current model. Implementing admitting trauma service or short-stay trauma unit models appears to be the most sustainable, satisfactory means of caring for admitted trauma patients within our provincial trauma network. These models have been successfully implemented at sites of all accreditation levels I through III.

Cerebral arterial air embolism is associated with an intraosseous line in an adult trauma patient. *Jennifer Chao, Nicole Mak.* From the University of British Columbia, Vancouver, BC.

Background: In trauma resuscitation, intraosseous (IO) insertion is a fast and reliable means of vascular access. Complications are uncommon and include infection, fluid extravasation and emboli. Arterial emboli in the form of fat and marrow have been well-documented. However, arterial air emboli secondary to IO use is extremely rare and sparsely documented in the literature. We reviewed our case of cerebral arterial air emboli (CAAE) following the use of an IO line in an adult. **Methods:** This is a case of CAAE in a 53-year-old man who fell from a height of 40 feet. Initial blood pressure measured by paramedics on-scene was 69/46 mm Hg. A right tibial IO line was inserted. Upon arrival to the hospital, assessment by the trauma team revealed 2 mm non-reactive pupils, nonpurposeful left arm movement, pneumothorax associated with rib fractures and an unstable pelvic fracture. **Results:** Rapid whole-body CT revealed air in the right subarachnoid space, right superior ophthalmic vein and right cavernous sinus without skull fractures. Air was also present in the inferior vena cava (IVC) and in the right common iliac and right popliteal veins. Being too unstable for hyperbaric oxygen therapy (HBOT), the patient's pelvis was operatively stabilized, and he was managed supportively for CAAE. Repeat CT on postinjury day 0 revealed infarcted right parietal and frontal lobes and interval resolution of intracranial air. Owing to poor neurologic recovery and extensive injuries, the family eventually decided to proceed to palliation, and the patient expired. We deduce that the poor neurologic outcome of this patient is secondary to CAAE. From the pattern and distribution of venous air detected on CT, we infer that the air emboli in this patient was likely secondary to the IO. Air embolism associated with IO insertion in adults has not been previously reported. Two existing case reports are for pediatric nontrauma patients. CAAE is better described in association with central venous catheterization. Patients typically have radiological evidence of intracranial air and present with focal neurologic deficits, seizures or coma. An autopsy was not performed, but possibilities for arteriovenous shunting of air emboli in our patient include intracardiac and intrapulmonary shunts. It remains unclear whether this particular patient could have benefited from HBOT following the initial stabilization period. **Conclusion:** To our knowledge, this is the first case report of CAAE in an adult presumed to be secondary to an IO line. Air emboli secondary to IO and central lines are rare but real occurrences. Attention to proper technique during their placement and use should be acknowledged and carried out. If available and appropriate to care, HBOT should be considered for a patient with CAAE, preferably within 6 hours of presentation.

Effect of pre- and in-hospital time to operation on mortality in severe penetrating chest trauma. *Vincent Cheng¹, Kenji Inaba¹, Kazubide Matsushima¹, Saskya Byerly¹, Morgan Schellenberg², Yue Jiang³, Desmond Khor¹, Demetrios Demetriades¹.* From the ¹Division of Trauma and Surgical Critical Care, Department of Surgery, LAC+USC Medical Center, University of Southern California, Los Angeles, Calif.; ²LAC+USC Medical Center, Los Angeles, Calif.; and ³Department of Biostatistics, University of North Carolina, Chapel Hill, NC.

Background: In patients who have sustained traumatic chest injuries, delay to medical intervention has been associated with poorer clinical outcomes. The impact of prehospital and in-hospital delays to operation on mortality for patients with penetrating chest injuries requiring immediate surgical intervention is unclear on a national level. **Methods:** The National Trauma Data Bank was queried for penetrating chest trauma admissions from 2007 to 2014 with Abbreviated Injury Scale scores of 3 or higher. Transferred patients and patients dead on arrival were excluded. Only patients requiring emergent operations within 30 minutes of admission were included. We used multivariate logistic regression to control for differences in patient characteristics and examined the impact on mortality of emergency medical service (EMS) response time, EMS transport time and emergency department (ED) time. **Results:** A total of 13 700 severe penetrating chest trauma admissions requiring emergent surgical intervention were identified. The EMS and ED times were recorded for 8125 admissions. Of these admissions, 7337 (90%) were male, and the median age was 29 years (interquartile range [IQR] 22–40 years). Whereas 5117 patients (63%) sustained stab injuries, 3028 patients (37%) sustained gunshot wounds. The median injury severity score was 18 (IQR 13–27). A median of 6 minutes (IQR 4–9 minutes) elapsed between EMS dispatch and arrival at the scene. EMS required a median of 18 minutes (IQR 13–26 minutes) to transport patients to the hospital. The median ED time before arrival in the operating room was 18 minutes (IQR 13–24 minutes). Multivariate binary regression showed that longer ED time was associated with higher mortality (OR 1.011, $p = 0.036$). EMS response time (OR 1.001, $p = 0.288$) and EMS transport time (OR 1.000, $p = 0.357$) were not significantly associated with mortality. **Conclusion:** Even after adjusting for differences in patient and injury characteristics, longer in-hospital delays before emergent operative intervention are significantly associated with increased mortality in patients sustaining severe penetrating chest trauma. However, no significant associations were established between prehospital times and mortality. These results warrant prospective validation of streamlined transitions from the ED to the operating room.

Accuracy of alert times in major trauma patients could save a substantial amount of money! *M. Azam Majeed.* From the University Hospital Birmingham, Birmingham, UK.

Background: In the management of major trauma, time to treatment is of utmost importance. This time starts from the time of injury to the time patients receive specialist care. Traditionally all these suspected major trauma patients are received by a trauma team consisting of multiple specialties. Our objective was to analyze the data of expected time of arrival (ETA) and actual time of arrival in the resuscitation room and the cost

impact of unavailable human resources. **Methods:** We did a retrospective analysis of the notes from July 1, 2015, to Aug. 31, 2015, at University Hospital Birmingham. All adult major trauma patients were included in the study. **Results:** We had a total of 198 patients presenting during the study period, but only 82 were included owing to insufficient records on the trauma alert sheet. We had 39 female (20%) and 159 male (80%) patients with a mean age of 50 years. The most common single body region involved was the head (23%), followed by the chest (10%); the rest of the patients had multiple regions involved. Only 7% patients arrived within the expected time (within a 5-minute margin). The rest were delayed to a varying length ranging from 6 minutes to 65 minutes, with a mean delay of about 36 minutes. **Conclusion:** A mean delay of 36 minutes in 81 trauma patients will add up to 121 hours for each clinician and nurse. This in total will add up to 607 hours for clinicians and 363 hours for nurses while dealing with 81 major trauma patients. We see about 1000 major trauma patients per year, and this will lead to thousands of hours and thus thousands of pounds wasted that could be potentially saved.

Impact of whole-body computed tomography in early diagnosis and management of major trauma. *M. Azam Majeed.* From the University Hospital Birmingham, Birmingham, UK.

Background: Major trauma describes serious and often multiple injuries that may require life-saving interventions. It is the biggest killer of people younger than 45 years in the UK. The National Audit Office report (2010) estimated that there are 20 000 cases of major trauma per year in England; 5400 people die of their injuries, with many others sustaining permanent disability. In poly-trauma patients every second counts. Time is of the essence. Our objective was to determine the incidence and impact of positive whole-body computed tomography scans (WBCTs) in suspected polytrauma patients. **Methods:** We did the retrospective analysis of case notes from June 2014 to June 2015 for patients presenting at University Hospital Birmingham. All adult major trauma patients who triggered the trauma triage tool were included. **Results:** We had a total of 489 patients over this period who had WBCTs. They were predominantly male (88%). The mean age was 53 years. The mean injury severity score was 39. The most common cause was motor vehicle collisions (37%), followed by falls (20%) and assault (6%). Sixty-nine percent of patients had positive WBCTs, as multiple regions were involved. The most common region involved was the thorax, followed by the head, then the pelvis and finally the abdomen. The mean time to CT was 29 minutes. **Conclusion:** Major trauma patients require more time and resources to manage, as traditionally the whole trauma team, rather than 1 emergency department physician, receives the patients. All patients in the study had a diagnosis within 45 minutes of arrival, which led to earlier treatment (e.g., blood products, operating room) and will improve the survival outcome.

Correlation between physical examination and whole-body computed tomography in major trauma. *M. Azam Majeed, Shaun Thein, Charn Gill.* From the University Hospital Birmingham, Birmingham, UK.

Background: Rapid radiological investigation is a backbone of the UK Major Trauma Network, with major trauma centres

(MTCs) required to have immediate (< 60 minutes, ideally 30 minutes) access to CT scanning. Patients undergo whole-body computed tomography (WBCT; trauma series) depending on the primary survey findings. We aimed to assess the sensitivity and specificity of the primary survey compared with the WBCT report in an MTC. **Methods:** Fifty patients (44 men, 6 women; mean age 40 years) were transferred by the ambulance service as a “trauma alert” to The Queen Elizabeth Hospital Birmingham, UK, between March and June 2015. One patient was excluded, as they were transferred from another hospital. Initial observations, injury mechanism, A-to-E assessment, CT scan and results were recorded. Shock was calculated according to Advanced Trauma Life Support (ATLS) guidelines. Qualification for WBCT on arrival was assessed according to local guidelines. **Results:** Forty-seven of 49 patients survived to discharge, with an average stay of 17.3 days. Thirteen (26.5%) patients were in class IV shock on arrival. Forty-four patients qualified for WBCT on arrival; of the remaining 5, 3 underwent WBCT, and 2 had partial-body CT scans owing to clinical judgment. Thirty-eight patients underwent WBCT, 7 underwent partial-body CT and 4 were not scanned (1 burn patient, 1 CT abandoned and patients taken to the operating room, 2 not specified). See Table 1 for sensitivity and specificity of body region from primary survey to WBCT. One patient underwent further imaging to include other body regions. **Conclusion:** This study demonstrates the importance of WBCT scanning in the trauma patient, given the low sensitivity of the primary survey, and would suggest all trauma patients should undergo WBCT on admission. Clinical examination is good to rule out, but not as good to rule in, major trauma.

Table 1.

Body region	Sensitivity, %	Specificity, %
Head	61	94
Thorax	41	95
Abdomen/Pelvis	40	85
Spine	93	28
Long bones	50	78

The use of clinical decision rules in evaluating blunt abdominal trauma in pediatric patients: a systematic literature review. *Azim Kasmani¹, Elizabeth Clement¹, Andrea Wintbrop².* From the ¹Department of Surgery, Queen’s University, Kingston, Ont.; and the ²University of Alberta, Edmonton, Alta.

Background: Blunt abdominal trauma (BAT) is a leading cause of morbidity and mortality in pediatric patients. Evaluation for intra-abdominal injury (IAI) following BAT can be challenging in children. Although computed tomography (CT) is a reliable modality to evaluate for IAI, there are valid concerns about radiation exposure, and it does not often change management in children. We systematically reviewed the literature on the use of clinical decision rules (CDRs) to evaluate for IAI in children after BAT. **Methods:** A search of peer reviewed literature was conducted using Medline, EMBASE, CINAHL and Cochrane databases. We included randomized trials and observational studies evaluating pediatric patients presenting after BAT and the use of CDRs compared with CT or operation for detection

of IAI. Trials evaluating a single method of assessment or injury to a specific organ were excluded. Citations were reviewed by 2 independent assessors for inclusion and assessment of methodologic quality. **Results:** In total 850 citations were identified, and 28 articles were retrieved for full text screening. Six citations met the inclusion criteria: 4 new CDRs and 2 CDR validation studies. Four studies were prospective and 2 were retrospective. The number of patients ranged from 147 to 12 044, and presence of IAI ranged from 6% to 20%. Sensitivities were all above 91%, and negative predictive values were all above 97%. However, studies noted that some important injuries were missed. Specificity and positive predictive value were not strong in the identified studies. Study quality scores on the Jadad scale varied from 19 to 25. Some CDRs were based only on history and physical examination, while others included laboratory values. Overall, studies showed a reduction in the need for CT to detect IAI following BAT in children. **Conclusion:** Although 4 unique CDRs exist to evaluate pediatric patients for IAI following BAT, they cannot be compared owing to differences in underlying populations. Further, there has been limited validation of their use. Optimally, prospective multi-institutional validation would be required to establish robustness before widespread implementation efforts. This could also include assessment of each CDR within a trauma database for validation and comparison of their effectiveness within the same patient population.

Trauma-related mortality at a Canadian level I trauma centre: a descriptive analysis. *William Shibao Lao¹, Matt LeBreton², Jacinthe Lampron¹.* From the ¹University of Ottawa, Ottawa, Ont.; and ²The Ottawa Hospital, Ottawa, Ont.

Background: Trauma-related mortality in the civilian population has traditionally been described by a trimodal distribution model. With the advent of modern trauma resuscitation, the validity of this model has come into question. The main objective of this study is to describe the epidemiology of trauma-related mortality at a Canadian level I trauma centre. The secondary objective is to determine whether or not trauma mortality, both overall and grouped into major mechanisms, still follows a trimodal pattern. **Methods:** A retrospective review of all trauma-related deaths occurring at The Ottawa Hospital from April 2011 to April 2016 was conducted. Patients were included if their death occurred in the context of a traumatic injury. We gathered and analyzed patients’ demographic characteristics, injury severity score (ISS), Abbreviated Injury Scale score (AIS), mechanism of injury, resuscitation process, operative intervention and information surrounding their death. Time of death was divided between near-immediate (within 2 hours), early (2–24 hours) and late (> 24 hours). **Results:** During the study period, 3451 trauma admissions (defined as ISS > 12) were recorded. Of these, 426 (12%) resulted in death. The mean age of the deceased was 66 years, which is older than that of the overall trauma population (mean age 56 years). Male patients accounted for 68% of all traumatic deaths. The mean ISS of the deceased was 25.6. The most common location of fatal trauma was the victims’ home (57%), followed by roads (25%) and workplaces/schools (11%). Of all lethal injuries, only 4% were work-related. Blunt trauma accounted for the majority of deaths ($n = 356$, 84%), with falls being the leading cause (70%), followed by motor vehicle collisions (13%), car–pedestrian collisions (10%) and assault (7%).

Penetrating traumas were responsible for 8% of admissions ($n = 291$) and 9% of deaths ($n = 39$). Of these, 62% were due to ballistic injuries, and 38% were due to stabbings. The remainder of deaths were attributed to drowning and asphyxia (5%) and burns and blast injuries (2%). During resuscitation, 4% of the patients who died had received an emergency thoracotomy and 20% had undergone a surgical intervention in the operating room within 48 hours of presentation. The most commonly involved services were neurosurgery (67%), followed by trauma/general surgery and orthopedic surgery (both 15%). Of all patients brought to the operating room, 4% were receiving ongoing CPR, and 2% suffered an intraoperative arrest. **Conclusion:** Our preliminary data indicate that falls account for the majority of traumatic deaths in a rapidly aging population. Additional data, including timing and cause of death, continue to be collected and analyzed. With the advent of modern prehospital and critical care, we will put the validity of the decades-old trimodal distribution model of mortality to the test. Ultimately, we hope to identify casualty patterns that will guide the creation of trauma prevention and treatment policies.

Trauma discharge summaries: an evaluation of quality and content accuracy in patients discharged home. *Rafael Olarte¹, Lesley Gotlib Conn¹, Brigette Hales², Aaron Watamaniuk², Tracey DasGupta², Avery Nathens².* From the ¹Sunnybrook Research Institute, Toronto, Ont.; and the ²Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: A transition from hospitalization to home represents a vulnerable period during which severely injured patients are often unable to advocate for themselves. Discharge summaries may facilitate this process by providing an explanation of patients' medical problems, the interventions provided by multiple consulting services and the ongoing care plan. We plan to evaluate the accuracy and content of trauma discharge summaries for patients discharged to home in order to assess their effectiveness as a communication tool. **Methods:** We designed a retrospective quality audit process of 200 consecutive trauma-discharged patients from Sunnybrook between 2014 and 2015. A senior trauma physician determined the information deemed essential in the discharge summary. A data analyst blinded to the institutional discharge summary process extracted the data. We compared the medical records and discharge summaries, assessing the percentage of accuracy between reported injuries, incidental findings, outcomes, follow-up instructions and activity restrictions. **Results:** We selected a subgroup of 67 patients that were transitioned to home. The median age was 46 years (interquartile range [IQR] 27–59 years); 81% ($n = 54$) were male, and 19% ($n = 13$) were female. The median length of stay (LOS) was 8 days (IQR 5–12 days). All patients were transferred to the intensive care unit (ICU) during hospitalization, with a median LOS in the ICU of 3 days (IQR 1.5–5 days). Overall, the proportion of discharge summaries missing information ranged from 4% to 57%. In comparison to medical records, injuries were missing in 15 (22%) summaries, procedures in 2 (4%) and follow-up instructions in 7 (11%), respectively. Additionally, we found higher proportions of missing data among complications in 6 (30%) summaries, incidental findings in 5 (42%) and activity restrictions in 21 (57%), respectively. **Conclusion:** Auditing and developing a transferable template for trauma discharge sum-

maries may result in a measurable improvement strategy to improve the communication of patient injuries and care plans among severely injured patients transitioned to home.

Understanding the role of preregistry data in monitoring quality of trauma care. *Trina Stephens¹, Sean Staniforth².* From ¹Queen's University, Kingston, Ont.; and ²Lions Gate Hospital, North Vancouver, BC.

Background: Trauma care requires the coordinated efforts of multidisciplinary teams of health professionals. As research evolves into clinical practice, monitoring is necessary to identify quality concerns and bridge knowledge gaps. While provincial trauma registries provide a wealth of information that reflect overarching goals, practical limitations delay data entry, making it difficult to monitor local quality concerns in a timely manner. The objective of this study was to understand the role of preregistry data in trauma care. **Methods:** A review of approaches used to monitor quality of trauma care was conducted in the lower mainland region of British Columbia, Canada. Trauma team leaders and data analysts from 2 level I trauma centres and 2 level III trauma centres were interviewed in order to understand how each site identifies and tracks issues with trauma care delivery. A literature review was also conducted to compare standardized tracking methods with those identified in the regional review. **Results:** Representatives from each centre noted deficiencies in the current standardized approach to data collection (British Columbia Trauma Registry, BCTR) that prevent timely and accurate identification of quality issues in trauma care. To circumvent these issues, each site devised alternative strategies to monitor quality concerns. Specifically, 3 strategies emerged: formal preregistry, informal preregistry and BCTR supplemented with electronic medical record (EMR) audits. Informal preregistry uses a fully customized set of fields to monitor trauma care. Data are stored on a secure sharing platform, where they can be accessed by the trauma team. Advantages include the immediate availability of data that reflect the needs of the institution. Disadvantages include the lack of reporting of data to Trauma Services BC for research and long-term storage. Formal preregistry uses standardized audit filters provided by Trauma Services BC, augmented with customized fields that reflect institution-specific goals. Advantages include the immediate availability of data and reporting and storage of standardized fields to Trauma Services BC. A disadvantage is the lack of reporting and storage of customized fields, which cannot be submitted with standardized fields. Use of the BCTR with EMR supplementation was possible where BCTR data entry is concurrent. Advantages of this approach include the reporting of all data to Trauma Services BC. Disadvantages include a lack of data specificity to institution goals and absence of clinical insight in data entry. **Conclusion:** A review of practices in 4 trauma-designated hospitals in British Columbia revealed the use of quality-monitoring strategies beyond the scope of the BCTR, demonstrating a need for standardized preregistry data collection. Data fields should reflect regional goals, include as few items as possible for rapid data entry by a clinician and be reportable to Trauma Services BC for research and long-term storage. Specific audit filters are suggested based on the regional and literature review.

Identifying patients who may benefit from resuscitative balloon occlusion of the aorta among trauma patients who

present to Saskatchewan emergency departments. *Brittany Albrecht*. From the University of Saskatchewan, Saskatoon, Sask.

Background: Our study sought to determine whether or not Saskatchewan emergency departments (ED) would benefit from resuscitative endovascular balloon occlusion of the aorta (REBOA), an endovascular trauma technology used for exsanguinating torso hemorrhage. **Methods:** A retrospective chart review of all Canadian Triage and Acuity Scale (CTAS) level 1 and 2 trauma admissions was undertaken in order to determine which patients would have been eligible for/benefitted from REBOA. Key inclusion criteria were exsanguinating subdiaphragmatic hemorrhage, age < 70 years, pulseless electrical activity (PEA) less than 10 minutes and systolic BP less than 70 mm Hg. **Results:** Four of the 244 (1.64%) patients reviewed were eligible for REBOA. The mean age of participants was 40.6 ± 21.3 years, and 77.9% were male. Tier 1 activation was called in 43.4% of cases. Initial CTAS levels 1, 2, 3 and 4 were 20.5%, 63.9%, 9.8% and 5.7% for all patients, respectively. Nurses modified a number of level 1 (changed to 23.8%), level 2 (changed to 67.6%), level 3 (changed to 7.8%) and level 4 (changed to 0.8%) CTAS upon arrival to the ED. Twenty-eight participants died in the ED. Participants had varied and, at times, multiple reasons for being classified as ineligible candidates for REBOA. There were 23 patients older than 70 years and 21 patients younger than 18 years. Three patients presented with PEA. Ninety-one patients presented with stable vital signs, and 3 presented with cardiac arrest due to causes other than exsanguination due to severe subdiaphragmatic trauma. **Conclusion:** In total, 1.64% of Saskatchewan traumas were eligible for REBOA. Because our study focused only on those that occurred in 2015, it is likely that more research of the same nature is necessary. Owing to year-to-year variation in trauma nature and number, in order to establish whether or not there is a need for REBOA, a larger patient number and longer timeframes are needed. A larger data set would allow a better assessment of trauma trends and technological needs.

Prevalence of posttraumatic stress symptoms following physical injury in a Canadian pediatric emergency cohort. *Sarah Curtis¹, Bill Sevcik², Cathy Falconer², Heidi Wilkes³, Abbeir Hussein⁴, Lindy VanRiper³, Amanda Newton⁴*. From the ¹University of Alberta, Edmonton, Alta.; ²Stollery Children's Hospital, Edmonton, Alta.; ³Department Psychiatry, University of Alberta, Edmonton, Alta.; and the ⁴Department of Pediatrics, University of Alberta, Edmonton, Alta.

Background: Physical injuries are the largest cause of morbidity and mortality among North American children and are the leading cause of emergency department (ED) visits for children older than 1 year. The prevalence of posttraumatic stress symptoms (PTSS) following isolated physical trauma in Canadian pediatric ED cohorts is unknown. Studies from other clinical settings and jurisdictions suggest that persistent PTSS are often under-reported. **Methods:** We conducted a 1-year prospective cohort study of injured children aged 8–16 years presenting to the pediatric ED of the Stollery Children's Hospital in Edmonton, Alta. Children were screened for risk of PTSS using the Screening Tool for Early Predictors of PTSD (STEPP) and the

STEPP-AUS (Modified Australian STEPP). We subsequently assessed participants by email at 1-month postinjury using a PTSS self-report measure, the Acute Stress List for Children (ASC-Kids). **Results:** A total of 250 children were enrolled in the study, with 71% (178/250) providing primary outcome data at 1 month postinjury. The mean age was 12.4 years, and 54% were male. The mean Canadian Triage and Acuity Scale level at presentation was 3 (range 1–5). Mean estimate of injury severity by caregivers, on a 5-point scale was 3. In total 9% of the children were admitted to inpatient units. Types of injuries included fractures (34%), sprains (13%), concussions (11%), soft tissue (15%) and lacerations (9%). Injuries were largely caused by sports (53%), slip/fall (10%), motor vehicle collision (6%) and playground incidents (5%). The most frequently affected body parts were the head (10%), ankle (9.6%), knee (8.5%), wrist (8.1%), face (7.8%) and forearm (7.4%). In total 4% of children sustained more than 1 injury. At baseline, 10% of children screened positive for risk of later PTSS using the STEPP screening tool, and 32% screened positive using the STEPP-AUS screening tool. The primary outcome measure was the proportion of children choosing the maximum score 3 or more times on 18 questions of the ASC-KIDS measure at 1 month postinjury. At 1 month postinjury, 17% of injured children in this cohort reported the persistence of 3 or more frequently experienced PTSS. **Conclusion:** Persistence of untreated PTSS is associated with impaired healing, poorer functional recovery and impaired quality of life. Given the general prevalence of injury and the probable harm of untreated negative psychological symptoms in the developing brain, findings have implications for clinicians and systems managing pediatric injuries.

Dog-related injury in a pediatric emergency department. *Sarah Curtis¹, Melanie Rock¹, Sylvia Checkley², Marcella St. Louis³, Catherine Stewart¹, Manasi Rajagopal¹*. From the ¹University of Alberta, Edmonton, Alta.; ²University of Calgary, Calgary, Alta.; and the ³University of Calgary School of Veterinary Medicine, Calgary, Alta.

Background: Dog bites are a significant type of injury seen in emergency departments (ED), but a neglected consideration during development of policy and practice of municipal legislation and health services. This chart review aimed to evaluate incidence and management of dog-related injuries and dog bites seen in the Stollery Children's Hospital in Edmonton, Alta., from the years 2002–2016. **Methods:** We reviewed all medical charts for children aged 1 day to 16 years who sustained an injury from a dog. Data covered 6 broad domains: visit details, demographics and medical history of the child, dog characteristics and circumstances of injury/bite, characteristics of injury/bite, and clinical management and consultations. Descriptive statistics were used to describe categorical variables as proportions and continuous variables as means or medians. **Results:** In total, 697 charts were reviewed. The mean age of patients was 5 years, and 53% were boys. In total, 85% received care in the ED, and 13% were admitted to hospital for further management. The most common site of injury was the face (65%), followed by the upper extremities (25%), lower extremities (13%), head (6%) and neck (3%). Analgesia was given to 38% of patients, and 19% required procedural sedation for treatment of injuries. Sutures were administered to 36% of patients, and 63% were

treated with antibiotics; 11% of patients required advice only. In total, 58% of patients received consults within Alberta Health Services as a result of their injuries. Plastic surgery was the most frequently consulted service (46%), followed by social work (8%), infectious disease (6%), orthopedics (6%), ophthalmology (5%), radiology (5%), rehabilitation (5%), home care (3%), pediatric surgery (2%), psychiatry 1.5%, dentistry (1.2%), pediatrics (1%), otolaryngology (1%) and child life (1%). The majority of bites were from a known dog from another household (42%), followed by the family dog (32%), unknown (12%) and not documented (12%). Public health was notified about the bite in only 12% of cases. **Conclusion:** Consultations with specialists as a result of dog bites were frequent, implying considerable costs to the health care system. Rates of reporting to public health were low, suggesting that statistics on the incidence of dog bites and breeds of biting dogs are likely inaccurate. Medical charts contained little documentation of dog characteristics and incident details. Young (lower to the ground) children were at highest risk for dog bites, and faces were the most frequently bitten area.

Canadian Forces fresh whole blood donors in Afghanistan: a descriptive study. *Erin Mannard¹, Jason Acker², Homer Tien³, Andrew Beckett¹.* From ¹McGill University, Montreal, Que.; ²Canadian Blood Services, Ottawa, Ont.; and the ³Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: Fresh whole blood (FWB) provides all required clotting factors and red blood cells required to resuscitate the bleeding combat casualty. From 2006 to 2009, Canadian Forces Health Services (CFHS) and Canadian Blood Services (CBS) instituted an FWB walking blood bank (WBB) at Kandahar Airfield in Afghanistan. In this descriptive study, we reviewed the CBS donor screening data to review the number of donation deferrals, type of deferrals and percent ABO/Rh error on identity discs (ID discs). **Methods:** We queried the CBS and CFHS WBB program database for the period 2006–2009 after approval by CFHS and CBS institutional review board. All data were de-identified and placed into a protected database before analysis. Demographic data, such as age, sex and previous donations, were collected. We compared ABO and Rh type with data on members' medical files. Deferral codes were noted and unencrypted by CBS specialists. Data were summarized and presented as means and percentages. **Results:** Individual donor records from 711 potential WBB donors were reviewed from 3 separate locations across Canada. Many potential FWB donors had donated blood before (37%). The percentage of women screened was 11% (76). In total, 469 (66%) potential donors were deferred from donating FWB, with 97% of deferrals being temporary, falling into both long-term (61–730 days) and short-term (1–60 days) categories. The most common cause for deferral across all 3 camps was recent vaccination (44%), followed by transmissible disease risk from new tattoo or piercing in the last 6 months (16%). Percent error on ID discs was below 1.2%. There were no cases of transfusion-transmitted infections identified. **Conclusion:** This is the first study to report on the CFHS WBB program from 2006 to 2009. In total, 66% of donors were deferred initially. However, many of these deferrals were temporary and related to the timing of predeployment vaccinations and travel to malarial endemic areas. This is an important study, as identifying these 2 types of deferrals will allow for development

of CBS/CFHS WBB donor screening protocols to reduce the number of deferrals and maximize the potential WBB donor pool.

Early crisis nontechnical skill teaching in residency leads to long-term skill retention and improved performance during crises: a prospective nonrandomized controlled study. *Aristithes Doumouras, Paul Engels.* From McMaster University, Hamilton, Ont.

Background: Medical error is common in crises, and the majority of observed errors are nontechnical in nature. The long-term impact of teaching crisis nontechnical skills to residents has not been evaluated. The objective of this study was to determine the effect of simulation-based teaching of crisis nontechnical skills 1 year after initial teaching. **Methods:** This was a prospective study using both historical controls and a before and after methodology to evaluate the effect of a high-fidelity simulation curriculum that used crisis resource management principles to teach nontechnical skills during trauma and nontrauma crises. Postgraduate year (PGY)-2 and PGY-3 residents were invited to take part in a prospective training course over 2 years. The primary outcome was leader performance evaluated by expert raters using the previously validated 7-point Ottawa Global Rating Scale. **Results:** Overall, 23 residents performed 30 simulations over the 2 years, with the intervention group of 7 residents being assessed in both years. This study elucidated several key points in resident performance during crisis scenarios over several simulation training days. The most important insight is that meaningful nontechnical skills are not likely to develop naturally in a spontaneous fashion during junior residency and that specific nontechnical skills training improves objective performance during simulated general surgical crises over the previous year and compared with untrained historical controls. This was most evident in the trained PGY-3 scores compared with both the untrained PGY-3 controls 1.20 (95% CI 0.37–2.03, $p = 0.005$) and all the PGY-2 scores 1.09 (95% CI 0.70–1.47, $p < 0.001$). In addition, when compared with the historical PGY-3 controls, there were no significant differences between untrained PGY-2 residents and untrained PGY-3 residents, indicating the importance of specific and focused training in nontechnical skills to ensure a high level of performance. Moreover, the teaching of these skills early in residency appears to be durable up to 1 year later without specific or focused nontechnical skills training in between. Finally, the scores for residents for the second trauma scenario were significantly greater than the first trauma scenario, regardless of scenario type, suggesting learning can be achieved through focused debriefing, and the performance during penetrating trauma scenarios were worse than blunt traumas. **Conclusion:** The PGY-3 residents who had prior training had significantly improved crisis performance compared with historical PGY-3 controls and untrained PGY-2 residents. There were no significant differences between the crisis performance of PGY-2 residents and the untrained PGY-3 controls. This confirms the beneficial effect and long-term retention after crisis nontechnical skill training.

Heads up! Caring for concussions. *Zabva Hussein¹, Emilie Joos².* From the ¹Vancouver General Hospital, Vancouver, BC; and the ²University of British Columbia, Vancouver, BC.

Background: Since 2011, the number of patients seen at Vancouver General Hospital (VGH) for a concussion has increased

every year. In 2015, VGH saw approximately 1400 individuals with concussions, and this number is expected to continue to grow. Falls, transportation- and sport-related injuries are common mechanisms for concussions, and as a level I trauma centre, VGH decided to undertake a review of how concussion care is provided at its site with the intent to develop a standard guideline. **Methods:** A steering committee was convened with representation from an emergency physician, trauma surgeon, occupational therapist, physiatrist from GF Strong and the VGH injury prevention lead. Through an iterative mapping process, the committee finalized a future state map based on the Ontario Neurotrauma Guidelines, showing how a patient with a mild traumatic brain injury should flow through the system and the actions to be taken by various health care providers. New clinical forms and patient handouts were also developed. **Results:** The future state map was turned into a standard clinical pathway that, in September 2016, was shared across departments and disciplines along with the new clinical forms and patient handouts. The primary outcome was to increase the rate at which patients with diagnosed concussions are provided with access to care based on best practice recommendations. Other intended outcomes included improving providers' knowledge of current evidence in concussion care and supports available to patients, reducing the recovery time of patients experiencing postconcussion symptoms and ensuring continuity of care as patients with concussions move through the health care system. A standard clinical pathway will also improve the consistency by which concussions are documented in patients' charts and coded in health registries, thus more accurately measuring the incidence of concussions seen at VGH. This has the potential of informing future decisions about concussion care. GF Strong is collecting data on the number of appropriately referred concussion patients from the emergency department (ED) and trauma services. Trauma services is collecting data on the number of delayed referrals made to GF Strong, and over time data will be available from the ED about the number of patients who return owing to unresolved postconcussion symptoms. Together, these data will provide evidence about the effectiveness of this initiative. **Conclusion:** Concussion rates are increasing, and without a clinical pathway and ongoing education health care providers are stymied as to how to care for these patients — particularly those at risk of prolonged postconcussion symptoms. Health regions across BC and Canada have expressed interest in applying the pathway and tools developed at VGH in their own settings. The approach undertaken for this initiative has wide applicability to address issues that involve stakeholder engagement, process mapping, developing change ideas, education and evaluation.

Staying on your feet. *Zabra Hussein, Roger Mab, Rishma Dbhalla.* From the Vancouver General Hospital, Vancouver, BC.

Background: Each year, roughly 200 000 BC seniors experience a fall. An estimated 10 000 of these falls result in hospitalization. Once a senior has experienced a fall, the risk of a subsequent fall significantly increases. With such staggering numbers, it is imperative to look at ways to prevent falls and the reoccurrence of falls. Preventative strategies exist that can help maintain the independence of seniors and reduce the burden placed on our acute care system. **Methods:** Richmond Public Health and

Home Health along with BC Emergency Health Services, Fire Rescue and the Vancouver General Hospital (VGH) injury prevention lead partnered to develop a protocol whereby first responders providing lift assists to seniors could refer these patients to Richmond Public Health in cases where they decline transport to the emergency department (ED). With this referral, Richmond Public Health would intervene and follow up with each senior with the goal of preventing a subsequent fall by addressing the 4 evidence-based preventative measures for falls prevention. **Results:** This initiative was slated for roll-out in November 2016. Richmond Public Health will be tracking the number of new referrals received from the first responders, the number of ED visits owing to falls, the number of seniors refusing service after being contacted and the number of seniors who attend the Seniors Falls Prevention Clinic. The first responders will be collecting information about the number of repeat calls they receive from an individual senior as well as the number of seniors who decline an offer of referral to Richmond Public Health. This information will highlight the effectiveness of this initiative and provide insight as to whether this initiative should be spread to other health regions. **Conclusion:** Seniors who fall are a significant source of ED visits and hospital admissions. Evidence-based strategies exist, but identifying seniors at risk for a fall remains a challenge. The partnerships developed as a result of this initiative aim to overcome this challenge and contribute to strengthening the relationship between first responders and the health region, increasing awareness of the Seniors Falls Prevention Clinic and increasing the public's and health care providers' knowledge about falls prevention.

Knowledge transfer: a clinical intervention guide to optimize and harmonize trauma care for patients with rib fractures. *Nathalie Rodrigue.* From McGill University, Montreal, Que.

Background: The Montreal General Hospital (MGH) Trauma Program developed an evidence-based clinical intervention guide to optimize and harmonize trauma care for patients with rib fractures. The guide consisted 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 the plan-do-study-act (PDSA) method, physicians, nurses, respiratory therapists and physiotherapists were educated with the goal to improve patient outcomes by standardizing clinical care in the emergency department (ED). These included providing timely and efficacious pain control; interventions to reduce morbidity; reducing the clinician decision time to admit the patients or discharge home; discharging the patient with follow-up and clear instructions regarding analgesia, respiratory exercises and mobilization; and telephone follow-up. **Results:** Prior to implementation, the rate of trained personnel ranged from 59% of nurses and patient attendants to 90% of physiotherapists. Two systematic chart reviews revealed a 50% guideline utilization rate at 1 month (June to July), which increased to 80% (July to September). Subsequent to implementation, average guideline utilization was 71%, seen in part or in whole among 52 users. Implementation facilitators included having a dedicated and motivated implementation team, presence of students, the ability to adapt the guide following staff feedback, nurses training themselves, funds awarded from the *Institut*

nationale d'excellente en santé et en services sociaux (INESSS) and protected time for the project manager to coordinate activities 1 day a week. Challenges included training more than 200 staff, high turnover/rotation of staff, time to monitor indicators and outcomes, health care restructuring and budgetary restrictions. **Conclusion:** Facilitating the implementation of knowledge into practice is recognized by clinicians and researchers alike. Therefore, ongoing stakeholder education with an emphasis on compliance of guideline usage continues to be our major focus. Furthermore, there is an interest in implementing this guideline on the wards. Where evidence is implemented, improvements in cost and outcomes may result, including fewer repeat ED visits, lower complication rates and decreased mortality.

Early fixed wing activation transfers from the Northern Health Authority 2014–2015. *Stephen Wheeler¹, Jordan Oliver².* From ¹BC Emergency Health Services, Vancouver, BC; and the ²Northern Health Authority, Prince George, BC.

Background: Early fixed wing activation (EFWA) has been operational in BC since 2010. It identifies potential major trauma patients and activates fixed wing aircraft to be ready for launch to remote areas of the province before the patient arrives at a local medical facility. Assessment at the facility then determines if the aircraft will be launched. This retrospective analysis looked at 1 year of EFWA alerts in the Northern Health Authority (NHA) to determine how many patients transferred to the local medical facility met launch criteria after assessment there. **Methods:** All EFWA activations are identified and logged by the British Columbia Ambulance Service dispatch centres. The NHA Trauma Program was supplied with a list of EFWA for the year Apr. 1, 2014, to Mar. 31, 2015. The NHA then did a review of all the charts. Patients were subgrouped into 3 geographical areas. For each region the number of patients who had secondary transfers from the primary site to a trauma centre or who died before transfer were identified. **Results:** For the selected year a total of 48 EFWA events were identified for a total of 62 patients. These were broken down geographically: 18 events and 19 patients in the northwest, 18 events with 31 patients in the northern central region, and 12 events and 12 patients in the northeast. The geographic breakdown was performed as some patients were transferred to the trauma centre in Prince George, whereas others were transferred directly out of the NHA to Vancouver. This may account for the differences among the regions in the number of patients meeting the criteria. In the northwest 12 patients met the criteria in 18 events (66.6%). In the central region 7 patients met the criteria in 18 events (39%). In the northeast 9 patients met the criteria in 12 events (75%). Overall 28 patients met the criteria on chart review. Deaths were included in patients who met the criteria. Six patients died before arrival at the hospital (met criteria). Three patients died in hospital (met criteria). Thirty patients (48%) were stable at the scene. Out of 48 EFWA events, 28 patients met the criteria (deaths and survivors) for an overall rate of 58%. There were 7 EFWA events where multiple patients had the same event number. This probably increased the number of patients who were included but who did not meet the criteria. The rate is therefore calculated as patients who met the criteria per event. **Conclusion:** Reducing time to definitive care for injured patients is the goal of all trauma systems. Launching fixed wing aircraft requires more planning and time than launching

rotor aircraft and diverts resources away from other patients. Overtriage rates should be kept to a minimum. Activating aircraft earlier for launching reduces the time required to launch and will reduce trauma patients' time to definitive care. This retrospective analysis shows that dispatch can identify remote severely injured patients.

Early fixed wing launch of aircraft for trauma patients in remote BC. *Stephen Wheeler, Julius Ueckermann, Rabul Chhokar.* From the BC Emergency Health Services, Vancouver, BC.

Background: Autolaunch capture of trauma patients by rotary aircraft is limited by the cruising range of the aircraft. In British Columbia, autolaunch rotor aircraft are in Richmond and Kamloops; although this covers a large proportion of the population, it is geographically only a small proportion of the province. Early fixed wing launch (EFWL) identifies potential major trauma patients and mobilizes aircraft to remote areas of the province before the patient arrives at a local medical facility, reducing time to definitive care. **Methods:** Five years ago the British Columbia Ambulance Service started an early fixed wing activation (EFWA), where aircraft would be put on standby to launch based on Medical Priority Dispatch System (MPDS) criteria or by request from the responding ground crew. The patient would then be transported to the local medical facility, where the physician would have 30 minutes to decide whether to launch the aircraft. Post hoc case analysis by BC Emergency Health Services (BCEHS) and the Northern Health Authority (NHA) showed multiple instances of delayed definitive care. **Results:** Launching a fixed wing aircraft is a much more complicated process than a rotor launch, as a runway and launching slot are required. Overtriage must be kept to a minimum, hence the previous "activation only" process, resulting in a delay of the aircraft launch until the patient was in a medical facility where they could be properly assessed. In the last 3 years BCEHS has had an emergency physician (EPOS) available by telephone within 30 seconds 24 hours a day. Using the EPOS and linking them directly to the prehospital paramedic at the scene through the air dispatch centre allows medical oversight and allows an EFWL. This process required refinement of the previous activation criteria, an algorithm outlining the process, the development of an online education program for primary responders in remote BC, education of our air dispatchers and education of the on-call emergency physicians. Potential problems with communications are expected owing to BC's geography, but by using the algorithm and the launch criteria it is expected that the on-call physician will have appropriate information to launch the aircraft. Previous experience with EFWA is that with only call taker information only 58% of events had patient transports. With on-scene paramedic assessments and EPOS consultation we expect specificity will increase, and there will be a decrease in overall transport times. **Conclusion:** It is expected that the new EFWL program will reduce the time for trauma patients in remote BC to reach definitive care. The expected time savings should be greater than just the delay to launch, as often those delays prevented launching later owing to crew timeout, weather and daylight issues. BCEHS and the NHA will be collecting case information on all EFWL patients. Going forward we will be looking at comparisons with the EFWA cohort.

Hospital mortality after hip fracture surgery in relation to length of stay by care delivery factors. *Katie Sheehan, Boris*

Sobolev, Pierre Guy; The Canadian Collaborative Study on Hip Fractures. From the University of British Columbia, Vancouver, BC.

Background: Two hypotheses were offered for the effect of shorter hospital stays on mortality after hip fracture surgery: worsening the quality of care and shifting death occurrence to postacute settings. We tested whether the risk of hospital death after hip fracture surgery differed across years when postoperative stays shortened and whether care factors moderated the association. **Methods:** We analyzed acute hospital discharge abstracts for subgroups defined by hospital type, bed capacity, surgical volume and admission time from a total of 153 917 patients aged 65 years or older who were surgically treated for a first hip fracture. The main outcome measure was risk of hospital death. **Results:** We found a decrease in the 30-day risk of hospital death from 7.0% (95% CI 6.6–7.5) in 2004 to 5.4% (95% CI 5.0–5.7) in 2012, with an adjusted odds ratio (OR) of 0.73 (95% CI 0.65–0.82). In a subgroup analysis, only large community hospitals showed the reduction of ORs by calendar year. No trend was observed in teaching and medium community hospitals. By 2012, the risk of death in large higher-volume community hospitals was 35% lower for weekend admissions (OR 0.65, 95% CI 0.45–0.92) and 39% lower for weekday admissions (OR 0.61, 95% CI 0.41–0.92) compared with 2004. In large lower-volume community hospitals, the 2012 risk was 56% lower for weekend admissions (OR 0.44, 95% CI 0.26–0.76) compared with 2004. **Conclusion:** The risk of hospital death after hip fracture surgery decreased only in large community hospitals, despite universal shortening of hospital stays. This supports the concern of worsening the quality of hip fracture care due to shorter stays.

Nonoperative management of blunt splenic trauma: Does splenic artery embolization increase the risk of early infectious complications? Michael Yang¹, Tanya Charyk Stewart¹, William Leeper², Neil Parry², Kelly Vogt². From the ¹London Health Sciences Centre, London, Ont.; and ²Western University and London Health Sciences Centre, London, Ont.

Background: Recent data suggest that splenectomy for splenic trauma is an independent risk factor for early posttrauma infectious complications. No data exist to determine if the same risk is conferred with splenic artery embolization (SAE) in nonoperatively managed patients with blunt splenic injury. This study was undertaken to assess whether receiving SAE increases the risk of early infectious complications among patients who have incurred blunt splenic trauma. **Methods:** This retrospective cohort study evaluated all adult patients managed nonoperatively for blunt splenic injury over a 3-year period in a single Canadian lead trauma centre. Demographic and clinical data, splenic injury management and in-hospital infectious complications were collected from the trauma registry and electronic medical record. Patients who received SAE were compared with those who did not using both univariate and multivariate analysis to identify the risk of early infectious complications. **Results:** A total of 140 patients were included in the study: 45 (32.1%) received SAE and 95 (67.9%) were managed by observation alone (OA). Overall, the demographic and clinical characteristics were similar between the 2 groups, with the exception of abdomen injury

severity (46.7% in the SAE group had AIS > 3 v. 14.7% in the OA group, $p < 0.001$), splenic injury grade (48.9% had severe injury [grade IV and V] in the SAE group v. 3.2% in the OA group, $p < 0.001$) and the need for mechanical ventilation (8.9% in the SAE group v. 27.4% in the OA group, $p = 0.012$). The rate for any infectious complication (including urinary tract infection, pneumonia, blood stream infection and other nosocomial infections) was found to be 19.3%. On univariate analysis, there was no difference in the rate of early infectious complications between those who did and did not receive SAE (13.3% v. 22.1%, $p = 0.219$). Even after adjusting for mechanical ventilation and grade of splenic injury, SAE did not confer an increased risk of early infectious complications (adjusted odds ratio 0.78, 95% CI 0.18–3.37, $p = 0.741$). Only mechanical ventilation was associated with an increased odds of early infectious complications (adjusted odds ratio 5.83, 95% CI 2.26–14.99, $p < 0.001$). **Conclusion:** Unlike splenectomy, SAE is not associated with an increased risk of early infectious complications after blunt trauma, even in patients with severe splenic injury. This modality should continue to be preferentially considered over splenectomy in the management of appropriate patients with blunt splenic trauma.

Feasibility of administrative data for studying complications after hip fracture surgery. Katie Sheehan, Boris Sobolev, Pierre Guy; The Canadian Collaborative Study on Hip Fractures. From the University of British Columbia, Vancouver, BC.

Background: There is limited information on the occurrence of complications after hip fracture surgery. This may be due to lack of information in administrative data on complications. This study sought to determine the feasibility of applying the Agency for Healthcare Research and Quality Patient Safety Indicator 04 (AHRQ PSI-4) to identify complications after urgent hip fracture surgery from discharge abstracts. **Methods:** We obtained Canadian Institute for Health Information discharge abstracts for patients 65 years or older who were surgically treated for nonpathological first hip fracture between Jan. 1, 2004, and Dec. 31, 2012, in Canada, except for Quebec. We applied technical specifications from AHRQ PSI-4 version 5.0 to identify complications from hip fracture discharge abstracts. **Results:** Among 153 613 patients admitted with hip fracture, we identified 12 383 (8.1%) patients with at least 1 postsurgical complication. Among patients with postsurgical complications, we identified 3066 (24.8%) patient admissions to the intensive care unit. Overall, 7487 (4.9%) patients experienced pneumonia, 1664 (1.1%) experienced shock/myocardial infarction, 651 (0.4%) experienced sepsis, 1862 (1.1%) experienced deep venous thrombosis/pulmonary embolism and 1919 (1.3%) experienced gastrointestinal hemorrhage/acute ulcer. **Conclusion:** We report the incidence of 8.1% for in-hospital complications among patients who underwent hip fracture surgery in Canada between 2004 and 2012. Others reported that death after serious but treatable complications could be considered as a quality indicator for postsurgical care. The AHRQ PSI-4 could be considered to identify these serious complications for evaluation of postsurgical care after hip fracture.

Framework for an integrated performance reporting strategy for a provincial trauma system. David Evans¹, Ellen Randall¹,

Hugh Anton², Dug Andrusiek³, Mark Dalgarno¹, Boris Sobolev⁴. From the ¹Vancouver General Hospital, Vancouver, BC; ²GF Strong Rehabilitation Centre, Vancouver, BC; the ³British Columbia Ambulance Service, Vancouver, BC; and the ⁴University of British Columbia, Vancouver, BC.

Background: British Columbia recently established Trauma Services BC (TSBC) to advance optimal performance of a province-wide system of trauma care. A performance evaluation and reporting strategy endorsed by multiagency stakeholders was needed. Our research assisted TSBC to clarify its management goals through the recommendation of whole-system performance measures that reflect the strategic priorities of governing agencies and partners, meet the needs of decision makers and target meaningful outcome objectives relatable to modifiable processes. **Methods:** Four working groups were established to specify decision makers' needs, determine preferred outcomes, describe key processes and devise a policy-relevant performance reporting framework. Key organizational relationships were delineated and a swim-lane process map of trauma management constructed to drive outputs. Decision makers across agencies then convened in a consensus-building effort to confirm the scope of the trauma system and prioritize the high-level outcomes, processes and metrics needed to drive whole-system performance. **Results:** A process–structure–outcome framework integrating patient-level trauma care with population-level injury control across multiple agencies was proposed. There was consensus that the system scope should ultimately extend beyond major trauma to include all injuries. System impact on burden of injury was the highest-level shared performance objective. Feasible metrics capturing burden included injury rates, adjusted mortality, potential years of life lost (PYLL) and direct/indirect costs associated with injury. Preventable death and disability, long-term outcomes after major trauma, appropriate access to definitive and specialized care, care quality and effectiveness of recovery care were preferred performance drivers for the system of major trauma care. The cost-effectiveness of injury risk-reduction efforts, the quality of information management systems, estimations of emergency preparedness and system-driven regulatory changes impacting societal behaviours and the built environment were considered important for comprehensive whole-system performance evaluation. **Conclusion:** Whole-system performance measures must reflect both health care delivery and population health management. Measures meaningful to decision makers across organizations are essential to align performance objectives and direct system change that targets desired outcomes. Accountability in a shared governance system requires performance measures that clearly capture operational objectives that are shared by all partners. Commonly used metrics to gauge trauma system performance are largely insufficient. The innovation of new performance metrics is required.

Early telephone follow-up for traumatic brain injury patients using the Rivermead Post-Concussion Symptoms Questionnaire. *Ginette Thibault-Halman¹, Lynne Fenerty¹, Paula Taylor², Nelofar Kureshi¹, Simon Walling¹, David B. Clarke¹.* From the ¹Division of Neurosurgery, Dalhousie University/QEII Health Sciences Centre, Halifax, NS; and the ²Nova Scotia Rehabilitation Centre, Halifax, NS.

Background: Patients who experience a mild or moderate traumatic brain injury (TBI) are often discharged into the community

without a formalized rehabilitation plan. As a means of assessing clinical course and providing support following discharge after TBI, we implemented a pilot quality study to examine the frequency and severity of common post-TBI symptoms, as assessed with the Rivermead Post-Concussion Symptoms Questionnaire (RPCQ). **Methods:** All adult patients from the neurosurgery service at the Halifax Infirmery were interviewed by phone 2 weeks postdischarge home by a rehab-based nurse practitioner. Those discharged to local hospitals, out of province, with chronic subdural hematomas or admitted to inpatient rehabilitation were excluded. The RPCQ components (cognitive, emotional and somatic) were analyzed. Findings from the interview and management recommendations were communicated to family practitioners and the treating neurosurgeon through a dictated case summary letter. **Results:** The RPCQ results were available for 46 patients. The mean Glasgow Coma Scale (GCS) score from the first health care facility encounter was 13.6 ± 2 . Two weeks following discharge, 52% had cognitive symptoms, whereas 91% had somatic and 100% had emotional symptoms. Patients reported fatigue as the most common symptom (67%), whereas double vision was reported as the least common symptom (4%). In addition to providing reassurance, specific written recommendations were provided for 37% of patients, including management of specific symptoms, return to work and need for formal outpatient rehab assessment. **Conclusion:** All patients admitted to neurosurgery with a mild or moderate TBI had symptoms that persisted postdischarge. A telephone follow-up for TBI patients, using RPCQ as a structured evaluative tool, is a relatively low-cost intervention that provides additional support and guidance for patients and their family care practitioners. The next phase of this pilot study aims to administer the RPCQ at various intervals postdischarge to facilitate identification of patients who require further intervention, including additional services.

Simulation-based training for burr hole surgery and surgical instrument recognition. *David B. Clarke¹, Murray Hong¹, Nelofar Kureshi¹, Lynne Fenerty¹, Ginette Thibault-Halman¹, Ryan D'Arcy².* From the ¹Division of Neurosurgery, Dalhousie University/QEII Health Sciences Centre, Halifax, NS; and the ²Faculty of Applied Sciences, Simon Fraser University, Burnaby, BC.

Background: Surgical simulation training offers trainees the opportunity to practise surgical skills before entering the operating room. The objectives of this study were to determine the effect of tablet-based simulation for instrument recognition in learning appropriate instruments for a burr hole surgery and whether simulation-based learning translated to real instrument recognition with retention. **Methods:** Randomized trials of neurosurgery residents and perioperative nurses were conducted. Participants were trained using PeriopSim for instrument recognition and a burr hole procedure as well as real instruments. Group A performed simulation tasks using PeriopSim before identifying real instruments, whereas group B was asked to identify real instruments before performing the simulation tasks. Nurses' delayed recall was assessed at 7 days. A repeated-measure analysis of variance assessed change in simulation performance over time. **Results:** We recruited 16 residents and 100 nurses for these trials. All participants showed significant overall improvement in total score on simulated tasks. Group A demonstrated

significantly better accuracy identifying real instruments than group B ($p < 0.001$). Furthermore, during knowledge recall testing for nurses on day 7, group A demonstrated improved accuracy and speed in identifying real instruments compared with group B. **Conclusion:** This is the first study to assess the effect of tablet-based simulation training on instrument recognition for residents and perioperative nurses. Our results show that recognition of surgical instruments by residents and nurses improves with repeated use of the PeriopSim platform as an educational tool. Moreover, instrument knowledge acquired through simulation training results in improved identification and retained recognition of real instruments.

Protecting children: a multidisciplinary team approach to prevent rear occupant motor vehicle crash-related injuries. *Tanya Charyk Stewart¹, Kevin McClafferty², Michael Shkrum³, Jason Gilliland³, Jean-Louis Comeau⁴, Neil Parry³, Allison Pellar², Peyton Schroeder³, Douglas D. Fraser⁵.* From the ¹London Health Sciences Centre, London, Ont.; ²Southwestern Collision Analysis, London, Ont.; ³Western University, London, Ont.; ⁴Transport Canada, Ottawa, Ont.; and the ⁵Children's Hospital, London Health Sciences Centre, London, Ont.

Background: While significant progress has been made in reducing the number of vehicle occupants killed in crashes, much of this work has focused on the front seat. As nearly 79% of rear seat occupants are children, they represent a vulnerable population. This paper describes the development of a multidisciplinary team of physicians, epidemiologists, engineers and geographers tasked with studying crash and injury data to determine the risks associated with pediatric rear seat occupants in crashes. **Methods:** Daily level I pediatric trauma centre (PTC) emergency and admission reports were reviewed to identify all pediatric patients treated following a motor vehicle crash (MVC). Injuries were scored with the Abbreviated Injury Scale 2005, and the injury severity score (ISS) was calculated. Engineers were notified of MVCs involving children in the rear seat. Those admitted to the PTC had crash investigations. When full crash investigations were not warranted, data from police crash reports were collected and entered into an integrated crash injury database. **Results:** The team output to date included developing a process of identifying pediatric crash occupants, scoring injuries and notifying the crash investigators in a real-time manner. Our efforts have led to the development of an integrated crash and injury database that combines the biomechanical crash data and data from prehospital and police services with injury and health outcome data from the PTC. Three years after the initiation of this project, there have been 550 pediatric patients entered into our database, with 3 deaths (1%). More girls (54%) came to hospital, and the mean age was 9.0 ± 6.3 years. There were 484 (88%) passengers; 71% ($n = 343$) were occupants in the rear seat. Nearly half of the occupants ($n = 259$; 47%) used a seat belt; 154 (28%) were in an infant/child seat, and 45 (8%) were in a booster seat. There were 106 cases (19%) in which an airbag deployed. In total, 341 (62%) involved passenger vehicles, 202 (37%) a van/truck and 6 (1%) a bus. Most crashes involved impact with a moving object ($n = 437$; 80%); 61 (11%) impacted a fixed object and 49 (9%) were roll-overs. The majority of injured patients had a low severity of injury, with 80% having an ISS between 1 and 8. The mean ISS

was 10.5 ± 5.8 . There were 85 crash investigations involving 149 children, with 68 injured in the rear seat. **Conclusion:** Accurate data on crashes and injury are essential for research to tackle road safety issues using a best practice, public health approach. The development of a multidisciplinary team to study real-world crash data provides insight into the risk factors (i.e., social, biomechanical and environmental) contributing to the crash and injuries to children in the rear seat. This knowledge can be translated into changes in the built environment and policies to foster strategies for injury reduction.

Defining the gastroesophageal junction in trauma: epidemiology and management of a challenging injury. *Morgan Schellenberg, Kenji Inaba, Jim Bardes, Daniel O'Brien, Lydia Lam, Elizabeth Benjamin, Daniel Grabo, Demetrios Demetriades.* From the LAC+USC Medical Center, Los Angeles, Calif.

Background: Injuries to the gastroesophageal (GE) junction are infrequently encountered because of the high mortality associated with injuries to this anatomic area. Consequently, there is a paucity of literature on the patient demographic characteristics and treatment of GE junction injuries. The aim of this study was to examine the epidemiology and surgical management of these rare injuries. **Methods:** Patients presenting to a high-volume level I trauma centre between January 2008 and August 2016 with a traumatic esophageal or gastric injury based on ICD-9 and ICD-10 codes were extracted from the trauma registry. Patient charts were then reviewed, and all patients who sustained an injury to the GE junction were enrolled. Patient demographics, injury characteristics, procedures and outcomes were abstracted. Statistical analysis was performed with SPSS software. **Results:** Of the 238 patients who sustained an injury to the esophagus or stomach during the study period, 28 (11.8%) were found to have a GE junction injury. Mean age was 26 years (range 14–57 years) and 89.3% were male. Mechanism of injury was penetrating in 96.4% ($n = 27$; 81.5% gunshot wounds) and blunt in 3.6% ($n = 1$). Most patients ($n = 18$, 64.3%) were taken directly to the operating room (OR): 11 (61.1%) for hemodynamic instability, 7 (38.9%) for peritonitis and 1 (5.6%) for evisceration. Ten (35.7%) underwent computed tomography before transfer to the OR, of which 9 (90%) scans demonstrated GE junction injury. All patients underwent repair via laparotomy. One (3.6%) patient also required thoracotomy to facilitate repair. Six (21.4%) patients required thoracotomy for aortic cross-clamping. GE junction injuries were typically managed with primary repair ($n = 22$, 78.6%) or were stapled off and left in discontinuity ($n = 4$, 14.3%). Bougie dilators were never used. Most patients ($n = 26$, 92.9%) had associated injuries, of which injury to the liver was most common ($n = 16$, 57.1%). Patients had a mean injury severity score of 25 (range 9–75), and all required admission to the intensive care unit. Mortality was 25% ($n = 7$; 42.9% intraoperative). Most patients did not require total parenteral nutrition ($n = 25$, 89.3%) or a surgically placed feeding tube ($n = 26$, 92.9%). Of the 13 patients discharged alive who presented for clinical follow-up, all but 1 ($n = 12$, 92.3%) were eating independently by the first clinic visit (mean 26 days, range 11–38 days). **Conclusion:** GE junction injuries are uncommon given their proximity to critical structures. They typically occur after gunshot wounds. Patients are severely injured and frequently have associated

intracavitary injuries, and mortality is high. Most injuries can be fixed through the abdomen alone and do not require thoracotomy for repair. Adjuncts in elective GE junction surgery, such as bougie dilators, were not used. Despite the severity of injuries, most patients were eating independently by the first clinic visit.

Injury prevention in medical education: a systematic literature review. *Erika Schmitz¹, Sonshire Figueira², Jacinthe Lampron².* From the ¹University of Ottawa, Ottawa, Ont.; and ²The Ottawa Hospital, Ottawa, Ont.

Background: The cost of injury is unquestionably rising. Injury is the number one cause of death for Canadians aged 1–44 years. To reduce the global burden of injury, the need for health care professionals who have injury prevention proficiency is mounting. The aim of this study was to review the literature and chart the range of injury prevention and control curricula among medical undergraduate and residency programs. **Methods:** A systematic literature review (November 2006–2016) was conducted using EMBASE, Medline, ERIC and CINAHL. Four reviewers independently selected studies, extracted data, checked accuracy and assessed risk of bias. Articles were included if they were peer-reviewed, published in English and reported data on injury prevention and control curricula. The PRISMA guideline was followed. We assessed quality using the Newcastle–Ottawa Scale. The study was registered with PROSPERO, #CRD42016048805. **Results:** In total 824 articles were identified with the initial search strategy. Only articles that meet the inclusion criteria will be included for this scoping review. Internal consistency reliability, generalizability, evidence for content, criterion-related (e.g., Pearson r) and construct validity (e.g., principal component factor analysis) will be synthesized. The systematic review will synthesize the characteristics (population, intervention type, outcome measures) described in the literature. The review will be the first step in identifying gaps in current injury prevention and control curricula for medical students and residents. **Conclusion:** A limited number of injury prevention and control curriculum studies are reported across the literature. Given that physicians play a vital role in the prevention or control of injuries, further development of medical undergraduate and residency programs to include core concepts of injury prevention would be beneficial.

A 10-year evaluation of necrotizing pancreatitis, its treatment and its impact on hospital outcomes and cost. *Jim Bardes, Aaron Strumwasser, Morgan Schellenberg, Kenji Inaba, Damon Clark, Kazubide Matsushima, Daniel Grabo, Demetrios Demetriades.* From the LAC + USC Medical Center, Los Angeles, Calif.

Background: Pancreatitis remains a leading cause for hospitalization, morbidity and mortality. A wider range of treatment methods have been developed and used over the last decade for the treatment of necrotizing pancreatitis. In an era of focus on quality, more information is needed on the impact new treatment methods have on cost and outcomes. This study aims to evaluate the varying treatments for necrotizing pancreatitis and differences in morbidity and cost. **Methods:** A 10-year (2005–2015) retrospective review of all patients admitted and treated for necrotizing pancreatitis at our academic centre was per-

formed. Patients identified with a diagnosis of necrotizing pancreatitis were selected and analyzed based on primary treatment modality (surgery, endoscopic procedures, percutaneous drainage and nonoperative management). Data were abstracted from an emergency surgery registry that included etiology, procedures, morbidity, mortality and total hospital charges (\$USD). **Results:** We identified 208 patients during the study period. Mean age was 47 years (range 15–92 years), and 55.7% were male. Of these, 65 (31.3%) patients were treated with surgical intervention, 39 (18.8%) with endoscopic procedures, 12 (5.8%) with interventional radiology (IR) procedures and 92 (44%) with nonoperative management. Surgical intervention was associated with the highest cost (\$165 ± 210K) and was significantly more costly than endoscopic ($p = 0.001$) or nonoperative management ($p = 0.001$). Nonoperative management was second-highest in cost (\$71.2 ± 117K), followed by endoscopic intervention (\$48.4 ± 37K). IR was the cheapest option, (\$44 ± 25K), demonstrating cost savings compared with surgical intervention ($p = 0.05$). Length of stay was longest for surgical intervention (20.2 ± 24 days), followed by nonoperative management (9.6 ± 11 days), endoscopic intervention (8.9 ± 6 days) and IR (7.4 ± 4 days). Surgical intervention resulted in significantly longer stay than endoscopic treatment, percutaneous drainage and nonoperative management. Infectious complications were the most common in all groups (surgical patients 29%, nonoperative 25%, endoscopic 20%, and IR 53%). Mortality was low at 3% and was distributed throughout all treatment groups. **Conclusion:** Health care systems must strive for improvements in both quality and cost in the care of necrotizing pancreatitis. A significant shift has occurred in its management, with the increased utilization of endoscopic intervention and IR-based therapy. This shift demonstrates a significant decrease in cost and length of stay with similar morbidity. IR and endoscopic techniques should be used as a primary intervention when possible.

How not to fall: monkey-bar injuries. *Ioana Bratu¹, Katherine Impey², Tara Rankin², Bill Sevcik², Cathy Falconer².* From the ¹University of Alberta, Edmonton, Alta.; and ²Stollery Children's Hospital, Edmonton, Alta.

Background: Children require the creativity and exercise that playgrounds offer in order to thrive developmentally and to deter childhood obesity. The Canadian Standards Association has developed safety standards in an attempt to lower the risk of fall injuries in playgrounds. Although safety standards have been successful at reducing traumatic head injuries from falls, there are no recent Canadian studies that have examined the trends and patterns of playground equipment-related injuries, more specifically monkey bars. **Methods:** A retrospective analysis of pediatric patients (< 17 years) who sustained monkey bar trauma and were treated at a children's hospital in Canada was done using existing data from the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) database and complemented with details of a medical chart review by comparing epidemiology, injury, treatment and outcomes. **Results:** The total number of injured children who visited the Stollery Children's Hospital for monkey bar-related injuries was 201. The average age of a child with monkey bar injuries was 6.75 years. Girls were more commonly injured; the ratio of boys to girls who presented to the emergency department (ED) was 85:116. Of all

monkey bar injury–related pediatric patients who visited the Stollery ED, 58% ($n = 117$) had upper-extremity fractures and 13% ($n = 26$) of all patients required surgery. Surgery was needed exclusively for upper-extremity fractures, with supracondylar fractures accounting for 77% of the injuries. While radial and ulna fractures made up 15% of the injuries requiring surgery, they accounted for 65% of all upper-extremity fractures. This suggests that although radial and ulna fractures may occur more often, they do not often require surgery. As a comparison, 56% of all supracondylar fractures required surgery. The most common type of supracondylar fracture requiring surgery was a type III (55%), followed by type II (35%). There were no type I supracondylar fractures that required surgery, and there were 2 cases that did not specify the type of supracondylar fracture. Of the 201 pediatric patients, 27 required hospital admission, 26 of whom were admitted for surgery and 1 admitted for observation of a mild head trauma. **Conclusion:** Upper-extremity fractures make up a significant portion of monkey bar injuries. Current safety standards have been successful at reducing the number and severity of head injuries in children; however, they do not adequately curtail the risk of fractures in children on playgrounds. A reduction in the number of fractures occurring in Canadian playgrounds would decrease the burden on EDs and hospitals and create a safer environment for children to play.

Impact of adding TTA criteria in a registry on TTA criteria and compliance. *Jaimini Thakore¹, Jennifer McMillan², Dori Williams², Joanna Szpakowski², Deanna Fong², Erin Shangguan², Zonia Rurka³, Cindy Bouwsema³.* From the ¹Provincial Health Services Authority, Vancouver, BC; the ²BC Trauma Registry, Vancouver, BC; and ³Interior Health, Kelowna, BC.

Background: To meet the requirements of Accreditation Canada's Trauma Distinction Program, the BC Trauma Registry (BCTR) made significant changes to its inclusion criteria in 2015. One of those changes was to include all admitted patients who met local trauma team activation (TTA) criteria to ensure that TTA compliance was measurable. **Methods:** Data on the usage of trauma team activations were collected before the criteria change; however, there was no data collection on whether cases met local TTA criteria. The BCTR made a decision at all sites in BC to include patients who met TTA criteria and who had a TTA. A new field was created to capture those patients who met TTA criteria. **Results:** Data before the change indicated that only a few cases were not being included in the denominator of the Accreditation Canada indicator. Individual site TTA criterion appeared clear when the new criteria were implemented; however, after implementation of the new BCTR inclusion criteria, it became apparent that the TTA criteria in many sites involved the discretion of clinicians. This made registry data collection difficult. The degree of impact on local TTA criteria as a result of the BCTR inclusion criteria change varied among sites in BC. With health records analysts now assessing whether a case met the site TTA criteria, new questions came up. Some trauma sites had to clarify their criteria while others had previously simplified their criteria and did not have issues with clarity. There was also a general need to improve the documentation of TTA in patient records. This discovery resulted in sites reviewing their data regularly. With engagement of clinical leaders at sites and health records analysts focusing on

details and clarifying the local requirements, the number of patients with missed TTAs decreased over time. **Conclusion:** By using TTA criteria met as an inclusion criterion for the registry, BCTR health records analysts had detailed discussions with the clinicians that resulted in changes in TTA criteria at 3 sites and decreased missed TTAs provincially. Health records analysts came with a different viewpoint, which encouraged clinical staff to review their criteria and have increased focus on their missed TTAs.

Intraosseous device use in trauma patients: the Alberta experience. *Paul Engels¹, Angela Coates², Jessica Mckee³, Chad Ball⁴, Sandy Widder⁵.* From ¹McMaster University, Hamilton, Ont.; the ²Hamilton Health Sciences Trauma Program, Hamilton, Ont.; ³Innovative Trauma Care, Calgary Alta.; the ⁴Departments of Surgery and Oncology, Foothills Medical Centre and University of Calgary, Calgary, Alta.; and the ⁵University of Alberta, Edmonton, Alta.

Background: Although used primarily in the pediatric population for decades, the use of intraosseous (IO) devices in the resuscitation of severely injured adult trauma patients has become more commonplace. We therefore sought to assess the frequency of use and describe the patient type and clinical circumstances surrounding the use of IO devices in trauma patients injured in Alberta. **Methods:** The Alberta Trauma Registry was queried for patients who received an IO device during the period 2000–2010. Patients meeting these criteria underwent subsequent hospital-level chart review and data abstraction to complement data available in the registry. Characteristics were compared between patients who received an IO device and those who did not. **Results:** Out of 20 946 cases, 183 patients were identified as possibly receiving IO insertion. After exclusion of 16 patients who were brought to non-major trauma centres and chart-level review of all cases at major trauma centres, there remained 36 patients who actually had an IO device placement attempt. Out of 36 cases, only 4 were attempted in 2000–2006, 6 in 2007, 8 in 2008, 5 in 2009 and 13 in 2010. Of these 36 cases, 28 had the IO attempted in the field, with 24 being successful. IO was attempted in the field by STARS air ambulance ($n = 8$), paramedics ($n = 18$) and nurses ($n = 1$). CPR was performed in the field in 33% of cases. Of the 36 IOs attempted, locations of insertion were the tibia ($n = 27$), humerus ($n = 3$), sternum ($n = 4$) and unknown ($n = 1$). Of the 24 successfully placed IOs, they were used to administer crystalloid ($n = 24$), blood ($n = 8$) and medications ($n = 17$). Comparing this cohort to the non-IO cohort who presented to the major trauma centres ($n = 20\ 311$), the IO cohort had a similar age (39 v. 45 years, $p = 0.112$) but higher injury severity score (35 v. 23, $p < 0.001$). There was no difference in the sex of the patients between cohorts ($p = 0.273$), but there was a higher incidence of penetrating trauma (11.1% v. 5.5%, $p < 0.001$) and burn (11.1% v. 1.6%, $p < 0.001$) mechanism in the IO cohort. The mortality for the IO cohort was 52.8% compared with 11.2% ($p < 0.001$). **Conclusion:** Our study demonstrates that only a minority of adult trauma patients received IO devices as part of their resuscitation. Patients who received IOs were younger, more severely injured, more likely to have been injured by penetrating or burn mechanism, and often received CPR. This study provides important information on how IOs were being used in Alberta trauma patients from 2000 to 2010; the increasing use over time suggests opportunities for further research in this area.

An audit of venous thromboembolism prophylaxis in trauma patients at a level I trauma centre. *Paul Engels¹, Husham Bakry¹, Angela Coates², Abdulaziz Alali¹, Ahmed Bugshan¹, Abdullab Alghamdi¹, Ahmed AL-Jabri¹.* From ¹McMaster University, Hamilton, Ont.; and the ²Hamilton Health Sciences Trauma Program, Hamilton, Ont.

Background: Major trauma patients are one of the highest risk groups for venous thromboembolism (VTE). Currently there is no formal protocol for VTE prophylaxis at our hospital, although there is a thrombosis service. We hypothesized that significant variation in VTE prophylaxis regimens still exists among clinicians. The purpose of our study was to audit the clinical practice related to the administration of VTE prophylaxis in trauma patients at our centre. **Methods:** We used our trauma registry to identify all patients older than 16 years admitted to the trauma service for more than 24 hours between Jan. 1, 2012, and June 30, 2013. Trauma registry data were supplemented with chart-level review and data abstraction, which included details on the administration of VTE prophylaxis, recommendations made by the thrombosis service and potential contraindications to administration. We also identified any cases of VTE during the index admission. **Results:** We identified 633 cases from our registry that met inclusion criteria and formed our study cohort. Mean injury severity score was 16, mechanism was blunt in 93%, mean hospital length of stay was 11 days, and mortality was 8%. Any type of VTE prophylaxis was ordered on admission for 83.4% of patients, and 81.2% received it. Of these patients, 44.9% received pharmacologic VTE prophylaxis, 58.8% received mechanical VTE prophylaxis, and 3.7% received both. In total 402 patients did not receive any pharmacologic VTE prophylaxis, with potential contraindications identified in 83.6%. Potential contraindications identified were active extravasation on admission computed tomography scan (83.6%), surgical or angiographic procedure performed within the first 24 hours (30%), blood transfusion within the first 24 hours (13.9%) and thrombosis service recommendation against VTE prophylaxis (4%); no contraindication was found in 16%. Thrombosis service consultation was documented in 26% of the cohort. A total of 22 patients were diagnosed with a VTE, with 19 receiving some form of VTE prophylaxis. **Conclusion:** We previously reported preliminary results on 114 cases and are now presenting the full results from our completed study. Our study demonstrates good but less than universal application of any type of VTE prophylaxis in admitted trauma patients, and use of pharmacologic VTE prophylaxis in only half of such patients. Opportunities to improve care include improved ordering of VTE prophylaxis on admission, identifying perceived barriers to using pharmacologic VTE prophylaxis and possibly greater utilization of the thrombosis service.

Creation of a multi-agency provincial PIPS review committee. *Jaimini Thakore¹, Jennifer McMillan², Recep Gezer³, Beide Bekele¹, David Evans³, Catherine Jones¹.* From the ¹Provincial Health Services Authority, Vancouver, BC; ²BC Trauma Registry, Vancouver, BC; and ³Trauma Services BC, Vancouver, BC.

Background: Trauma care in British Columbia is delivered through collaboration between acute care facilities (across 5 health authorities) and transport/triage support of BC Emergency Health Services (BCEHS). Although continuous quality

improvement for trauma care is done in a variety of ways at site and regional levels, there is a gap for system-level performance and quality reviews from a provincial standpoint. In response, Trauma Services BC created the Performance Improvement and Patient Safety (PIPS) program. **Methods:** Collaborating with regional health authorities, BCEHS and other provincial partners, the provincial PIPS program sought to develop a standardized framework to monitor key performance and quality indicators and make necessary recommendations for optimal trauma care delivery in BC. This work was built on existing processes and ensured that issues that affected sites, regions and the province could be reviewed. **Results:** The PIPS program initially sought to focus on monitoring trauma deaths across the province. Through committed engagement of regional and provincial partners, the PIPS program established a process for reviewing system-related trauma mortality and will establish a process for reviewing adverse outcomes provincially. Health authorities and BCEHS were engaged and agreed to a provincial review committee protected under section 51 of the *BC Evidence Act*. Based on findings from the reviews, a provincial PIPS committee will make recommendations to enhance efficiency and performance while also supporting ongoing and reactive performance needs of Trauma Services BC (TSBC) partners across the province. Leveraging the BC Patient Safety and Learning System (BCPSLS) to ensure privacy and confidentiality, the committee will receive cases referred by regional trauma programs and its provincial partners for system-level considerations. On completion of the review, the committee will propose recommendations that, when approved, will be assigned to partners for implementation. These recommendations will be regularly monitored and reported provincially to promote learning and evaluate impact in performance. **Conclusion:** After the implementation of this framework in September 2016, TSBC looks forward to using the output of the PIPS framework to drive change, system-level improvements and evidence-based decision-making in trauma management and care delivery across BC. We anticipate to have several recommendations over the next 6–8 months.

Unplanned emergency department/urgent care centre visit or hospital readmission within 30 days of discharge from a pediatric trauma centre. *Sherry MacGillivray, Linda-Mae Grey, Jonathan Guilfoyle, Steven Lopushinsky.* From Alberta Health Services, Calgary, Alta.

Background: Unplanned emergency department/urgent care centre (ED/UCC) visits or hospital readmission rates within 30 days of discharge following a major trauma are potential quality indicators for trauma programs. These rates may reflect issues such as missed injuries, premature discharge, inadequate teaching or suboptimal follow-up. The objective of this quality initiative is to review the rate of unplanned return visits at a level I pediatric trauma centre and determine its utility as a quality indicator. **Methods:** Using the Alberta Children's Hospital (ACH) Trauma Database, patients with an injury severity score of 12 or higher admitted between 2012 and 2015 were identified. A manual search of Netcare and Clinibase was performed to identify those patients who presented to an Alberta ED/UCC within 30 days of discharge from ACH. Each chart was abstracted to capture specific clinical details. Out-of-province patients were excluded from the analysis. **Results:** During the 4-year study period, an unplanned

return rate of 11% (37 of 335 major trauma admissions) was identified. Of these visits 4 (1%) returned with complaints unrelated to their recent trauma, 25 (7%) were treated and released, and 8 (2%) required admission that was related to their recent injury. For those patients who were treated and released at an ED/UCC the most common complaint was postconcussive symptoms ($n = 12$, 48%), such as vomiting, dizziness, headache, poor feeding and sleeplessness. The majority were treated with oral ondansetron and ibuprofen. Three (12%) patients returned with abdominal pain and vomiting postabdominal trauma; typically laboratories were repeated, oral analgesia and ondansetron were given. Six (24%) patients returned for wound concerns or dressing/stoma supplies. The remainder of the patients (4, 16%) returned with mild symptoms, such as respiratory complaints, leg pain and an allergy to antibiotics. Of the 8 unplanned readmissions, 2 patients presented with missed injuries. One required a halo for a C-spine fracture, the other received oral anticoagulants for a carotid dissection. Three of these 8 patients required operative procedures (tracheostomy, ventriculoperitoneal shunt and orthopedic pinning); 2 were treated conservatively with intravenous therapy and medications for infection or concussive symptoms; and 1 was readmitted with persistent abdominal pain where further investigations identified a hepatic sarcoma. There were no deaths identified. **Conclusion:** This quality initiative showed that unplanned ED/UCC visits were infrequent and typically related to transient symptoms and complications from their initial injury. The 2% readmission rate was felt to be relatively low and was mostly considered nonpreventable. However, we have identified opportunity for initiatives looking at discharge instructions, patient education and outpatient follow-up management. The ACH Trauma Program feels it is important to include return visits as a quality indicator in our trauma quality management process.

Application of change management techniques during fast implementation in trauma code activations within the pediatric emergency department. *Lianne McLean, Suzanne Beno, Tania Principi, Jason Fischer.* From the The Hospital for Sick Children, Toronto, Ont.

Background: Focused assessment with sonography in trauma (FAST) is used in adult traumas to assess for the presence of free fluid in the abdomen and thorax. Efforts are underway to research the applicability of FAST in pediatric trauma activations. The aim of this study was to increase the utilization of FAST during traumas in our pediatric emergency department. **Methods:** This is a prospective cohort quality improvement study done in a pediatric tertiary care level I trauma centre. Education was undertaken to train pediatric emergency faculty, fellows and pediatric surgery fellows in FAST as well as implementation of a staged iterative process, simulation cases, feedback and competency assessments. Surveys were distributed to trauma team members after all traumas to assess for perceived barriers and integration into the trauma assessment. **Results:** From October 2014 to March 2016, 101 FAST scans were assessed. Over the course of the study the utilization of FAST increased from 43% of total traumas (60% of those surveyed) in the first month to 82% of surveyed activations subsequently. Staff who had completed competency assessments increased, with FAST completion consistently less than 5 minutes. Hindrance and distraction scores were low from the onset of the study and remained constant at less than 3.5/10 throughout

the study period. **Conclusion:** Perceptions and total number of scans improved over the course of this study, with hindrance and distraction measures staying constant. This study supports a multidisciplinary staged implementation of FAST into trauma activations, demonstrating the possibilities of iterative change in integrating new modalities in trauma care.

Understanding clinical variation in hip fracture care in New Brunswick. *Susan Benjamin, Allison Chisholm, Ian Watson, Tusbar Pische.* From the NB Trauma Program, Fredericton, NB.

Background: The mandate of the New Brunswick Trauma Program (NBTP) includes supporting excellence in trauma care. Excellence includes consideration of clinical consistency across sites of care. Data from the NB Trauma Registry (NBTR) were used to understand if there was clinical care consistency among persons aged 65 years and older with isolated hip fractures, a common injury cared for at the province's level I, II and III designated trauma centres. **Methods:** The NBTR includes data for all patients aged 65 years and older admitted with isolated hip fracture to the province's level I, II or III designated trauma centres having had a Canadian Triage and Acuity Scale score of 1, 2 or 3 on arrival in the emergency department. The study reviewed cases between Apr. 1, 2014, and Mar. 31, 2015. Demographic data, length of stay (LOS) and discharge disposition were stratified by age and by admission facility. **Results:** In total, 445 isolated hip fractures were identified in the registry over the study period. The average patient age was 83 years, with an average and median LOS of 21.5 days and 10.0 days, respectively. Further stratification noted variances in LOS and crude mortality across sites. Discharge disposition also varied among centres, with up to 68.5% of patients from one facility being sent to a second acute care facility, meaning the true LOS could be only partially evaluated. Predictably, we also noted progressively higher median LOS and crude mortality as age increased. Crude mortality also differed depending on the admission facility, although the number of cases and other confounding factors prevent comparison between sites. Further study is required to examine variation in local care practices ranging from time to operating room to availability of in-hospital rehabilitation resources. Existing barriers to discharge must also be evaluated. **Conclusion:** With an aging demographic in New Brunswick, understanding the burden of injury presented by isolated hip fractures is increasingly important. Our results demonstrate variability in LOS, discharge disposition and crude mortality. Further study is required to understand the true burden of this injury to both the patient and the health care system. A root cause analysis of these variability patterns has the potential to result in significant patient benefit and health care dollar savings.

The evolutionary practice of spinal protection in New Brunswick's adult trauma patients. *Eric Beirsto¹, Dana Curwen¹, Brian Attfield¹, Shelley Woodford², Susan Benjamin², Tusbar Pische², Ian Watson².* From ¹Ambulance New Brunswick, Moncton, NB; and the ²NB Trauma Program, Fredericton, NB.

Background: With growing evidence to support a change in practice, we sought to develop provincial consensus, and plan,

implement and evaluate a change in the way trauma patients receive spinal immobilization in New Brunswick. This change, implemented in December 2015, removed the long spine board, straps and head blocks from the practice of more than 1000 paramedics across New Brunswick, with concurrent introduction of scoop stretchers and supporting education in both prehospital and emergency department (ED) settings. **Methods:** Following development and approval of a consensus statement that recommended significant changes to spinal protection practices, supporting education for paramedics, ED and diagnostic imaging staff was planned, delivered and evaluated. Data from Ambulance New Brunswick and the NB Trauma Registry (NBTR) were used to evaluate the effectiveness of implementation and detection of potential patient risk. We also surveyed prehospital and ED staff to evaluate awareness, acceptance and potential changes in risk perception. **Results:** Data from January to June 2015 (preimplementation) were compared with data from January to June 2016 (postimplementation). There were 1189 qualifying patients in the preimplementation cohort, 93.7% of whom received full spinal protection. There were 977 qualifying patients in the postimplementation cohort, of whom only 1.8% received full spinal immobilization. The NBTR allows review of all trauma patients with an initial Canadian Triage and Acuity Scale score of 1, 2 or 3 who arrived at any of the province's level I, II or III designated trauma centres. This review included case-level analysis of all patients who arrived by ambulance and for whom a clinical quality filter was identified by a trauma nurse. There were 4 cases where isolated femur fractures were not immobilized with a traction splint and where the absence of a spine board may have contributed to inadequate fracture immobilization. There were no other clinical quality filters applied that could reasonably be attributed to the absence of historical spinal immobilization practices. Finally, there were 147 survey responses. Universally strong support was present for the change in practice. However, up to 34% of respondent groups suggested that they may have a lower perception of patient risk when presented with a patient in a cervical collar but not on a long spine board, head blocks and straps. **Conclusion:** Our results demonstrate that paramedics and ED staff have readily and immediately embraced this significant change in prehospital clinical practice. Early collaboration, coordinated implementation and rigorous evaluation methods helped ensure successful implementation. Additional educational support for paramedics and nurses may be warranted to address decreased perception of patient risk when spinal protection changes are made.

High-risk medications in geriatric trauma patients: What are the effects, and how well do we mitigate them? *Erica Lester¹, Sandy Widder², Vanessa Fawcett¹, Mark Dykstra¹, Bonnie Tsang¹, Chantalle Grant¹.* From the ¹University of Alberta, Edmonton, Alta.; and the ²University of Alberta Hospital, Edmonton, Alta.

Background: Polypharmacy is a known risk factor for trauma in the elderly. The Beers Criteria for Potentially Inappropriate Medication Use in Older Adults outlines medications for which the risks of use outweigh the benefits. This study assesses the nature of polypharmacy, reports on its modification during hospital admission, and measures the impact of Beers Criteria medica-

tions (BCMs) on outcomes in geriatric trauma patients in the Edmonton Zone. **Methods:** A retrospective study of geriatric (age > 65 years) major trauma (injury severity score [ISS] > 12) patients admitted to a level I trauma centre over 2 years was conducted. Basic descriptive statistics were used to explore the change in medication prescriptions pre- and postadmission. Multivariable regression was used to assess the impact of admission medications on length of stay (LOS) and 30-day mortality. **Results:** The mean age of patients included in this study was 76.0 ± 8.2 years, and mean ISS was 22.2 ± 7.5 . The mean number of admission medications was 4.71 ± 3.82 , and the mean number of BCMs per patient was 1.25 ± 1.37 . The change in BCMs prescribed from admission to discharge ranged from -3 to 5, and the overall number of BCMs prescribed preinjury did not significantly change after hospital discharge. Neither the specialty service discharging the patient nor the location to which the patient was discharged was associated with a significant change in the number of BCMs prescribed. The adjusted odds ratio for 30-day mortality for each additional BCM prescribed was 1.79 (95% CI 1.08–2.95, $p < 0.001$) versus 1.25 (95% CI 1.02–1.53, $p < 0.002$) for each additional medication of any type. The adjusted incidence rate ratio for LOS for each additional BCM was 1.15 (95% CI 1.03–1.30, $p < 0.010$) versus 1.05 (95% CI 1.01–1.10, $p < 0.002$) for all medications. **Conclusion:** The number of high-risk medications prescribed to the elderly was not significantly altered during trauma admissions in the Edmonton Zone. Each BCM increased the hospital LOS by 15%, and was associated with an increased odds of 30-day mortality. Further work is needed to ensure that medical professionals caring for elderly trauma patients are aware of the Beers criteria, and that quality medication reviews are conducted during hospital admission.

A descriptive study of Canadian pediatric trauma systems and pediatric emergency physician trauma team leader maintenance of competency. *Kate Fathi¹, Garth Meckler², Karen Black².* From the ¹The Hospital for Sick Children, Toronto, Ont.; and the ²BC Children's Hospital, Vancouver, BC.

Background: The current organization of Canadian pediatric trauma systems and the methods used to maintain trauma competency have not been described. This study aims to describe trauma systems in Canadian pediatric emergency departments (EDs), the initial requirements and certification of pediatric emergency medicine (PEM) physicians as pediatric trauma team leaders (TTLs) within the Canadian pediatric trauma centres, and continuing medical education requirements and opportunities for pediatric trauma physicians. **Methods:** This is a descriptive study of Canadian pediatric trauma centres within the Pediatric Emergency Research Canada network. Online questionnaires regarding institutional and demographic data were completed by trauma coordinators. Pediatric ED division heads or medical directors were interviewed in person or by telephone, exploring the initial and ongoing maintenance of competence requirements at each site. Standard descriptive statistics were used to analyze trauma systems and competency. A qualitative framework was used to analyze interviews. **Results:** The survey response rate from 13 PEM centres was 69% for online questionnaires and 100% for interviews. A total of 70% of pediatric trauma centres are accredited by the Trauma Association of

Canada or Accreditation Canada. A total of 88% of sites distinguish between major and minor trauma, although definitions are inconsistent across centres. A total of 92% of centres have trauma activation protocols, and 66% have a tiered trauma activation. All but 2 centres have a designated trauma team. The reported average volume of major trauma patients per year is 70 (range 29–123). TTL staffing is diverse, with 61.5% having an on-call TTL physician and 38.5% having an on-shift PEM TTL. Of the sites with an on-call TTL, 25% have surgery as TTL, 25% have the designated TTL from a mixture of specialty services, and 50% have the TTL split according to trauma activation tier. Most sites (80%) require Advanced Trauma Life Support (ATLS) certification for PEM physicians acting as TTL, but only 30% require maintenance of certification. The reported maintenance of competency requirements are limited for PEM physicians participating in trauma: 16.7% of sites require trauma maintenance of competency, 7.7% of sites report a formal TTL assessment process, 0% of sites track cases or procedures performed per physician, and 0% of sites report a formal feedback process with regards to trauma performance. **Conclusion:** Across Canadian pediatric EDs there is no unified approach to trauma; however, most centres are accredited and have distinct teams and activation criteria. Overall there is inconsistent trauma maintenance of competency, which may be particularly important given the relatively low volume of major trauma. In Canada, we have the opportunity to standardize pediatric trauma and share best practices.

Patterns of injury in private aviation accidents. *Oriane Longerstaey¹, Kenji Inaba², Gustavo Recinos², Alberto Aiolfi², Elizabeth Benjamin², Lydia Lam³, Kazubide Matsushima², Aaron Strumwasser², Demetrios Demetriades³.* From the ¹Keck School of Medicine of USC/LAC+USC Medical Center, Los Angeles, Calif.; the ²Division of Trauma and Surgical Critical Care, USC/LAC+USC Medical Center, Los Angeles, Calif.; and the ³LAC+USC Medical Center, Los Angeles, Calif.

Background: The National Transportation Safety Board documents nearly 1500 private aviation accidents a year in the United States. Although these data demonstrate that the majority of these accidents do not result in fatalities, the burden of injuries in survivors remains undefined, and this was the focus of the following study. **Methods:** Patients involved in aviation accidents that were neither commercial nor military were retrospectively identified from the National Trauma Data Bank (NTDB) from January 2007 to December 2014. Clinical demographics and outcomes were abstracted. **Results:** During the study period, a total of 2 989 627 patients were registered in the NTDB. The most common mechanism of injury was motor vehicle collisions, affecting 1 148 281 (38.4%) patients. In comparison, private aviation made up only 1335 (0.04%) of these injuries. Median age was 54 years (interquartile range [IQR] 2–88 years), with 87.0% of the population being male. On presentation, 13.6% had a Glasgow Coma Scale (GCS) score of 8 or lower, 7.2% were hypotensive, and the median injury severity score (ISS) was 13 (IQR 6–22), with 20.7% patients having an ISS above 25. Lower extremities were the most common body region injured (53.3%), followed by the spine (50.2%), face (49.2%), head (44.8%), thorax (44.2%), upper extremities

(43.1%), abdomen (19.9%) and neck (4.1%). Overall mortality was 6.4%, with most deaths occurring within the first 24 hours (72.1%). Among patients who died, the most prevalent injuries were rib/sternal fractures (51.2%), intracranial bleeds (39.7%), and hemo/pneumothoraxes (39.5%). As for operative burden, 31.7% of patients had major orthopedic procedures, 11.1% had spinal procedures, 7.5% had vascular procedures, 3.8% underwent laparotomies, 0.9% had craniectomies/craniotomies and 0.8% had a thoracotomy. After logistic regression was performed, having a GCS score of 8 or lower, being hypotensive and having a thoracic vascular injury were all independent predictors of mortality. **Conclusion:** Private aviation accidents are rare and associated with low mortality, but are a significant burden of injury. Patients who survive experience high rates of lower-extremity, spine and facial injuries; and the need for surgical interventions, particularly orthopedic procedures, is common.

Comparison of tranexamic acid plasma concentrations when administered via intraosseous and intravenous routes. *Soren Boysen¹, Jessica Pang², Nigel Caulkett², Cameron Knight², John Mikler², Hugh Semple².* From the ¹University of Calgary, Faculty of Veterinary Medicine, Calgary, Alta.; and the ²University of Calgary, Calgary, Alta.

Background: There is a lack of information regarding intraosseous (IO) administration of tranexamic acid (TXA). The hypothesis of this study is that a single bolus IO injection of TXA will have a similar pharmacokinetic profile to TXA administered at the same dose intravenously (IV). **Methods:** Swine were divided into 2 groups: IV ($n = 8$) and IO ($n = 8$). Each animal received 30 mg/kg of TXA. Blood was collected for pharmacokinetic analysis over a 3-hour period. Maximum TXA plasma concentration and time, distribution half-life, half-life, area under the curve, plasma clearance and volume of distribution were calculated. One- and 2-way analysis of variance for repeated measures (time, group) with Tukey and Bonferonni post hoc tests were used to compare TXA plasma concentrations within and between groups. **Results:** Plasma concentrations of TXA were significantly higher ($p < 0.0001$) in the IV group during the TXA infusion. Peak plasma concentrations occurred 4 minutes after initiation of the bolus in the IV group (9.36 ± 3.20 ng/ μ L) and 5 minutes after initiation of the bolus in the IO group (4.46 ± 0.49 ng/ μ L). Plasma concentrations were very similar from the completion of injection onward. There were no significant differences between the 2 administration routes for any other pharmacokinetic variables measured. **Conclusion:** The results of this study support pharmacokinetic bioequivalence of IO and IV administration of TXA.

Effect of postintubation hypotension on outcomes in major trauma patients. *Robert Green¹, Michael Butler², Mete Erdogan¹.* From ¹Trauma Nova Scotia, Halifax, NS; and ²Dalhousie University, Halifax, NS.

Background: Previous studies have shown that the development of postintubation hypotension (PIH) is common and associated with poor outcomes in critically ill patients who require emergency endotracheal intubation (ETI). However, PIH has not been evaluated previously in the trauma population. The aim of

this study was to determine the incidence of PIH in trauma patients and to evaluate the association between PIH and patient outcomes. **Methods:** This study was a retrospective case series of adult (age ≥ 16 years) trauma patients requiring intubation after referral to a provincial trauma team located at a level I centre in Halifax, NS, between 2000 and 2015. Data were collected from a provincial trauma registry and the patient charts. We evaluated PIH incidence and created a logistic regression model to determine the likelihood of mortality in PIH and non-PIH groups after controlling for potential confounding variables. **Results:** Overall, 477 patients arrived unintubated and required ETI by the trauma team during the study period, of which 444 patients met eligibility criteria and were included in the analysis. The incidence of PIH was 36.3% (161 of 444) in our study population. The PIH and non-PIH groups were similar with respect to sex, provider level and volume of fluid administered within 15 minutes of intubation. Patients in the PIH group were older (44.8 ± 20.8 years v. 39.0 ± 18.2 years, $p = 0.003$) and more likely to have an injury severity score of 12 or higher (84.8% v. 75.4%, $p = 0.021$). In-hospital mortality in the PIH group was 29.8% (48 of 161) compared with 15.9% (45 of 283) in the non-PIH group ($p = 0.001$). Death in the emergency department occurred in 7.5% (12 of 161) of patients in the PIH group versus 1.4% (4 of 283) in the non-PIH group ($p = 0.002$). Fewer patients in the PIH than in the non-PIH group required hospital admission (86.3% v. 93.3%, $p = 0.017$) and ICU admission (76.4% v. 86.6, $p = 0.009$). After controlling for possible confounding factors, development of PIH was associated with increased mortality in trauma patients (odds ratio [OR] 1.83, 95% CI 1.01–3.31, $p = 0.047$). **Conclusion:** In our study, development of PIH was common (36.3%) and associated with increased mortality (OR 1.83). Clinicians should attempt to minimize hemodynamic instability during ETI in patients with traumatic injuries. Further investigation of PIH in the trauma population is warranted.

Injuries related to distraction by mobile devices while driving: a systematic review. *Natasa Zatezalo¹, Mete Erdogan², Robert Green².* From ¹Dalhousie University Medical School, Halifax, NS; and ²Trauma Nova Scotia, Halifax, NS.

Background: Globally, distracted driving is a growing public health concern owing to increased risk of involvement in a motor vehicle collision (MVC). While the use of mobile devices (i.e., cellular phones, smartphones) by drivers has increased dramatically in the 21st century, the proportion of MVC injuries caused by mobile device use is unclear. The objective of this study was to determine the proportion of MVC injuries related to distracted driving involving use of a mobile device. **Methods:** We systematically searched the grey literature and 5 databases (PubMed, EMBASE, CINAHL, TRIS, Web of Science) from inception to September 2016 to identify reports of MVC injuries (regardless of severity) attributed to mobile device use. Descriptive statistics were used to evaluate injury characteristics and prevalence. We calculated a rate of distracted driving–related trauma, defined as ratio of drivers injured or killed in mobile device–related MVCs to total number of drivers injured or killed in MVCs. **Results:** A total of 4231 articles were screened, of which 12 met all eligibility criteria. Studies were published between 1998 and 2014. Most were performed in the United States ($n = 5$) and Australia ($n = 3$). Studies varied in the methods used for determining that driver

distraction by a mobile device was involved in an MVC. Overall, the median rate of distracted driving–related trauma was 2.4% (range 0.04%–44.7%). The severity of injuries reported ranged from minor to fatal; 2 studies also included possible injury. Studies reporting higher rates of distracted driving–related trauma tended to have been performed more recently. Among studies that stratified distraction-related injuries by age group, most injuries were seen in drivers aged 20–30 years. The association between mobile device use and road traffic injury was evaluated in 3 studies. Two of these studies found that the likelihood of serious or fatal injury was significantly increased by mobile phone use. The third study reported that the risk of being injured or killed in a crash for drivers using a hand-held phone was only significantly increased in drivers aged 25–29 years when compared with drivers involved in MVCs without any distraction. **Conclusion:** Previous investigations have determined that road traffic injuries and fatalities were attributed to driver distraction by mobile devices in 2.4% of MVC cases (range 0.04%–44.7%). However, studies included in this review were subject to significant methodological limitations in the collection of reliable data on distraction-related MVCs. Thus, we believe that further investigation is required to determine an accurate rate of distracted driving–related trauma.

Medical student–performed ultrasonography in trauma. Postcourse survey and performance results in patients undergoing DPL. *Matt Kaminsky.* From Cook County Trauma Unit, Chicago, Ill.

Background: Nonradiologist-performed ultrasonography continues to evolve with more junior residents and student sonographers. We hypothesize that a limited ultrasound course would be well received by medical students with new skills to generate reasonable ultrasound images and ability to detect clinically relevant free intra-abdominal fluid at time of diagnostic peritoneal lavage (DPL). A postcourse survey was performed to explore the students' perception of skill acquisition and opinions on the utility of the course at their level of training. **Methods:** Third- and fourth-year medical students were given an abbreviated 1-hour video and hands-on ultrasound course. Students were assessed for image acquisition of the hepatorenal and splenorenal fossa to detect 0, 200, 400, 600, 800 and 1000 mL of DPL fluid infiltrated in stages. A postcourse survey was performed to explore the students' perception of skill acquisition and opinions on the utility of the course at their level of training. **Results:** Between June 2013 and August 2014 more than 90 medical students rotating in the trauma department underwent the directed training course. Twenty patients requiring DPL were paired with a medical student for assessment of ultrasound skill acquisition. Students evaluated were able to generate an adequate image of the hepatorenal fossa at a rate of 90%, with the performance rate dropping to 67% for the splenorenal fossa. The mean volume of DPL fluid to correctly generate an initial positive interpretation by the medical student was 625 ± 205 mL for the hepatorenal fossa and 833 ± 197 mL for the splenorenal fossa. A sensitivity of 86.5% (95% CI 74.2%–94.4%) and specificity of 93.1% (95% CI 83.3%–98.1%) was determined for the hepatorenal fossa. For the splenorenal fossa the students achieved a sensitivity of 61.1% (95% CI 35.8%–82.6%) and specificity of 91.9% (95% CI 82.2%–97.3%). Students uniformly felt they had acquired a new

skill set that would be easily applicable to their future career/residency. **Conclusion:** After limited but directed focused assessment with sonography for trauma (FAST) ultrasound training course, students were able to generate adequate images of the hepatorenal and splenorenal fossa, with good sensitivity and specificity at detecting free fluid, particularly for the hepatorenal fossa. Short directed training courses in ultrasound are feasible, practical and well received by students, with clinically relevant performance achievable. Our postcourse survey revealed significant confidence at skill acquisition.

BC equestrian-related injuries: a review of the last 5 years. *Rachel Lim¹, Kasra Hassani¹, Joe Haegert², Jaimini Thakore², Karli Gamble².* From ¹Fraser Health, Surrey, BC; and ²Provincial Health Services Authority, Vancouver, BC.

Background: Horseback riding is a popular yet dangerous sport. It has been estimated to have a hospital admission rate of 0.49/1000 hours of activity, making it more dangerous than motorcycle riding, skiing, automobile racing, football and rugby. The patterns of injury and demographics of patients with equestrian-related injuries vary widely among regions, emphasizing the need for local studies. Furthermore, equestrian injuries in British Columbia have not been studied for almost 2 decades, prompting a revisit. **Methods:** This is a retrospective study using secondary data from the BC Trauma Registry (BCTR) and the Discharge Abstract Database (DAD). The population of interest in this study was all patients with equestrian-related injuries admitted to an acute care hospital in British Columbia between Apr. 1, 2010, and Mar. 31, 2015. Data were filtered using ICD codes V80.0-V80.9 and analyzed using standard descriptive and inferential statistical methods. **Results:** From 2010 to 2015, there were a total of 1017 cases of equestrian injuries in BC, which is almost half of what had been reported from 1991 to 1996. Only 1 patient died of their injuries during this period, which is a dramatic reduction from the 15 deaths that occurred between 1991 and 1996. Injuries were more common in the 10–19 year and 40–59 year age ranges and were 3 times as common among women than men. Although 62% of injuries belonged to women in 1991–1996, this percentage has climbed to 73% in our data. Injuries were most common in the Interior Health region and least common in the Vancouver Coastal Health region. **Conclusion:** Although the rate and number of equestrian injuries have decreased compared with 2 decades ago, they have remained relatively flat in the past half-decade. Additionally, the percentage of women who sustained an injury while horseback riding has increased. The results of this study will help in planning and implementation of awareness and injury prevention campaigns to help reduce the rate and severity of equestrian injuries in British Columbia.

Interesting case: gunshot wound to the cardiac septum. *Matt Kaminsky.* From the Cook County Trauma Unit, Chicago, Ill.

Background: A 17-year-old boy presents to the trauma bay with stable vital signs and a single gunshot wound to the left thoraco-abdomen midaxillary line. Anteroposterior chest x-ray and subsequent lateral film appear to reveal the bullet within the heart. Immediate focused assessment with sonography for trauma (FAST) scan was positive only for a left-sided hemothorax, and

follow-up emergent cardiac ultrasound by cardiology was negative for pericardial effusion, structural abnormalities, or dysfunction. **Methods:** This is a case for poster with beautiful images. No methods are present. **Results:** Computed tomography (CT) angiogram of the chest demonstrated the bullet within the heart, possibly in the cardiac septum or within a trabecula of the right ventricle. Splenic injury with active extravasation was also noted. Prior to transfer to the operating room, a repeat transthoracic echocardiogram (TTE) with cardiology verified no pericardial effusion and stable but inexact bullet location. The missile appeared to be within the septum between the tricuspid and aortic valves, but an intraventricular location could not be ruled out. The patient underwent an exploratory laparotomy and splenectomy. A 3 cm linear serosal injury was noted along the anterior surface of the stomach, and a small entry wound was noted near the lateral edge of segment III of the liver. **Conclusion:** Owing to the lack of pericardial effusion, patient stability and the possibility that the bullet had simply migrated to the heart from a branch of the left hepatic vein, no urgency for immediate cardiac exploration was indicated. Further localization of the missile was desired for better cardiac surgical planning. A gated CT scan was performed the following morning, with elective cardiac surgery 2 days after admission. A retained missile with the septum was confirmed, removed and patched.

Motocross versus motorcycle injury patterns: a retrospective NTDB analysis. *Nicole Fierro¹, Kenji Inaba², Alberto Aiolfi², Gustavo Recinos², Elizabeth Benjamin², Lydia Lam², Aaron Strumwasser², Demetrios Demetriades².* From the ¹LAC + USC Medical Center, Los Angeles, Calif.; and the ²Division of Trauma and Surgical Critical Care, LAC+USC Medical Center, Los Angeles, Calif.

Background: Whereas motorcycle crashes have been well studied, motocross-related injury patterns and outcomes are poorly understood. The purpose of this analysis was to compare motocross and motorcycle collisions. **Methods:** Data on motocross drivers and passengers were extracted from the National Trauma Databank (2007–2014). Variables extracted were demographics, comorbidities, mechanism of injuries, Abbreviated Injury Scale (AIS) score for each body area, injury severity score (ISS) and vital signs in the emergency department (ED). Outcomes included mortality, complications, ventilation days, length of stay (LOS) in the intensive care unit and hospital LOS. **Results:** A total of 5 774 836 patients were entered into the NTDB, of which 141 529 (2.4%) patients were involved in either a motocross or motorcycle collision. Of those collisions, 31 252 (22.1%) involved motocross bikes, and the remaining 110 277 (77.9%) involved motorcycles. Most of the patients were drivers (94.4%). Motocross riders were younger (23 years v. 42 years, $p < 0.001$) and less likely to be female (9.5% v. 13.4%, $p < 0.001$). Compared with motorcycle riders, helmets were used more often by motocross riders (68.9% v. 54.1%, $p < 0.001$). Motocross patients were more likely to have a severe abdominal injury (AIS ≥ 3 ; 31.6% v. 28.7%, $p < 0.001$), whereas they were less likely to have severe head or chest injuries (43.6% v. 53.8%, $p < 0.001$ and 75.0% v. 76.0%, $p = 0.029$, respectively). Extremity fractures were significantly higher in motocross patients (33.5% v. 32.6%, $p = 0.006$). Overall mortality for both groups was 1.2%, and was significantly lower in the motocross group (0.3% v.

1.4%, $p < 0.001$). Stepwise logistic regression analysis identified age older than 60 years, Glasgow Coma Scale score of 8 or lower, hypotension on admission, severe head injury (AIS ≥ 3), and riding a motorcycle, either as a driver or passenger, to be independent predictors of mortality. Helmet use was protective against death for all patients (OR 0.866, 95% CI 0.755–0.992, $p = 0.039$). In the subgroup analysis, being motocross drivers or passengers were independent predictors of lower mortality (OR 0.458, 95% CI 0.359–0.585, $p < 0.001$ and OR 0.127, CI 95% 0.017–0.944, $p = 0.044$, respectively). **Conclusion:** Motocross and motorcycle collisions are distinct mechanisms of injury. Motocross collisions are associated with improved outcomes compared with motorcycle collisions. Riding a motorcycle is an independent risk factor for mortality. Wearing a helmet is a protective factor against death for both motocross and motorcycle riders.

Prehospital time: an urban trauma quality marker? *John Kubasiak, Chris Knapp, Andrew Dennis, Kimberly Joseph, Kimberly Nagy, Fredric Starr, Matt Kaminsky, Faran Bokhari.* From the Cook County Hospital, Chicago, Ill.

Background: The impact of prehospital emergency medical service (EMS) on urban times has recently been debated. In our urban multicentre trauma region recent investigations have used distance as a proxy for time. The opportunity to use this information as an external quality measure led our group to explore the impact of EMS prehospital time on risk-adjusted mortality at urban trauma centres in our trauma region. **Methods:** Patients in the Illinois State Trauma Registry who sustained gunshot wounds (GSW) and were transported to the emergency department (ED) via ambulance with valid prehospital transport times were included. Mortality was investigated across prehospital time, injury severity score (ISS), prehospital systolic blood pressure (SBP) and heart rate (HR). **Results:** Between 2003 and 2013, 8005 patients met the criteria for inclusion. Overall mortality was 16.9% ($n = 1355$), 91.9% of patients were male, and 83.0% were African-American. Mortality in the ED was 9.4%, and 36.4% of patients went on to the operating room from the ED. Total prehospital median time was 28.9 minutes (range 4–654 minutes), response median time was 1.1 minute (range 0–541 minutes), scene median time was 12.34 minutes (range 1–508 minutes), and transport median time was 16.0 minutes (range 1–652 minutes). On univariate analysis no statistical difference was seen in mortality by median total prehospital time, scene time, or transport time. On logistic regression scene time and transport time were not significant. Hypotension, HR and decreased GSW were significant predictors of mortality. **Conclusion:** In our urban trauma region prehospital EMS time was not a significant predictor of mortality. Expected outcomes, including hypotension, tachycardia or decreased GSW, were significant predictors of mortality. Based on this state registry prehospital EMS times should not be used as a quality measure for regional trauma centres.

Pattern of traumatic intracranial hemorrhage predicts the need for serial head imaging. *John Kubasiak, Chris Knapp, Andrew Dennis, Fredric Starr, Kimberly Nagy, Kimberly Joseph, Matt Kaminsky, Faran Bokhari.* From the Cook County Hospital, Chicago, Ill.

Background: Patients with blunt head trauma (BHT) and intracranial hemorrhage (ICH) are at risk for continued bleeding after

the initial traumatic event. Current recommendations include serial observations in monitored units and interval head computed tomography scans (hCT). These interval hCTs carry the risk of increased radiation exposure and risk of transporting seriously ill patients for imaging. We hypothesize that different patterns of ICH lead to different rates of medical and surgical interventions. **Methods:** We retrospectively reviewed all admissions between January 2011 and January 2013, collecting admission information, anticoagulation use, physical exams and laboratory results. We grouped patients into no intervention and intervention categories. Intervention was determined as new surgery, monitor, medical therapy, or additional imaging ordered. The primary outcome was type of ICH on initial imaging; the secondary outcome was the pattern of ICHs. **Results:** Subarachnoid hematoma (SAH; $p = 0.032$) and intraventricular hematoma ($p = 0.034$) alone were significant; subdural hematoma ($p = 0.148$) and epidural hematoma ($p = 0.860$) were not significant for intervention. Age ($p = 0.756$) and injury severity score ($p = 0.779$) were not significant for intervention. After logistic regression, intubation on arrival (odds ratio [OR] 2.66, 95% CI 1.04–5.70) and subarachnoid hemorrhage (OR 2.30, 95% CI 1.05–5.04) were significant predictors. When examining for patterns of ICH we found the addition of SAH to any other ICH led to an increased rate of intervention (OR 2.30, 95% CI 1.07–4.93). **Conclusion:** We found that the presence of SAH with any other associated abnormality on initial hCT demonstrated an increased need for intervention. When caring for patients with ICH, application of these findings could reduce the need for serial hCT scans in patients without SAH, thus saving time, transport risks and radiation exposure. Further prospective study is underway.

Trauma in pregnancy: the mother of innovation. *Nasira Lakha, Richard Simons, Heather Wong, Laurie McLauchlin.* From Trauma Services, Vancouver General Hospital, Vancouver, BC.

Background: Vancouver General Hospital (VGH) is the quaternary referral centre for trauma patients for the region and province. There is no maternal, fetal, and obstetric care at VGH, making it challenging to care for pregnant women. This care is available at neonatal centres geographically separated from VGH. The level III trauma centres have limited obstetrics and are not resourced to care for the major trauma patients. This has posed challenges in providing comprehensive trauma care at VGH. **Methods:** A retrospective analysis of pregnant trauma cases indicated the majority of pregnant trauma patients were transferred to VGH for treatment of their severe injuries. This is in alignment with prehospital destination guidelines and VGH being the quaternary trauma centre for BC. The injury severity score for these patients ranged from 1 to 30. **Results:** Over a 5-year period, a total of 25 pregnant trauma patients were treated within the 3 VGH trauma centres. Nineteen received treatment at VGH, and a gap in obstetrical care was identified. A partnership between BC's specialized women's hospital and VGH was formed, providing on-call coverage of maternal fetal medicine physicians and nurses for all pregnant major trauma admission with direct communication with the attending physician. This provided continuous coverage and provision of perinatal care and allowed for a collaborative medical management model. A clinical practice guideline and framework on the management of the pregnant major trauma patient was developed for both VGH and

prehospital use. This partnership led to the development of a Code Pink algorithm for VGH that supports an imminent delivery. **Conclusion:** The goal to improve patient care and outcomes for this special population in an environment without specialized maternal fetal care has resulted in collaborative decision-making about patient care and disposition for both trauma and other specialized services. All cases are rigorously reviewed for education and quality improvement. This has optimized the outcomes for pregnant women requiring specialized services and has resulted in an integration of protocols and implementation of a neonatal resuscitation program at VGH.

Routine transfusion of platelets to patients on acetylsalicylic acid or clopidogrel with traumatic intracranial bleeds does not change craniotomy needs and may not be warranted. *Farid Muakkassa¹, Robert Marley¹, Ayab El-Khatib², Courtney Docherty³, Hannab Stephen⁴, Linda Muakkassa⁴, Ann Salvator¹.* From the ¹Cleveland Clinic Akron General, Akron, Ohio; ²Northeast Ohio Medical University, Rootstown, Ohio; ³Philadelphia College of Osteopathic Medicine, Philadelphia, Pa.; and the ⁴University of Akron, Akron, Ohio.

Background: Patients are increasingly taking antiplatelet drugs, such as acetylsalicylic acid (ASA) and clopidogrel (CL) to prevent clotting of stents or treatment of vascular disease. After a traumatic intracranial bleed (TIB), they are often transfused with platelets in an attempt to reverse the effect of ASA/CL and decrease neurologic complications. This study evaluates the effects of platelet transfusions in an era where blood conservation strategies are used by hospitals to decrease blood product-associated complications. **Methods:** Patients admitted between 2011 and 2015 who were on ASA/CL and who sustained a TIB were divided into 2 groups: those who received platelet transfusion (PLT) and those who did not (NOPLT). Data collected were demographics, hospital mortality, morbidity (i.e., infections, neurologic complications, transfusion complications), craniotomies, repeat head computed tomography (CT) changes and length of stay (LOS) in the intensive care unit (ICU). Multivariable logistic regression was used to compare the 2 groups. **Results:** A total of 579 TIB trauma patients were identified: 168 in the PLT group and 411 in the NOPLT group. After adjusting for covariates, including age, ASA and CL use, coronary artery disease, respiratory failure, skull fractures and hypertension, the PLT group had significantly more stays in the ICU longer than 3 days (odds ratio [OR] 1.7, $p = 0.03$) and a trend toward increased mortality (OR 2.1, $p = 0.08$) than the NOPLT group, adjusting for the combination of ASA and CL. There was no significant difference in craniotomies between the PLT ($n = 20$, 12%) and the NOPLT group ($n = 41$, 10%, $p = 0.59$). The PLT group had a trend toward more infections than the NOPLT group ($n = 17$, 10% v. $n = 25$, 6%, $p = 0.07$). There was no difference in the results of the initial head CT before platelet transfusion and the one posttransfusion regarding the size of the bleed (decreased 42% v. unchanged 30% v. increased in severity 17%, $p = 0.41$). **Conclusion:** There was no statistical difference in craniotomies or CT scan changes between the PLT and NOPLT groups. The PLT group had a trend toward higher mortality and increased rate of infections compared with the NOPLT group. Routine platelet transfusion of patients on ASA/CL

with TIB may not be warranted. Testing platelet function at presentation in the ASA/CL patients with TIBs may help select which patients may benefit from platelet transfusion.

Routine lower-extremity deep vein thrombosis surveillance in trauma patients has too low a yield for it to be considered clinically beneficial. *Farid Muakkassa¹, Robert Marley¹, Erinn Coe^{2,3}, Courtney Docherty^{3,4}, Linda Muakkassa⁴, Hannab Stephen⁴, Danny Aiti⁵, Ann Salvator¹.* From the ¹Cleveland Clinic Akron General, Akron, Ohio; ²Northeast Ohio Medical University, Rootstown, Ohio; ³Philadelphia College of Osteopathic Medicine, Philadelphia, Pa.; ⁴University of Akron, Akron, Ohio; and ⁵Ohio State University, Columbus, Ohio.

Background: Trauma patients are at risk for deep vein thrombosis (DVT), which can range from being asymptomatic to causing morbidity or be potentially fatal with pulmonary embolisms (PE). Their detection and treatment are perceived to be important to decrease morbidity and mortality. This study sought to evaluate the effectiveness and clinical relevance of a DVT surveillance protocol in a surgical intensive care unit (SICU) at a level I trauma centre. **Methods:** Trauma patients admitted to the SICU from 2006 through 2014 had routine bilateral lower extremity Doppler studies done on day 5 of admission and then weekly until discharge from the SICU. Data were collected prospectively and included demographics, comorbidities, mortality, incidence of DVTs and PEs, inferior vena cava filters (IVCF) placed, onset of chemoprophylaxis, operative procedure, and time from admission to DVT or PE. χ^2 analysis was used to compare the DVT and PE groups. **Results:** There were a total of 2572 trauma patients screened for DVT in the SICU. Doppler studies revealed the following: DVT ($n = 54$, 2.1%) and DVT/PE ($n = 14$, 0.5%). There were also diagnoses of PE ($n = 8$, 0.3%) with a negative Doppler. There were 5 deaths in the DVT group and 1 death in the DVT/PE group not related to DVT/PE. There was no statistical difference in the onset of chemoprophylaxis if started more than 5 days after admission to the SICU among the 3 groups (DVT 36% v. DVT/PE 37% v. PE 50%, $p = 0.74$). There were no statistically significant differences among the 3 groups for placement of IVCF (DVT 17% v. DVT/PE 28% v. PE 37%, $p = 0.26$), intracranial bleeds (DVT 52% v. DVT/PE 28% v. PE 37%, $p = 0.26$), vertebral fractures (DVT 22% v. DVT/PE 29% v. PE 50%, $p = 0.24$), lower extremity fractures (DVT 9% v. DVT/PE 21% v. PE 12%, $p = 0.45$), or splenic injury (DVT 4% v. DVT/PE 0 v. PE 12%, $p = 0.15$), respectively. There was a statistically higher incidence of DVT/PE in the pelvic fracture group (DVT 2% v. DVT/PE 29% v. PE 37%, $p = 0.001$). All patients had compression devices and chemoprophylaxis with unfractionated heparin or low molecular-weight heparin initiated depending on physician preference. **Conclusion:** Although a DVT surveillance protocol may detect asymptomatic DVTs and prompt insertion of IVCF in patients with contraindications to anticoagulation, its yield is low and clinically of no benefit in altering outcomes. It is recommended that lower extremity Doppler should not be obtained routinely as part of a surveillance protocol in the SICU, but should be considered in patients with select injuries with higher incidence of DVT/PE, such as pelvic fractures.

Feasibility of remote ischemic conditioning in posttraumatic hemorrhagic shock patients: a phase II randomized

controlled trial. *Chung Ho Leung*¹, *Sandro Rizoli*¹, *Josh Bell*¹, *Shawn Rhind*², *Andrew Baker*¹, *Christopher Caldarone*¹, *Ori Rotstein*¹. From ¹St. Michael's Hospital, Toronto, Ont.; and ²Defense Research and Development Canada, Toronto, Ont.

Background: Resuscitated trauma patients are susceptible to late morbidity due to the development of systemic inflammation and organ dysfunction. Remote ischemic conditioning (RIC) is a non-invasive intervention comprising transient limb ischemia reperfusion that mitigates distant organ injury and inflammation in animal models of ischemia reperfusion and resuscitated hemorrhagic shock. The present phase II randomized controlled single-centre trial was designed to evaluate the feasibility of administering RIC postinjury in hemorrhagic shock patients upon arrival to the trauma centre. **Methods:** Eligible patients admitted to St. Michael's Hospital with blunt or penetrating trauma in hemorrhagic shock (systolic BP < 90 mm HG) were randomized in a 1:1 ratio to receive either sham intervention (0 mm Hg) or RIC (4 cycles of 5-minute thigh cuff inflation at 250 mm Hg followed by 5-minute deflation using a pneumatic tourniquet). Feasibility was determined by whether RIC was administered and completed within 4 hours of injury. **Results:** Forty-seven patients with a median injury severity score (ISS) of 13.5 were enrolled between May 2015 and September 2016, of whom 41 patients had completed either the sham ($n = 23$) or RIC ($n = 18$) intervention. The majority of patients received the intervention in the trauma bay ($n = 17$), followed by the computed tomography room ($n = 11$), operating room ($n = 10$), emergency department ($n = 2$) and intensive care unit ($n = 2$). Nine patients had the intervention interrupted due to transfer between departments, but had the full intervention completed within 4 hours of injury. Of the patients who did not complete the intervention, 1 was from the sham intervention group and 5 were from the RIC group. The reasons for incompletion were vascular surgery on the thigh ($n = 1$), death after enrolment ($n = 1$), declined consent after enrolment ($n = 1$), stopped due to discomfort ($n = 1$), and deemed ineligible after enrolment ($n = 2$). No adverse events were reported that were associated with the interventions. Peripheral blood samples were obtained from patients and healthy controls at admission, 1 hour, 3 hours, and 24 hours after RIC for subsequent immunoinflammatory biomarker analyses. **Conclusion:** Administration of RIC in the trauma bay was not always feasible, as the patients were transferred before initiation or completion of the RIC cycles. However, implementation of RIC to initiate in other departments improved feasibility, and RIC was well tolerated among most patients. Subsequent analysis of blood samples from these patients will provide insight on the potential immunomodulatory effects of RIC. RIC represents a potential intervention to improve the outcome in trauma patients.

Techniques in crisis resource management teaching. *Courtney Fulton*¹, *Bianka Saravana-Bawan*¹, *Brigitta Riley*¹, *Sandy Widdler*², *Damian Paton-Gay*². From ¹Alberta Health Services, Edmonton, Alta.; and the ²University of Alberta Hospital, Edmonton, Alta.

Background: Health care training has traditionally focused heavily on medical knowledge and clinical skills. These are, however, not the only components of successful patient management. Nontechnical skills, such as crisis resource management (CRM),

have a significant impact on patient care and have been incorporated into the training of many health care disciplines. This study examines whether there is a difference in CRM skills between traditional lectures or indirect learning through team problem-solving scenarios. **Methods:** Two groups of preclinical students in health care disciplines were taught CRM through either lectures or by completing a nonclinical teamwork activity. Subsequently, both groups were tasked with a 5-minute CPR simulation. Performance was assessed for clinical skill with a basic life support checklist and for CRM with the Ottawa Global Rating Scale, a CRM-specific evaluation tool. The groups were then reassessed within 6 months with repeat simulation. **Results:** Results of this pilot study suggest a trend toward improved performance in the team-building activity group in both clinical (26.5 v. 22.1) and CRM skills (29.3 v. 26.7). Repeat simulation testing of both instructional groups 4 months later compared with preclinical students who received no formal CRM education revealed that groups who had either the lecture or activity simulation training both scored higher on CRM skills than those without any prior CRM training (35.3 and 34.5 v. 31.8). On repeat testing, there was no significant difference between the direct instruction and indirect learning groups (35.3 v. 34.5). **Conclusion:** CRM enhances team dynamics by focusing on a shared mental model, closed loop communication and the ability to adapt roles for different scenarios. Our preliminary results suggest that education in CRM skills improves clinical performance and should therefore be included in health care training. Further, CRM instruction through indirect learning, such as through a nonclinical teamwork activity, may be superior to instruction through traditional direct instruction, but the effect may not last without repeated practice.

The utility of repeat head imaging in patients with traumatic intracranial hemorrhage and Glasgow Coma Scale score of 15. *Saif Al Ghafr*¹, *Nisreen Maghraby*², *Joe Nemetb*². From ¹McGill University, Montreal, Que.; and ²McGill University Health Centre, Montreal, Que.

Background: Traditionally, patients with traumatic intracranial hemorrhage (ICH) who don't require immediate intervention are observed for a minimum of 6 hours and then undergo repeat head computed tomography (CT) to guide subsequent management. This study sought to determine the frequency with which repeat brain CT in traumatic ICH patients with a Glasgow Coma Scale (GCS) score of 15 led to a clinically significant change in management, specifically surgical intervention and admission to the intensive care unit. **Methods:** A prospective pilot study was conducted on trauma patients who presented or transferred to the Montreal General Hospital emergency department between August 2015 and February 2016 and met the inclusion criteria: head trauma within 24 hours and intracranial bleeding on the initial head image, age older than 18 years, GCS score of 15 and no neurologic deficits. We excluded the patients with epidural hemorrhage, known cranial pathology or coagulation disorder. **Results:** Twenty-nine patients enrolled in the study: 16 female and 13 male patients. All the initial scans were done according to the Canadian CT head rule (CCHR) and were repeated routinely without any clinical deterioration. Twenty-seven scans showed same or better findings, and 2 scans showed worsening of the bleeding but no surgical or medical treatment needed. One

patient was admitted to the critical care unit for other injuries. **Conclusion:** The repeat head CT scan in patients with traumatic ICH with a GCS score of 15 and absence of any neurologic deficits doesn't result in change of their management and saves the patients unnecessary radiation exposure. This is a pilot project that is ongoing; a larger number of patients need to be enrolled before definitive conclusions can be made.

Direct oral anticoagulant effect on ROTEM: a case series. *Syed Mabamad, Alun Ackery, Hina Chaudhry, Amanda McFarlan, Sandro Rizoli, Michelle Sholzberg.* From St. Michael's Hospital, Toronto, Ont.

Background: Direct oral anticoagulants (DOACs) are routinely used in the prevention and management of thromboembolism. Given the widespread use of DOAC therapy, detection of residual DOAC activity is becoming increasingly important to inform appropriate care of bleeding and provide urgent operative clearance. Routine static coagulation studies (activated partial thromboplastin time [aPTT] and prothrombin time [PT]) are poorly sensitive to DOACs. We examined whether dynamic rotational thromboelastometry (ROTEM) can detect DOAC presence more effectively than static assays. **Methods:** We conducted a retrospective review of patients who underwent urgent surgery or experienced spontaneous or traumatic bleeding while on DOAC therapy between 2015 and 2016 at St. Michael's Hospital, a level I trauma centre. ROTEM (EXTEM-clotting time [EXTEM-CT] in seconds), aPTT in seconds, PT in seconds, DOAC-specific drug test (anti-Xa and Hemoclot in ng/mL) results, and relevant clinical parameters were recorded. International Society of Thrombosis and Hemostasis (ISTH) definitions of major bleeding were used. **Results:** Ten DOAC patients were reviewed (1 dabigatran, 3 rivaroxaban, 6 apixaban). Nine had major bleeding. For the dabigatran patient (fatal intracranial hemorrhage [ICH] post-fall), hemoclot, aPTT, and EXTEM-CT were 20, 47.8 and 90, respectively. The prolonged EXTEM-CT and aPTT were related to traumatic coagulopathy given the low dabigatran level. For rivaroxaban patient 1 (spontaneous hemothorax), anti-Xa, PT and EXTEM-CT were 336.42, 23.9 and 181, respectively, at time 1; 196.52, 17.7 and 151, respectively, at time 2; and 183.25, 16.7 and 144, respectively, at time 3. For patient 2 (fatal spontaneous ICH), anti-Xa, PT and EXTEM-CT were 189.53, 19.2 and 157, respectively, at time 1; 32.00, 12.2 and 103, respectively, at time 2; and 18.09, 11.6 and 95, respectively, at time 3. For patient 3 (thigh/abdomen stab wound), anti-Xa, PT and EXTEM-CT were unknown, 5.5 and 108, respectively, at time 1; and 170.57, 14.7 and 78, respectively, at time 2. For these patients, EXTEM-CT appeared to correlate with rivaroxaban levels. For apixaban patient 1 (ICH post-fall), the lone EXTEM-CT was within the reference range and was determined after anti-Xa normalized. Anti-Xa, PT and EXTEM-CT were 49.95, unknown and unknown, respectively, at time 1; and 22.18, 11.4 and 70, respectively, at time 2. For patient 2 (ICH post-fall), EXTEM-CT shortened as apixaban levels declined. Anti-Xa, PT and EXTEM-CT were 190.88, 14.3 and 84, respectively, at time 1; unknown, 13.6 and 73, respectively, at time 2; and 107.50, 15.4 and unknown, respectively, at time 3. For patient 3 (ICH post-fall), anti-Xa, PT and EXTEM-CT were 42.62, 13.3 and 91, respectively, at time 1; and 28.52, 13.7 and 107, respectively, at time 2. The prolonged EXTEM-CT and PT at time 2 was due to traumatic coagulopathy. Anti-Xa, PT and EXTEM-CT were

105.17, 18.2 and 174, respectively, for patient 4 (ICH post-fall), and they were unknown, 11.8 and 98, respectively, at time 1; 142.91, unknown and unknown, respectively, at time 2; and 45.91, 10.7 and unknown, respectively, at time 3 for patient 5 (ICH post-motor vehicle collision [MVC]). For both patients, EXTEM-CT was assessed only once and was found to be prolonged, corresponding to high apixaban levels. For patient 6 (no bleed post-MVC), anti-Xa, PT and EXTEM-CT were 200.84, 15.4 and 113, respectively. **Conclusion:** ROTEM appears to be variably sensitive to different DOACs. EXTEM-CT appears to be more sensitive to direct Xa inhibitors (rivaroxaban, apixaban) than to dabigatran in this small patient sample. EXTEM-CT appears to have similar sensitivity to PT for rivaroxaban and apixaban. Further research is necessary to determine the role of ROTEM in this increasingly relevant clinical setting.

When math saves lives: probabilistic risk assessment for rare traumatic events. *Nori Bradley, Naisan Garraway, Nasira Lakha, Heather Wong, Richard Simons.* From the Vancouver General Hospital Trauma Services, Vancouver, BC.

Background: Trauma care depends on teamwork and system coordination to optimize treatment. Rare but serious traumatic events are high-risk for errors given the unfamiliarity of the team/system in managing such events. Probabilistic risk assessment (PRA) quantifies risk in rare events to identify weaknesses in a system and more effectively target interventions. Our objective is to introduce PRA as a safety tool that can be applied to multiple trauma scenarios in multiple settings. **Methods:** A trauma in pregnancy example will illustrate the methodology and Boolean principles of a PRA to calculate probability of event failures and subsequent effects of change interventions. Risk of institutional clinical practice guideline event failures can be calculated using data from local audits, available literature, and/or expert consensus. **Results:** Probability of failed management during acute stabilization/assessment of a pregnant trauma patient can be high. Assumptions for points of system failures in rare events may not reflect true probabilities of actual failure in your institution. Quantification of failure risks allows change interventions to be appropriately targeted to maximize reduction in overall system failure. Specific examples will show how clinical interventions or changes in system design can reduce high-probability failure risks, thus significantly impacting likelihood of system failure. **Conclusion:** PRA provides a methodology to identify and target areas at highest probability of failure during high-risk but rare events. It allows for optimization of your system within local logistical and financial constraints. It also provides before and after quantification of your change interventions.

What attributes define excellence in a trauma team — a qualitative study. *Farah Kassam¹, Alexander Cheong², David Evans³, Ash Singhal².* From the ¹University of British Columbia, Vancouver, BC; the ²BC Children's Hospital, Vancouver, BC; and ³Trauma Services, Vancouver General Hospital, Vancouver, BC.

Background: Hospital trauma teams consist of a diverse spectrum of health care professionals who work together to deliver quality care. While a well-performing trauma team is often believed to be self-evident, little is objectively known about the

personal and professional characteristics associated with quality care in a trauma setting. The purpose of this study was to determine the traits and characteristics deemed of greatest value for trauma team leaders and team members. **Methods:** Semistructured interviews were conducted with purposefully selected trauma team leaders and trauma team members at a tertiary urban Canadian trauma centre. Standard qualitative research methodology was used. Thematic saturation was achieved after 5 interviews, and 5 further interviews were conducted to ensure a breadth of trauma care disciplines were included. Interviews were recorded, transcribed and analyzed via an inductive analysis approach. **Results:** Thematic content analysis was conducted and revealed specific themes that emerged from the transcribed interviews. A total of 6 attributes were identified to be of greatest value for trauma team leaders: communication, role clarity, experience, anticipation, management and decisiveness. The language used by health care practitioners in each interview was further analyzed for any commonalities. Although there was variability in how respondents described each attribute, it was discovered that common descriptive terms were emphasized in the interviews. For example, for communication, respondents emphasized the terms “closed-loop,” “clear” and “directive.” For role clarity, respondents emphasized the term “clear leadership handover.” For experience, respondents emphasized “knowledge,” “expertise” and “ability to prioritize.” For management, “delegation of tasks” and “controlled noise and chaos” were emphasized. With respect to trauma team members, a total of 4 attributes were identified to be of greatest value: engagement, efficiency, experience and collaboration. Common terminology was also found in respondents’ descriptions of attributes for trauma team members. For example, for engagement, the term “focused” was emphasized. For efficiency, “reporting back to the team leader” was emphasized. For collaboration, the term “respect” was emphasized. Identifying the attributes of greatest value and language used to describe each attribute is critical to objectively defining what characteristics make a “good” trauma team. **Conclusion:** Our study provides a novel approach to finding a common language to define trauma quality. The results of this qualitative study provide unique insight in identifying characteristics that are critical to establishing a “good” trauma team. These findings are useful to inform trauma quality determination, education of trauma practitioners and continuing medical education assessment tools.

Concussion and admission diagnosis among seniors who fall: a descriptive analysis. *Richard Louis, Susan Benjamin, Allison Chisholm, Tusbar Pische, Ian Watson.* From the NB Trauma Program, Fredericton, NB.

Background: New Brunswick has the largest proportion of seniors of any Canadian province according to the most recent data from Statistics Canada. Several studies have shown that falls are the leading cause of concussion for seniors 65 years of age and older. We sought to better understand whether screening for potential concussion is consistently completed among seniors admitted to hospital for other primary diagnoses following a fall. **Methods:** The NB Trauma Registry (NBTR) contains comprehensive injury data for all trauma patients admitted to level I, II and III trauma centres in the province, regardless of injury severity score. An initial review of this data set for admissions between Apr. 1, 2014, and Mar. 31, 2015, was completed to identify cases where seniors were admitted with injury after a fall. These cases

were further explored to confirm the presence of an admission diagnosis of concussion. **Results:** A total of 1119 cases of traumatic injuries in individuals older than 65 years were identified in the NBTR over the study period. With 975 cases of seniors admitted to hospital following a fall, 96 had a documented admission diagnosis of a traumatic head injury, 10 were documented as having a nonspecified head injury, and only 9 (1% of the total number of seniors who were hospitalised post-fall) had a documented admission diagnosis of concussion. We further stratified this data by age, sex and admission facility trauma designation. Women who were admitted to hospital had a slightly higher rate of documented concussion (1%) than men (0.7%). When stratified by age, the rate of documented concussion ranged from 0% to 1.57%. No cases were documented in seniors younger than 75 years. Finally, analysis by admission facility trauma designation noted a range in documented concussion diagnosis of 0% to 5.36%. **Conclusion:** Our review identified important subpopulations of seniors admitted after a fall where concussion was not a documented admission diagnosis despite the evidence suggesting high risk for such injuries. This absence of concussion as a documented admission diagnosis requires further investigation. Specifically, whether concussion is actively considered during the inpatient experience deserves review, particularly given the current absence of concussion as an admission diagnosis among most seniors who fall and require hospitalization.

A retrospective examination of current clinical practice for clearing the pediatric cervical spine at a single tertiary care centre. *Adriana Dekirmendjian¹, Bethany Easterbrook¹, Karen Bailey².* From the ¹McMaster Pediatric Surgery Research Collaborative, Hamilton, Ont.; and the ²McMaster Children’s Hospital, Hamilton, Ont.

Background: Approximately 60%–80% of all pediatric vertebral injuries are to the cervical spine (C-spine), with a mortality of 13%–28%. Appropriate management and clearance of the pediatric C-spine is necessary for preventing missed injuries and devastating neurologic consequences. To ensure proper management, institutions have implemented specific C-spine clearance guidelines. This study aimed to examine current management and clearance of the pediatric C-spine and assess adherence to guidelines at a single pediatric tertiary care centre. **Methods:** A retrospective chart review was performed of all pediatric patients (≤ 18 years of age) in the local trauma registry who received trauma team activation at a single tertiary care centre between Nov. 1, 2013, and Aug. 31, 2015. Data were collected on patient demographics, C-spine clearance methods, documentation and adherence to the local C-spine clearance guidelines. Descriptive statistics were calculated to assess documentation and compliance with C-spine clearance criteria. **Results:** In total, 140 of 173 abstracted cases were included in our analysis. Of the 33 cases excluded, 32 did not involve trauma team activation upon arrival, and 1 case was incomplete in the medical record. Ninety-seven (69%) patients were boys, and the mean age was 9.91 ± 5.35 years. Motor vehicle collision was listed as the most prevalent mechanism of injury, accounting for 29% of cases. Patients’ mean injury severity score at admission was 8.18 ± 7.89 , and median length of stay in hospital was 1.28 days (range 0–143 days). In this cohort, 79% ($n = 110$) of cases were managed in accordance with C-spine clearance criteria. The primary reason for noncompliance

was acquisition of unnecessary radiographs in 15 (11%) patients. Plain radiographs and computed tomography scans were obtained in 49% ($n = 69$) and 44% ($n = 44$) of patients, respectively. Documentation of clearance was reported in 74% ($n = 104$) of patients. Of the patients who received explicit documentation of clearance, 43% ($n = 45$), 18% ($n = 19$) and 17% ($n = 18$) of patients were cleared by the trauma team, neurosurgery and pediatric intensive care unit physicians, respectively. **Conclusion:** The majority of cases in this cohort were managed in accordance with C-spine clearance criteria; however, improvements can be made regarding guideline adherence and explicit documentation of clearance. Future directions include implementing documentation tools to increase guideline adherence and reporting of C-spine clearance.

Clinicians' and patients' acceptability assessment of a self-management intervention to prevent acute to chronic pain transition after major lower-extremity trauma. *Melanie Berube¹, Céline Gélinas², Geraldine Martorella³, Nancy Feeley², José Côté⁴, George-Yves Laflamme¹, Dominique Rouleau¹, Manon Choinière⁴.* From the ¹Hôpital du Sacré-Coeur de Montréal, Montreal, Que.; ²McGill University, Montreal, Que.; ³Florida State University, Tallahassee, Fla.; and the ⁴Centre de recherche du Centre hospitalier de l'Université de Montréal, Montreal, Que.

Background: Up to 86% of patients with major lower-extremity trauma develop chronic pain. People affected by chronic pain report a poorer quality of life than individuals affected by common chronic diseases. Moreover, chronic pain imposes a high socioeconomic burden. Several psychological risk factors have been identified to be involved in the development of chronic pain, which can be addressed by self-management interventions. Consequently, we have developed a pain self-management intervention tailored to patients with major lower-extremity trauma. **Methods:** The objective of this study was to assess the acceptability of a preliminary version of a self-management intervention (iPACT-E-Trauma) that aims at preventing chronic pain after major lower-extremity trauma from the perspective of both clinicians and patients. A descriptive design was used. Clinicians from 3 Canadian trauma centres assessed iPACT-E-Trauma's preliminary version acceptability through a questionnaire and a focus group. A pretest of iPACT-E-Trauma was conducted in patients to allow them to assess its acceptability. **Results:** Clinicians ($n = 10$), including nurses, orthopedic surgeons, a physician specialized in pain management, a psychiatrist and physiotherapists, and patients ($n = 6$) positively or very positively evaluated (median scores $\geq 2/4$) the acceptability of the iPACT-E-Trauma preliminary version in terms of its efficacy, appropriateness, suitability and convenience. Clinicians identified self-monitoring activities requiring patients to document their self-management behaviours (e.g., consumption of analgesics, use of cryotherapy, deep breathing relaxation exercises, activities performed throughout the day) as the least suitable and convenient intervention components. They also questioned the capacity of patients to stay concentrated for the entire session duration early after injury and recommended the development of a web-based application to increase the feasibility of intervention delivery during patients' hospitalization. Procedures used for the documentation of self-management behaviours were simplified and sessions' duration

reduced before conducting the acceptability assessment of iPACT-E-Trauma by patients. In this regard, patients indicated the need to better tailor iPACT-E-Trauma according to their pain intensity, knowledge and application of self-management behaviours as well as their recovery pace. They also confirmed that receiving the educational content through a web format would be an acceptable mode of delivery. Further improvements were made to iPACT-E-Trauma to tailor intervention content and activities according to patients' pain experience and coaching needs. A web application of the intervention's educational content, called Soulage TAVIE Post-Trauma, was also developed. **Conclusion:** This study allowed the development of a self-management intervention acceptable from the perspective of clinicians and patients focused on the prevention of an acute to chronic pain transition in severely injured patients. Adaptations were made to common strategies used in the context of such an intervention to ensure their adequacy for patients with major lower-extremity trauma in the acute care phase. Next steps will be to test the feasibility and efficacy of the intervention.

Hydrogen-enriched lactated Ringer solution enhances endogenous superoxide dismutase activity: protection against damage from reactive oxygen species. *Joao Rezende Neto¹, Chung Ho Leung¹, Carlos Semprun², Mobamed Serban Hamam³, Sandro Rizoli¹, Ori Rotstein¹.* From ¹St Michael's Hospital, Toronto, Ont.; ²Sunnybrook Health Sciences Centre, Toronto, Ont.; and the ³University of Toronto, Toronto, Ont.

Background: Reactive oxygen species (ROS) provoke oxidative damage in response to hemorrhagic shock (HS). Hydrogen-enriched crystalloid solutions are scavengers of ROS, and superoxide dismutase (SOD) is an endogenous antioxidant. The present study was set forth to investigate the role of hydrogen-enriched lactated Ringer solution (HLR) in plasma SOD activity in HS. **Methods:** Male rats ($n = 21$) were divided into 3 resuscitation groups: group 1, sham; group 2, lactated Ringer solution; group 3, HLR (0.8 mM). Animals underwent hemorrhagic shock (mean arterial pressure [MAP] 40 mm Hg for 40 minutes) and ischemia of the middle lobe of the liver for 30 minutes and were euthanized after an additional 90 minutes. Plasma SOD activity was assessed by chemiluminescence; baseline and final samples were compared. **Results:** HS provoked significant decrease in MAP compared with the sham group ($p < 0.05$); no differences in MAP were shown after resuscitation. The 3 groups had similar plasma SOD activity at baseline. However, activity of endogenous plasma SOD was significantly higher in HLR group (group 3) in the final samples compared with all other groups ($p < 0.05$). **Conclusion:** Exogenous HLR increases endogenous plasma SOD activity in HS resuscitation. This is a potential mechanism for protection against damage from ROS.

A noninvasive device for primary fascial closure of the "open abdomen" to prevent the "homeless bowel": a prospective randomized clinical trial. *Joao Rezende Neto¹, Gbassan Al Kefeiri¹, Carlos Semprun², Sandro Rizoli¹, Ori Rotstein¹.* From ¹St Michael's Hospital, Toronto, Ont.; and ²Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: The "open abdomen" is a widely used strategy in trauma and emergency surgery, but loss of abdominal domain

and the “homeless bowel” are major complications. Temporary closure devices designed to prevent fascial retraction often compromise fascial integrity. We tested a new device applied externally to the abdominal wall without sutures to gradually produce midline traction and facilitate primary fascial closure. **Methods:** The device used in conjunction with vacuum-assisted closure (VAC) was compared with VAC alone. **Results:** Our sample comprised 20 patients: 10 in the VAC group and 10 in the device group. There were no significant differences between the groups in body mass index, APACHE II score and lactate levels. Baseline width of the fascial defects at the widest point were 12.3 ± 0.7 cm and 14.9 ± 0.9 cm, and the defect areas were 251 ± 20.7 cm² and 315 ± 37 cm² in the VAC and the new device groups, respectively ($p > 0.05$). At 4 ± 1 day there was greater than 65% reduction in the maximum width and area of the fascial defects, respectively, with the new device: 14.9 ± 0 cm versus 9.8 ± 1.6 cm and 315 ± 37 cm² versus 218 ± 48 cm² ($p < 0.05$). In contrast, the VAC group had greater than 5% increase in maximum width and area of the fascial defect compared with baseline. Primary fascial closure by direct suture of the fascial edges was achieved in 8 of 10 patients in the new device group. In contrast, only 5 patients underwent fascial closure by primary suture in the VAC group. Moreover, 5 patients in that group required mesh and/or a component separation procedure. There were no complications related to the new device. **Conclusion:** The new device facilitated primary fascial closure of the “open abdomen” and effectively prevented lateralization of the muscles by encompassing the entire abdominal wall.

Outcomes of patients with trauma and in-hospital cardiac arrest. *Reyaf Consunji, Fayez Bishma Irfan, Ayman El Menyar, Stephen Thomas, Hassan Al Thani, Ruben Peralta.* From the Hamad Medical Corporation, Doha, Qatar.

Background: There is scarce information available on trauma patients with in-hospital cardiac arrest (IHCAT), despite it being a serious complication with a high mortality. This study describes the epidemiological characteristics and outcomes of IHCAT patients in Qatar. **Methods:** IHCAT patients were identified from the trauma registry of the Hamad Trauma Center, the national trauma centre of Qatar. Data were collected retrospectively from the registry for patients who sustained traumatic injuries between January 2010 and December 2015. Data collected and analyzed included epidemiologic characteristics, trauma and injury features, comorbidities and clinical outcomes. **Results:** Of 240 trauma patients with IHCAT, most were male ($n = 214$, 89%), and the with median age was 32 years (interquartile range 23–47 years). Frequently observed nationalities with IHCAT were Qatari ($n = 38$, 16%), Indian ($n = 33$, 14%), Nepalese ($n = 30$, 12.5%), Egyptian ($n = 13$, 5.4%) and Bangladeshi ($n = 12$, 5%). Most of the patients received prehospital care and were transported by ambulance ($n = 182$, 76%) and air ambulance ($n = 34$, 14%). The mechanism of injury in most cases was motor vehicle crashes ($n = 83$, 34.6%), pedestrian–motor vehicle collisions ($n = 69$, 29%) and falls ($n = 40$, 16.7%). The mean injury severity score was 30 ± 13 . Mean length of stay was 13 ± 28.6 days. Most of the patients died ($n = 214$, 89%). Recurrent cardiac arrest (RCA) occurred in around 92 (41%) IHCAT patients; RCA number and survival rates were as follows: single cardiac arrest ($n = 50$, 6%), 2 arrests ($n = 23$, 13%) and 3 arrests

($n = 19$, 7.6%). **Conclusion:** Trauma patients with in-hospital cardiac arrest should be differentiated from trauma patients with out-of-hospital cardiac arrest as they have a higher chance of survival (11%) and better prognosis. More studies are required to determine the outcomes and prognosis in such patients.

Traumatic lung resection and pneumonectomy: Does extent of excision still determine outcomes? *Katelyn Young, Kathryn Jaap, James Dove, Marie Hunsinger, Mobsen Shababang, Joseph Blansfield, Denise Torres, Jeffrey Wild.* From the Geisinger Medical Center, Danville, Pa.

Background: Posttraumatic pneumonectomy has historically carried an extremely high mortality secondary to shock, respiratory insufficiency and right heart failure. Recent single-institution reports, however, have suggested that advancements in prehospital care, perioperative cardiovascular surveillance and optimal fluid management have contributed to improved outcomes for pneumonectomy and lung-conserving surgical resection. The present study aims to evaluate the presentation, morbidity and mortality of patients undergoing posttraumatic pneumonectomy or lung resection using the National Trauma Data Bank (NTDB). **Methods:** This was a retrospective review of patients entered into the NTDB between 2008 and 2014. All adults (≥ 15 years) sustaining blunt or penetrating trauma who underwent pulmonary wedge resection, lobectomy or pneumonectomy were included. Patients were classified by the most extensive procedure performed. Statistical evaluation used univariate analysis and multivariate analysis, which used multiple imputations and controlled for clustering by facility. Patients undergoing wedge resection served as the reference group for all multivariate comparisons. **Results:** A total of 1813 patients were included, and penetrating trauma accounted for the majority of cases (1269, 70.0%). Wedge resection and lobectomy were used in 896 (49.4%) and 634 (35.0%) patients, respectively. Pneumonectomy was performed in the remaining 297 individuals (15.6%), with 27 of those patients initially undergoing a lung-conserving resection. Blunt trauma was responsible for a significantly higher percentage of patients in the pneumonectomy group than wedge resection and lobectomy (37.1% v. 27.1% v. 30.9%, respectively, $p < 0.001$). The injury severity score was also significantly higher for patients who underwent pneumonectomy than wedge resection and lobectomy (30.6 ± 17.3 v. 26.5 ± 14.6 v. 26.0 ± 14.6 , respectively, $p < 0.0001$). There were 644 inpatient deaths, and there was a stepwise increase in mortality as the extent of resection increased (wedge 29.2% v. lobectomy 31.2% v. pneumonectomy 65%, $p < 0.0001$). Multivariate analysis demonstrated that pneumonectomy was associated with a significantly increased risk of death (odds ratio [OR] 4.45, 95% CI 3.17–6.62). After adjusting for hospital length of stay greater than 48 hours, lobectomy, in addition to pneumonectomy, was found to have a significantly increased risk of postoperative morbidity (OR 1.33, 95% CI 1.07–1.64 and OR 1.35, 95% CI 1.01–1.65, respectively). Only lobectomy patients, however, demonstrated an increased risk of pulmonary complications (OR 1.51, 95% CI 1.16–1.97). **Conclusion:** In recent trauma experience, lobectomy has maintained a high risk of morbidity, whereas mortality may have decreased compared with previously published reports. In contrast, pneumonectomy patients continue to demonstrate the highest injury severity and have maintained extremely high

morbidity and mortality. Thus, recently reported advancements in the management of individuals with critical thoracic injuries may be benefiting lobectomy patients; however, the outcomes for pneumonectomy have not yet shown improvement.

Accessibility of trauma patients to trauma centres in Oman. *Hani Al-Qadbi, Sara Al-Kindi.* From the Sultan Qaboos University Hospital, Seeb, Oman.

Background: Oman is a country of rapidly developing economy and population. It has registered high numbers of motor vehicle collision (MVC)-related deaths and injuries. This study evaluated the accessibility of trauma victims to the trauma centres in different regions of Oman. **Methods:** Data were collected from the Ministry of Health and Armed Forces health services. Electronic data on locations of MVCs were obtained from The Royal Oman Police. One hotspot (i.e., location of the most MVCs in a given governorate) was identified for each governorate in Oman. Health care facilities were identified and classified into 5 classes. Distances between health facilities and hotspots were calculated with Google Maps. Resultant data were plotted using www.scribblemaps.com. **Results:** Thirty-two trauma centres were included, 4 were ranked as class 5. Muscat Governorate had 43% of the class 5 and 4 trauma centres. Musandam, Al-Wusta and Al-Buraimi lacked class 5 or 4 trauma centres. General surgery and emergency departments were available in 69% and 75%, respectively. Orthopedics were available in 59% and neurosurgery in 12% of the centres. Intensive care units were available in 11 centres; there were 4 in Muscat and none in South Al-Sharqiya. The mean distance between a hotspot and the nearest health facility was 34.69 km. In addition, the mean distance between a hotspot and the nearest class 4 or 5 trauma centre was 83.25 km. **Conclusion:** To build a trauma care infrastructure and reduce MVC-associated morbidity and mortality, certain areas in Oman need upgrading of the available trauma centres and/or new trauma centres.

Is there consensus in trauma team activation criteria: a systematic review. *Jaob Pace¹, Kelly Vogt¹, Neil Parry¹, Chad Ball², Ian Ball¹, Bourke Tillmann³.* From the ¹London Health Sciences Centre, London Ont.; the ²Departments of Surgery and Oncology, Foothills Medical Centre and University of Calgary, Calgary, Alta.; and ³Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: Despite evidence supporting improved outcomes for major trauma patients with trauma team activation (TTA), standard criteria to trigger TTA are not well known. We undertook this study to review the current literature evaluating TTA criteria. **Methods:** A systematic review of 3 standard databases as well as the grey literature was conducted with the assistance of a trained librarian. Studies were identified for inclusion if they described predefined TTA criteria for patients receiving trauma care in the emergency department. Studies were reviewed by 2 independent reviewers, and data were extracted on the study population, TTA criteria and measures of over-/undertriage or appropriateness of TTA reported. **Results:** The preliminary search yielded 1331 studies, of which 39 were included in the analysis. These 39 studies reported on 41 unique sets of TTA criteria. There were no criteria found to be consistent across all studies. The most commonly cited criterion was systolic blood pressure. These studies used injury severity score and/or metrics

of resource utilization to define appropriateness of TTA. Among these studies, altered level of consciousness, abnormal respiratory effort, hypotension and penetrating reported over-/undertriage rates ranged from 9% to 96.5% and from 1% to 42%, respectively. Studies were judged to be of overall moderate quality. **Conclusion:** Despite a documented importance of TTA, there is no consensus in the literature with respect to the appropriate components of a set of TTA criteria. A common definition of appropriate activation is required, and future work should focus on defining universally accepted TTA criteria.

Do higher transfusion ratios of FFP:RBC, PLT:RBC or FFP:PLT:RBC improve outcomes in trauma? A systematic review and meta-analysis. *Luis Teodoro Da Luz, Rachel Strauss, Ayman Abdelhadi, Pablo Perez, Avery Nathens, Homer Tien, Barto Nascimento.* From the Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: Bleeding and coagulopathy account for the most potentially preventable in-hospital deaths in trauma. Recently, higher ratios of fresh frozen plasma (FFP):red blood cells (RBC), platelets (PLT):RBC, or FFP:PLT:RBC have been used in bleeding trauma patients with the objective of improving bleeding and coagulopathy. We conducted a systematic review and meta-analysis on the effects of high ratios in bleeding, coagulopathy and other clinical outcomes, including mortality. **Methods:** Observational and experimental studies in humans were included. Medline, EMBASE and Cochrane databases were searched up to September 2016. Data on the effect of high transfusion ratios of FFP:RBC, PLT:RBC and FFP:PLT:RBC on exposure to allogeneic blood products, reversal of coagulopathy, adverse events and mortality were extracted. Methodological quality was assessed separately for observational (Newcastle-Ottawa) and experimental (Cochrane Collaboration Risk of Bias Tool) studies. Meta-analysis on randomized controlled trials (RCTs) was conducted. **Results:** Twenty-seven studies met the inclusion criteria: 2 RCTs and 25 cohort studies (15 prospective and 10 retrospective). Quality of cohort studies and RCTs was moderate. Overall, studies reported earlier correction of coagulopathy with high transfusion ratios, as measured by laboratory tests, specific clotting factors and viscoelastic tests. Moreover, high ratios of transfusion demonstrated a reduced exposure to allogeneic blood products and decreased massive transfusion. There was a trend for increased numbers of respiratory complications and thromboembolic events and a decrease in mortality. **Conclusion:** Higher transfusion ratios used for resuscitation of bleeding trauma patients promote decreased exposure to allogeneic blood products, improvement of standard laboratory and viscoelastic tests, and improvement of mortality. However, properly designed RCTs are still warranted to confirm these previous findings.

Do field triage criteria correctly identify patients suitable to be transferred to a trauma centre? A systematic review and meta-analysis. *Luis Teodoro Da Luz, Jose Estrada-Codécido, Selma Alqattan, Carlos Semprun, Avery Nathens, Homer Tien, Barto Nascimento.* From the Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: Emergency medical services use the field triage criteria to identify patients who require transportation to a trauma

centre where the provided care decreases risk of death. However, the complexity in the field assessment can affect triage decisions. We performed a systematic review of the literature on the use of field triage criteria and its ability to identify severe trauma. **Methods:** Observational and experimental studies were included. Medline, EMBASE and Cochrane were searched up to September 2016. Data on patients transferred to a trauma centre were extracted (injury severity score [ISS], blood transfusion, intensive care unit [ICU] admission, angioembolization, surgery and mortality). Methodological quality was assessed for cohort (Newcastle–Ottawa) and experimental (Cochrane Collaboration Risk of Bias Tool) studies. **Results:** Fifteen studies were included (10 retrospective, $n = 335\ 815$, and 5 prospective, $n = 27\ 295$). Physiologic criteria (step 1) were used as sole intervention in 4 studies. Physiologic and anatomic criteria (step 2) were used in 1 study. Physiologic and anatomic criteria and mechanism of injury (step 3) were used in 2 studies. Steps 1, 2, 3 and 4 (special patients and considerations) were used in 8 studies. Outcomes included in the studies were death ($n = 7$), ICU admission ($n = 4$), need for surgery ($n = 7$), blood transfusion ($n = 2$), urgent angioembolization ($n = 1$) and ISS above 16 ($n = 10$). Overall, predictive values for detection of the related outcomes were high, but variable depending on the step used and the outcome measured. **Conclusion:** The use of the different steps in the field triage criteria have high but variable sensitivity/specificity and predictive values depending on the outcome measured. Moderate methodologic quality of the included studies warrant further research.

Quick to be seen, quick to come back: Does first visit CTAS category predict which patients will require admission on unplanned return visit in a level I trauma centre? Michael Howlett¹, David Lewis¹, Jacqueline Fraser¹, Paul Atkinson². From the ¹Saint John Regional Hospital, Saint John, NB; and ²Dalhousie University, Halifax, NS.

Background: The percentage of unplanned return visits (URV) to the emergency department (ED) within 48 or 72 hours of discharge resulting in hospital admission is recommended as a quality indicator. To our knowledge there are no published Canadian data on the percentage of ED URV admissions. This study examines URV data from the ED in a level I trauma centre, and in particular the correlation between URV admission rates and first visit Canadian Triage Acuity Scale (CTAS) category. **Methods:** A retrospective analysis of 12 months of data was completed for URV to the ED of a 445-bed regional trauma centre with 57 000 annual attendances. URV was defined as return within 72 hours of an earlier visit resulting in discharge from the ED. Planned return visits were excluded. We analyzed overall URV percentage, URV percentage by first visit CTAS category, percentage of URV admitted and URV admission percentage by first visit CTAS category. Pearson r correlation and Fisher exact tests were used. **Results:** During the 12-month period there were 57 025 registrations, of which 46 793 patients were discharged. There were 3566 URVs (7.62% of those discharged); the number of URVs admitted was 532 (1.14% of those discharged). The return rate/admission rates by CTAS category were as follows: CTAS 1 6.74%/1.55%, CTAS 2 7.86%/1.92%, CTAS 3 8.54%/1.35%, CTAS 4 5.99%/0.40%, CTAS 5 5.55%/0.27%. The relative risk of admission on return for discharged CTAS groups 1 and

2 compared with CTAS 3, 4 and 5 was 1.90 (95 CI 1.57–2.30, $p < 0.0001$). The rate of admission on return was negatively correlated with initial CTAS level (Pearson $r = -0.89$, 95% CI -0.99 to -0.03 , $R^2 = 0.79$, $F = 11.25$, $p = 0.04$). **Conclusion:** We have demonstrated an association between first visit CTAS category and the URV admission rate. If admission is taken as a marker of illness severity, then the likelihood of an inappropriate discharge is inversely proportional to first visit CTAS score. While this makes sense intuitively, our data confirm this association in a Canadian trauma centre and support the reporting of ED URV admission data by first visit triage category as an important quality indicator.

Impact of geography and timely transfer on trauma mortality in British Columbia. Hamid Izadi¹, David Evans¹, Recep Gezer¹, Jaimini Thakore². From ¹Trauma Services, Vancouver General Hospital, Vancouver, BC; and ²Provincial Health Services Authority, Vancouver, BC.

Background: Death due to traumatic injury is the leading cause of potential years of life lost in Canada. Prevention requires a clear understanding of where actionable opportunities exist. To this end, we undertook a 3-year analysis of all trauma deaths in British Columbia focusing on time to death following injury and geographic location as a proxy for access to definitive care. This analysis can serve as a framework for annual review of trauma mortality in BC. **Methods:** We undertook a retrospective descriptive study of trauma-related deaths in BC between 2012 and 2015. Variables included age, sex, mechanism of injury, injury severity and geographic zones for injury location. We interrogated the Discharge Abstract Database (DAD), capturing deaths in all BC hospitals; the BC Trauma Registry (BCTR) from BC's 11 designated trauma hospitals; and the BC Coroners Service data. Time to death intervals from the time of the emergency medical services (EMS) call were < 1 hour, 1–4 hours, 4–12 hours, 12–24 hours, 24–72 hours, 3–7 days and 7–30 days. **Results:** We identified 2827 trauma-related deaths in the study period. Mortality for the years 2013, 2014 and 2015 was 20.7, 20.7 and 19.7 per 100 000, respectively, with only one-third of these deaths captured by BCTR. More than 80% of deaths were due to a blunt mechanism. Males accounted for 55% of DAD and 65% of BCTR trauma deaths. In those older than 75 years, 14% died of their injuries compared with 4.5% and 1.6% for those aged 16–74 years and 0–15 years, respectively. Most injuries occurred in the 16–74 age group. Mortality by geography was 7.8, 10.1, 3.8, and 1.5 per 100 000 for metro, urban, rural and remote designations, respectively. Annual rates were constant across all categories except in remote settings, where mortality was more than halved over the study period. Incident times were missing for 285 of 1131 BCTR patients. The proportion of deaths occurring in each time interval were as follows: < 1 hour (11%), 1–2 hours (6%), 2–4 hours (6%), 4–12 hours (13%), 12–24 hours (8%), 24–72 hours (15%), 3–7 days (15%), 7–30 days (19%) and > 30 days (6%). In those transferred to a designated trauma centre from the scene or a referring first facility, the proportion of deaths by time category were as follows: < 1 hour (0%), 1–2 hours (0%), 2–4 hours (3%), 4–12 hours (11%), 12–24 hours (13%), 24–72 hours (25%), 3–7 days (18%), 7–30 days (27%) and > 30 days (3%). **Conclusion:** Few studies have reported time to death after injury. Trauma mortality in BC

for the past 3 years increased slightly. Nearly 23% of deaths occurred within 4 hours of injury, while 20% occurred 7–30 days after injury. Prevention depends on death occurrence after injury and hospitalization, which is difficult to identify in large data sets. Delineating cause of death with patient, provider, or system factors is needed to guide strategies to reduce preventable death following injury.

E-cigarette explosions: profiling patterns of traumatic injury in North America. *Miliana Vojvodic¹, Jamie Harshman², Alan D. Rogers³.* From the ¹University of Toronto, Toronto, Ont.; ²Halton Health Sciences, Oakville, Ont.; and the ³Ross Tilley Burn Centre, Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: The use of e-cigarettes has grown exponentially in North America over the past 5 years. E-cigarette battery explosions and ensuing traumatic injuries are gaining considerable media traction. While the risk of spontaneous explosions of lithium batteries have been documented, there is a paucity of medical literature on the epidemiology, injury patterns and management principles of these novel trauma cases. **Methods:** An electronic search was conducted using the MEDLINE database. Search terms included “e-cigarette” AND “injury,” OR “burn,” OR “explosion,” OR “trauma,” “vaping and burn,” “vaping and injury,” and “cigarette and battery and burn.” A web search identified news media reports of e-cigarette explosions from 2015 to 2016 in the United States and Canada using the same terms listed above. Media and academic sources were reviewed and tabulated by date and geographic location. **Results:** A search of the medical literature yielded 4 case reports, 2 case series and 1 published abstract describing burns sustained from overheating or explosion of an e-cigarette device. All cases were published between 2015 and 2016. Two additional unpublished cases from our institution were included; one of them involved the largest burn size noted to date (total body surface area [TBSA] 10%). A search of public media reports revealed 32 burns and associated injuries related to e-cigarette explosions. Twenty-six of these cases involved cutaneous burns, and 2 others involved burns to the eyes and oropharynx. Nonburn injuries included lacerations, facial fractures, cervical spine fractures and ocular and dental trauma. The reported incidence of e-cigarette-related injuries has risen from 0–3 cases per month in 2015 to 4–9 cases per month from January to May 2016. Of patients with burns, TBSA ranged from 1% to 8%. In total, 73% of the burns were categorized as second- or third-degree, or mixed second- and third-degree. The anatomic regions with the highest burn incidence were the thighs (66%), hands (38%) and the face and/or neck (18%). Of the cases reported, 50% required surgical débridement and grafting as part of wound treatment. **Conclusion:** This review highlights e-cigarette battery explosions as an emerging etiology of blast injuries and burn traumas. Trauma and acute care physicians must become familiar with the presentation and management principles of e-cigarette explosions, including their complex thermal and nonthermal injury patterns.

Quality assessment of a minimal tablet-based trauma registry, iTrauma, in Tanzania. *Annie Lalonde¹, Respicious Boniface², Lawrence Museru², David Bracco¹, Dan Deckelbaum¹, Tarek Razek¹.* From ¹McGill University,

Montreal, Que.; and ²Mohimbili Orthopedic Institute, Dar es Salaam, Tanzania.

Background: One of the main keys to decreasing injury-related morbidity and mortality is understanding its epidemiology. Over the course of a 10-year partnership between Tanzania and the Centre for Global Surgery at the McGill University Health Centre, a trauma registry has been deployed in 6 different hospitals in Tanzania. A quality assessment of the iTrauma registry use was conducted to evaluate the quality of the data and their usefulness. **Methods:** Three main components of the electronic registry were evaluated both objectively and subjectively: the quality of the data collected, the data collection process and the use of data found in the registry. This evaluation was done through a retrospective review of hospital charts and hospital logbooks, on-site evaluations and focus group discussions. **Results:** Three years ago, the hospitals transitioned to an electronic database system called iTrauma. Since then, more than 39 000 patients have been entered in the database. File completeness was on average 93.1%. iTrauma data were found to be accurate, though comparison was limited by the incompleteness of hospital records. The catch rate of iTrauma compared with hospital logbooks was on average 37.1%. Focus group discussions were highly informative and revealed many hospital-specific issues that could be addressed in a timely manner. **Conclusion:** Data quality assessment is an essential step of validating the credibility and usefulness of a trauma registry. An efficient method was developed for iTrauma and demonstrated the robustness of this registry. It also showed that iTrauma, despite collecting minimal data, provides a more reliable and complete source of patient information than hospital records.

Subjective pain scores with the application and removal of the iTClamp in healthy volunteers. *Jessica Mckee¹, Ian Mckee, Chad Ball², Paul McBeth³, Brad Bennett⁴, Dennis Filips¹, Andrew Kirkpatrick³.* From ¹Innovative Trauma Care, Calgary, Alta.; the ²Departments of Surgery and Oncology, Foothills Medical Centre and University of Calgary, Calgary, Alta.; the ³Departments of Surgery and Critical Care Medicine, Foothills Medical Centre and University of Calgary, Calgary, Alta.; and the ⁴Wilderness Medical Society, Salt Lake City, Utah.

Background: Controlling hemorrhage is of the utmost importance, as bleeding is still a leading cause of preventable death. New hemorrhage control adjuncts are continually being developed. One such product is the iTClamp. The iTClamp has several publications on its ability to effectively control bleeding when applied. However, this device contains 8 small needles that anchor it to the skin, and as such one concern that is continually raised is whether the iTClamp is painful when applied. **Methods:** Innovative Trauma Care, manufacturer of the iTClamp conducted 2 training laboratories in 2014. During these training sessions, individuals curious about the pain level were offered the opportunity to have an iTClamp applied to them. Sterile prep and devices were provided, and individuals were asked to fill out a Likert style pain scale regarding the level of pain experienced with the iTClamp application/removal. **Results:** Twenty-six men asked to have a sterile iTClamp applied over the course of the 2 training sessions. Of these, 81% ($n = 21$) of the applications

were to the arm, 1 (3.5%) was to the leg, 1 (3.5%) was to the back of the hand, and for 3 (11%) the location is unknown. Among the participants, 73% ($n = 19$) had someone else apply the iTClamp, and 15% ($n = 4$) applied it to themselves; for 3 participants (11%) the applicator was not reported. Of the 73% ($n = 19$) who reported minor oozing blood on removal of the iTClamp, only 26% ($n = 5$) applied a bandage after device removal. Four (15%) participants reported bleeding on iTClamp removal, and 3 (75%) of them applied a bandage. Each individual rated the pain on a scale of 0–10, with 0 being no pain at all. The mean pain on application was 2.0 ± 1.1 , and mean pain on removal was 1.9 ± 1.5 . The maximum pain reported on application and removal were 5.0 and 7.0, respectively, with a minimum score of 0 for both. There was no difference between application and removal pain ($p = 0.52$), with 2 individuals reporting that pain was less than they expected or that the pain would be inconsequential with an injury/distraction. **Conclusion:** Although the idea of having 8 needles applied to the skin is stressful to many people and they have expressed concern that the iTClamp application would be painful, we have demonstrated that the experienced pain is very mild and may in fact be a lower pain rating than previously published pain scores from other hemorrhage control devices.

A 15-year retrospective analysis of major trauma recidivism and alcohol use in Nova Scotia. *Mete Erdogan¹, Nelofar Kureshi², Mark Asbridge³, Robert Green¹.* From ¹Trauma Nova Scotia, Halifax, NS; the ²Division of Neurosurgery, Dalhousie University/QEII Health Sciences Centre, Halifax, NS; and ³Dalhousie University, Halifax, NS.

Background: Trauma recidivists are individuals who present on more than 1 occasion for different episodes of traumatic injury. The factors associated with recidivism have not been fully investigated. Alcohol may be an important factor, as its use is known to increase the risk of injury. The purpose of this study was to describe recidivism of patients with major trauma in Nova Scotia over a 15-year study period and its association with alcohol use. **Methods:** We performed a retrospective analysis of all adult (age > 17 years) major trauma patients in Nova Scotia between 2001 and 2015 using data from the Nova Scotia Trauma Registry. Alcohol-related trauma recidivists were defined as having more than 1 traumatic injury with a positive blood alcohol concentration (BAC) at any injury. Patients were grouped by BAC (negative [< 2 mmol/L], low [$2\text{--}10$ mmol/L], moderate [$10.1\text{--}17.3$ mmol/L], high [> 17.3 mmol/L]) at time of injury (nonrecidivists) or by highest BAC recorded at any injury (recidivists). **Results:** A total of 9365 trauma patients were included in the analysis; the mean age of the sample at first injury was 52 ± 21.5 years, and 73% of patients were male. Of these patients, 150 (1.6%) sustained more than 1 traumatic injury during the study period (6 recidivists had more than 2 traumas). Recidivists and nonrecidivists were similar in terms of age (mean 50 ± 22.5 years v. 52 ± 21.5 years). A greater proportion of recidivists were male (83% v. 73%, $p = 0.008$). Blunt injuries were predominant in both nonrecidivists (84%) and recidivists (first injury 87%, second injury 83%). With respect to injury severity at first injury, the mean injury severity score was higher in nonrecidivists than recidivists (18.0 v. 21.9, $p < 0.001$). BAC testing was performed in 64% (96/150) of recidi-

vists and 47% (4337/9215) of nonrecidivists. Among recidivists, 68% (65/96) had a positive BAC on at least 1 injury, whereas 46% (2010/4337) of nonrecidivists tested positive for blood alcohol at injury. Patients with a positive BAC were 2.4 times more likely to be recidivists (95% CI 1.6–3.7, $p < 0.001$). Recidivists were more likely to be severely intoxicated than nonrecidivists (OR 1.9, 95% CI 1.3–2.9, $p = 0.001$). Mortality at hospital discharge was similar (both 31%). **Conclusion:** In our study, alcohol intoxication was an important factor in trauma recidivism. Further inquiry into the impact of alcohol use on trauma recidivism is warranted.

Tissue plasminogen activator is released early during hemorrhagic shock from multiple visceral sources, and unexpectedly decreases with duration of shock. *Hunter Moore¹, Ernest Moore², Eduardo Gonzalez¹, Michael Chapman¹.* From the ¹University of Colorado, Denver, Colo.; and the ²Journal of Trauma and Acute Care Surgery, Denver, Colo.

Background: Tissue plasminogen activator (tPA) is the driver of hyperfibrinolysis (HF) in trauma and is presumed to come from endothelium. However, it remains unclear how rapidly tPA levels rise following hemorrhagic shock and if tPA is preferentially released from specific organs. We hypothesized that tPA is released progressively during hemorrhagic shock and that multiple organs can contribute to this response. **Methods:** Swine underwent tissue injury or hemorrhagic shock. Samples were obtained at baseline, 15, 30 and 60 minutes. Additional animals underwent isolation of arterial inflow of the spleen, kidney, liver and bowel. After baseline samples from systemic venous outflow of organs, arteries were occluded. Samples were collected at 15 minutes, 30 minutes and at 45 minutes after reperfusion. Pooled samples ($n = 5$ per group) were analyzed for tPA activity and its inhibitor plasminogen activator inhibitor -1 (PAI-1) and inactive complex. **Results:** tPA activity levels quadrupled between 15 and 30 minutes of shock from an activity level of 0.55 IU/mL to 2.24 IU/mL. During tissue injury the maximum tPA activity during the experiment was 0.33 IU/mL. When evaluating organ beds over time tPA activity levels were statistically different ($p = 0.009$). tPA activity peaked after 15 minutes of arterial inflow with a median tPA activity of 2.0 (interquartile range 1.9–3.5). The spleen had the highest tPA activity (3.9 IU/mL). As time progressed tPA levels dropped to a median activity range of 0.74 IU/mL at 30 minutes and 0.31 IU/mL after reperfusion. Systemic venous samples during the experiment remained stable, ranging from 0.28 IU/mL to 0.75 IU/mL. PAI-1 activity remained constant over time in the organ beds ($p = 0.809$), but complex levels significantly increased over time ($p = 0.034$) from 10 ng/mL at baseline to 26 ng/mL at 30 minutes of arterial inflow. **Conclusion:** Hemorrhagic shock, but not tissue injury, promotes increased systemic tPA activity. All visceral organs release tPA, which peaks within 15 minutes of inflow occlusion. Interestingly, tPA activity decreases with further shock, independent of increased PAI-1 activity. These data suggest endothelial exhaust of tPA and another manifestation of endotheliopathy of trauma.

Introduction and virtual validation of a universally applicable decision tree for the treatment of pelvic fracture-associated shock. *Matthew Menon, Robert Petretta, Saif*

Alduboori, Craig Domke, Lauren Beaupre. From the University of Alberta, Edmonton, Alta.

Background: Decision trees for treating pelvis fracture-associated shock are complex and difficult to apply quickly in practice. Clinically significant pelvic hemorrhage is most often treated with preperitoneal pelvic packing or angioembolization and appropriate resuscitation. We developed a protocol for treatment of pelvis fracture-associated shock that can be quickly applied in any clinical setting. This investigation introduces and validates the use of our protocol using a virtual cohort of participants from previously published studies. **Methods:** A systematic review previously presented by the authors examining the results of preperitoneal pelvic packing versus angioembolization for pelvic fracture-associated shock was updated. Pooled results from identified studies were examined. Data regarding the clinical course of groups of participants in the identified publications were virtually fed through our universally applicable decision tree. Discrepancies between previously published protocols and our decision tree were identified and examined for interventions not captured by our protocol. **Results:** Our search strategy identified 26 applicable studies published between 1995 and 2016. All studies included patients considered to have significant bleeding associated with a pelvis fracture, although the definition of shock was inconsistent among studies. In total, 2353 patients were included in the pooled results from the identified papers. Studies contained a range of 11 to 317 participants. A total of 1409 patients underwent primary open surgical treatment. Of these, 449 patients underwent isolated primary pelvic packing according to the published data. Of the operatively treated patients, 165 (11.7%) subsequently required angioembolization. In total, 944 patients underwent primary angioembolization. Of these, 20 (2.1%) subsequently underwent open packing according to the published data. Each published decision tree was examined and found to be reducible in the final treatment decision to our simplified protocol. Our protocol did not capture the details of medical resuscitation, which were heterogeneous among published decision trees. The clinical course of each group of patients was virtually taken through our protocol. All patients' clinical courses were described by our decision tree. No definitive clinical decisions related to pelvic hemorrhage with or without hemoperitoneum were identified that were not captured by our universally applicable protocol. We were unable to identify any published clinical scenario where our protocol was not effective in retrospective examination. **Conclusion:** Our universal protocol for the treatment of pelvic fracture-associated shock performed as well as previously published protocols. Currently published protocols potentially delay definitive treatment of hemorrhage with unnecessarily complex decision trees. An advantage of our protocol is that the simplified decision tree emphasizes the definitive treatment for stopping bleeding while still allowing for ongoing resuscitation. The described protocol is applicable in all facilities and can be used worldwide.

Canadian hospital disaster preparedness. *Mohammad Fakhradeen¹, Francois de Champlain², Nisreen Maghraby¹, Valerie Homier².* From ¹McGill University, Montreal, Que.; and the ²McGill University Health Centre, Montreal, Que.

Background: The objective of this study is to determine whether or not Canadian hospitals are objectively prepared to

respond to a disaster. The most recent study of Canadian disaster preparedness, which provided very limited insight owing to the poor response rate (11%), was published in 2011. There have been many new natural and man-made disaster threats since then, which mandates a reassessment of preparedness to face these new disaster response challenges in Canada. **Methods:** A 12-item paper survey was distributed to a convenience sample of attendants of 3 Canadian conferences: the Trauma Association of Canada conference (May 2016), the Canadian Conference on Emergency Planning and Preparedness for Healthcare Facilities (May 2016) and the Canadian Association of Emergency Physicians conference (June 2016). Responders included emergency department (ED) chiefs/physicians, trauma surgeons/directors/fellows, emergency medical services (EMS) fellows/medical directors, ED nurse managers, and/or emergency management personnel. **Results:** The response rate was 86.1%. Most responders were from Ontario (54.4%), followed by Quebec (30.9%) and Alberta, British Columbia, New Brunswick and Nova Scotia (14.7%); there were no responders from other provinces. Most responders were from level I trauma centres (45.6%), followed by level II trauma centres (16.2%), urban nontrauma centres (20.6%), rural centres (8.8%), remote centres (4.4%) and other (4.4%). Most responders were ED physicians (38.5%), followed by emergency managers (11.5%) and trauma directors (9.0%). In total 97.5% reported they had disaster response plans for external disasters, and 89.7% had plans for internal disasters. Regarding drills, 70.6% reported tabletop drills within the last 3 years (50% within last year), whereas 10.3% reporting never having tabletop drills 10.3%; 57.3% reported live drills within the last 3 years (33.8% within last year), whereas 19.1% reported never having live drills; and 60.3% reported involvement of other agencies (EMS, police, fire department). For communication, 63.2% reported a centralized mass notification system. The last back-up personnel call exercise occurred within the last 3 years for 61.8%, but never occurred for 16.2%. In total 45.6% reported that the regional EMS had a substitute communication mode, whereas 23.5% reported no substitute communication mode and 30.9% didn't know. The last activation for real external disaster was reported by 44.1% to be within last 3 years (22.1% within last year), 5.9% within the last 5 years, 20.6% more than 5 years ago, and 20.6% never; 8.8% didn't know when the last activation occurred. **Conclusion:** The presence of disaster plans in Canadian hospitals is high. The drill frequency is also higher than previously reported, but should be increased further to comply with most recognized international recommendations for disaster preparedness. Study limitations include recall and sampling biases, as the collected data were limited to academic settings with uneven representations of certain provinces and rural areas. Standardized assessment of hospital emergency preparedness is warranted in light of these results and disaster trends worldwide.

The impact of acute care surgery patients in the intensive care unit. *Haitian He, Jeremy Grushka, Andrew Beckett, Paola Fata, Tarek Razek, Dan Deckelbaum, Liane Feldman, Kosar Khwaja.* From McGill University, Montreal, Que.

Background: Emergency general surgery patients make up an important portion of all intensive care unit (ICU) cases and have various diagnoses requiring specialized care, yet very little is

known about their outcomes and demographics. With the recent implementation of acute care surgery (ACS) services to specifically handle these complex cases, we describe the characteristics and outcomes of these patients in the ICU. **Methods:** This is a retrospective study for the period 2011–2015 looking at acute care surgery patients in the ICU at 2 major hospitals within the McGill University Health Centre: the Montreal General Hospital (MGH) and the Royal Victoria Hospital (RVH). A prospectively collected database was queried for all patients admitted to the ICU with an ACS diagnosis or who developed an ACS condition while in the ICU. Data on baseline demographic characteristics, length of stay in the ICU, ventilator days, complications and ICU mortality were obtained. Fisher exact tests and multiregression analysis was conducted. **Results:** ACS admissions represented 29% (2287 of 7924) of total ICU admissions, comprising 1913 individual patients. Baseline demographics were similar between the 2 hospitals: age at admission was 64.2 ± 0.49 years at MGH and 63.9 ± 0.59 years at RVH, and percentage of female patients was 40.3% at MGH and 40.5% at RVH. Proportion of diagnoses was also similar. Although the length of ICU stay was similar at both sites (6.41 ± 0.38 days at MGH and 6.47 ± 0.41 days at RVH), there were important differences in the rate of readmission and ICU mortality. The 3 most common diagnoses were septic shock (32.5%), upper gastrointestinal (GI) bleed (20.2%) and sepsis (16.4%). Within each diagnosis, the majority of the cases were male (61.73% combined average). Rate of readmission was between the averages from both sites (17.08%). Septic shock was associated with longer than average ICU stays (9.75 days) and a mortality of 19.92%. Upper GI bleed was associated with an ICU stay of 3.74 days and a mortality of 9.51%. Sepsis was also correlated with lower than average mortality (9.60%) and an ICU stay of 5.57 days. **Conclusion:** This study describes the ACS population in 2 large Canadian ICUs. Common diagnosis, demographics, ICU stay and mortality are described. Site-specific differences were identified particularly in the rate of readmission and ICU mortality, which necessitates a deeper dive to understand the contributing factors. It is clear that ACS patients make up an important portion of the ICU population, with major resource and economic implications. Further study is needed to understand this critically ill cohort of ACS patients.

Predictors of primary fascial closure in trauma and acute care surgery patients with open abdominal wounds: a systematic review and meta-analysis. *Derek Roberts¹, Andrew Kirkpatrick², Annika Reintam Blaser³, Jan De Waele³.* From the ¹Department of Surgery, University of Calgary and the Foothills Medical Centre, Calgary, Alta.; the ²Departments of Surgery and Critical Care Medicine, Foothills Medical Centre and University of Calgary, Calgary, Alta.; and the ³University of Tartu, Tartu, Estonia.

Background: Primary fascial closure (fascia-to-fascia closure of the open abdomen during the index hospitalization) in adults with open abdominal wounds has been reported to be associated with improved patient-important outcomes. We conducted a systematic review to identify predictors of early primary fascial closure in trauma and acute surgery patients to guide development of an evidence-based open abdominal management pathway. **Methods:** We searched electronic databases (MEDLINE,

EMBASE, the Cochrane Library, and Web of Science) from 1950 to Sept. 1, 2016, and reference lists of included articles for observational studies reporting predictors of primary fascial closure in adult trauma and acute care surgery patients. Identified predictors were summarized with narrative synthesis methods and combined to provide summary estimates using DerSimonian and Laird random-effects models. **Results:** We included 9 studies enrolling 2344 adult trauma and acute care surgery patients in the systematic review. The studies evaluated 18 potential independent predictors of early primary fascial closure, which could be combined into 7 themes. These included the injury severity of the patient, degree of patient physiologic derangement upon presentation, presence of intra-abdominal hypertension in the intensive care unit (ICU), delayed time to first take-back or requirement for multiple take-backs, administration of a large volume of crystalloid fluids, development of an enteric fistula or intra-abdominal sepsis/infectious complications, and miscellaneous. Independent predictors with evidence suggesting a decreased odds of primary fascial closure included an increased injury severity score (pooled odds ratio [OR] per unit increase 1.02, 95% CI 0.97–1.08; $n = 2$ studies) and international normalized ratio (OR 0.18, 95% CI 0.034–0.98; $n = 1$ study) upon presentation; a higher intra-abdominal pressure (IAP) in the ICU (OR per increase in IAP 0.85, 95% CI 0.76–0.95; $n = 1$ study); time to take-back greater than 48 hours (OR 0.53, 95% CI 0.29–0.98; $n = 1$ study) or an increased number of take-backs (OR per take-back 0.18, 95% CI 0.11–0.29; $n = 1$ study); administration of a large volume of crystalloid fluids (pooled OR 0.51, 95% CI 0.28–0.94; $n = 2$ studies); and development of an enteric fistula (OR 0.16, 95% CI 0.030–0.81; $n = 1$ study) or intra-abdominal abscess (OR 0.38, 95% CI 0.18–0.84; $n = 1$ study). **Conclusion:** Our findings suggest that primary fascial closure rates in trauma and acute care surgery patients may be improved by returning to the operating room earlier than 48 hours after the index laparotomy; limiting the use of crystalloid fluids perioperatively; and preventing and/or treating intra-abdominal hypertension, enteric fistulae, and intra-abdominal collections postoperatively. These findings should be confirmed by randomized trials before they are used to inform practice.

Successful ATLS promulgation in Kenya: a novel partnership model. *Abdullah Saleh¹, Harvey Hawes², Daniel Ojuka¹, James Kisia², Gerry Gomez³, Clark Simons³, Andrew Baker⁴.* From ¹Innovative Canadians for Change, Edmonton, Alta.; ²Kenya Red Cross Society, Nairobi, Kenya; ³Indiana University, Bloomington, Ind.; and the ⁴American College of Surgeons, Chicago, Ill.

Background: Trauma is a leading cause of death worldwide. The American College of Surgeons (ACS) Advanced Trauma Life Support (ATLS) is the recognized standard of care for systematic assessment and resuscitation of injured patients, but its promulgation is lengthy, costly and requires significant organizational and administrative support. Despite previous unsuccessful promulgation attempts in sub-Saharan Africa, Kenyan doctors recognize the need for ATLS education. A novel partnership structure was developed to sustainably bring ATLS to Kenya. **Methods:** A tripartite agreement was created between the Surgical Society of Kenya, the Kenya Red Cross Society and Innovative Canadians for Change (ICChange), with a commitment to curb non-ACS

approved training. In collaboration with the ACS and academic partners (Indiana, Alberta and John Hopkins universities), a site visit and demonstration course was undertaken and novel affordable simulators were introduced and their use in courses assessed. Evaluation of the trainees through pre- and post-tests was performed. **Results:** Through collaboration between the Surgical Society of Kenya, the Kenya Red Cross Society and ICChange, a novel partnership structure for supporting ATLS promulgation in Kenya was developed. An official ATLS approved training site in Nairobi was selected and equipped with affordable trauma skill simulators, and a local medical director and course coordinator were selected. Training courses, beginning with a demonstration course, started in 2015, and to date 3 ATLS Provider courses and 2 ATLS Instructor courses have been offered to a total of 67 registered trainees. Provider course candidates have passed with a success rate of 91% (42/46), with 19 (41%) providers being identified as Instructor potentials, 18 of whom went on to enroll in Instructor courses. Similar preliminary success has been shown in both Instructor courses, with an 85% (18/21) success rate. All 18 newly registered ATLS instructors are currently obtaining necessary teaching experience. **Conclusion:** ATLS is the recognized standard for trauma training worldwide but is beyond the reach of many low- and middle-income countries owing to prohibitive promulgation costs as well as expensive approved skill simulators. This partnership has demonstrated the feasibility of ACS-quality ATLS training in Kenya and the use of affordable approved simulators. It represents a successful model for wide and sustainable dissemination. Results of the promulgation have been promising thus far, and courses continue to be in demand.

Impact of a traumatology service at a level III trauma centre. *Brian Baker*¹, *Matthew Turton*¹, *Cynthia Thurston*², *Davinder Dhat*³. From the ¹University of British Columbia, Vancouver, BC; the ²Fraser Health Authority, Surrey, BC; and the ³Fraser Health Trauma Network, Surrey, BC.

Background: In Canada's regionalized trauma system, level III trauma centres play a significant role in providing care to trauma patients not requiring the complex care of higher-level centres. Despite this, there is a paucity of literature surrounding traumatology services at such centres. Our study sought to determine the impact of a traumatology service on patient length of stay at a level III trauma centre. **Methods:** We conducted a retrospective review of data collected by the BC Trauma Registry (BCTR) before and after institution of a traumatology service at a level III trauma centre. We included 4199 patients between January 2008 and December 2015. The primary outcome was length of stay (LOS). Secondary outcomes included in-hospital complications and time to institution of venous thromboembolism prophylaxis. **Results:** After institution of a traumatology service there was a trend toward decreased LOS in all patients (mean 0.55 days, $p = 0.66$), reaching statistical significance for all patients with an injury severity score (ISS) less than 16 (mean 0.66 days, $p < 0.05$). Combined in-hospital complications were lower among the traumatology service (10% v. 6%, $p < 0.05$) despite being increased overall (5% v. 9%, $p < 0.05$). Venous thromboembolism prophylaxis was instituted more often within 72 hours among patients admitted under traumatology than all other services combined (60.2% v. 41.8%, $p < 0.05$). The overall mortality was low at about 3%, and no mortality benefit was found. **Conclusion:** The

introduction of a dedicated traumatology service at our level III centre significantly decreased the average LOS for all trauma patients with an ISS less than 16, which is more than 90% of the trauma patients seen at our centre. This is relevant in an era of hospital overcrowding and increased patient complications associated with longer LOS.

Does the use of ultrasound during simulated trauma scenarios improve diagnostic abilities? *Devon McLean*. From the University of British Columbia, BC.

Background: Point of care ultrasonography is a key adjunct in the management of trauma patients. Indeed, the focused assessment with sonography in trauma (FAST) scan is ubiquitously used in trauma care. Both the Royal College of Physicians and Surgeons of Canada and the College of Family Physicians of Canada recommend training in ultrasonography. This study aimed to assess the impact of an ultrasound simulator on the diagnostic capabilities of residents and attending physicians participating in simulated trauma scenarios. **Methods:** Twelve residents and 20 attending physicians participated in 114 high-fidelity trauma simulations. For each simulation, participants generated 2 differential diagnosis lists consisting of up to 5 items ranked in decreasing likelihood with corresponding confidence percentages. The first list was created following a basic physical exam of a simulated patient, and the second following a simulated ultrasound scan. The 2 lists were compared in order to determine if ultrasonography improved diagnostic performance. **Results:** Participants improved significantly ($\chi^2_1 = 37.7$, $p < 0.0001$) from 53 (46%, $n = 114$) correct diagnoses ranked at the top of their differential list before ultrasonography to 97 (85%) following ultrasonography. Of the 61 scenarios where an incorrect top-ranked diagnosis was given, 51 (84%) improved following ultrasonography. Participants were assigned a score based on where the correct diagnosis was ranked. If the correct diagnosis was first on the list, they received 5 points, if ranked second they received 4 points, and so on. Scores increased from 3.2 (median 4, interquartile range [IQR] 2–5) to 4.7 (median 5, IQR 5–5), which was a statistically significant increase ($W = 1364$, $p < 0.0001$). Participants were more confident in their diagnoses after using the ultrasound simulator, as shown by the increase in their mean confidence in the correct diagnosis from 48.7% \pm 34.0% to 83.6% \pm 25.7%, which was statistically significant ($t = 11.3$, $p < 0.0001$). Additionally, participants were more precise in their differential diagnosis lists following ultrasonography. Lists were reduced from 3.5 (IQR 3–4) items before ultrasonography to 2.5 (IQR 2–3) items following ultrasonography, which was a statistically significant decrease ($W = 2875$, $p < 0.0001$). The participant pool was also split into 2 groups: residents and attending physicians. We compared the diagnostic performance of these 2 groups for each of the above analyses both before and after ultrasonography. No differences in performance were detected. **Conclusion:** This study showed that ultrasonography in simulated trauma scenarios improved the diagnostic capabilities of residents and attending physicians. Specifically, participants improved in diagnostic accuracy, confidence and precision. These findings are in keeping with the current literature, which demonstrates the utility of ultrasonography in trauma care. Additionally, we have shown that an ultrasound simulator can be integrated into high-fidelity simulation in a way that improves diagnostic performance.

Detection of traumatic pancreatic duct disruption in the modern era. *Morgan Schellenberg, Kenji Inaba, Jim Bardes, Vincent Cheng, Kazubide Matsushima, Lydia Lam, Elizabeth Benjamin, Demetrios Demetriades.* From the LAC+USC Medical Center, Los Angeles, Calif.

Background: Pancreatic trauma management hinges upon the presence or absence of pancreatic duct injury. Although numerous methods for assessing the pancreatic duct in trauma have been described, it is unclear which techniques are used in modern practice and how frequently they accurately clarify the status of the duct. The aim of this study was to examine the management of pancreatic trauma and the methods used for pancreatic duct evaluation. **Methods:** Patients presenting to a level I trauma centre (January 2008 to June 2015) who sustained a pancreatic injury (American Association for the Surgery of Trauma [AAST] grades I-V) were identified from the trauma registry based on ICD-9 and ICD-10 codes. Patient demographics, injury characteristics, investigations, procedures, technique of pancreatic duct evaluation and outcomes were abstracted. Statistical analysis was performed with SPSS. **Results:** Seventy-one patients with pancreatic injuries were identified. The mean age was 35 years (range 11–87 years), and 85.9% were male. The mechanism of injury was penetrating in 71.8% and blunt in 28.2%. The AAST grade of pancreatic injuries was grade I in 25 patients (35.2%), II in 24 (33.8%), III in 19 (26.8%), IV in 2 (2.8%) and V in 1 (1.4%). Associated injuries were common ($n = 69$, 97.2%), especially injuries to the stomach ($n = 31$, 43.7%) and liver ($n = 24$, 33.8%). The mean injury severity score was 24 (range 4–75), and mortality was 19.7%. Twenty-one patients (29.6%) underwent computed tomography (CT); 16 (76.2%) scans demonstrated pancreatic injury. Ten (47.6%) of these patients then underwent laparotomy, while 6 (28.5%) were successfully managed nonoperatively. Five patients (23.8%) underwent CT showing a normal pancreas, but were brought for laparotomy for management of other injuries and were then found to have pancreatic injuries. Most patients ($n = 50$, 70.4%) underwent immediate laparotomy. Overall, 65 patients (91.5%) were managed operatively. The overwhelming majority were assessed intraoperatively for ductal injury with visual inspection alone ($n = 63$, 93.8%). Four patients (6.2%) underwent intraoperative pancreatography (1 via duodenotomy and 3 via cholecystotomy), all of which were inconclusive for duct injury. No patient underwent intraoperative endoscopic retrograde cholangiopancreatography (ERCP), early magnetic resonance cholangiopancreatography, or intraoperative ultrasonography. Patients were typically managed with drain placement ($n = 27$, 38.0%) or distal pancreatectomy ($n = 28$, 39.4%). Primary repair, local resection and trauma Whipples were infrequent (each $n \leq 4$). Pancreatic complications (abscess, fistula, leak) occurred in 17 patients (23.9%). **Conclusion:** Patients typically sustain pancreatic injury by penetrating mechanisms and are severely injured. CT is not a sensitive test for diagnosing pancreatic injuries. Invasive, time consuming and frequently inconclusive methods of evaluation for pancreatic duct disruption, such as duodenotomy/cholecystotomy for pancreatography or intraoperative ERCP, have no role in the management of these patients. Clinical suspicion for ductal injury based on intraoperative visual inspection alone is sufficient to guide management of pancreatic injuries.

Initial implementation of a first-ever trauma registry in Mozambique: challenges, results and lessons learned. *Fadi Hamadani¹, Dan Deckelbaum¹, Shailvi Gupta², Ivandra Magaia³, Catarina Maguni⁴, Paloma Maripiba³, Ezio Massinga⁵, Mario Jacobe³, Prem Yonaban³, Cybil Abou-Rizk², Tarek Razek¹, Otilia Neves⁶.* From the ¹McGill University Health Centre, Montreal, Que.; the ²Centre for Global Surgery, McGill University, Montreal, Que.; ³Central Maputo Hospital, Maputo, Mozambique; ⁴Mavalene General Hospital, Maputo, Mozambique; ⁵Jose Macamo Hospital, Maputo, Mozambique; and the ⁶Ministry of Health, Maputo, Mozambique.

Background: Mozambique has had no policy-driven trauma system and no hospital-based trauma registries, and injury was not a public health priority. In other low-income countries, trauma system implementation and trauma registries have helped to reduce mortality from injury by up to 35%. In 2014, we introduced a trauma registry in 4 hospitals in Maputo, Mozambique, serving 18 000 patients yearly. The project has since expanded nationally. This study summarizes the challenges, results and lessons learned from this large national undertaking. **Methods:** Between October 2014 and September 2015, we implemented a trauma registry at 4 hospitals in Maputo. In October 2015 the project began to be expanded nationally. Physicians and allied health professionals at each hospital were trained to implement the registry, and each identified and trained data collectors. We conducted semistructured interviews with the key stakeholders of this project to identify the challenges, results and creative solutions implemented for the success of this project. **Results:** The majority of participants identified the importance of having a trauma registry and its usefulness in identifying gaps in trauma care. The registry identified that less than 5% of injured patients arrived by ambulance, which served as evidence for the need for a prehospital system, which the Ministry of Health began implementing. Participants also highlighted how the registry has allowed for a structured clinical approach to patients, ensuring that severely injured patients are identified early. Challenges reported included the high rates of missing data, the difficulty in establishing a streamlined flow of trauma patients within each hospital, and the bureaucratic challenges faced when attempting to improve capacity for trauma care at each hospital by introducing a trauma bay and new technologies. Participants identified the need to improve data completeness, to disseminate the results of the project nationally and internationally, to improve interdivisional cooperation and to continue educating health providers on the importance of registries. Participants also identified political instabilities in the region as a potential source of challenge in expanding the project nationally; they also identified the lack of uniform resource allocation and low personnel in many areas, especially rural areas, as a major burden that would need to be overcome. **Conclusion:** Introduction of a trauma registry system in Mozambique is feasible and necessary. Initial findings provide insight into the nature of traumas seen in Maputo hospitals, but also underscore future challenges, especially in minimizing missing data, using data to develop evidence-based trauma prevention policies, and ensuring the sustainability of these efforts by ensuring continued governmental support, education and resource allocation. Many of these measures are being undertaken.

Rural patient transfer: a review of the evidence on best practices. *Jude Kornelsen¹, Jel Coward², Rebecca Lindley², Brent Hobbs², Jeff Hussey².* From the ¹University of British Columbia, Vancouver, BC.; and the ²Rural and Remote Division of Family Practice, University of British Columbia, Vancouver, BC.

Background: The transport of high-acuity rural patients poses unique challenges to health planners in Canada and other jurisdictions marked by expansive geography. This realist review consolidates international peer-reviewed and grey literature on best practices for the transport of rural patients through a rural lens. That is, findings are based on understanding the realities of rural high-acuity care, the essential role of rural care providers and the need for networks of supportive infrastructure. **Methods:** The review set out to answer the guiding question: What are the best practice models for transferring medically complex rural patients to secondary/tertiary care? A 2-pronged search strategy was applied to respond to the research question, including a review of the academic literature yielding 151 articles that met inclusion criteria and a broad “grey literature” review of emergency transport systems across Canada and international jurisdictions of comparable circumstances. **Results:** Data were organized under the following thematic points: evidence on timing to definitive care, equipment and technology, health human resources, dispatch and communication and governance. An overarching finding was on the importance of maintaining patients in rural environments when possible to avoid unnecessary iatrogenic risk associated with transfer, within the context of providing equivalent, high-quality patient care. Appropriate local care was seen to increase the capacity and confidence of rural hospitals, including local patient and urban provider trust. Best practices in supporting local sites included increased local interprofessional education, streamlining communication between rural and referral sites and stabilizing the overall rural health service infrastructure. This involved ensuring dispatch agents are transport physicians with the medical authority to assume patient responsibility and offer clinical support as well as the operational capacity to initiate and organize patient transfer. The potential for the utility of telehealth linkages to support both the transport and local management of complex and high-acuity patients was noted. When secondary or tertiary care is needed, evidence demonstrated the importance of efficient timing and advanced care during the transport. **Conclusion:** Evidence suggests the need for a reorganization of transport, focused on the needs of rural patients and recognizing the essential role of rural providers. At a planning level, this requires the involvement of rural communities (patients, pro-

viders and other key stakeholders) and at a systems level involves recognizing the crucial role of rural providers in providing critical care and in transport decision-making. This requires supporting and maintaining the capacity of rural sites.

Trauma team activation criteria: aiming for 90% and above. *Angie Brisson¹, Nasira Lakha².* From ¹Vancouver Coastal Health, Vancouver, BC; and ²Trauma Services, Vancouver General Hospital, Vancouver, BC.

Background: As trauma patients require immediate access to specialized care, trauma team activation (TTA) criteria were developed with the goal of ensuring the necessary resources are immediately available. Criteria are based on mechanism of injury and presenting physiologic criteria, anatomic criteria or special considerations. This triggers a system-wide response to respond immediately to the acutely injured trauma patient. A compliance of 90% or higher is required at all times. **Methods:** A retrospective analysis examined the compliance of TTAs for patients who met the criteria. Owing to low compliance, TTA criteria were updated to align with local destination guidelines and Centers for Disease Control and Prevention recommendations. A decision support tool was created to assist emergency staff to determine if patients met criteria on arrival and subsequently initiate a TTA. Additional reference material (lanyard cards and emergency department [ED] memo, used by charge nurses to collect information about incoming patients) were all updated for consistency. **Results:** In collaboration with the ED, the trauma team developed TTA criteria to ensure that the resources necessary to address the clinical needs of injured patients are immediately available. With the goal of improving the compliance of TTA to 90% and to meet the core indicator threshold for Accreditation Canada’s Trauma Distinction for patients who meet criteria, the compliance rate improved from 77%–89% to 91%–100%. The reference material for the ED at Vancouver General Hospital served as a guide that the team used in real time to guide decision-making. All missed activation cases were reviewed collaboratively between the trauma team and ED to determine the cause and areas of improvement. **Conclusion:** Activating a TTA provides immediate resources to seriously injured trauma patients, and is vital to saving lives. By creating a decision support tool and revising reference material available in the ED, TTA compliance for patients who meet criteria improved from 77%–89% to 91%–100%. The reference material serves as a guideline to activate and assemble the trauma team in order to expedite care of critical or seriously injured patients who require rapid, organized trauma resuscitation, evaluation and stabilization to promote optimal outcomes.