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## Trauma 2012

**Trauma Association of Canada (TAC)  
Annual Scientific Meeting**

**The Hilton Toronto, Toronto, Ont.**

**Thursday, Apr. 12 to Friday, Apr. 13, 2012**

**Abstracts**

# Trauma Association of Canada Annual Scientific Meeting abstracts

**Erythropoietin resuscitated with normal saline, Ringer's lactate and 7.5% hypertonic saline reduces small intestine injury in a hemorrhagic shock and resuscitation rat model.** R. Kao,\* X. Jiao,<sup>†</sup> A. Xenocostas,<sup>†</sup> T. Rui,\* N. Parry,<sup>†</sup> D. Driman,<sup>†</sup> C. Martin.<sup>†</sup> From the \*University of Western Ontario and the <sup>†</sup>London Health Sciences Centre, London, Ont.

**Background:** Bacterial translocation (BT) from the gut can develop and persist after short periods of hemorrhagic shock secondary to traumatic injuries. Erythropoietin (EPO) exerts hemodynamic and anti-inflammatory effects in addition to its erythropoietic effect. We tested the hypothesis that EPO given at the time of acute resuscitation with normal saline (NS), Ringer's lactate (RL) or 7.5% hypertonic saline (7.5%HTS) will limit shock-induced mucosal injury and BT. **Methods:** Rats were hemorrhaged 30 mL/kg over 10 minutes via arterial catheter for 50 minutes, then randomized to 1 of 6 resuscitation groups ( $n = 5/\text{group}$ ): NS, NS+EPO, RL, RL+EPO, 7.5%HTS and 7.5%HTS+EPO. Intravenous EPO (1000 U/kg) was given at the start of NS or RL (3 times the volume of shed blood) and 4 mL/kg of 7.5%HTS+1 volume of RL resuscitation. Postresuscitation gut function was evaluated using agar cultures of mesenteric lymph nodes and portal vein plasma lipopolysaccharide, IL-6 and TNF- $\alpha$  levels. Three of 5 rats per group underwent light microscopic examination using semi-thin plastic sections of the distal ileum and fluorescein isothiocyanate dextran 4000 used to assess the distal ileum mucosal permeability to macromolecules. **Results:** Two hours postshock and resuscitation, BT to mesenteric lymph nodes decreased in the NS+EPO versus the NS group ( $299 \pm 104$  v.  $1050 \pm 105$  CFU/gm,  $p < 0.05$ ); the addition of EPO to the RL or 7.5%HTS had no effect. Comparing different solutions, there was a significant increase in BT in the NS group versus the RL+EPO, 7.5%HTS+EPO and 7.5%HTS groups ( $1050 \pm 105$  v.  $357 \pm 134$ ,  $462 \pm 129$ ,  $428 \pm 106$  CFU/gm, respectively;  $p < 0.05$ ). There were no significant differences in terminal ileum permeability between groups, but there was a noticeable trend in decreasing terminal ileum permeability in the EPO-treated groups: NS versus NS+EPO ( $18.0 \pm 9.5$  v.  $12.9 \pm 6.3$   $\mu\text{g/mL}$ ,  $p = 0.84$ ), RL versus RL+EPO ( $17.7 \pm 5.9$  v.  $8.4 \pm 2.7$   $\mu\text{g/mL}$ ,  $p = 0.22$ ) and 7.5%HTS versus 7.5%HTS+EPO ( $11.4 \pm 6.4$  v.  $6.5 \pm 2.9$   $\mu\text{g/mL}$ ,  $p = 0.69$ ). There was no significant morphological evidence of mucosal injuries and no cytokine differences between groups and within groups. **Conclusion:** Preliminary data from an uncontrolled mean arterial pressure hemorrhagic shock rat model revealed that BT is an early event occurring within 2 hours of injury and resuscitation before any evidence of histological injury. Erythropoietin with NS significantly decreased BT to the portal vein as compared with NS alone, but not with RL and 7.5%HTS.

**Analgesia in the management of pediatric trauma in the resuscitative phase: the role of the trauma centre.** A. Rajagopalan, T. Charyk Stewart, J. Walsh, N. Parry,

N. Merritt. From the London Health Sciences Centre, London, Ont.

**Background:** The objective of this study was to evaluate use of analgesia in the resuscitative phase of severely injured pediatric patients. **Methods:** A retrospective cohort of pediatric patients (age  $< 18$  yr, Injury Severity Score [ISS]  $\geq 12$ ) was identified from the London Health Sciences Centre's Trauma Registry, 2007–2010. Variables were compared between analgesia and nonanalgesia groups with Pearson  $\chi^2$  and Mann–Whitney  $U$  tests. Resuscitative analgesia use was assessed through multivariate logistic regression controlling for age, sex, mechanism, arrival and trauma team activation (TTA). **Results:** Analgesia was used in 32% of cases. Univariate analysis did not reveal any differences in sex, age, injury type, injury profile and arrival patterns. Significant differences were found with analgesia used more frequently in patients injured in a motor vehicle (58% v. 42%,  $p = 0.026$ ) and having parents in the resuscitation room (17% v. 6%,  $p = 0.01$ ). Analgesia patients were slightly more injured (median ISS 22 v. 17,  $p = 0.027$ ) and had 2.25 times more TTA (39% v. 17%). Logistic regression revealed patients arriving directly to a trauma centre had a higher incidence of administering analgesia (OR 2.009, 95% CI 1.027–3.930), as did TTA (OR 2.182, 95% CI 1.007–4.725) and having parents in the resuscitation room (OR 3.558, CI 1.225–10.331). Narcotics were most commonly used (82%), followed by benzodiazepines (16%), with 66% given during the primary survey. **Conclusion:** Use of analgesia is important in the acute management of pediatric trauma. Direct presentation to a level 1 trauma centre, TTA and the presence of parents lead to higher appropriate use of analgesia in pediatric trauma resuscitation.

**Multidisciplinary trauma team care in Kandahar, Afghanistan: current injury patterns and care practices.** A. Beckett,\* E. Elster.<sup>†</sup> From the \*University of Toronto, Toronto, Ont., and the <sup>†</sup>US Navy

**Background:** Multidisciplinary trauma care systems have been shown to improve patient outcomes. Medical care in support of the Global War on Terror (GWOT) has provided opportunities to refine these systems. We report on the multidisciplinary trauma care system at Kandahar Airfield, Afghanistan. **Methods:** We reviewed the Joint Trauma System Registry, Kandahar, from Oct. 1, 2009, to Dec. 31, 2010, and extracted data regarding patient demographics, clinical variables and outcomes. **Results:** During the study period, 2480 trauma patients were treated, with the most common source of injury being from improvised explosive device (IED) blasts (915), followed by gunshot wounds (GSW; 327). In 2010, 17 patients with triple amputations as a result of injuries from IEDs were seen. The average Injury Severity Score in 2010 was 12.0, and 109 patients were massively transfused. From Jan. 1, 2010, to Dec. 31, 2010, 4106.24 operating room hours were logged to complete 1914 patient cases. The mean number of procedures per patient in 2010 was 3.11.

In-house mortality was 4.1% in 2010, compared with 4.8 from October to December 2009. **Conclusion:** Multinational, multidisciplinary care is required for the large number of severely injured patients seen at Kandahar Airfield. Multidisciplinary trauma care in Kandahar is effective and can be readily employed in combat hospitals in Afghanistan.

**Does computed tomography for penetrating renal injury reduce renal exploration? An 8-year review at a Canadian level 1 trauma centre.** A. Beckett,\* H. Tien.† From the \*University of Toronto and the †Sunnybrook Health Sciences Centre, Toronto, Ont.

**Background:** Penetrating renal injuries have historically been treated with operative exploration. However, use of computed tomography (CT) to investigate these injuries has allowed for an increasing number to be managed nonoperatively. We reviewed those patients at our level 1 trauma centre who underwent CT before laparotomy or observation to determine if they have lower rates of renal exploration (total nephrectomy, partial nephrectomy or renal repair) compared with those patients without a preoperative CT. **Methods:** For the years 2002–2010, our institutional database identified 75 patients who were initially hemodynamically stable and received a diagnosis of penetrating renal trauma by CT scan or operation. These patients were divided into 2 groups based on whether or not they had a CT of the abdomen before laparotomy or observation. **Results:** We identified 75 patients with penetrating renal injuries; 8 were excluded because of hemodynamic instability (systolic blood pressure < 90 mm Hg) or missing data. Of the 42 patients who had a preoperative CT, 14 (33.3%) went on to have renal exploration. Of the 25 patients who did not have a CT preoperatively, 15 (60%) had renal exploration ( $p = 0.0331$ ). We found an association between preoperative CT and decreased mortality. **Conclusion:** Preoperative CT is associated with a decreased rate of operative exploration for penetrating renal injuries and a trend for decreased mortality. However, there may be a selection bias, as hemodynamically unstable patients do not typically undergo CT. We conclude that CT investigation of hemodynamically stable penetrating renal trauma patients improves patient outcome and decreases operative exploration rates.

**The other side of pediatric trauma: violence and intent injury.** R. Rex,\* L. Phillips,\* I. Bratu.† From \*Concordia University College of Alberta and the †Division of Pediatric General Surgery, Department of Surgery, Stollery Children's Hospital, Edmonton, Alta.

**Background:** Trauma is the number one cause of pediatric morbidity and mortality in Alberta. The purpose of this study is to examine the types and severity of intent pediatric traumas in Alberta, in order to support prevention strategies. **Methods:** Data for intent trauma in patients aged 0 to less than 18 years, with an Injury Severity Score (ISS) of 12 or more, treated at 5 major trauma centres in Alberta from 1996 to 2010, were extracted using the Alberta Trauma Registry. Patients were examined with respect to demographics, injury characteristics, use of hospital resources and location of injury. Statistical analysis of the data was conducted in SPSS, using the Student  $t$  test and  $\chi^2$  test, with  $p < 0.05$  considered significant. **Results:** In total, 367 children were treated for

intent trauma with a mean ISS of 22.8 (SD 8.5) and 23.2% mortality. The cause of intent injury was assault (48%), child abuse (34%) and suicide (18%). The incidence of trauma was observed to be higher in age groups 0–4 years and 10–17 years, compared with children aged 5–9 years. Of pediatric intent trauma patients, 74% were boys, and with increasing age, boys were more likely to be injured than girls. The most common place of injury for all types of injuries was the home. **Conclusion:** Tragically, the pediatric intent trauma mortality rate is higher than the average pediatric mortality rate for all types of trauma. The higher rates of intent injuries in children 0–4 years and 10–17 years should guide prevention strategies to further awareness about shaken baby syndrome and suicide prevention.

**Upregulation of activated protein C leads to factor V deficiency in early trauma coagulopathy.** S. Shah,\* B. Nascimento,† R. Pinto,† J. Callum,† H. Tien,† S. Rizoli.† From \*Wayne State University, Detroit, Mich., and the †Sunnybrook Health Sciences Centre, Toronto, Ont.

**Background:** Trauma is a leading cause of death worldwide. An acute coagulopathy is observed in a quarter of trauma patients upon hospital arrival. Current literature suggests upregulation of the protein C pathway contributes to acute coagulopathy by activating thrombomodulin, thereby preventing thrombin generation. We recently demonstrated a critical factor V (FV) deficiency in coagulopathic trauma patients. Activated protein C (APC) inactivates FV, but the link between APC and FV in early trauma-associated coagulopathy (TAC) remains uninvestigated. We hypothesize that APC's inactivation of FV is a major step in the pathophysiology of early TAC. **Methods:** This study is a subgroup analysis ( $n = 10$ ) of a prospective randomized controlled trial on massively bleeding trauma patients. A Western blot was conducted to demonstrate the cleavage of FV at the APC-specific sites of Arg 306–506. A Pearson correlation test was conducted to depict the relationship between FV and APC. **Results:** An FV deficiency was noted in all massively bleeding patients. An upregulation ( $APC > 1.82$ ) of APC was present in all patients. The Western blot demonstrated APC-specific proteolytic cleavage (Arg 306–506) of FV in all patients. The Pearson correlation test showed a significant inverse relationship between FV and APC ( $r^2 = -0.508, p < 0.05, CI 95\%$ ). **Conclusion:** This study demonstrates an important link between APC and FV in early TAC. An early and significant deficiency in FV greatly impairs thrombin formation, debilitating the hemostatic response to trauma. This presents important implications for clinical practice, as FV can only be replaced by fresh plasma transfusion.

**A provincial integrated model of improved care for patients following hip fracture.** J. Waddell,\* J. McMullan,† R. McGlasson,† N. Mahomed,‡ J. Flannery.§ From \*St. Michael's Hospital, the †Bone and Joint Health Network, Sunnybrook Health Sciences Centre, the ‡University Health Network and the §Toronto Rehabilitation Institute, Toronto, Ont.

**Background:** Fractures of the proximal femur are increasing in incidence as the population ages. In order to address this problem, the province of Ontario (population 14 million) has advocated an integrated model of care. **Methods:** A policy to improve the

outcome for patients sustaining hip fractures has been developed. It has been implemented in the 14 health regions of the province. The objectives are, first, that all surgical procedures be performed within 48 hours of a patient's admission to hospital; second, that surgical treatment of hip fractures must permit unrestricted weight bearing; and third, that there be a structured acute care postoperative course followed by admission to progressive rehabilitation. **Results:** Since the implementation of this policy, 89% of all hip fracture patients are receiving definitive surgical treatment within 48 hours of admission. Site variations are identified and remedial actions implemented for those hospitals that fail to meet this target. Acute care length of stay following hip fracture has declined from a mean of 17 days to a mean of 8 days in 80% of cases. The number of patients with hip fractures returning to their preinjury residence has increased significantly from approximately 35% to 52% at 3 months postfracture. **Conclusion:** A structured program for hip fracture care can be developed in large population areas and has been implemented for the approximate 10 000 patients sustaining hip fractures annually within our jurisdiction. This model should be broadly applicable to other health regions.

**Sports concussion: an Olympic boxing model comparing sex with biomechanics and traumatic brain injury.** *M. Boitano,\* C. Bir,† F. Baillie.\** From the \*Hamilton General Hospital, Hamilton, Ont., and †Wayne State University, Detroit, Mich.

**Background:** This National Ignition Facility study is the first research project on the biomechanics of a punch that is collected by real-time data. The objective was to compare the punch mechanics of male and female boxers by measuring the location, frequency and severity of impacts during a sparring bout, along with an evaluation of cognitive function and sequelae. **Methods:** Using the previously validated instrumented boxing headgear (IBH), 3 tests were analyzed for each impact: translational and rotational accelerations and Head Injury Criterion (HIC). The ImPACT concussion management software was used to evaluate cognitive function. Data were collected on 30 male and 30 female boxers. **Results:** For males, a mean (SD) [peak] HIC of 43 (100) [1652], translational acceleration of 30 (21) [191]g and a rotational acceleration of 2571 (1852) [17 156] rad/s<sup>2</sup> was obtained. For females, a mean (SD) [peak] HIC of 32 (66) [1079], translational acceleration of 28 (17) [184]g and a rotational acceleration of 2533 (1524) [13 113] rad/s<sup>2</sup> was obtained. Only 1 male boxer sustained a concussion with post-concussive symptomatology. **Conclusion:** Statistical significance was shown between sex peak values. There was no statistical difference between the sexes when analyzing cognitive functions. A decrease in delayed memory was noted in both. Our goal is to develop safety measures and training that will focus on decreasing translational and especially rotational acceleration.

**A multifaceted quality improvement strategy to optimize monitoring and management of delirium in trauma patients: results of a clinician survey.** *S. Faidi,\* A. Coates,\* S. Asiri,† P. Foster,\* F. Baillie,† M. Bhandari.†* From the \*Hamilton Health Sciences Trauma Program and †McMaster University, Hamilton, Ont.

**Background:** Delirium is a serious complication in trauma patients and can lead to adverse outcomes such as prolonged

hospital stay and even death. Despite good evidence to support regular monitoring for delirium, an audit of current practice on our trauma ward showed that this is not the case. We designed a multifaceted quality improvement (QI) strategy directed at nurses, physicians and allied health professionals to implement daily delirium monitoring into bedside care. Our strategy includes a clinician questionnaire, multidisciplinary educational workshops, audit and feedback, and tailoring interviews. We will present the findings from the clinician questionnaire in the context of our QI strategy. **Methods:** A questionnaire was administered to nurses, physicians and allied health professionals who work on the trauma ward to determine their current knowledge about risk factors for delirium, as well as assessment and management of this complication. **Results:** Thirty-nine (64%) questionnaires were returned. The majority of respondents (92%) were unable to identify the key diagnostic features of delirium, and nearly all clinicians were unfamiliar with the 3 types of delirium. Routine assessment for delirium was recognized as important (72%); however, the majority of clinicians (64%) were unsure about proper assessment methods. Few respondents (28%) reported feeling confident in identifying delirium, with many (67%) questioning their ability to effectively manage the care of a patient with delirium. **Conclusion:** The survey demonstrates a discrepancy between the perceived importance of monitoring for delirium in trauma patients and current assessment practices. Our findings will inform the content of the multidisciplinary educational workshops.

**Risk factors for severe all-terrain vehicle injuries in Alberta.** *O. Babatunde,\* L. Phillips,† I. Bratu.‡* From the \*University of Alberta, †Concordia University College of Alberta and the ‡Division of Pediatric General Surgery, Department of Surgery, Stollery Children's Hospital, Edmonton, Alta.

**Background:** We wish to examine if there are different patterns of all-terrain vehical (ATV) injury and outcomes between age groups in Alberta to better understand where to focus preventative and safety measures. **Methods:** Using the Alberta Trauma Registry, we collected data on individuals of all ages in Alberta who sustained an ATV injury with an Injury Severity Score (ISS) greater than 12 from Jan. 1, 1996, to Dec. 31, 2010. Multinomial regression is used for risk factor determination of sustaining increasingly severe injuries for 3 age groups: 0–16, 17–55 and older than 55 years. **Results:** The number of ATV injuries has dramatically increased from a cumulative incidence rate (CIR) of 5.5 per 100 000 in 1996–97 to 30.7 in 2009–10. Of the 774 cases, 82% were male, with a mean age of 33.2 years and a median ISS of 20, and 3.9% died. Sex and sustaining a rollover are not risk factors for a higher ISS. Those aged 0–16 years are 1.9 (95% CI 1.1–3.35) times more likely to have a higher ISS as compared with those older than 55 years. Individuals who use their ATV on the street and do not wearing a helmet are 2.02 (95% CI 1.33–3.06) and 1.59 (95% CI 1.16–2.17) times more likely to sustain a higher ISS, respectively. **Conclusion:** Over the last 14 years, severe ATV injuries in Alberta have increased by over 600%. The underage ( $\leq 16$  yr), those not wearing helmets and those riding on the street sustain the most severe injuries. Legislation needs to protect the underage from riding ATVs and mandate helmet use with adequate licensing for adult ATV riders.

**Evaluating potential spatial access to trauma centre care by severely injured patients.** *F. Lawson,\* N. Schuurman,\* L. Oliver,† A. Nathens.‡* From \*Simon Fraser University, Burnaby, BC, †Statistics Canada, Ottawa, and ‡St. Michael's Hospital, Toronto, Ont.

**Background:** The purpose of this study was to evaluate potential spatial access to trauma centre care in Canada through the examination of the spatial relationships between the population of severely injured patients and trauma centres. **Methods:** Both hospitalization and mortality data were used to identify adults who were hospitalized or died as a result of a major trauma. Geographic information system (GIS) methods were then used to measure their potential spatial accessibility to definitive trauma centre care. In addition to a commonly used drive time method, a new method for measuring spatial accessibility was employed, which combined the use of a spatial scan statistic and a drive time catchment method. **Results:** Of the 63 138 major traumas identified in this study, 68.5% of patients lived within 1 hour travel time to a trauma centre. However, access to trauma centre care varied from province to province. Of the 364 significant spatial clusters of major trauma identified, 61.0% were farther than 1 hour from a trauma centre. Major traumas that resulted in death before hospital admission had poorer (62.4%) potential spatial access to trauma centre care than the major trauma patients who survived to hospital admission (70.0%). **Conclusion:** This research demonstrated that there is significant variation in potential spatial access to trauma centre care across Canada. In addition to evaluating access, this study was unique because it identified clusters of major trauma with low and high relative access to trauma centre care.

**Incidence of brain injury in facial fractures.** *A. Grant,\* A. Yazdani.†* From the \*University of Western Ontario and the †London Health Sciences Centre, London, Ont.

**Background:** Plastic surgeons are responsible for treating a significant number of facial fractures. These fractures can be associated with head and cervical spine injury, as impact forces are transmitted through the head and neck. The incidence of minor brain injury in these patients is not well defined. Minor brain injury can result in morbidity, affecting function, safety and return to work, as well as potential mortality. This prospective study aims to determine the incidence of minor brain injury in 100 consecutive patients with facial fractures. **Methods:** Data were collected over a 9-month period by a craniofacial surgeon in a level 1 trauma centre. A clinical questionnaire was designed to capture information about major and minor brain injury in patients with facial fractures. Assessments were completed in a variety of hospital settings during the first patient encounter. **Results:** The average age of the group was 34, the majority of whom were male. Time between injury and assessment ranged from less than 72 hours to more than 3 weeks. The incidence of brain injury in this group was 67% overall; 29% with major and 38% with minor brain injury. Subgroup analysis revealed that major brain injury was commonly diagnosed early in the emergency department or the intensive care unit. However, minor brain injury tended to be diagnosed late in the outpatient craniofacial clinic. **Conclusion:** These results demonstrate that facial fractures are often associated with brain injury. Furthermore,

there should be a high level of suspicion for minor traumatic brain injury in patients with facial fractures.

**Surgical outcomes and the acute care surgery service.** *M. Sudarshan, M. Alhabboubi, E. St. Louis, X. Tan, P. Fata, D. Deckelbaum, T. Chughtai, T. Razek, K. Khwaja.* From the McGill University Health Centre, Montréal, Que.

**Background:** An acute care surgery (ACS) service was implemented at our large teaching hospital, and we analyzed how this service impacts efficiency, morbidity and mortality. **Methods:** Prospective collection of data was completed over a 3-month period. A retrospective review of all general surgery admissions from the emergency department (pre-ACS) over a 1-year period was also conducted. Factors analyzed included length of stay, complications and in-hospital mortality. **Results:** We identified 121 admissions from the ACS service and 527 patients from the pre-ACS service. In-hospital mortality was 2% for the pre-ACS group and 2.4% for the ACS group (NS,  $p = 0.73$ ); 29% of patients in the pre-ACS had a length of stay of greater than 7 days compared with 20% in the ACS group ( $p < 0.0001$ ); and 89% of patients in the pre-ACS group had no in-hospital complications compared with 80% of patients in the ACS group ( $p = 0.0087$ ). The average time to first contact with the patient after consult request was 211 minutes in the pre-ACS group and 103 minutes in the ACS group. The Charlson comorbidity index was greater than 5 for 38% of the pre-ACS and 28% for the ACS group ( $p = 0.024$ ). **Conclusion:** Our results suggest an ACS service can possibly reduce emergency department burden by reducing the time to first contact with a patient. Patients also were found to have a shorter length of stay. The Charlson comorbidity index was higher for the ACS group, which might reflect the increased in-hospital complications.

**The acute care general surgery population and prognostic factors for morbidity and mortality.** *M. Sudarshan, E. St. Louis, M. Alhabboubi, X. Tan, P. Fata, D. Deckelbaum, T. Chughtai, T. Razek, K. Khwaja.* From the McGill University Health Centre, Montréal, Que.

**Background:** Our purpose was to identify prognostic factors in emergency general surgery patients that can lead to prediction and early recognition of patients with increased morbidity or mortality, guiding earlier and more aggressive intervention for this important population. **Methods:** All general surgery admissions from the emergency department were reviewed retrospectively over 1 year. Factors from the history, physical exam and laboratory measures were correlated with in-hospital complications, the requirement for surgery, length of stay in hospital and mortality. **Results:** We identified 527 patients as admissions to the general surgery ward from the emergency department. The most common conditions included acute appendicitis (21.6%), acute cholecystitis (8.5%) and small bowel obstruction (12.5%). The presence of more than 3 comorbidities and an age of more than 60 were predictive of worse outcomes in terms of mortality, increased length of stay, increased in-hospital complications and conservative management of the surgical condition ( $p < 0.05$ ). Presence of tachycardia ( $p < 0.05$ ) was associated with a higher rate of mortality and longer length of stay. Increased urea ( $p < 0.05$ ) levels were found in those with higher mortality and increased rate of complications.

Duration of surgery directly correlated with the number of in-hospital complications **Conclusion:** We demonstrate that with the identification of key prognostic indicators on first contact, it is possible to estimate the risk of adverse outcomes for the emergency general surgery patient population.

**Disaster preparedness of trauma.** *M. Takahashi,\* M. Takada,† M. Sawano,\* H. Ito,‡ H. Tsutsumi.\** From the \*Saitama Medical University, Saitama, the †Chiba University, Chiba, and the ‡Fukaya Red Cross Hospital, Fukaya, Japan

**Background:** We experienced a big earthquake on March 11, 2011. Sixteen years ago, a big earthquake was also experienced on Jan. 17, 1995, resulting in a number of preventable trauma deaths. **Methods:** The number of deaths and injuries from trauma that occurred during the 2 earthquakes were compared. **Results:** There were 6434 deaths and 43 792 injured persons in the last earthquake (M7.3). In this earthquake (M8.4), there were 15 782 deaths (more than twice than last time). However, there were fewer injured persons (5932), and we did not see the same kinds of preventable deaths caused by externally caused injuries. In addition, disaster units (such as disaster medical assistance teams) could do nothing about on-site medical treatment. **Conclusion:** The higher number of deaths in the 2011 earthquake was owing to the resulting tsunami. When planning disaster preparedness for trauma, it is important to consider the features of the area, as shown by our analysis of the data and incredible photos.

**What would you like to know and how can we help you? Assessing the needs of regional trauma centres.** *M. Waggott, A. Keenan.* From The Ottawa Hospital, Ottawa, Ont.

**Background:** This study was conducted at a lead trauma hospital in Ontario. This enhanced replication study will explore any changes in the educational needs of staff at regional hospitals related to trauma, while identifying the clinical and educational resources available. **Methods:** A mixed method design is being used. Site visits with semistructured interviews are being conducted with key stakeholders from the regional hospitals. Surveys will determine the learning needs and resources available. This information is being analyzed for themes and trends. **Results:** Preliminary results show a strong interest by regional hospitals to receive educational support from the lead trauma hospital, specifically information that is related to assessment and transferring unstable patients. They prefer that the education be delivered in an interactive format in their local setting. The limited resources (personnel and equipment) must also be considered when providing relevant education. The most commonly cited reason for not participating in trauma education is distance, lack of time and lack of funding. **Conclusion:** A systems approach to trauma care must also be considered when planning trauma education. An enhanced understanding of both regional and urban trauma care is required to provide exemplary trauma care across the trauma continuum. This study provides a framework to conduct educational need assessments related to trauma. Conducting a needs assessment before program planning and implementation is important so that limited resources are used appropriately. It also ensures that educational programs are

designed and delivered in a way that best meets the needs of the audience.

**Posttraumatic stress disorder screening for trauma patients at a level 1 trauma centre.** *J. Lampron, M. Waggott.* From The Ottawa Hospital, Ottawa, Ont

**Background:** This project was developed to determine the prevalence of posttraumatic stress disorder (PTSD) symptoms in trauma patients admitted to an adult lead trauma hospital. Data from the trauma database will also be used to determine if there is coloration between the severity of PTSD symptoms, Injury Severity Scores (ISS) and mechanism of injury. **Methods:** A replication study of “Implementing a posttraumatic stress and functional outcome screening process for trauma patients at a level 1 adult trauma center” is being conducted. The PTSD Checklist – Civilian version (PCLC) is used to screen for symptoms of PTSD. If patients are screened as having severe symptoms of PTSD, they are given a PTSD information booklet and referred to a psychologist. The scores obtained from this screening tool will also be correlated with the patients’ ISS scores and mechanism of injury. **Results:** In similar studies in the United States, screening for PTSD using the PCLC has identified that up to 40% of trauma patients experience symptoms of PTSD. Currently there is anecdotal evidence that patients admitted to the trauma unit are experiencing PTSD. **Conclusion:** The anticipated outcome of this project is that many trauma patients will exhibit severe symptoms of PTSD, who previous to this project would go unrecognized. We also anticipate an increase in the amount of psychology referrals made for these patients both on an inpatient and outpatient basis.

**Physical and finite element model reconstruction of a subdural hematoma event.** *A. Post,\* B. Hoshizaki,\* S. Brien,† M. Gilchrist.\** From the \*University of Ottawa and the †Royal College of Physicians and Surgeons of Canada, Ottawa, Ont.

**Background:** Traumatic brain injury contributes to a high degree of morbidity and mortality in society. In an effort to prevent these injuries, research has focused on establishing thresholds for their prediction. The purpose of this study was to use a combination of physical and finite element models to reconstruct a subdural hematoma head injury event to examine possible thresholds for this type of injury. **Methods:** A subdural hematoma case from the Hull Hospital was used as the sample reconstruction. The injury case was reconstructed in laboratory from injury report forms and eyewitness accounts using Hybrid III dummy systems and the brain tissue deformation using the University College Dublin Brain Trauma Model. A variety of possible impact scenarios were reconstructed **Results:** The results indicated that the maximum principal strain at the subdural site was between 26% and 38%, Von Mises stress between 9.1 and 12.5 kPa, strain rate between 51.7 and 110 seconds<sup>-1</sup> and strain-by-strain rate 14.8 and 42.0. **Conclusion:** The results indicate that the threshold for subdural hematoma using this reconstructive method is consistent with the values attained from previous literature. The results are also consistent with anatomic tissue mechanical testing. Overall, the results indicate that this method of accident reconstruction can be used for further brain injury analysis.

**Abdominal wall reconstruction in the trauma patient with an open abdomen.** *E. Beale, J. Janis, H. Phelan, J. Minei.* From the University of Texas Southwestern Medical School, Dallas, Tex.

**Background:** Which trauma patients are at greatest risk for developing a frozen abdomen, and which surgical techniques are best at obtaining fascial closure of the open abdomen? We hypothesized that penetrating injuries, increasing degree of abdominal injury and larger volume of crystalloid resuscitation would lead to an increased likelihood of planned ventral hernia repair. **Methods:** We conducted a 3-year retrospective review of open abdomen patients. Patients were divided into the successful closure (SC) group, primary fascial closure obtained, and the failed closure (FC) group, skin grafting of open abdomen with planned hernia repair. Univariate and stepwise logistical analysis were conducted between SC and FC groups. Fascial- or vacuum-based surgical management techniques were compared with  $\chi^2$  analysis. **Results:** Data between SC ( $n = 44$ ) and FC ( $n = 18$ ) groups including patient demographics, admission/laboratory data and crystalloid volumes (15.6 L v. 16.8 L,  $p = 0.5$ ) were similar except initial base excess ( $-8.0$  v.  $-11.4$ ,  $p = 0.009$ ), Injury Severity Score (ISS; 29.0 v. 20.6,  $p = 0.04$ ), penetrating injury (47.7% v. 77.8%,  $p = 0.03$ ), number of surgeries (3.1 v. 9.7,  $p < 0.001$ ) and days with open abdomen (3.9 v. 53.8 d,  $p < 0.001$ ). Multivariate analysis revealed significant predictors were abdominal trauma index (ATI), base excess on arrival and ISS ( $p < 0.05$ ). Fascial- and vacuum-based management comparison of SC and FC groups showed no difference. **Conclusion:** Trauma patients significantly at risk for FC include those with base excess less than  $-15.5$ , penetrating injury, increasing ATI and a lower ISS; however, crystalloid volumes were not clinically significant. Vacuum- and fascial-based management are equally effective in obtaining definitive fascial closure of the open abdomen.

**Development and pilot testing of a survey to measure patient and family experiences with injury care.** *N. Bobrovitz, M.J. Santana, H.T. Stelfox.* From the University of Calgary, Calgary, Alta.

**Background:** To deliver patient-centred trauma care, we must capture feedback from patients and family on the services they receive. We therefore developed and pilot tested a survey to measure patient and family experiences with major injury care. **Methods:** We conducted a literature review and focus groups to generate survey items. We pilot tested the survey at a level 1 trauma centre and assessed feasibility of implementation and construct validity with Spearman rank correlation coefficients. Open-ended questions were qualitatively analyzed to explore whether responses corroborated survey content. **Results:** We developed a survey with 2 parts: acute care component (46 items) and post-acute care component (27 items) with 9 domains. We offered the survey to 170 patients/families, of whom 134 (79%) responded. Patients were primarily male (73%) with major injuries (median Injury Severity Score 18, interquartile range 16–25). Overall, 76% ( $n = 102$ ) of participants reported being either completely or very satisfied with their injury care, whereas 18% ( $n = 24$ ) reported being mostly satisfied and 6% ( $n = 8$ ) reported being slightly or very dissatisfied. The majority of survey items were significantly correlated with overall satisfaction (46 of 60 items). Almost all qualitatively identified

themes matched survey domains, adding support to the survey content. **Conclusion:** This pilot study demonstrates the feasibility of implementing a survey to capture patient and family experiences of major injury care and provides preliminary evidence of the instrument's content and construct validity.

**Occult shock in trauma: What are Canadian traumatologists missing?** *T. Zakrison,\* V. McCredie,\* E. Leung,\* G. Garcia,† S. Rizoli,‡ A. Nathens.\** From \*St. Michael's Hospital, Toronto, Ont., the †Ryder Trauma Center, Miller School of Medicine, University of Miami, Miami, Fla., and the ‡Sunnybrook Health Sciences Centre, Toronto, Ont.

**Background:** Occult shock (OS) is known to lead to worse outcomes, including mortality, in trauma patients. This causes metabolic acidosis while vital signs remain normal in the face of early, occult hemorrhage. Our goal is to determine what Canadian traumatologists know about OS and how well they screen for this clinical entity. **Methods:** A survey exploring the knowledge of and screening practices for OS was electronically mailed to the national membership of the Trauma Association of Canada (TAC). This survey was validated and iteratively pilot tested for clarity and clinimetric properties among local trauma practitioners. **Results:** A total of 86 members of the TAC responded. Of these, 46% were trauma surgeons, with close to half having completed a fellowship in critical care medicine. The majority of these practitioners have worked in urban centres for more than 10 years. Whereas 78% of respondents were aware of OS and 96% felt trauma centres should be screening for OS or are already doing so (88% and 8%, respectively), only 1 in 4 traumatologists knew how to screen for OS. Thirty-seven percent of traumatologists did not know how many patients present in OS at their local institution. More than half of the respondents still rely on vital signs to identify patients in early shock, whereas 65% of trauma surgeons are drawing blood gases only on patients who present as hemodynamically abnormal. **Conclusion:** In theory, most Canadian traumatologists are aware of the importance of screening for OS in trauma patients. In practice, however, there exists a significant knowledge gap, with wide variation in national trauma screening and resuscitation practices. This may have significant implications for the quality of care and clinical outcomes of Canadian trauma patients and merits further study.

**Timeliness in obtaining emergent percutaneous procedures for the severely injured patient: How long is too long?** *A. Smith,\* E. Dixon,† D. Niven,‡ A. Kirkpatrick,‡ D. Feliciano,§ S. D'Amours,¶ C. Ball.\*\** From the \*Department of General Surgery, University of Calgary, the †Departments of Surgery and Community Health Sciences, Foothills Medical Centre and University of Calgary, the ‡Departments of Surgery and Critical Care Medicine, Foothills Medical Centre and University of Calgary, Calgary, Alta., the §Grady Memorial Hospital, Atlanta, Ga., the ¶Liverpool Hospital, Sydney, Australia, and the \*\*Departments of Surgery and Oncology, Foothills Medical Centre and University of Calgary, Calgary, Alta.

**Background:** Modern trauma care relies heavily on nonoperative, emergent percutaneous procedures in the management of injured patients. Unfortunately, specific quality measures such as

time from arrival to angiography have not been widely discussed. The objective of this study was to evaluate the time interval from presentation to initiation of emergent percutaneous procedures in severely injured patients. **Methods:** All severely injured trauma patients (Injury Severity Score [ISS] > 12) presenting to a level 1 trauma centre between Feb. 1, 2007, and Jan. 31, 2010, were analyzed. Standard statistical methodology was employed ( $p < 0.05$ ). **Results:** Among 60 severely injured patients (93% blunt, mean ISS 31, mortality 12%), the median time to initiation of an angiographic procedure was 300 minutes. Of all procedures, 85% were therapeutic embolizations. Splenic (median time 266 min) and pelvic (median time 280 min) embolization occurred in 43% and 25% of procedures, respectively. Nearly 22% of patients required both an emergent percutaneous procedure and a subsequent operative procedure (the median time between angiography and operation was 1 day). **Conclusion:** A wide range in time intervals for obtaining emergent percutaneous procedures was observed. Improved processes emphasizing patient transition from the trauma bay to angiography suite are essential. Discussion regarding the “appropriate” time to angiography should now begin, with the intention to use this measure as a quality outcome for all level 1 trauma centres.

**97% of massive transfusion protocol activations do not include a complete hemorrhage panel. M. Bawazeer,\* N. Ahmed,\* H. Izadi,† A. McFarlan,\* A. Nathens,\* K. Pavenski.\*** From \*St. Michael’s Hospital and the †University of Toronto, Toronto, Ont.

**Background:** Massive transfusion protocol (MTP) as part of a protocolized resuscitation improves outcomes. **Methods:** We measured institutional compliance with MTP to determine the causes of noncompliance: 72 consecutive MTPs were reviewed

(from January 2010 to September 2011), and 12 compliance measures were established. Data elements were prospectively collected and retrieved from blood bank, trauma registry and clinical records (Table). **Results:** The mean age of the study population was 47.3 years, comprising 78% males, 74% blunt injuries, with an average Injury Severity Score of 36 and mortality of 47.3%. Blood products were wasted in 5.5% of cases. **Conclusion:** Strategies to improve compliance should be targeted at the early measurement of fibrinogen and cryoprecipitation, frequent measurement of blood values and timely deactivation of MTP.

**Trauma systems in Canada: What system components facilitate access to definitive care? C. Evans,\* A. Nathens,† J. Bridge,† J. Tallon.‡** From \*Queen’s University, Kingston, †St. Michael’s University, Toronto, Ont., and ‡Dalhousie University, Halifax, NS

**Background:** Despite evidence that patients sustaining major traumatic injuries have improved outcomes when they are cared for within an organized system of care, the extent of trauma system development in Canada is limited. One of the primary objectives of a trauma system is to ensure access to care. As access is particularly challenging in the face of Canada’s geographic expanse, we set out to evaluate components of trauma systems across Canada that might facilitate access to care. **Methods:** A nationwide online and mail survey was sent to stakeholders in all provinces and territories. Targeted respondents were trauma clinicians, medical directors, program managers, prehospital providers and administrators at the regional and provincial levels. A “snowball” approach was used to expand the sample base of the survey. **Results:** Respondents ( $n = 26$ ) representing all provinces and territories participated in the survey. All stakeholder groups were represented, including emergency medical services (25% respondents), trauma medical directors (19% respondents) and administrators (25% respondents). Components felt to facilitate access to a trauma centre (and the percentage of provinces with that feature) include provincial oversight (50% of provinces), an inclusive system design (50% of provinces), prehospital destination and bypass protocols (90% of provinces) and “no refusal” policies at trauma centres (80% of provinces). Challenges, in certain provinces, to ensuring timely access to a trauma centre include: perceived lack of provincial leadership over the system, difficulties in providing prehospital coverage to northern regions and limited interfacility transfer protocols. **Conclusion:** This work provides an inventory of trauma systems in Canada and highlights opportunities to improve access to definitive trauma care for Canadians.

**The role of trauma team leaders in missed injuries: Does specialty matter? T. Leeper,\* W. Leeper,† K. Vogt,† T. Charyk Stewart,† D. Gray,† N. Parry.†** From the \*University of Western Ontario and the †London Health Sciences Centre, London, Ont.

**Background:** The purpose of this study was to assess the frequency, type and severity of missed injuries in trauma patients, and to explore the factors associated with missed injuries including the role of the trauma team leader (TTL). **Methods:** A retrospective review was conducted of a random sample of 10% of all trauma patients (Injury Severity Score [ISS] > 12) from 1999

**Table. Institutional compliance with massive transfusion protocol (MTP)**

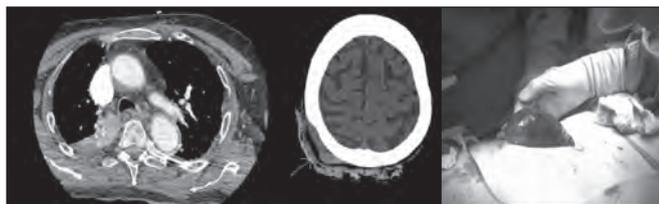
Protocol criteria	% compliance	Comments
Average compliance	66.9	
Activated based on MTP criteria?	82.0	18% did not meet criteria; 42.2% = delay > 15 min
Timely communication with BB?	52.8	Within 10 min of patient arrival
Group and screen sent?	93.1	From trauma bay
Hemorrhage panel sent?	1.4	CBC, INR, FN; FN missing in 97%
MTP based BP given?	55.6	6:4:1; RBC:FP:platelets + early cryoprecipitate
Hypothermia corrected?	82.0	Active rewarming within 2 h of ICU arrival
Acidosis corrected?	94.5	HC03 infusion within 2 h of ICU arrival
FV11a given according to MTP?	74.5	Given in 5.5% of cases
ABG, electrolytes, CBC, INR, FN measured?	15.3	Q30 minutes
Timely MTP deactivation?	51.4	Within 1 h of last BP given
Potassium measured?	82.0	Within 2 h of MTP activation
Calcium measured?	68.1	Within 2 h of MTP activation

ABG = arterial blood gas; BB = blood bank; BP = blood products; CBC = complete blood count; FN = fibrinogen; FP = flow properties; ICU = intensive care unit; INR = international normalized ratio; RBC = red blood cell.

to 2009. Missed injuries were defined as those identified greater than 24 hours after presentation and were independently adjudicated by 2 reviewers. Trauma team leaders were identified as either surgeons or nonsurgeons. **Results:** Of our total trauma population of 2956 patients, 300 charts were pulled for detailed review. Missed injuries occurred in 46 (15%) patients. Missed injuries most commonly were fractures ( $n = 32$ , 70%) and thoracic injuries ( $n = 23$ , 50%). The majority of missed injuries resulted in minor morbidity, with only 3 (7%) requiring operative intervention. On univariate analysis, higher ISS ( $p < 0.01$ ), higher maximum Abbreviated Injury Scale thorax score ( $p < 0.01$ ) and nonsurgeon TTL status were predictive of missed injuries ( $p = 0.02$ ). Multivariable logistic regression revealed that, after adjustment for age, ISS and severe head injuries, the presence of a nonsurgeon TTL was associated with an increased odds of missed injury (OR 2.15, 95% CI 1.10–4.20). **Conclusion:** Missed injuries occurred in 15% of patients. A unique finding was the increased odds of missed injury with nonsurgeon TTLs. Further research should be undertaken to explore this relationship and identify ideal training for TTLs.

**The adverse consequences of dabigatran among trauma and acute surgical patients.** *D. Kagedan,\* A. Ameer,† M. Alhabboubi,† S. Alzaid,† D. Deckelbaum,† P. Fata,† K. Khwaja,† T. Razek.†* From the \*University of Toronto, Toronto, Ont., and the †McGill University Health Centre, Montréal, Que.

**Background:** Dabigatran (Pradaxa) is an increasingly popular oral anticoagulant. Limitations of this drug include the inability to accurately assess the degree of anticoagulation using standard clotting tests (international normalized ratio, activated partial thromboplastin time) and the lack of a clinically effective means of reversing its effects. We present 4 cases illustrating the challenges of managing trauma and acute surgical patients anticoagulated with dabigatran. **Methods:** We conducted a retrospective chart review of 4 patients on dabigatran admitted to the trauma and acute care surgery services. **Results:** Four patients anticoagulated with dabigatran for chronic atrial fibrillation were admitted to hospital, 1 for acute hemorrhagic cholecystitis and 3 following falls. Of the latter group, 1 developed hemothorax (Figure, left), 1 developed a gluteal hematoma and hemopneumothorax, and 1 developed a subgaleal hematoma (Figure, centre). None of the patients' anticoagulation could be appropriately reversed, and all required blood transfusions and blood products beyond what would be expected for their injuries. The patient with hemorrhagic cholecystitis required an open cholecystectomy (Figure, right). All 4 patients were admitted to intensive care. Hematology recommended alternative forms of anticoagulation in all cases. All 4 previously independent patients were discharged to convalescent care. **Conclusion:** Dabigatran is associated with increased transfusion requirement, morbidity and resource utilization



among patients who develop major bleeding. Current management consists of supportive therapy, as no agent has been shown to reverse its effects.

**A descriptive study of bicycle helmet use in Montréal.** *T. Grenier, D. Deckelbaum, L. Drudi, K. Boulva, N. Rodrigue, K. Khwaja, T. Chughtai, P. Fata, T. Razek.* From the McGill University Health Centre, Montréal, Que.

**Background:** Traumatic brain injury may occur as a result of a cyclist collision, especially in the population of cyclists not wearing helmets. It is well established that helmet use significantly reduces the occurrence of head and brain injuries. The purpose of this study is to describe helmet use among the Montréal cyclist population as a step in planning injury prevention programs. **Methods:** Cyclists were observed at various locations on the island of Montréal. Locations were categorized as commuter route, bicycle path, residential area, school zone, park and other; 22 locations were selected with each observation lasting 60 minutes on weekdays and weekends during daytime hours between August and October 2011. **Results:** A total of 4789 cyclists were observed. The overall helmet compliance was found to be 45.77%. Youth had the highest compliance with 73.47%, whereas youth adults had the lowest with 33.63%. Adult and senior compliance was 46.15% and 56.52%, respectively. Visible minorities were observed wearing a helmet 28.95% of the time compared with Caucasian cyclists at 47.35%. BIXI riders were observed wearing a helmet 12.78% of the time. **Conclusion:** Helmet use in Montréal is considerably low, with the majority of users not wearing a helmet. Injury prevention programs should target the entire cyclist population, but special attention may be warranted in specific groups: young adults, visible minorities and BIXI riders.

**Factor XIII, desmopressin and permissive hypotension enhance clot formation compared with normotensive resuscitation: uncontrolled hemorrhagic shock model.** *J. Rezendo-Neto,\* S. Rizoli,† P. Carreiro,\* T. Lisboa,\* P. Winter,\* E. Ribeiro,\* J. Cunha-Melo,\* M. Andrade.\** From the \*Federal University of Minas Gerais, Belo Horizonte, Brazil, and the †Sunnybrook Health Sciences Centre, Toronto, Ont.

**Background:** Severe hemorrhage is the second most common cause of death in trauma patients. Our group has previously shown that permissive hypertension (PHT) and desmopressin (DDAVP) enhance clot formation. The purpose of this study was to investigate the coagulation effect of exogenous factor XIII, DDAVP and platelet-mediated hemostasis time (PHT). **Methods:** Male New Zealand rabbits ( $n = 30$ ) were divided in 5 groups: sham (G1); factor XIII without shock (G2); factor XIII + PHT (G3); factor XIII + PHT + DDAVP (G4); and normotensive resuscitation (NTR; G5). Sham animals underwent vascular cannulation only; the other groups (except G2) underwent uncontrolled hemorrhagic shock produced by an aortic injury. Factor XIII (35 U/kg), DDAVP (0.3 µg/kg) and crystalloids were given intravenously starting 15 minutes after injury. Mean arterial blood pressure was maintained at 60% of baseline in PHT groups; fluid infusion lasted 90 minutes. Baseline and postshock thromboelastometry and electron microscopy of the clots were performed. **Results:** Normotensive resuscitation animals (G5) had the longest clot formation time (mean 215

[SD 56] s) compared with all other groups ( $p < 0.05$ ). The association of factor XIII + DDAVP + permissive hypertension (G4) resulted in the strongest clots (mean 5.4 [SD 1.5] mm,  $p < 0.05$ ), as well as significantly thicker fibrin net on electron microscopy images. **Conclusion:** The association of factor XIII to DDAVP and permissive hypotension significantly improved hemostasis compared with normotensive resuscitation in uncontrolled hemorrhagic shock.

**Negative pressure wound therapy for critically ill adults with open abdominal wounds: a systematic review.** *D. Roberts,\* D. Zygun,† J. Grendar,‡ C. Ball,§ H. Robertson,¶ J.-F. Ouellet,‡ M. Cheatham,\*\* A. Kirkpatrick.††* From the \*Departments of Surgery, Community Health Sciences and Critical Care Medicine, Foothills Medical Centre and University of Calgary, the †Departments of Critical Care Medicine, Community Health Sciences, and Clinical Neurosciences, Foothills Medical Centre and University of Calgary, the ‡Department of Surgery, Foothills Medical Centre and University of Calgary, the §Departments of Surgery and Oncology, Foothills Medical Centre and University of Calgary, the ¶Health Sciences Library, Foothills Medical Centre and University of Calgary, Calgary, Alta., the \*\*Department of Surgical Education, Orlando Regional Medical Centre, Orlando, Fla., and the ††Departments of Surgery and Critical Care Medicine, Foothills Medical Centre and University of Calgary, Calgary, Alta.

**Background:** Open abdominal management with temporary abdominal closure (TAC) is increasingly used. We systematically reviewed studies comparing negative pressure wound therapy (NPWT) to alternate TAC techniques in critically ill trauma or surgery patients. **Methods:** We searched MEDLINE, PubMed, EMBASE, Web of Science, the Cochrane Database, clinical trials registries and bibliographies of included articles. Two authors screened identified citations, abstracted data and assessed methodological quality. **Results:** Among 2715 citations identified, 2 randomized controlled trials (RCTs) and 9 cohort studies met inclusion criteria. The overall study methodologic quality was moderate. One RCT observed an increased fascial closure rate (RR 2.4, 95% CI 1.0–5.3) and reduced hospital stay following the addition of retention sutured sequential fascial closure to the Kinetic Concepts Inc. (KCI) vacuum-assisted closure (VAC). Another reported a trend toward a higher fascial closure using the KCI VAC versus vacuum pack (RR 2.6, 95% CI 0.95–7.1). One prospective cohort study observed a reduction in mortality (RR 0.48, 95% CI 0.25–0.92) and an increased fascial closure rate (RR 1.5, 95% CI 1.1–2.0) in patients who received the ABThera versus vacuum pack. Another noted a reduction in lactate, intra-abdominal pressure and hospital stay for those fitted with the KCI VAC versus a Bogota bag. Most retrospective cohort studies found no beneficial effect of NPWT over alternate TAC methods. **Conclusion:** Studies with lower risk of bias suggest that NPWT versus selected alternate TAC methods may be linked with an improved mortality and/or fascial closure rate. Randomized controlled trials comparing NPWT and alternate TAC methods are warranted.

**The “weekend warrior” Fact or fiction for major trauma?** *D. Roberts,\* C. Ball,† J.-F. Ouellet,‡ P. McBeth,‡*

*A. Kirkpatrick,§ E. Dixon.¶* From the \*Departments of Surgery, Community Health Sciences, and Critical Care Medicine, Foothills Medical Centre and University of Calgary, the †Departments of Surgery and Oncology, Foothills Medical Centre and University of Calgary, the ‡Department of Surgery, Foothills Medical Centre and University of Calgary, Calgary, the §Departments of Surgery and Critical Care Medicine, Foothills Medical Centre and University of Calgary, and the ¶Departments of Surgery and Community Health Sciences, Foothills Medical Centre and University of Calgary, Calgary, Alta.

**Background:** The “weekend warrior” engages in demanding recreational sporting activities on the weekend despite minimal physical activity during the week. The purpose of this study was to identify the incidence and injury patterns of major trauma owing to recreational sporting activities on the weekend versus weekdays. **Methods:** All adults who were severely injured (Injury Severity Score [ISS]  $\geq 12$ ) while engaged in recreational sporting activities (1995–2009) were analyzed. Days of the week were evaluated with regard to major injuries. Standard statistical methodology was employed ( $p < 0.05$  was considered significant). **Results:** Among 351 severely injured recreational athletes (mean ISS 21, mean hospital stay 11 d, mortality rate 6.6%), 192 (55%) were injured on the weekend and 159 (45%) during the week ( $p > 0.05$ ). The most common sporting mechanisms were motocross (23.6%), hiking/mountain or rock-climbing (15.4%), skateboarding or rollerblading (12.3%), hockey/ice-skating (10.3%), aircraft-related (9.9%) and water-related (7.7%) activities. This distribution was similar regardless of the day of the week. These injuries most commonly resulted from falls or faulty jumps ( $p = 0.01$ ). Injury patterns were similar across both groups (head, 55.8%; spine, 35.1%; chest, 35.0%; extremities, 31.1%; face, 17.4%; abdomen, 13.1%;  $p > 0.05$ ). Surgical intervention was required in 41% of patients (15.1% open reduction internal fixation, 8.3% spinal fixation, 7.4% craniotomy, 5.1% facial repair, 4.3% laparotomy). If pro-rated for the number of days within each timeframe, weekend warriors have 3-fold more injuries per day (96 v. 32 per day,  $p < 0.05$ ). **Conclusion:** The “weekend warrior” concept is a validated entity when based on an injuries-per-day basis. This reality provides food for thought for all “weekend warriors.”

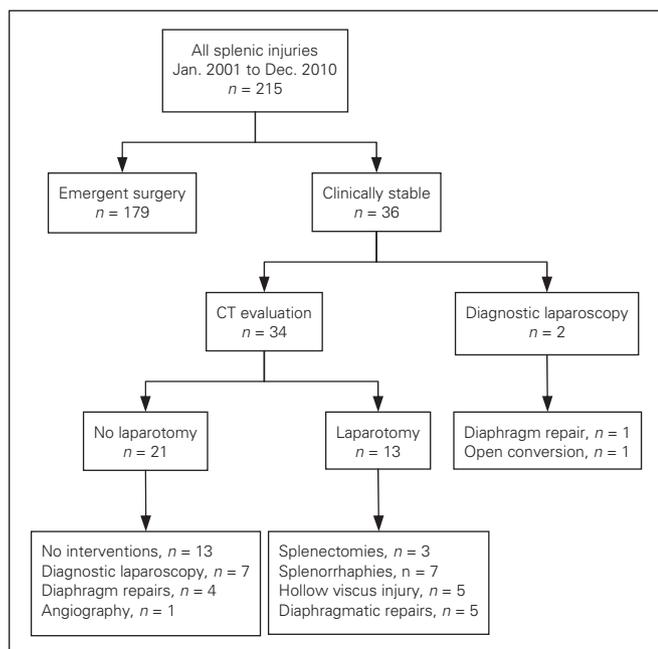
**Canadian injury prevention curriculum: a means to promote injury prevention.** *P. Stark,\* P. Groff.†* From the \*Alberta Centre for Injury Control and Research, School of Public Health, Edmonton, Alta., and †SMARTRISK, Toronto, Ont.

**Background:** Experts in injury prevention across Canada recognized that one of the major obstacles to having the injury issue acknowledged and addressed is a lack of critical mass of knowledgeable practitioners. The Canadian Collaborative Centres for Injury Prevention (CCCIP) partnered to develop a national injury prevention curriculum to address injury prevention and provide Canadian content. The curriculum would increase the number of individuals prepared with a basic understanding of injury epidemiology, principles of injury prevention, applied planning methodologies and program development, implementation and evaluation. **Methods:** An environmental scan and

educational needs assessment were conducted among injury prevention stakeholders to inform development of the curriculum. The curriculum was developed, pilot tested, revised and finalized for dissemination. **Results:** The curriculum development focused on key components of injury prevention based on a public health approach including defining the problem, identifying risk factors, selecting an intervention, implementation and evaluation. The pre-post surveys completed by participants of the pilot workshops show that there was an increase in knowledge of injury prevention, with emphasis on knowledge of intervention strategies. A 6-month follow-up survey had almost 80% of respondents reporting they had applied knowledge gained from the curriculum workshop to their work. **Conclusion:** With over 1227 people having completed the curriculum since 2003, the curriculum has increased the knowledge and skill level of individuals promoting injury prevention. The CCCIP is currently revising the curriculum to ensure materials are relevant and reflect current injury prevention research and practice.

**Penetrating splenic trauma: Safe for nonoperative management? R. Berg, K. Inaba, O. Okoye, J. Pasley, D. Demetriades. From the Division of Trauma and Critical Care Surgery, Department of Surgery, University of Southern California, Los Angeles, Calif.**

**Background:** Supported by data from multicentre, retrospective trials, nonoperative management (NOM) has become the dominant paradigm for blunt splenic injury. Nonoperative management is also feasible in selected penetrating abdominal trauma patients, including those with solid organ injury. Despite increasing experience with NOM of penetrating splenic injury, little is known about the efficacy and safety of this approach. **Methods:** We retrospectively reviewed all patients admitted with penetrating splenic trauma who arrived alive to the Los Angeles County and University of Southern California Medical Center between January 2000 and December 2010. **Results:** During the study period, 215 patients sustained penetrating splenic injury (Figure).



Emergent laparotomy was performed in 179 (83%). Of 36 initially stable patients, 21 (58%) were ultimately managed without laparotomy. Diaphragm injury occurred in 11 of 36 (31%) of this population. The incidence of hollow viscus injury in those failing NOM was 5 of 13 (38%). Mortality in those requiring emergent surgery was 16%. No deaths occurred in patients undergoing NOM. Subsequent splenectomy was performed in only 3 of 36 (8%) of initially clinically stable patients, splenorrhaphy in 8 of 36 (22%). **Conclusion:** Nonoperative management of penetrating splenic trauma appears safe in clinically stable patients and is ultimately successful in over half of these (9% of the total population with penetrating injury). A high incidence of concomitant diaphragm injury will mandate diagnostic laparoscopy in many patients. Hollow viscus injury may be responsible for over a third of NOM failures. Delayed laparotomy does not increase mortality nor preclude splenic salvage. Multicentre study is necessary to determine risk factors for NOM failure.

**The pediatric advanced trauma life support course: a national initiative. S. Mehta,\* F. Al-Harhi,† A. Cheng,‡ A. Lalani,\* A. Mikrogianakis.‡ From the \*Hospital for Sick Children, Toronto, Ont., the †BC Children’s Hospital, Vancouver, BC, and the ‡Alberta Children’s Hospital, Calgary, Alta.**

**Background:** Trauma is the leading cause of pediatric death, yet options for standardized pediatric-specific trauma training are limited. Hence, a national needs assessment was conducted by Delphi method to determine consensus on approximately 100 key learning objectives for a course for physicians involved in the management of pediatric trauma. **Methods:** Pediatric trauma experts from across Canada were recruited, and electronic surveys were sent inviting them to rate potential learning objectives, modified from the Canadian and American subspecialty board objectives. The results of each iteration were used to generate a shorter list for the next round, and after 3 rounds, a final list of learning objectives was obtained. The results of each round were analyzed and sent to 5 experts blinded from each other. For data analysis, the first round included any item with over 50% “agreed” or “strongly agreed” ratings, whereas the subsequent rounds included items with over 75% of such ratings. **Results:** Starting the process with 234 items, 21 chapters and 54 skills and procedures, the first round process resulted in 182 items, 20 chapters and 43 skills and procedures. The second round process resulted in 128 items, 17 chapters and 31 skills and procedures, whereas the third round resulted in 106 items, 15 chapters and 27 skills and procedures. **Conclusion:** The results of the Delphi process have provided a comprehensive list of learning objectives to be used to build a pediatric trauma course.

**The effectiveness of a psycho-educational program among outpatients with burns or complex trauma. P. Gardner, S. Cayne, D. Knittel-Keren, M. Gomez. From the St. John’s Rehab Hospital, Toronto, Ont.**

**Background:** This study evaluated the effectiveness of a psycho-educational program among traumatically injured outpatients with burns or complex trauma at a rehabilitation hospital. The intervention addressed psychological distress, promoted psychosocial functioning, assertiveness, functional coping styles and

encouraged responsibility toward community reintegration. **Methods:** We conducted a retrospective review of self-report outcome measures completed pre and post group intervention (June 2008 to July 2010), measuring differences in the following outcomes: health assertiveness skills (Health Assertiveness and Knowledge Questionnaire), coping styles (Coping with Health Injuries and Problems Scale), depression, anxiety and stress (Depression Anxiety Stress Scale 21) and stress (Perceived Stress Scale). Paired *t* tests and Pearson correlations were performed, with a *p* < 0.05 significance. **Results:** There were 26 traumatically injured outpatients (burns = 18, complex trauma = 8). The majority of patients were male (73%), the mean age was 40.4 (SD 2.3) years, and the mean time from injury to assessment was 5.6 (SD 0.6) months. There was a significant increase in health assertiveness (13.1 v. 11.8, *p* = 0.005) and a significant reduction in stress level (20.7 v. 23.2, *p* = 0.027) postintervention. Both groups had a significant negative correlation between health assertiveness and preintervention emotional preoccupation coping style (*r* = -0.48, *p* < 0.05), stress (*r* = -0.52, *p* < 0.05), depression (*r* = -0.57, *p* < 0.005) and anxiety (*r* = -0.65, *p* = 0.001). **Conclusion:** The psycho-educational program improved health assertiveness skills and reduced the psychological distress in burn and complex trauma outpatients. This study provides evidence for the relationship between health assertiveness, coping styles and level of psychological distress and helps guide group content to further improve program effectiveness. A larger sample size is warranted to achieve an accurate representation of each population.

**Trauma centre performance indicators for nonfatal outcomes: a scoping review.** L. Moore,\* H.T. Stelfox,† A. Turgeon,‡ J. Lapointe,‡ G. Bourgeois.§ From the \*University Laval, Laval, Que., the †University of Calgary, Calgary, Alta., the ‡Unité de traumatologie-urgence-soins intensifs, Centre de Recherche FRQS du CHA (Hôpital de l'Enfant-Jésus), Laval, and the §Institut national d'excellence en santé et en services sociaux, Québec, Que.

**Background:** Trauma centre performance evaluations are largely limited to mortality despite the importance of evaluating nonfatal outcomes. The objective of this study was to identify the nonfatal outcomes that have been used to evaluate trauma care and describe definitions used and the methodological quality of studies. **Methods:** We conducted a scoping review of studies using at least one nonfatal outcome to evaluate the performance of acute care hospitals for the treatment of global trauma populations. We searched MEDLINE, EMBASE, Cochrane Central, CINAHL, BIOSIS, TRIP and ProQuest databases. Two reviewers independently evaluated citations for eligibility. Methodological quality was evaluated using elements of the STROBE statement, Cochrane's risk of bias tool and the Downs and Black tool. **Results:** Out of 14 521 identified citations, 30 were considered eligible. We identified 10 nonfatal outcomes: complications (*n* = 25), missed injuries (3), readmissions (3), unplanned intensive care unit (ICU) admissions (3), unplanned surgeries (3), length of hospital stay (16), length of ICU stay (15), duration of mechanical ventilation (2), discharge destination (2) and functional capacity (3). There was high heterogeneity in the definitions used. Only 23.3% used risk adjustment, 60% reported a measure of variation, none reported any data quality efforts, 1% adequately addressed the problem of missing data, and 20% reported a sensitivity

analysis. **Conclusion:** Definitions of nonfatal outcomes are variable, and important methodological issues were identified in studies having used these outcomes. There is a need to reach consensus on which nonfatal outcomes should be used to evaluate trauma care and to develop valid and reliable performance indicators based on these outcomes.

**The evaluation of short track speed skating helmet performance.** M. Vassilyadi,\* C. Karton,† P. Rousseau,† B. Hoshizaki.† From the \*Children's Hospital of Eastern Ontario and the †University of Ottawa, Ottawa, Ont

**Background:** Like many sports involving high speeds and body contact, concussions are a concern for short track speed skating athletes and coaches. The protective headgear worn by the athletes was originally designed to decrease risk of catastrophic head injuries through impact attenuation based on safety standards that employ peak linear acceleration. Whereas peak linear acceleration has been shown to be closely linked to the mechanisms for severe brain injuries, it is the combination of peak linear and more importantly peak angular acceleration that is more closely associated with concussion. Thus, the purpose of this study was to evaluate the ability of speed skating helmets to manage both peak linear and angular acceleration. **Methods:** Two short track speed skating helmets were tested by dropping a Hybrid III headform at a velocity of 4 m/s on a monorail at 3 different locations. **Results:** Peak linear accelerations ranged from 59.0g to 81.9g, which were below an estimated 106 g representing an 80% probability threshold of sustaining a concussion. Conversely, peak angular accelerations ranged from 7619 rad/s<sup>2</sup> to 9884 rad/s<sup>2</sup>, where 5 out of 6 impacts exceeded an 80% estimated concussion threshold of 7900 rad/s<sup>2</sup>. **Conclusion:** The results of this research study indicated that whereas the tested helmets were effective at maintaining peak linear acceleration below an 80% concussion risk, they were less successful at managing peak angular acceleration. Thus, the helmets may be more effective at managing the risk of severe brain injury than decreasing the risk of concussion.

**Complication rates as a trauma care performance indicator: a systematic review.** L. Moore,\* H.T. Stelfox,† A. Turgeon,‡ G. Bourgeois,§ J. Lapointe.‡ From the Université Laval, Laval, Que., the †University of Calgary, Calgary, Alta., the ‡Unité de traumatologie-urgence-soins intensifs, Centre de Recherche FRQS du CHA (Hôpital de l'Enfant-Jésus), Laval, and the §Institut national d'excellence en santé et en services sociaux, Québec, Que.

**Background:** Information on complication rates is essential to trauma quality improvement efforts. However, there is no consensus on which complications should be evaluated and how they should be defined. The objective of the present study is to identify the complications that have been used to evaluate trauma care. **Methods:** We performed a systematic review of studies that used at least one complication to evaluate the performance of acute care hospitals for the treatment of global trauma populations. We searched MEDLINE, EMBASE, Cochrane Central, CINAHL, BIOSIS, TRIP and ProQuest databases and trauma association websites. Two reviewers independently evaluated citations for eligibility and extracted information using a piloted electronic data

abstraction form. **Results:** Out of 6521 identified citations, 24 were considered eligible for inclusion. Up to 153 complications were used to evaluate trauma care. Among the most frequently studied complications were deep vein thrombosis ( $n = 12$ ), pulmonary embolism (10), sepsis (8), pneumonia (7), wound infection (7), urinary tract infection (8), myocardial infection (6) and acute respiratory distress syndrome (5). Complications were identified using chart abstraction ( $n = 13$ ), administrative data (2) and prospective cohort data (2). Composite complication rates varied from 1% to 61% across studies, reflecting observed heterogeneity in definitions and inclusion/exclusion criteria. **Conclusion:** In our study, we identified high heterogeneity in complications used to evaluate trauma care and how they were defined. Results suggest the need for consensus on how complications should be evaluated in order to provide valid and comparable information that can be used to improve the quality of trauma care.

**Unplanned readmission following admission for traumatic injury: When, where and why? L. Moore,\* H. T. Steffox,† A. Turgeon,‡ G. Bourgeois,§ J. Lapointe.‡** From the \*Université Laval, Laval, Que., the †University of Calgary, Calgary, Alta., the ‡Unité de traumatologie-urgence-soins intensifs, Centre de Recherche FRSQ du CHA (Hôpital de l'Enfant-Jésus), Laval, and the §Institut national d'excellence en santé et en services sociaux, Québec, Que.

**Background:** Hospital readmission rates are used to evaluate quality of care in many health care sectors, but few data are available on readmission rates following discharge after traumatic injury. This study aimed to describe unplanned readmission rates following trauma according to timing (months since discharge), diagnostic category (late effects of trauma v. other) and type of hospital (same hospital, other trauma centre, nondesignated hospital). **Methods:** The study was based on adults admitted to any of the 59 trauma centres of the Quebec trauma system and discharged alive (1999–2010,  $n = 126\ 870$ ). Trauma registry data were linked to hospital discharge data to obtain information on readmissions up to 12 months postdischarge. Readmission rates were calculated according to time since discharge and stratified by age ( $< 65$ ,  $\geq 65$ ). **Results:** Readmission rates at 30 days, 3, 6, 9 and 12 months were 6.0%, 10.9%, 15.3%, 18.6% and 20.5% in the global trauma population and 7.9%, 15.2%, 21.6%, 26.3% and 29.0% in patients aged 65 or over, respectively. The most common reasons for readmission were another injury (15%), circulatory system (12%), musculo-skeletal system (11%) and complications or late effects of trauma (9%); 48% of patients were readmitted to the same trauma centre, 30% to another trauma centre, and 18% to a nondesignated hospital. **Conclusion:** Unplanned readmission following discharge from acute care for trauma is frequent and often related to complications or late effects of trauma. Given the costs associated with hospital admission, the evaluation of readmission rates should be part of trauma quality assurance efforts.

**Reconstructions of concussive impacts in ice hockey. B. Hoshizaki, P. Rousseau.** From the University of Ottawa, Ottawa, Ont.

**Background:** Ice hockey has been identified as the sport with the highest rate of concussion per athlete exposure. Despite

being the most common head injury, the mechanism that causes concussions is not well understood. The purpose of this study was to reconstruct 2 ice hockey incidents that led to diagnosed concussions. **Methods:** Two accidents were reconstructed in laboratory. The first accident reconstructed was a shoulder hit to the jaw, whereas the second was a high-velocity impact into the boards. Velocity and impact locations were obtained using video recordings. Maximum principal strain (MPS), representing brain deformation, was obtained using a validated finite element brain model. **Results:** The first reconstruction showed that the brain underwent peak MPS of 0.42 in the parietal lobe, whereas the second reconstruction showed that the brain underwent peak MPS of 0.25 in the lower portion of the frontal lobe. Differences in magnitude and location may explain why time to return to play was different for both players. **Conclusion:** Biomechanical parameters of a collision such as velocity, location and contact surface influence brain tissue deformation and may affect concussion severity and recovery time.

**How does head CT correlate with ICP monitoring and impact monitoring discontinuation in trauma patients with a Marshall CT score of I–II? J. Rezende-Neto,\* B. Braga,\* R. Faleiro,\* M. Magaldi,\* G. Cardoso,\* W. Lozada,\* L. Duarte,\* S. Rizoli.†** From the \*Federal University of Minas Gerais, Belo Horizonte, Brazil, and the †Sunnybrook Health Sciences Centre, Toronto, Ont.

**Background:** Computed tomography (CT) scanning and intracranial pressure (ICP) monitoring are important in the management of severe head trauma. However, correlation between CT and ICP for monitoring discontinuation in patients with less significant CT findings requires investigation. **Methods:** We conducted a prospective study of patients with ICP-monitored head trauma (Glasgow Coma Scale score  $\leq 8$ ) and a Marshall CT score of I–II; all underwent head CT at 48 hours. **Results:** We looked at 40 patients who sustained blunt trauma to the head. Intracranial pressure was 20 mm Hg or lower in 27 patients during the first 48 hours; only 2 of those (7.4%) had CT progression or a new lesion. The other 13 patients had an ICP greater than 20 mm Hg in the first 48 hours; 8 of those (61.5%) had a new lesion or CT progression; the other 5 had high ICP only. Serial CTs and ICP monitoring continued for 7 days in 4 patients with a new lesion or CT progression, and in 3 patients with high ICP only. Intracranial pressure monitoring was discontinued in the other 6 patients based on clinical improvement. An increase in ICP during the first 48 hours correlated with a new lesion on CT ( $p < 0.05$ ). The relative risk of a new lesion or CT progression was 8.3 if ICP greater than 20 mm Hg during the first 48 hours (95% CI 2.3–32.4). **Conclusion:** Patients with Marshall CT scores of I–II and an ICP greater than 20 mm Hg during the first 48 hours are at 8 times greater risk of presenting a new lesion or CT progression of the original lesion than if their ICP stays at 20 mm Hg or lower.

**Impact of massive transfusion protocol and exclusion of plasma products from female donors on outcome of trauma patients in Calgary region of Alberta Health Services. I. Slaba,\* C. Ball,† E. Oddone-Paolucci,‡ C. Doig,\* J. Kortbeek.§** From the \*Department of Critical Care Medicine, University of Calgary, the †Departments of Surgery

and Oncology, Foothills Medical Centre and University of Calgary, the †Departments of Surgery and Community Health Sciences, Office of Surgical Research, Faculty of Medicine, University of Calgary, and the ‡Department of Surgery, University of Calgary, Calgary, Alta.

**Background:** In 2007, massive transfusion protocol (MTP) and the restriction of plasma products from female donors were introduced in the Calgary zone of Alberta Health Services. The aim of this study is to evaluate the impact of these policies on the mortality and morbidity (multiple system organ failure [MSOF] and transfusion-related acute lung injury [TRALI]) of trauma patients with severe hemorrhage in our region. **Methods:** This is a retrospective cohort study of adult patients with major trauma and major hemorrhage admitted to the Foothill Medical Centre's intensive care unit (ICU) since 2004. Comparison of patients and their subgroups according to the severity of the bleeding before and after the intervention (introduction of MTP and exclusion of plasma from female donors in 2004) will be done using descriptive statistics and nested case-control study. Our primary outcomes are ICU and hospital mortality and the incidence of MSOF and TRALI. Our secondary outcomes are ICU and hospital length of stay and number of ventilator days. **Results:** Application to the ethics committee was submitted in November 2011. The estimated number of patients who will be included in the study is 600. The results will involve primary and secondary outcomes. We anticipate manuscript completion in March 2012. **Conclusion:** Massive transfusion protocol improved the outcome of trauma patients with severe hemorrhage in our region: Yes or no? Plasma from female donors is associated with TRALI: Yes or no? A high volume of transfused fresh frozen plasma is an independent risk factor of development of MSOF: Yes or no?

**Primary impact arthrodesis for a neglected open Weber B ankle fracture dislocation. A. Ramesh.**

**Background:** Primary ankle arthrodesis used to treat neglected open ankle fracture dislocation is a unique decision. A 63-year-old man presented to the emergency department with a 5-day-old open fracture dislocation of his right ankle. After thorough soft tissue debridement, a primary arthrodesis of the tibiotalar joint was performed. Soft tissue coverage was achieved with latissimus dorsi free flap, and the limb was salvaged. The use of such a technique to treat compound ankle fracture dislocation has not been previously described. **Methods:** Under general anesthesia with intravenous antibiotics prophylaxis, soft tissue debridement of necrotic tissue was performed. Flat cuts of the tibia and talar dome were done for primary arthrodesis and held with K-wires. An external fixator was applied in conjunction with vacuum-assisted closure dressing. **Results:** The limb was salvaged, providing good pain relief and early mobilization. In addition, the infection was controlled, the ankle stabilized and significant cost savings realized by avoiding amputation. **Conclusion:** We suggest the use of primary ankle arthrodesis as a very useful technique to preserve the threatened limb in extreme cases such as this.

**Impact of depression on neuropsychological functioning in electrical injury patients. A. Grigorovich,\* M. Gomez,\* J. Fish,† L. Leach.‡ From the \*St. John's Rehab Hospital, the †Hospital for Sick Kids and ‡Baycrest, Toronto, Ont.**

**Background:** This study investigated the relationship between severity of depressive symptoms and neuropsychological functioning in patients with an electrical injury (EI). We hypothesized that patients with an EI with more severe depressive symptomology would be more neuropsychologically impaired than those with milder symptoms or without depression. **Methods:** Data were obtained from an ongoing study of adult EI outpatients in a rehabilitation hospital between January 2008 and December 2010. Thirty consecutive patients (28 men) were studied, with a mean age of 43.4 (SD 10.0) years. All participants completed the Beck Depression Inventory (BDI-II) and a series of psychometric measures of neuropsychological functioning. Using BDI-II scores, participants were assigned to 1 of 3 groups: normal (0–13), mild-to-moderate depression (14–28) and severe depression (29–63). One-way analysis of variance was conducted to examine differences between groups. **Results:** Age, education and IQ were not significantly different between groups. The duration of the electric shock was significantly different between groups, with patients in the mild-to-moderate and severe groups having longer times than those in the normal group (27.4 v. 60.4 v. 9.6 mo,  $p = 0.022$ ). Patients in the severe group performed significantly worse ( $p < 0.05$ ) on measures of verbal recall than patients in the mild-to-moderate or normal groups. Measures of attention, psychomotor speed, executive functioning and visual recall were not significantly different between groups. **Conclusion:** These results suggest that depression is associated with deficits in verbal memory in patients with an EI, and that severity of depression symptoms may affect the severity of cognitive impairment. Also, the duration of the electric shock may influence the severity of depression.

**Predicting the need for tracheostomy in patients with cervical spinal cord injury. N. Parry, P. Leelapattana, J. Fleming, C. Bailey. From the London Health Sciences Centre, London, Ont.**

**Background:** It is difficult to predict which patients with a cervical spinal cord injury (CSCI) will require intubation and prolonged mechanical ventilation and therefore most benefit from early tracheostomy. This study intended to show the benefits of early tracheostomy and to identify predictors of prolonged mechanical ventilation after CSCI. **Methods:** A retrospective review of patients 16 years of age and older with acute CSCI admitted to a Canadian level 1 trauma centre from 1991 to 2010 was performed. Demographic data and clinical parameters were extracted from medical records and the trauma registry. Regression analysis was used to identify predictors of prolonged mechanical ventilation. **Results:** There were 66 eligible patients, of whom 42 (62%) required tracheostomy. After adjusting for the number of ventilator days following injury, patients who had a tracheostomy had fewer pulmonary complications than those who did not have a tracheostomy ( $p = 0.001$ ). Furthermore, mortality was significantly lower in patients who had a tracheostomy after adjusting for age and Injury Severity Score (ISS; 2.4% v. 24%,  $p = 0.025$ ). Early tracheostomy resulted in fewer days on the ventilator and a shorter hospital stay. Clinical parameters that predicted mechanical ventilation to be required longer than 7 days were ISS greater than 32, complete spinal cord injury and a Pao<sub>2</sub>/FiO<sub>2</sub> ratio less than 300 three days following a CSCI. **Conclusion:** We recommend early tracheostomy if the ISS is

greater than 32, the patient has a complete spinal cord injury and the PaO<sub>2</sub>/FiO<sub>2</sub> ratio is less than 300 three days after injury.

**Predicting crumpling during computed tomography imaging using base deficit.** C. Pajak, B. Nolan, C. DeMestral, A. McFarlan, R. Zakirova, A. Nathens. From St. Michael's Hospital, Toronto, Ont.

**Background:** Computed tomography (CT) scans provide critical information to guide the management of trauma patients. Clinical deterioration while obtaining CT imaging occurs not infrequently and remains difficult to predict. Our objectives were to identify factors predictive of a patient crumpling during CT and to explore the implications on in-hospital mortality. **Methods:** Data from a level 1 trauma centre registry were used to identify all adult patients who underwent a CT scan following evaluation in the trauma bay over 2009–11. Registry data were supplemented with chart abstraction. A CT-related crump was defined as cardiac arrest, hypotension, bradycardia, need for intubation or reduced consciousness while obtaining a CT. Logistic regression was used to identify predictors of crumpling and to characterize the strength of association between CT crump and mortality. **Results:** We identified 547 trauma patients who had a CT: 48 (9%) crumpled during their scans. Older age, a modified Glasgow Coma Scale (GCS<sub>m</sub>) score of 4 or less and base deficit of –6 or less were associated with crumpling ( $p < 0.05$ ). After adjusting for age and GCS<sub>m</sub>, base deficit of –6 or less remained predictive of crumpling (OR 2.36, 1.01–5.53). Furthermore, when controlling for age, Injury Severity Score, GCS<sub>m</sub> in the trauma bay and mechanism, crumpling during CT remained highly associated with increased in-hospital 30-day mortality (OR 3.78, 1.74–8.26). **Conclusion:** A base deficit of –6 or less may be useful in identifying those at increased risk of crumpling while undergoing CT. Crumpling during CT scanning is highly associated with early in-hospital mortality.

**Feasibility of using telehomecare technology to support patients with an acquired brain injury and family caregivers.** B. Rosenbloom,\* J. Dabbs,\* D. Duff,† A. Michalak,\* L.A. Mitchell,‡ A. Nathens,\* M. Singh,§ J. Topolovec-Vranic,\* D. Tymianski,¶ L. Yetman,\*\* S. Canzian.\* From \*St. Michael's Hospital, †Sheridan College, Toronto, the ‡University of Guelph, Guelph, §York University, the ¶University Health Network, Toronto, Ont., and the \*\*University of New Brunswick, Saint John, NB

**Background:** Acquired brain injury (ABI) is often associated with rapid onset of illness, potentially permanent changes to the individual's behaviour, personality and cognitive function, and has a consequent impact upon the family that brings additional strain to the transition home from in-patient care. The purpose of this study was to examine the feasibility of using telehomecare (THC) technology as a means of support for individuals with ABI and their family caregiver (FCG) postdischarge from inpatient care. **Methods:** Survivors of moderate to severe ABI and their primary FCGs were recruited from a level 1 trauma centre. Contact between study coordinator and participants was made with THC equipment at established intervals during the initial 6 months postdischarge. **Results:** Six patient–FCG dyads and 1 ABI patient independent of their FCG consented to participate. Fre-

quent technological challenges with the THC equipment were encountered, including an inability to establish a connection, disconnected calls, asynchrony between the audio and video feeds, and poor connection quality. If any one of these problems occurred more than 2 times during the course of the interview, THC was aborted and interviews took place via telephone. A total of 63 interviews were completed. **Conclusion:** Telehomecare offers a valuable interface; however, the technological issues encountered limited its value. Participants indicated that the opportunity to speak regularly with a professional via telephone or THC was beneficial. Through the interviews, a tremendous amount of rich data were obtained regarding the experience of patients with ABI and their FCG immediately following discharge and will be used to design pre- and postdischarge programs to assist in the transition home.

**Program changes impact the outcomes of severely injured patients.** A. Grunfeld, I. MacPhail, L. Constable, R. van Heest. From the Royal Columbian Hospital, New Westminster, BC

**Background:** Sequential changes to trauma patient care were made at a level 1 trauma centre with a catchment of 1.6 million. An on-call trauma team leader (TTL) program started in October 2004, followed by the addition of an inpatient trauma service (TS) in January 2008. This study evaluates the incremental benefit of these changes. **Methods:** Using the Trauma Registry, we prospectively collected data on 3 trauma patient cohorts: 2 years before the implementation of the TTL program (Oct. 1, 2002, to Sept. 30, 2004), 2 years during the TTL program (Jan. 1, 2006, to Dec. 31, 2007) and 2 years after implementation of the TS (Apr. 1, 2008, to Mar. 31, 2010). Inclusion criteria were all trauma patients with an Injury Severity Score of 16 or greater and a hospital length of stay of 2 or more days, or patients who expired or transferred. Survival expectancy assessment was made using Trauma and Injury Severity Score methodology. **Results:**

Table. Outcomes of severely injured patients before and after implementation of changes to trauma patient care

Change to trauma patient care	No. patients	Mortality, no. (%)	Mean LOS, d	z score
Pre-TTL	560	101 (18)	19.9	0.25
TTL	840	126 (15)	19.3	2.25
TS	892	100 (11)	15.2	3.57

LOS = length of stay; TTL = trauma team leader; TS = trauma service.

**Conclusion:** Trauma system changes at our institution, culminating in the TS, have resulted in a significant increase in trauma volume, while decreasing patient mortality and improving hospital length of stay.

**Do trauma performance indicators accurately reflect changes in a maturing trauma program?** R. van Heest, A. Tam. From the Royal Columbian Hospital, New Westminster, BC

**Background:** At our level 1 trauma centre serving 1.6 million people, 2 distinct changes were made in trauma care delivery. An emergency department (ED) physician-led trauma team leader

(TTL) program started in 2004 to provide 24/7 on-call trauma coverage. In January 2008, an additional in-patient trauma service (TS), led by ED physicians and general/trauma surgeons, started. This study evaluates whether the implementation of these changes improved trauma processes and outcomes. **Methods:** Prospectively collected trauma registry data were obtained for three 12-month periods: before institution of a TTL program, after institution of the TTL program and after institution of the TS. Retrospective 3-month chart reviews were performed during the post-TTL and post-TS intervals. Inclusion criteria were patients with an Injury Severity Score (ISS) greater than 15 or penetrating injury, a length of stay (LOS) of 2 days or more, or patient death. The trauma processes (performance indicators) and outcomes captured were Glasgow Coma Scale score less than 13 and time to CT under 1 hour; abdominal injury and time to surgery (< 1 h or < 4 h); surgical head injury and time to surgery under 4 hours; mortality (overall and ISS > 15); and caseload ED LOS. **Results:** Incremental changes to trauma patient care at our institution resulted in an increased caseload, longer ED LOS and improved overall mortality. No other changes were observed. **Conclusion:** The improvement seen in trauma patient mortality cannot be explained by traditionally collected performance indicators. Further study is required to fully elucidate the system and hospital changes that lead to improved patient care.

**One-stop falls prevention information for clinicians: a multidisciplinary interactive algorithm for the prevention of falls in older adults. J. Fernandes. From the Alberta Centre for Injury Control and Research, Edmonton, Alta.**

**Background:** Since the American Geriatric Society, British Geriatric Society and American Academy of Orthopaedic Surgeons developed an algorithm in 2001 for screening older adults for falls, there has been an abundance of evidence for screening, assessing and managing falls risks. In response, a multidisciplinary falls prevention practitioner algorithm was created and targets seniors over 65 who are at risk of falling. This algorithm is part of an overall falls prevention campaign, "Finding Balance," that uses a web-based platform to reach Alberta seniors and their health practitioners. **Methods:** An electronic algorithm was created based on consistent, best practice information for all practitioners across Alberta. This multidisciplinary algorithm screens older adults for falls by identifying those who have had more than 1 fall in the past year, an injurious fall, or have mobility issues. If assessed as "low risk," the algorithm's guidelines focus on health promotion and key messages. If assessed as "high risk," guidelines are provided for a multifactorial fall risk assessment and suggestions for interventions and education. Links to specific topics are provided, and handouts/tools are available. **Results:** The algorithm was tested with over 20 practitioners from various disciplines and settings across Alberta. The algorithm is updated on an ongoing basis based on best practice information and new resources. **Conclusion:** This web tool provides a multidisciplinary approach to falls prevention and allows all practitioners access to resources and falls prevention tools regardless of practice location or work setting.

**Use of focused assessment with sonography for trauma (FAST) for combat casualties in forward facilities. J. Doucet, P. Mahadevan, D. Kim, V. Bansal, G. Casola, R. Coimbra.**

**From the University of California at San Diego, San Diego, Calif.**

**Background:** Current conflicts are the first to use ultrasound widely in forward surgical facilities. This study examines use of clinician-performed focused assessment with sonography for trauma (FAST) in forward surgical facilities on United States Marine Corps and Navy casualties from Iraq and Afghanistan. **Methods:** We reviewed 20 703 records from the US Navy's Tri-service Combat Trauma Registry from 2004 to 2010 for combat casualties undergoing FAST during assessment at echelon II facilities. Combat casualties had one or repeated FAST exams; all underwent subsequent laparotomy, sternotomy, thoracotomy, computed tomography (CT) imaging or observation. Operative and CT scan reports were reviewed for presence of intraperitoneal or intrapericardial fluid or injuries. Location of wounds, mechanism of injury, vital signs, transfusions, Abbreviated Injury Scale score, Injury Severity Score, procedures and outcomes were recorded. **Results:** Examinations using FAST were performed in 730 combat casualties (70 with blunt injuries, 660 with blast and/or penetrating injury). There were 670 true-negative results, 17 true-positive results, 40 false-negative results and 3 false-positive results; the sensitivity was 29.8%, and the specificity was 99.5%. In 100 casualties with penetrating torso injuries, sensitivity was 24.2% and specificity was 97.0%. In 71 casualties with blunt injury, sensitivity was 50.0% and specificity 100%. In 3 hypotensive patients with blunt abdominal trauma, sensitivity was 100% and specificity was 100%. In 9 of 40 (22.5%) false-negative exams, there was a delay in operative intervention until reaching echelon III surgical facilities; however, there were no deaths after any false-negative exam. **Conclusion:** In combat casualties with blast and/or penetrating injury, FAST is highly specific but insensitive. Negative FAST exams in combat casualties mandate further imaging and assessment.

**Alberta All-terrain Vehicle Working Group: a call to action. S. Schooler, C. Gladwin. From the Alberta Centre for Injury Control and Research, Edmonton, Alta.**

**Background:** All-terrain vehicles (ATVs) are used by many Albertans for farming and recreational purposes. From 2003 to 2009, Albertans made up 11% of the Canadian population; however, they purchased 19% of new ATV units sold in Canada ( $n = 105\ 079$ ). From 2002 to 2009, there were 113 ATV-related deaths in Alberta, of which 15% occurred in children less than 16 years of age ( $n = 17$ ). From 2003 to 2008, there has been a 30% increase in ATV-related emergency department visits ( $n = 4406$  to  $5834$ ) and hospital admissions ( $n = 533$  to  $781$ ). **Methods:** The Alberta Centre for Injury Control and Research (ACICR) established the Alberta All-terrain Vehicle Working Group (AAWG) in January 2009. The diversity within the AAWG facilitated a thorough review of data, scientific research, practitioner expertise, lived experience, as well as ATV owners' manuals and warning labels to produce ATV safety messages reflecting the primary risk factors for deaths. The ACICR facilitated AAWG dialogue through teleconference meetings, email and one-on-one telephone conversations. To build consensus, a modified version of the Delphi technique was used where anonymous voting and feedback was collected using online surveys. **Results:** All-terrain vehicle safety messages were developed that

resonated with the social and political contexts of AAWG members' communities. Multidisciplinary stakeholders and organizations participated in ATV safety campaigns. **Conclusion:** Participation from diverse stakeholders facilitates buy-in for campaign participation and a broader target audience reach. Facilitating open dialogue is necessary for message identification and support.

**Observations and potential role for the rural trauma team development course (RTTDC) in India.** *J. Ali,\* M. Misra,† S. Kumar,† S. Gautam,† A. Sorvari,\* B. Blackwood.‡* From the \*University of Toronto, Toronto, Ont., the †All India Institute of Medical Sciences, New Delhi, India, and the ‡American College of Surgeons, Chicago, Ill.

**Background:** Extremely dense traffic in India leads to delayed trauma centre care and increased rural trauma mortality. The rural trauma team development course (RTTDC) is aimed at improving trauma resuscitation in rural settings. We examine its role in rural India. **Methods:** The components of RTTDC include scenario-based didactic presentations following Advanced Trauma Life Support (ATLS) principles, a 20-item pretest and post-test, a manual, modules on communication and performance improvement and patient safety (PIPS) and questionnaires. Provider participants (23) performed resuscitation in small groups using scenarios in their rural institution; 20 (mostly ATLS faculty) trained as instructors, completed pre- and post-tests, modules and the questionnaires. Mean (and SD) multiple choice questionnaire (MCQ) scores were compared by *t* tests. The evaluation responses (16 items), questions on the relevance of PIPS and communications modules and general comments were analyzed. **Results:** Post MCQ scores improved, although they were lower in the provider group: students scored mean 13.6 (SD 1.4) pre and mean 6.8 (SD 0.90) post ( $p < 0.0001$ ), and faculty scored mean 3.8 (SD 2.0) pre and mean 1.5 (SD 0.9) post ( $p < 0001$ ). Responses on a 5-point Likert scale (strongly agree to strongly disagree) were graded: 20%–85% strongly agree, 10%–65% agree and 5% neutral by faculty and 80%–100% strongly agree and 5%–20% agree for providers. Performance improvement and patient safety was graded as very relevant by 72% of faculty and 65% of students and as relevant by 28% of faculty and 35% of students. Communications modules were very relevant for 78% of faculty and 74% of students and relevant for 22% of faculty and 26% of students. All students and 50% of faculty graded scenarios as very relevant, whereas 50% of faculty considered them relevant. **Conclusion:** Potential for improving rural trauma care in India through RTTDC by improved resuscitation, communication and PIPS was identified.

**An electronic strategy to facilitate information-sharing among trauma team leaders.** *B. Klassen,\* A. Coates,† F. Baillie.‡* From the \*Hamilton Health Sciences Centre, the †Hamilton Health Sciences Trauma Program and ‡McMaster University/Hamilton General Hospital, Hamilton, Ont.

**Background:** Information sharing with trauma team leaders (TTLs) can be challenging. We launched an electronic communication strategy with our TTLs. The intent of the strategy is, first, to gauge the level of understanding of our program structure,

process and roles, and second, to identify opportunities for program development and quality improvement. **Methods:** A series of questionnaires were circulated to our TTLs using Survey Monkey. Our first survey assessed awareness of our catchment area, Ontario government expectations and the TTL's role. The second survey focused on challenges faced by the TTLs. Our third survey evaluated the effectiveness of this strategy. Survey results were emailed to physicians with clarifying statements for each questionnaire item. **Results:** Seventy percent of TTLs are aware of our referral area and annual patient volume. Trauma team leaders have a good understanding of the Ontario government's expectations regarding acceptance of trauma patients and in relation to bed availability in the intensive care unit. Twenty-nine percent of TTLs correctly identified details in trauma team activation guidelines for burn patients. Trauma team leaders reported crowd control (29%) as the greatest challenge during resuscitation, and 36% identified communication challenges increased as injuries are identified as more emergent. Ninety-two percent of TTLs did not find the strategy burdensome, and the majority found the survey useful in communicating structure and policy and identifying areas in need of improvement. **Conclusion:** Trauma team leaders perceive the strategy as worthwhile, providing an efficient way to identify gaps in infrastructure knowledge and opportunities for more focused education.

**Development of quality indicators of trauma care by a consensus panel.** *M.J. Santana, H.T. Stelfox.* From the University of Calgary, Calgary, Alta.

**Background:** There is lack of consensus about which quality indicators (QI) should be used to evaluate trauma care. Therefore, we convened an expert consensus panel to select and develop population-based and evidence-based QIs of adult trauma care. **Methods:** A panel of experts in injury, quality of care and measurement from Canada, the United States and Australia selected and developed promising QIs of trauma care using a modified version of the RAND/UCLA Appropriateness Method (RAM). The panel was presented with a list of existing QIs, evidence and utilization patterns identified from systematic reviews and an international audit of QI practices. Panel members independently rated QIs on 8 dimensions (e.g., targets important improvements) and overall assessment using the validated RAM scale during 4 rounds of deliberation (3 remote and 1 in-person workshop). **Results:** The expert panel reviewed 84 QIs during 3 rounds; 27 QIs were rejected and 24 were merged to generate 33 QIs for refinement (literature review and serial revision by panelist working groups) and final review. A final consensus was achieved on 32 QIs, including structure (protocol for field triage), process (spine evaluation) and outcome (adverse event rate) measures that assessed prehospital care (time to definitive trauma centre), hospital care (tertiary survey), posthospital (evaluation of patient functional status) and secondary injury prevention (substance abuse screening). **Conclusion:** We developed 32 population-based and evidence-based QIs of trauma care using a validated consensus methodology. The indicators need to be empirically tested, but will provide an applied health tool to guide trauma quality improvement practices.

**An evaluation of a proactive geriatric trauma consultation service.** *A. McFarlan, A. Nathens, C. Wong, S. Straus, B. Haas,*

**M. Lenartowicz, M. Parkovnick. From St. Michael's Hospital, Toronto, Ont.**

**Background:** Delays in recognizing the special needs of older trauma patients may result in suboptimal care. The Geriatric Trauma Consultation Service (GTCS) is a proactive geriatric consultation model aimed at preventing and managing age-specific complications and discharge planning for patients 60 years or older admitted to the hospital trauma service. **Methods:** This was a before-and-after case series of patients admitted pre-GTCS (March 2005 to August 2007) and post-GTCS (September 2007 to March 2010). Study data were derived from medical record and trauma registry review. Abstracted data included demographics, the geriatric issues addressed, adherence to GTCS recommendations, geriatric-specific outcomes, trauma quality indicators, consultation requests and discharge destination. **Results:** We identified 238 pre-GTCS patients and 248 post-GTCS patients. The rate of adherence to recommendations made by the GTCS team was 93.2%. Fewer consultation requests were made to internal medicine and psychiatry in the post-GTCS group ( $n = 31$  v.  $n = 18$ ,  $p = 0.04$ ; and  $n = 33$  v.  $n = 18$ ,  $p = 0.02$ ; respectively). There were no differences in any prespecified complications except delirium (50.5% pre-GTCS v. 40.9% post-GTCS,  $p = 0.05$ ). Fewer patients admitted from home were discharged to long-term care among the post-GTCS group (6.5% pre-GTCS v. 1.7% post-GTCS,  $p = 0.03$ ). **Conclusion:** A proactive geriatric consultation model for elderly trauma patients may decrease delirium and discharge to long-term care. Future studies should include a multi-centre randomized trial of this model of care.

**Celebrity injury-related deaths: Is a gangster rapper really gangsta? C. Ball,\* N. Parry,† K. Inaba,‡ E. Dixon,§ A. Salim,¶ J. Pasley,\*\* A. Kirkpatrick.†† From the \*Departments of Surgery and Oncology, Foothills Medical Centre and University of Calgary, Calgary, Alta., the †London Health Sciences Centre, London, Ont., the ‡Division of Trauma and Critical Care Surgery, Department of Surgery, University of Southern California, Los Angeles, Calif., the §Departments of Surgery and Community Health Sciences, Foothills Medical Centre and University of Calgary, Calgary, Alta., ¶Cedars-Sinai Medical Center, Los Angeles, Calif., the \*\*LAC and USC Medical Center, Los Angeles, Calif., and the ††Departments of Surgery and Critical Care Medicine, Foothills Medical Centre and University of Calgary, Calgary, Alta.**

**Background:** Celebrity injury-related deaths are often a topic of conversation and receive wide media coverage. Despite stereotypes and broad generalizations, it is unclear which type of celebrity, as well as the mechanism of demise, is the most common. The objective of this study was to evaluate the epidemiology behind how celebrities die in traumatic injury scenarios. **Methods:** All known injury-related deaths in celebrities (musicians, athletes, actors, politicians and true celebrities) were evaluated from Jan. 1, 2000, until present using popular media. These categories were then compared using standard statistical methodology ( $p < 0.05$ ). Exclusion criteria included drug or alcohol overdoses and suicides. **Results:** Among 144 severely injured celebrities who died of their injuries, motor vehicle crashes were the most common. Both musi-

cians and politicians had a higher proportion of death due to interpersonal violence ( $p < 0.05$ ). These mechanisms were most commonly gunshot wounds. Interpersonal violence rates vary across the type of musician and type of athlete. The mean age of death was also younger in musicians and athletes ( $p < 0.05$ ). Additional mechanisms included airplane crashes, animal interactions, recreational activities and others. **Conclusion:** Despite some very exotic scenarios, most celebrities die of injury mechanisms similar to those in the general population. It is apparent, however, that musicians and athletes die more frequently at a younger age and by violent mechanisms.

**Prevention of delirium in trauma patients: Are we giving thiamine prophylaxis a fair chance? C. Blackmore,\* J.-F. Ouellet,† D. Niven,‡ A. Kirkpatrick,§ C. Ball,¶ From the \*Department of General Surgery, University of Calgary, the †Department of Surgery, Foothills Medical Centre and University of Calgary, ‡Alberta Health Services, the §Departments of Surgery and Critical Care Medicine, Foothills Medical Centre and University of Calgary, and the ¶Departments of Surgery and Oncology, Foothills Medical Centre and University of Calgary, Calgary, Alta.**

**Background:** Delirium is associated with increased morbidity and mortality in injured patients. Wernicke's encephalopathy (WE; delirium linked to malnutrition and chronic alcoholism) is prevented with administration of thiamine. Our primary goal was to evaluate current blood alcohol level (BAL) testing and thiamine prophylaxis in severely injured patients. **Methods:** One thousand consecutive patients were reviewed using medical records and the Alberta Trauma Registry. Standard statistical analyses were performed ( $p < 0.05$ ). **Results:** Among 1000 patients (mean age 48 yr, 70% male, mean Injury Severity Score 23, 90% survival), 627 had a BAL obtained on admission. Of these, 221 (35%) were greater than 0 mmol/L, and 189 (30%) were above the legal limit of 17.4 mmol/L. The mean positive BAL was 41.9 mmol/L. Over 4% had a known history of alcohol abuse. Injuries more commonly occurred in intoxicated patients after assaults (20% v. 9%) and pedestrians struck by motor vehicles (10% v. 6%;  $p < 0.05$ ). The majority of injuries occurred after falls (37%) and motor vehicle collisions (33%). Among all patients, 17% received thiamine prophylaxis. Of the 221 patients with elevated BAL, 44% received thiamine prophylaxis during their admission. Only 77% of those with a history of alcohol abuse received thiamine prophylaxis. **Conclusion:** Despite the strong link between alcohol abuse, trauma and WE, over one-third of patients were not screened for alcohol use. Furthermore, a minority of intoxicated patients received adequate prophylaxis against WE. Given the low risk and cost of BAL testing and thiamine prophylaxis, and the high cost of delirium, standard protocols for prophylaxis must be engaged.

**Intra-abdominal injury in patients who sustain more than one gunshot wound to the abdomen: Should non-operative management be used? J. Rezende-Neto,\* C. Neto,\* G. Nogueira,\* M. Fernandes,\* T. Almeida,\* E. Maria Savio de Abreu,† S. Rizoli,‡ W. Abrantes,\* V. Taranto.\* From the \*Federal University of Minas Gerais, Belo Horizonte, the †Risoleta Tolentino Neves University Hospital, Belo Horizonte, Brazil, and the ‡Sunnybrook Health Sciences Centre, Toronto, Ont.**

**Background:** Previous study has shown that selective nonoperative management (SNOM) was successful in 38% of patients with a single gunshot wound (GSW) to the abdomen. The incidence of intra-abdominal injuries in patients with multiple abdominal GSW should be determined before that policy is extended to those patients. The purpose of the present study was to determine the incidence of intra-abdominal injuries in selected patients with more than 1 GSW to the abdomen. **Methods:** A retrospective study of patients with GSW to the abdomen who were hemodynamically stable without diffuse peritoneal signs. **Results:** During an 11-month period, 672 patients were admitted with GSW. Of these, 35 patients sustained a single abdominal GSW, were hemodynamically stable without peritoneal signs (mean Injury Severity Score [ISS] 16.7), SNOM was successful in 14%, and only 3 patients (8.5%) had a nontherapeutic laparotomy in this group. Ten patients sustained multiple GSW to the abdomen and were hemodynamically stable without peritoneal signs (mean ISS 17.4). All patients underwent surgery; there were no nontherapeutic laparotomies in this group. **Conclusion:** The odds of performing a nontherapeutic laparotomy in selected patients who sustain multiple GSW to the abdomen were 228 times less than in patients with single GSW. Based on our data, laparotomy should be mandatory in patients who sustain multiple GSW to the abdomen.

**Retrospective review of blunt thoracic aortic injury management according to current treatment recommendations. B. Kidane,\* N. Parry,† T. Forbes.†** From the \*University of Western Ontario and the †London Health Sciences Centre, London, Ont.

**Background:** Blunt thoracic aortic injury (BTAI) is associated with high mortality. Recent Society for Vascular Surgery guidelines formally graded BTAI and recommended operative/endovascular repair for all but grade I injuries. Our objective was to retrospectively determine guideline adherence and its effect on mortality. **Methods:** Retrospective review of the trauma database at a lead Ontario trauma centre identified and graded all BTAIs between 1999 and 2011. **Results:** Imaging was accessible for 52 of 61 (85.2%) patients with BTAI. Injury distribution was: 14 (23.0%) grade I, 1 (1.6%) grade II, 35 (57.4%) grade III, 2 (3.3%) grade IV. Eighteen (29.5%) died. Nonoperative management was employed for 92.8% (13), 100% (1), 34.3% (12) and 0% of grade I, II, III and IV injuries, respectively. The operatively managed patient with a grade I injury was misclassified as grade III. He was lost to follow-up after discharge. Of nonoperatively managed patients with grade III injuries, 7 (63.6%) died before consideration of endovascular repair; another died early secondary to brain injury. The remaining 4 (11.4%) nonoperatively managed patients with grade III injuries survived to discharge but were lost to follow-up. For grade III injuries, endovascular repair was significantly associated with decreased mortality (OR 0.10, 0.02–0.53,  $p = 0.007$ ). Exclusion of those with presentation-day mortality negated the significant association (OR 0.84, 0.07–9.68,  $p = 1.00$ ). **Conclusion:** Minor (9.6%) deviation from guidelines did not result in additional morbidity/mortality. However, high loss to follow-up limits our conclusions. The mortality reduction seen with endovascular repair for grade III injury may be inflated by those who die before repair is considered. Larger prospective studies with appropriate exclusion criteria and better follow-up

are needed to elucidate the consequences of selective nonoperative management of grade III injury.

**Telemedicine for trauma resuscitation: developing a regional system to improve access to expert trauma care in Ontario. C. Hicks.** From St. Michael's Hospital, Toronto, Ont.

**Background:** Specialized care for severely injured trauma patients in specialized trauma centres is associated with a 25% decrease in mortality. In Ontario, patients initially brought to a nontrauma centre who require interfacility transport will wait an average of 6 hours (90th percentile = 11 h) for definitive care. Telemedicine technology permits real-time audio and video interaction between 2 remote sites. We describe the development and piloting of a regional tele-trauma initiative (TTR) that provides real-time expert guidance for trauma resuscitation and expediting interfacility transfer. **Methods:** Any adult patient with penetrating or unstable blunt trauma qualifies for inclusion in TTR. Using equipment and infrastructure provided by the Ontario Telemedicine Network (OTN) Emergency and Accelerated Specialist Access Program (EASAP), we have equipped 6 emergency departments (3 urban, 3 rural) with portable video conference technology and have created a call roster staffed by experts at 2 regional trauma centres. Teletrauma consultations are accessed through CritiCall Ontario; our current model provides 24/7 access to specialist consultation. To assess the impact of the intervention, we are using an inventory of postconsultation surveys and are tracking interfacility transport times. **Results:** Data collection is ongoing. At the time of writing, the current model has been operational for 6 weeks and captured 5 patient referrals. We aim to report aggregate results from 40 teletrauma consultations. **Conclusion:** The TTR project represents a novel intervention for improving access to trauma expertise at nontrauma centres, and has the potential to impact both quality of care and interfacility transport times.

**Comparing trauma quality indicator data between a pediatric and an adult trauma hospital. M. Brennan,\* H. Knight,† A. Keenan,† H. Yoxon.\*** From the \*Children's Hospital of Eastern Ontario and †The Ottawa Hospital, Ottawa, Ont.

**Background:** Patient care indicators are an integral part of a trauma program's performance improvement initiatives and are used to improve patient care as well as benchmark against other institutions and trend data over time. The purpose of this study is to compare adult and pediatric trauma indicator data from level 1 trauma centres to identify if similar indicators are applicable to both populations. **Methods:** Data on patients with an Injury Severity Score (ISS) of 12 or greater and patients having trauma team activation regardless of ISS from April 2006 to Mar. 31, 2011, were extracted from the trauma registries of the adult and pediatric level 1 trauma centres. A descriptive analysis was performed and indicators compared across populations. **Results:** Of 4037 patients, 84% were adult and 16% pediatric. There were 448 (11.1%) deaths, 93% adult and 7% pediatrics. In all, 29% of adults and 15% of pediatric patients developed a complication. The most frequent complication was pneumonia, 24% overall (23.7% adult and 30.2% pediatrics). Urinary tract infections

(16.7%) were the second most common infection in adults and decubitus ulcers (12.5%) in pediatrics. Six percent of adults and 12% of pediatrics required a readmission to the intensive care unit (ICU); 73% of adults and 41% of pediatrics stayed in the emergency department longer than 4 hours; 65% of adults and 37% of pediatrics admitted to the ICU spent longer than 2.5 hours in the emergency department. **Conclusion:** Specific trauma patient indicators are applicable to both adult and pediatric trauma populations. Significant differences between the adult and pediatric populations suggest consideration should be given to the modification of certain parameters in the 2 populations.

**Using local injury data to influence injury prevention priorities.** *M. Brennan.* From the Children's Hospital of Eastern Ontario, Ottawa, Ont.

**Background:** Injury databases exist in different forms and include varying degrees of detail. The purpose of this study was to describe injuries in the region to aid priority setting of local injury prevention practitioners' focus. **Methods:** Data of trauma patients with an Injury Severity Score of 12 or greater who were treated between April 2005 and March 2010 were extracted from the trauma registries of the 3 lead trauma hospitals in Eastern Ontario. The data for all injury admissions and emergency visits were extracted from the IntelliHealth system. Descriptive analysis was performed. Injury categories of interest were identified to direct data reporting. **Results:** There were a total of 2066 severe trauma cases, 14 737 hospitalizations and 204 909 emergency visits owing to injury in the 5-year period. Falls and road motor vehicle-related crashes accounted for 44% and 33% of the severely injured population, respectively, falls and self-harm accounted for 69.8% and 8.0% of hospitalizations, falls and sports accounted for 53.7% and 25.9% of emergency visits. Only 59% of severely injured motor vehicle occupants documented seatbelt use, with 69% of children under 8 years restrained in a child seat. The majority of in-hospital deaths due to injury were owing to falls, followed by road motor vehicle crashes. Injury areas identified as a priority include falls in the home and built environment, self-harm, motor vehicle distraction and restraints. **Conclusion:** Injury-prevention priorities can be supported by reviewing the local injury patterns and the burden of injury. Combining available data sources will provide a more comprehensive outlook for this process.

**Systems saving lives: a structured review of pediatric trauma systems.** *A.M. Harrington, A. Macpherson.* From York University, Toronto, Ont.

**Background:** In order to respond to the significant burden of injury faced by Canadians, the coordination of health services, such as a trauma system (TS), has the potential to dramatically improve treatment and management of the victims of traumatic injury. Although the evidence for adult trauma systems is promising, there is a growing debate over the impact of a pediatric TS on pediatric trauma outcomes. **Methods:** A systematic review is being conducted to discern the link between organized trauma systems and pediatric patient mortality. An initial review of the literature was performed to discern the impacts of a pediatric TS and the key components on mortality. To date, 28 articles have been located and included in the review. **Results:** Early research

is focused on the importance of trauma care regionalization and the potential impact on pediatric injury. However, very few studies investigate a pediatric TS as a whole, but rather focus on one of its primary components, pediatric trauma centres. Early evidence suggests that outcomes are improved when patients are treated at pediatric trauma centres or adult centres with pediatric qualifications. **Conclusion:** The current literature supports the development of pediatric TS and the continued surveillance of trauma care. Future research should begin to incorporate more functional outcomes, as mortality is not a sufficient indicator of trauma system function.

**What do students think of the St. Michael's Hospital ThinkFirst Injury Prevention Strategy for Youth?** *A. Sorvari, J. Bridge, J. Topolovec-Vranic, J. Mauceri, E. Butorac, N. Ahmed, J. Holmes.* From St. Michael's Hospital, Toronto, Ont.

**Background:** Youth are more vulnerable to injury than adults. Motor vehicle crashes (MVC) are the leading cause of injury for youth aged 15–24. Youth aged 16–19 years are at highest risk of being killed in an MVC. To address injury prevention and control strategies for teenagers, St. Michael's (SMH) developed a new program called ThinkFirst Injury Prevention Strategy for Youth (TIPSY). This educational program brings teenagers into the hospital setting to witness the reality of risky behaviours and serious injuries from the consequences of the choices they make. **Methods:** TIPSY is offered throughout the school year. It includes interactive sessions with critical care and trauma nurses, Safe and Sober Canada, Toronto Police Services and Mothers Against Drunk Driving who share their expertise and lived experiences, concluding with the students talking with a VIP (Voice of Injury Prevention), an individual who has sustained a head or spinal cord injury. Included are walking tours of the emergency department and the trauma/neurosurgery intensive care unit. Program messages include consequences of drinking/drugging and driving, importance of seat belt use, risks of driver inexperience related to age and dangers of cell phone distractions. **Results:** Since 2008, high school students from 31 schools throughout the Toronto District School Board have attended TIPSY; 412 completed evaluations indicated 96% would recommend this program; 92% indicated they expected to always wear a seat belt and 76% expected to wear a helmet. **Conclusion:** The TIPSY evaluations reveal the program is effective in increasing student awareness of their personal risk and consequences of injury. Future longitudinal research is required to determine if these realizations of risk translate to changes in behaviours and prevention of injuries.

**An evidence-based method for targeting a shaken baby syndrome prevention media campaign.** *T. Charyk Stewart,\* J. Gilliland,† M. Healy,† D.A. Tanner,\* D. Polgar,\* D.D. Fraser.‡* From the \*London Health Sciences Centre, the †University of Western Ontario and the ‡Children's Hospital, London Health Sciences Centre, London, Ont.

**Background:** A triple-dose shaken baby syndrome (SBS) prevention program (Period of PURPLE Crying) was implemented in London, Ontario. The third dose consisted of an education media campaign directed at the general public. Our objective was to

describe the qualitative and spatial methods developed to target SBS prevention. **Methods:** A questionnaire on the level of importance of various factors, rated on a 7-point Likert scale, was distributed to a panel of experts to determine the best advertising campaign locations. Ranked factors were used to create weights for statistical modelling and mapping within a geographic information system (GIS) to determine optimal ad locations. **Results:** The survey found locations of new families, high population density and high percentage of lone parents to be the most important factors for selecting billboard sites. The spatial analysis revealed 6 areas throughout the city that ranked highest in our factors. Five billboards, 4 core media posters and 6 transit shelters were selected for our “normalcy of crying” ads. These were supplemented with 6 bus backs, screen ads at 2 theatres, radio public services announcements, 5 radio interviews and 1000 posters. **Conclusion:** Extending the primary prevention to the public helps to create a cultural change in the way inconsolable crying, the trigger for SBS, is viewed. Using ranked factors and GIS, locations within the city with high visibility, a preponderance of new families and risk factors for SBS were identified. Media campaign targeting was facilitated, increasing the likelihood that our message was reaching the population in greatest need.

**The virtual mentor: cost-effective, nurse-practitioner performed, telementored lung sonography with remote physician guidance. N. Biegler,\* P. McBeth,† I. Crawford,‡ C. Tiruta,§ C. Ball,¶ A. Kirkpatrick.\*\*** From \*Trauma Services, Foothills Medical Centre, the †Department of Surgery, Foothills Medical Centre and University of Calgary, Calgary, Alta., the ‡University of Aberdeen, Scotland, UK,§Alberta Health Services, the ¶Departments of Surgery and Oncology, Foothills Medical Centre and University of Calgary, Calgary, and the \*\*Departments of Surgery and Critical Care Medicine, Foothills Medical Centre and University of Calgary, Calgary, Alta.

**Background:** Point-of-care ultrasound (POC-US) is increasingly common as ultrasound costs decrease and availability increases. Despite the utility of POC-US in trained hands, there are many situations wherein patients could benefit from the added safety of POC-US guidance, yet trained users are unavailable. We hypothesized that currently available and economic “off-the-shelf” (OTS) technologies could facilitate remote mentoring of a nurse-practitioner (NP) to assess for recurrent pneumothoraces after chest tube removal. **Methods:** The simple remote tele-ultrasound system consisted of a hand-held ultrasound, head-mounted video camera, microphone and OTS software on a laptop computer. The video output of a hand-held ultrasound machine was collated into a 2-way audio-visual interaction that included the macroscopic view of the NP’s hands and use of the ultrasound probe, to a remote mentor who provided real-time guidance and interpretation of the generated images. Seven pleural exams after chest-tube removal were conducted, guided by a remote trauma surgeon. **Results:** Twelve lung fields were examined. The remote exam was possible in all cases, with good connectivity, including 1 transatlantic interpretation. Compared with subsequent upright radiographs, there was 1 true-positive remotely diagnosed pneumothorax, 1 false-negative diagnosis and 10 true-negative diagnoses, for 100% sensitivity, 92% specificity and 93% accuracy for remotely-guided chest examination.

**Conclusion:** Remotely guiding an NP to perform ultrasound examinations can be simply and effectively performed over encrypted commercial software using low-cost OTS hardware. As informatics constantly improve, such mentored examinations may greater empower clinical care providers in austere settings.

**Quality indicators used by teaching versus nonteaching international trauma centres. V. Chaubey,\* D. Roberts,† M. Ferri,\* N. Bobrovitz,\* F. Khandwala,\* H.T. Stelfox.\*** From the \*University of Calgary and the †Departments of Surgery, Community Health Sciences, and Critical Care Medicine, Foothills Medical Centre and University of Calgary, Calgary, Alta.

**Background:** Evidence suggests that a beneficial relationship may exist between patient outcome and trauma centre teaching status. However, no study has evaluated whether organizational differences in trauma quality improvement programs may explain these improved outcomes. **Methods:** We performed a reanalysis of a web-based survey of 330 trauma centre program leaders in Canada, the United States, Australia and New Zealand. The survey collected data on trauma centres’ institutional characteristics, the nature of their quality improvement programs and quality indicators (QI) used. Trauma centre websites were also searched for additional QI data. **Results:** A total of 251 of 330 trauma centres (76%) responded, and the majority (97%) measured QIs. Teaching trauma centres compared with nonteaching centres more often afforded comprehensive, level 1 trauma care (87% v. 54%,  $p < 0.01$ ), were located in urban regions (86% v. 62%,  $p < 0.001$ ) and provided care to high volumes of patients (32% v. 8.1%,  $p < 0.001$ ). Compared with teaching centres, nonteaching centres more often measured QIs relating to patient triage and flow (15% v. 18%,  $p < 0.001$ ) and process efficiency (25% v. 30%,  $p < 0.001$ ). In contrast, teaching centres more often used QIs to evaluate the timeliness (23% v. 20%,  $p < 0.001$ ) and nature of treatment (18% v. 14%,  $p < 0.001$ ). **Conclusion:** There are subtle, yet potentially important differences in QI usage among teaching versus nonteaching trauma centres. Further investigation is warranted to determine if these differences contribute to improved patient outcomes.

**Compliance to advanced trauma life support protocols in adult trauma patients in the acute setting. B. Tsang, S. Widder, J. Mckee.** From the University of Alberta, Edmonton, Alta.

**Background:** Advanced trauma life support (ATLS) protocols provide a common approach for trauma resuscitation. The aim of this study is to measure ATLS compliance rates and factors at the University of Alberta Hospital (UAH). **Methods:** A retrospective chart review was conducted on adult (> 17 yr) major trauma patients (Injury Severity Score [ISS]  $\geq 12$ ) treated at the UAH from 2009 to 2010. Adherence to ATLS protocols was collected and  $\chi^2$ ,  $t$  tests and demographic analysis conducted. **Results:** A review of 508 patients (male:female 375:133, mean ISS 24.5 [SD 10.7], mean age 39.7 [SD 17.6] yr) revealed ATLS adherence ranging from 23% to 98.2% for 1’survey and chest auscultation/abdominal exam, respectively. In all, 53.9% ( $n = 274$ ) of cases involved a trauma team leader (TTL). Intravenous fluid replacement ( $p = 0.016$ ), digital rectal examination ( $p = 0.029$ ),

head-to-toe ( $p = 0.017$ ) and 1'survey ( $p = 0.000$ ) were more likely to be performed with a TTL. However, establishing a patent airway ( $p = 0.001$ ), pelvic radiograph ( $p = 0.006$ ) and cervical spine radiograph ( $p = 0.000$ ) were less likely to be performed with TTL involvement. Mean times to diagnostic imaging were lower with a TTL, with times to pelvic radiograph ( $p = 0.008$ ), chest computed tomography (CT;  $p = 0.005$ ), abdominal/pelvic CT ( $p = 0.013$ ), CT of the cervical spine ( $p = 0.05$ ) and CT of the thoracolumbar spine ( $p = 0.009$ ) being significantly lower. Of patients meeting trauma team criteria, 38.9% (198 of 508) were less likely to receive chest palpation ( $p = 0.001$ ), pelvic exam ( $p = 0.021$ ), digital rectal examination ( $p = 0.05$ ), 1'survey ( $p = 0.000$ ), head-to-toe ( $p = 0.001$ ) and 2'survey ( $p = 0.000$ ) without a TTL. All mean diagnostic imaging times were lower with TTL involvement in this group, including chest radiograph ( $p = 0.032$ ), pelvic radiograph ( $p = 0.037$ ), CT chest ( $p = 0.034$ ) and abdominal/pelvic CT ( $p = 0.055$ ). **Conclusion:** Trauma team leader involvement significantly improved compliance rate for many aspects of the ATLS protocols. Deficiencies identified in this study will guide future quality control initiatives for trauma management.

**Closing the quality improvement loop: a collaborative approach. S. Benjamin, A. Hogan. From the NB Trauma Program, Miramichi, NB**

**Background:** After reviewing trauma patient emergency department (ED) documentation, a standardized process and tool to communicate questions, concerns and care of hospitalized injured patients was developed by the Saint John Regional Hospital (SJRH) site of the NB Trauma Program. **Methods:** The trauma nurse reviewed all injury hospitalizations through the SJRH ED since April 2008. A list of indicators was identified according to Advanced Trauma Life Support and other locally accepted standards of care. A quality improvement (QI) report form was then developed to summarize patient care events, area(s) for further review within the ED and a section for expected follow-up. These reports were completed by the trauma nurse and forwarded to the ED, both pre- and postimplementation of dedicated physician quality improvement resources in the ED. **Results:** From Apr. 1, 2008, to Sept. 30, 2011, the trauma nurse reviewed 1601 charts; 12.4% resulted in a QI report form being forwarded to the ED. Prior to the implementation of a dedicated physician for quality improvement, 7% of forms were returned from ED. Following implementation of a dedicated physician for quality improvement in April 2010, the return rate improved to 47%. **Conclusion:** Successful QI processes within a major trauma centre emergency department require dedicated human resources for both the trauma program and ED physician reviewers. The NB Trauma Program and the SJRH ED have developed a successful and ongoing collaborative approach to reviewing physician trauma patient care and process.

**National Trauma Registry: "collecting" it all in New Brunswick. A. Hogan, S. Benjamin. From the NB Trauma Program, Miramichi, NB**

**Background:** Identification of seriously injured trauma patients (Injury Severity Score > 12) for submission to the National Trauma Registry (NTR) was time-consuming and only as complete as those cases that were identified. Admission diagnosis often did not provide required information for identification, and

patients were admitted through multiple entry points. **Methods:** All emergency department (ED) trauma admissions at our level 1 trauma centre were reviewed for patients with potentially qualifying injuries. Reports were also obtained every 3 months from the Discharge Abstract Database on patients containing injury-related (ICD-10) codes. A list was then developed, identifying those who potentially qualified for the NTR. Finally, this list was reviewed by health records professionals trained in the 2005 Abbreviated Injury Scale scoring to confirm qualification for the NTR. **Results:** Over the past 3 years, identification of seriously injured patients at this trauma centre has gone from assuming that all patients are identified to being certain that all qualifying patients are identified. In all, 92 cases were identified through the ED in 2010–11. As a result of additional screening, 117 new cases were identified, of which 42 qualified for the NTR, a 31% increase in qualifying cases. Even in-hospital falls with qualifying injuries have been identified through this process. **Conclusion:** A reliable, replicable method of capturing all seriously injured patients receiving care in this major trauma centre has been established with certainty. Future expansion of this methodology to other New Brunswick trauma centres will support the development of a comprehensive trauma registry.

**Does delay to initial reduction attempt affect success rates for anterior shoulder dislocation (pilot study)? J. Fraser,\* P. Atkinson,† S. Benjamin.\* From the \*New Brunswick Trauma Program, Miramichi, and the †Saint John Regional Hospital, Saint John, NB**

**Background:** Anterior shoulder dislocations that have been unreduced for days are often difficult or impossible to reduce in the emergency department (ED). It is important to know if this principle also applies to shorter delays of hours in the ED, as this may change triage priorities and impact on admission rates. There is currently no high quality evidence available to answer this question. **Methods:** The study was a retrospective database and chart review, with preliminary data collected on 102 patients presenting to the ED with anterior shoulder dislocations. The patients were identified from the New Brunswick trauma registry database at the Saint John Regional Hospital from 2009 to the current date. Patients were divided into 2 groups based on the number of attempts required to achieve successful reduction: group 1 (successful first attempt in the ED) and group 2 (requiring 2 or more attempts). The primary outcomes were time of injury and time of arrival to attempted shoulder reduction. Data were analyzed using the Mann–Whitney  $U$  test (GraphPad Prism). **Results:** The mean time from injury to successful reduction was significantly shorter for patients in group 1 than in group 2 (revised 159 v. 451 min,  $p = 0.0029$ ,  $n = 53$  v. 8). The mean time from ED arrival to successful reduction was less (but did not reach statistical significance) for group 1 than for group 2 (89 v. 116 min,  $p = 0.0917$ ,  $n = 102$  v. 14). **Conclusion:** Patients with successful first-time reduction for shoulder dislocation in the ED had significantly shorter times from injury to attempted reduction. Delaying reduction of anterior shoulder dislocations may impact success rates, supporting allocation of high field triage priority for these patients.

**Use of multidisciplinary, multi-site morbidity and mortality rounds in a provincial trauma system. M. Martin,**

**I. Watson, A. Hogan, S. Benjamin, S. Woodford. From the New Brunswick Trauma Program, Miramichi, NB**

**Background:** The NB Trauma Program is a formalized partnership of the 2 regional health authorities in the province, the provincial department of health and Ambulance NB, the single provincial emergency medical services agency. The program has capitalized on this partnership by hosting mortality and morbidity rounds (“M/M Rounds”) through use of telephone and video technology to include care providers of patients with major trauma across jurisdictional “boundaries” that have previously been seen as barriers to effective communications. **Methods:** A standardized protocol for identification of cases suitable for provincial M/M Rounds was developed. All identified care providers involved in qualifying cases (paramedics and dispatchers, physicians and hospital staff and the provincial trauma control physician) were invited to participate. The resulting discussion led to a maximum of 3 key recommendations following a standardized format that were shared with both participants and those within the healthcare system best positioned to enact change. The NB Trauma Program tracked and reported on both recommendations and progress toward implementation. **Results:** Since inception in April 2011, 19 cases (24% of those requiring provincial review) were identified for provincial M/M Rounds. To Nov. 1, 2011, 10 of these rounds have been completed, generating 25 recommendations for system-wide improvements that are now being tracked for implementation progress. **Conclusion:** Implementation of M/M Rounds that cross historical boundaries between care providers and between trauma centres in a unified, provincial trauma system provides a unique opportunity for system enhancements.

**Caring about trauma care: public awareness, knowledge and perceptions. J. Bridge,\* D. Gomez Jaramillo,† A. Nathens.\* From \*St. Michael’s Hospital and the †Department of Surgery, University of Toronto, Toronto, Ont.**

**Background:** Despite evidence demonstrating the clear benefits of receiving care at a trauma centre, little is known about the knowledge and perceptions held by the general public. Our objective was to understand the awareness, attitudes and expectations for trauma care among Ontario adults. **Methods:** A quantitative telephone survey was conducted in April 2011 among a randomly-selected, representative sample of 1000 Ontarians aged 18 years and older. Respondents were asked a series of questions including: personal experience with traumatic injury, awareness and knowledge of trauma care services, and perceived importance of trauma care. Data were weighted according to Statistics Canada’s census data for Ontario. The margin of error for the total sample was  $\pm 3.1\%$ , 19 times out of 20. **Results:** Almost half (46%) of Ontarians are unaware that most hospitals are not trauma centres, and half (51%) also believe that nearly all hospitals are capable of treating seriously injured patients. Furthermore, 40% incorrectly believe that severely injured patients can be transported to a trauma centre within 1 hour of placing a call to 911, from anywhere in the province. Most are also mistaken in their belief that all severely injured patients have an equal chance of being transported to a trauma centre, regardless of sex (92%) or age (78%). **Conclusion:** There is a gap between the Ontario public’s under-

standing/expectations versus reality when it comes to access to trauma care. Public awareness of these gaps should be considered as part of an advocacy strategy for system improvement.

**Assessing the quality of admission dictation at a level 1 trauma centre. S. Faidi,\* N. Alonazi,\* A. Coates,\* F. Baillie.† From the \*Hamilton Health Sciences Trauma Program and the †McMaster University/Hamilton General Hospital, Hamilton, Ont.**

**Background:** Quality documentation of the trauma admission dictation plays a central role in communication between members of the trauma team, facilitates continuity of care and guards against medical errors. Dictation should be completed in a timely manner. Admission notes at our level 1 trauma centre are generated by a voice dictation system with no structured format. The aim of this study is to assess the quality of admission dictation for patients admitted to our trauma program. **Methods:** We conducted semistructured interviews with trauma team leaders (TTLs) to identify the essential components of a comprehensive admission dictation. These components together with the stages of the Advanced Trauma Life Support protocol formed the criteria to assess the completeness and content of admission dictations. A retrospective chart review was performed on a random sample of trauma admission dictations. Each criterion was assessed as being stated (or implied) in the dictation, or absent. The time of dictation relative to the admission was also audited. **Results:** Preliminary results show inconsistencies in the content and structure of trauma admission dictations. Omissions in the critical components were identified. **Conclusion:** Our preliminary findings suggest a quality gap exists both in terms of completeness and consistency in approach to dictation at admission. Our results will inform the development of a structured dictation format to improve the admission documentation in our trauma program.

**Trauma trends in older adults: a decade in review. M. Waligora, C. Zhang, A. McFarlan, A. Sorvari, K. Chalklin, S. Canzian. From St. Michael’s Hospital, Toronto, Ont.**

**Background:** Injury in older adults is a serious concern, and as the population ages, many trauma centres are seeing more trauma patients over the age of 60. In order to meet the needs of this changing demographic, it is important for trauma centres to routinely analyze their trauma data and monitor injury trends. The aim of this study was to describe injury trends at a level 1 trauma centre for patients over the age of 60, including incidence, injury severity, etiology and mortality rate. **Methods:** Injury trend data were obtained from the local trauma registry of a level 1 trauma centre. Data were collected retrospectively for a 10-year period and included all trauma patients over the age of 60 years. Mechanism of injury was obtained using ICD-9-CM injury codes or E codes. **Results:** A steady increase in incidence of trauma in patients older than 60 is noted, with a decreasing trend in injury severity in this age group. Patterns in mechanism of injury were also noted, with a decrease in falls-related injury and an increase in transportation mechanisms such as motorcycle and bicycle crashes. Workplace injury and assaults also trended upwards in this time period. **Conclusion:** There are notable trends in traumatic injury in patients over the age of 60. Larger-scale, population-based data analysis can be considered to inform

community- and hospital-based injury prevention programs currently available through many public health agencies.

**Blunt splenic injury in patients with hereditary spherocytosis: a population-based analysis.** *M. Hsiao,\* A. Nathens,† C. DeMestral,† A. Hill,† J.C. Langer.‡* From the \*University of Toronto, †St. Michael's Hospital and the ‡Hospital for Sick Children, Toronto, Ont.

**Background:** Patients with hereditary spherocytosis (HS) and splenomegaly have a potential increased risk of blunt splenic injury (BSI) from trauma. We aim to quantify this risk. **Methods:** We used a population-based database consisting of all injury-related admissions in Canada from 2001 to 2010. Patients with BSI and HS were identified based on discharge diagnoses. Population estimates from the census were used to derive rates of BSI. The HS population at risk for BSI was estimated based on population rates of HS obtained from the literature. Rates of BSI in HS patients were then estimated, and relative rates of BSI in the HS population compared with those without HS were then calculated. **Results:** There were 8192 patients over 9 years with BSI and 202 405 788 person years of observation, yielding rates of BSI in the general population of 4.0 BSI per 100 000 person years. Only 2 BSI patients over this interval had a history of HS. Population rates of HS in the literature range from 1 in 2000 to 1 in 5000. Thus, rates of BSI in HS patients were estimated to range from a low of 2.0 to a high of 4.9 per 100 000 person years. The relative rate of BSI in HS patients compared with the general population ranged from a low of 0.5 (95% CI 0.1–1.8) to a high of 1.2 (95% CI 0.2–4.4). **Conclusion:** The rate of BSI in the HS patient population appears not to differ significantly from those in the general population.

**Analysis of trauma team activation in severe head injury: an institutional experience.** *S. Sharma.* From St. Michael's Hospital, Toronto, Ont.

**Background:** Outcome for patients with severe traumatic brain injury (sTBI) is improved when treated at trauma centres. Upon arrival at trauma centres, patients likely benefit from the systematic assessment and stabilization by trauma teams. We sought to evaluate if processes of care differed for those patients who arrived through trauma team activation (TTA) as opposed to those who did not. **Methods:** Adult patients (> 18) presenting to a level 1 trauma centre with isolated sTBI were identified. Logistic regression models were generated to identify factors associated with TTA, likelihood of intervention and greater time spent in the emergency department (ED). **Results:** We identified 501 patients over 2 years; 109 (22%) arrived through TTA. Elderly patients (> 65) were less likely to have a TTA (OR 0.47, 95% CI 0.27–0.84), whereas TTA was more likely in those with a motor Glasgow Coma Scale (mGCS) score less than 4 (OR 6.0, 95% CI 3.4–10.4) and those injured through a motor vehicle collision (MVC; OR 8.2, 95% CI 4.1–16.3) and pedestrian/recreational injuries (OR 6.9, 95% CI 3.2–15.1) when compared with falls. Patients with TTA were not more likely to undergo neurosurgical procedure (OR 0.89, 95% CI 0.42–1.86). Trauma team activation reduced the likelihood of patients with sTBI spending extended time (> 90 min) in the ED (OR 0.22, 95% CI 0.12–0.41). **Conclusion:** Trauma team activation reduces time spent in the ED and likely expedites defini-

tive care and disposition for patients with sTBI. Institutional adherence to established TTA guidelines may expedite care, thereby improving flow and reducing cost in the setting of sTBI.

**ROTEM results correlate with fresh frozen plasma transfusion in trauma patients.** *A. Sankarankutty, B. Nascimento, I. Alababtain, S.-Y. Fung, E. Passos, L. Luz, E. Brnjac, R. Pinto, S. Rizoli.* From the Sunnybrook Health Sciences Centre, Toronto, Ont.

**Background:** Evaluation of the coagulation status in acute trauma is challenging. Turn-around times for standard coagulation tests are typically 30–40 minutes. Point-of-care viscoelastic coagulation tests, such as TEG and ROTEM, potentially provide a rapid global evaluation of the clot formation, firmness and eventual dissolution. Our institution has the first ROTEM in clinical use in North America. In this study, we evaluated the ROTEM's capacity of predicting transfusion in trauma victims. **Methods:** We analyzed prospectively collected data from a cohort of all adult trauma patients admitted to a level 1 trauma centre, between Aug. 1 and Oct. 31, 2011. Patients without ROTEM data on arrival at the emergency department were excluded. Demographic, vital signs, laboratory, ROTEM, transfusion and outcome data were collected on all the patients. **Results:** Of 322 patients assessed, 203 patients were included: their mean age was 45 (SD 20.68) years, 73.5% were male, 27.96% involved penetrating injuries and mean Injury Severity Score was 21 (SD 12.19). Of these patients, 15.92% received packed red blood cells, 5.47% received fresh frozen plasma (FFP), 5.47% received platelets and 2.49% received cryoprecipitate. A significant negative correlation was detected between the EXTEM values of clot firmness at 10 and 20 minutes, as measured by A10 and A20, respectively, and the transfusion of FFP ( $\rho = -0.6$ ,  $p = 0.04$ ). **Conclusion:** Lower A10 and A20 EXTEM values were correlated with FFP transfusion suggesting the potential usefulness of ROTEM, as it provides these results within 20 minutes.

**10-year trend of assault in Alberta.** *J. Mckee,\* S. Widder.†* From the \*University of Alberta and †University of Alberta Hospital, Edmonton, Alta.

**Background:** Assault and injury from assault is common language in not only the research literature but in secular documents as well. Common language includes increasing police presence and harsher punishments. However, potentially preventing the assault from happening may be where attention needs to turn. **Methods:** A 10-year retrospective examination of Alberta Trauma Registry data was conducted on all major trauma patients (Injury Severity Score [ISS] > 12) from 2001 to 2010. The role and prevalence of assault (E code 960.0–969.9) has played in major trauma over the last 10 years is examined. The  $\chi^2$  and  $t$  tests and demographic analysis were conducted comparing alcohol use, age, ISS, length of stay (LOS), sex and death rate between assault and other forms of trauma. **Results:** Of 23 302 major traumas, 11.4% ( $n = 2666$ ) were classified as assault (mean age 31.8 [SD 13.8] yr, ISS 21 [SD 8.8], LOS 11 [SD 28] d,  $n = 2604$  male). When comparing assaults to all other forms of trauma, major trauma patients involved in an assault are younger ( $p = 0.000$ ), male ( $p = 0.000$ ), with a lower LOS in the intensive care unit ( $p = 0.000$ ), lower ISS ( $p = 0.000$ ) and lower LOS

( $p = 0.000$ ). However, the blood alcohol concentration involved in assault is significantly higher ( $p = 0.000$ ) at 27.9 (SD 25.7) mmol/L compared with the nonassault trauma at 12.8 (SD 21.9) mmol/L. **Conclusion:** The only difference between assault and homicide is whether the patient lives or dies, with Albertan's reporting heavy frequent drinking rates (7.9%) at higher than the national average (7.1%) and the only determining factor in assault being alcohol use. Perhaps it is time for better alcohol controls in Alberta.

**10-year trend in alcohol use in major trauma in Alberta. J. Mckee,\* S. Widder.† From the \*University of Alberta and the †University of Alberta Hospital, Edmonton, Alta.**

**Background:** Alcohol plays a major role in many injury issues. Whereas alcohol and its role in motor vehicle collisions (MVC) receives the brunt of attention, other alcohol-related injuries are often unacknowledged. **Methods:** A 10-year retrospective examination of Alberta Trauma Registry data was conducted on all major trauma patients (age  $\geq 12$  and Injury Severity Score [ISS]  $> 12$ ) from 2001 to 2010. The role and prevalence of alcohol is examined. Both  $\chi^2$  and  $t$  tests and demographic analysis were conducted. **Results:** Of 22 167 patients, only 61% ( $n = 13 547$ ) were screened for alcohol use. Of those screened, 38% ( $n = 5144$ ) tested positive for alcohol with a mean blood alcohol concentration (BAC) of 39.4 (SD 21.1) mmol/L, which is more than double the legal limit of 17 mmol/L. Those who tested positive were male ( $p = 0.000$ ), younger ( $p = 0.000$ ), had a longer length of stay in the intensive care unit ( $p = 0.043$ ), higher rate of death at the scene ( $p = 0.000$ ) and a lower ISS ( $p = 0.042$ ). The rate of alcohol use in major trauma has been on a steady rise, from 20.5% testing positive in 2001 to 24.4% in 2010. Railway incidents have the highest involvement of alcohol at 65%, followed by undetermined if accidental/self-inflicted (53.5%) and assault (49%); motor vehicle traffic incidents were sixth on the list at 25.4%. January had the lowest alcohol rate at 18.3% and April the highest at 25.3%. **Conclusion:** A great deal of attention and activity has been justly focused on alcohol use in MVCs in the province of Alberta. With alcohol playing a primary role in many other major trauma mechanisms, it is time to apply similar enthusiasm and processes to alcohol safety in all etiologies.

**10-year trend in major trauma injury related to motorcycles compared with all-terrain vehicles in Alberta. J. Mckee,\* S. Widder.† From the \*University of Alberta and the †University of Alberta Hospital, Edmonton, Alta.**

**Background:** Motorcycle injury is a known contributor to major trauma (Injury Severity Score [ISS]  $\geq 12$ ) in Alberta, with a recent study demonstrating that motorcyclists are at a 3.5 times greater risk of injury/death than other motor vehicle drivers and 34 times greater risk per mile travelled. However, much attention and funding in the past has focused on injuries sustained from all-terrain vehicle (ATV) crashes. **Methods:** A 10-year retrospective examination of Alberta Trauma Registry data was conducted on all major trauma patients (ISS  $> 12$ ) from 2001 to 2010. Injury rates, severity, mechanism and other injury data points such as ejection status were examined for motorcycles and ATVs. The  $\chi^2$  and  $t$  tests and demographic analysis were conducted comparing motorcycle injury to ATV injury. **Results:** Of 23 303 patients,

1371 sustained motorcycle injuries (mean age 36.9 [SD 14.7] yr, ISS 24.63 [SD 10.7],  $n = 1223$  male) and 773 sustained ATV injuries (mean age 33.6 [SD 16.7] yr, ISS 22.61 [SD 9.3],  $n = 629$  male). A higher average motorcycle injury rate of 5.9 in 100 major traumas with a range of 4.7–7.3 in 100 major traumas was demonstrated compared with ATV at 3.3 in 100 with a range of 2.2–4.0. Injured motorcyclists were older than their ATV counterparts ( $p = 0.000$ ), with a longer length of stay ( $p = 0.001$ ), ISS ( $p = 0.000$ ), death at scene ( $p = 0.03$ ), death in hospital ( $p = 0.000$ ) and distance ejected ( $p = 0.000$ ). However, ATV-injured patients had a higher blood alcohol concentration ( $p = 0.000$ ). **Conclusion:** A great deal of attention and activity has been justly focused on ATV safety in the province of Alberta. With motorcycle injuries being more severe and occurring at a higher major trauma rate, it is time to apply similar enthusiasm and processes to motorcycle safety.

**Referral to a community program for youth injured by violence: a feasibility study. C. Snider,\* A. Nathens.† From the \*Department of Emergency Medicine, University of Manitoba, Winnipeg, Man., and †St. Michael's Hospital, Toronto, Ont.**

**Background:** Youth violence is an immense burden in Canada. Violence is a recurring condition: approximately 40% of youth injured by violence will be reinjured within the next year. The objective of this study was to assess the feasibility of referring youth injured by violence to community-based intervention programs. **Methods:** Youth presenting to St. Michael's Hospital Emergency Department and Trauma Service were approached to participate in the study. Information about the study was conveyed using a computer tablet. Youth completed an online baseline survey. If a youth consented to participation, a research coordinator linked the youth with their chosen community partner. **Results:** Sixty youth (27% of eligible patients) were approached and 20 (33%) chose to participate; 92% were male, and the average age was 19.3. In the prior 6 months, 76% of participants had been in a physical fight, with 57% of all participants having visited a doctor for a fight-related injury. Fourteen youth (70% of enrolled) chose a community program; however, 5 were unable to be contacted the following day to facilitate the referral. **Conclusion:** This feasibility study demonstrates the complexity of recruiting and referring a high-risk population to community resources. The results from this study will be used to develop a larger study to determine the effectiveness of these referrals in reducing future intentional injury.

**New impaired driving laws impact on the trauma population at level 1 and 3 trauma centres in British Columbia, Canada. J. Szpakowski, R. Van Heest, L. Constable, F. Mancini. From the Royal Columbian Hospital, New Westminster, BC**

**Background:** The BC Ministry of Public Safety made amendments to the Motor Vehicle Act effective Sept. 20, 2010. In addition to blood alcohol levels (BAL) of 0.08 or greater, drivers with a BAL between 0.05 and 0.08 are now charged and fined. The impact of this legislation on a BC Trauma Centre's patient characteristics was studied. **Methods:** Using the BC Trauma Registry data, patients were divided into 2 cohorts, representing the

3 months before and 3 months after implementation of the new drinking and driving laws. Inclusion criteria were patients involved in a motor vehicle crash (MVC), aged 16 years and older with a length of stay 2 days or more or death. **Results:**

**Table. Characteristics of patients injured in a motor vehicle collision in BC before and after the implementation of new drinking and driving legislation**

Characteristic	Before, no.	After, no.
All MVC patients	268	268
Driver's ETOH between > 0.05 and < 0.08	0	0
Driver's ETOH ≥ 0.08	11	6
Drivers tested	24	23
Drivers total	53	50
Drivers expired	3	3
Average ISS	15	14

ETOH = blood alcohol; ISS = Injury Severity Score; MVC = motor vehicle collision.

**Conclusion:** The number and severity of patients treated at our trauma centre did not change with introduction of the new legislation. Blood alcohol levels are not being done regularly at our centre. Despite Ministry of Public Safety claims of decreased MVC fatalities, our level 1 trauma centre did not see the same reduction in MVC admissions or deaths.

**A validation study of the mobile medical unit/polyclinic team training for the Vancouver 2010 Winter Games. R. Brown,\* B. Heidary,\* N. Bell,\* L. Appleton,† P. Hennecke,\* J. Taunton,‡ K. Khwaja,§ M. O'Connor,¶ M. Hameed,\* N. Garraway,\* R. Simons,\* D. Evans,\* T. Taulu,\* L. Quinn,\* D. Kuipers.\*** From \*Trauma Services, Vancouver General Hospital, the †Provincial Health Services Authority, the ‡Division of Sports Medicine, Faculty of Medicine, University of British Columbia, Vancouver, BC, §McGill University, Montréal, Que., and the ¶Department of Emergency Medicine, Kingston General Hospital, Kingston, Ont.

**Background:** The mobile medical unit/polyclinic (MMU/PC) was an essential part of the medical services to support the ill or injured among the Olympic or Paralympic family during the 2010 Olympic and Paralympic Winter Games. The objective of this study was to validate the effectiveness of the multiphase education training program provided to clinical staff before deployment to the MMU. **Methods:** Medical personnel who participated in at least 1 of the 4 training programs — including weekend sessions, web-based modules, just-in-time training and daily simulation exercises — were invited to participate in a web-based survey and comment on their level of satisfaction with the training program. **Results:** A total of 64 (of 94 invited) physicians, nurses and respiratory therapists completed the survey. All participants reported favourably that the MMU/PC training positively impacted their knowledge, skills and team functions while deployed at the MMU/PC during the 2010 Olympic Games. However, components of the training program were valued differently depending on clinical job title, years of experience and prior experience in large scale events. Respondents with little or no experience working in large scale events (45%) rated daily simulations as the most valuable component of the training program for strengthening competencies and knowledge in clinical

skills for working in large scale events. **Conclusion:** The multi-phase MMU/PC training was validated to be beneficial for preparing the medical team for the 2010 Winter Games. In particular, this survey demonstrates the effectiveness of simulation training programs on teamwork competencies in ad hoc groups.

**Inferior vena cava filter use in major trauma: the Sunnybrook experience, 2000–2011. S. Shah,\* S. Rizoli,† C. Rogers,† W. Geerts.†** From \*Wayne State University, Detroit, Mich., and the †Sunnybrook Health Sciences Centre, Toronto, Ont.

**Background:** A dramatic increase in inferior vena cava filter (IVCF) use in trauma has not resolved its controversial role. The objectives of this study were to document the number, types and indications for IVCF insertion, filter-related complications and temporal trends in IVCF use over 11.5 years. **Methods:** We assessed all patients admitted to the Sunnybrook Regional Trauma Unit from Jan. 1, 2000, to June 30, 2011, with an Injury Severity Score (ISS) of 9 or greater who had an IVCF placed. Data were abstracted from the trauma database and patient records. **Results:** Over the study period, there were 10 536 eligible trauma admissions, and 46 IVCFs were inserted (0.4% or ~4/yr). Only a single prophylactic filter was inserted; 70% were optional and 72% of these were removed after an average of 25 days. Major complications occurred in 11% (either IVC thrombosis or inability to remove filter). Within 5 days of insertion, 80% of patients were started on anticoagulation. Compared with all trauma admissions, those with an IVCF were older (42 v. 52 yr), more severely injured (ISS 24 v. 35) and more likely to have major head/abdominal/spinal cord injuries and lower extremity fractures. There has been no temporal increase in filter use at our centre. In 2000–02, all IVCFs were permanent; since 2005, all filters have been optional. **Conclusion:** Our use of IVCF in major trauma is at variance with that reported in the literature, with much lower use and only 1 prophylactic filter in 11.5 years. We are aware of only 2 fatal pulmonary embolisms over the same time period.

**Relevance of cellular microparticles in trauma-induced coagulopathy: a systemic review. M. Shiu,\* S. Rhind,\* S. Rizoli.†** From \*DRDC – Toronto, and the †Sunnybrook Health Sciences Centre, Toronto, Ont.

**Background:** Trauma-induced inflammation and thrombosis are orchestrated by interactions between circulating blood cells, platelets, vascular endothelial cells and derived microparticles (MPs). Long regarded as cellular debris, recent findings demonstrate that MPs function as effectors in cell-to-cell communication and modulate inflammation and thrombosis. Yet few studies have examined the relevance of MPs in trauma-induced coagulopathy. This review addresses the emerging role of MPs in the pathogenesis of trauma and as potential prognostic indicators of outcome. **Methods:** Relevant studies were identified through a systematic literature search of PubMed with the key terms “microparticles” and “trauma.” Review articles, case series and case reports were excluded from the study. **Results:** We identified 9 primary investigations that met our inclusion criteria. Of these, 2 were on traumatic brain injury, 2 on blood transfusion, 2 on multiple trauma and 3 on intracerebral hemorrhage. Seven

studies demonstrated elevated circulating MPs in trauma patients: 4 studies showed increased procoagulant activity; 2 studies reported endothelial damage and 1 study found leukocyte activation. Three of the studies concluded MPs could be a novel biomarker for trauma, whereas 2 studies reported MPs were predictive of poor outcome. The 2 reports on blood transfusion suggested that reduction in procoagulant MPs in fresh frozen plasma after storage decreased hemostatic potential during transfusion. **Conclusion:** Current experimental literature confirms that MPs play a pivotal role in thrombin generation, shifting hemostatic balance toward a procoagulant state. There is insufficient clinical evidence to support their utility as surrogate markers of trauma severity or validated outcome predictors.

**Improving quality through trauma centre collaboratives. M. Chen. From St. Michael's Hospital, Toronto, Ont.**

**Background:** Commitments to quality, safety and operational efficiency are necessary in today's health care organizations. One way to ensure we are meeting these objectives is through the transparency of clinical data and processes across these institutions. In the care of the trauma patient, the use of external benchmarking can further advance the care and quality provided while fostering a culture of continuous learning and improvement. Through the collaboration of 2 level 1 trauma centres in Ontario, we created a platform that produces economies of scale for trauma research, standardized data, feedback mechanisms and a network for sharing best practices in trauma patient care. **Methods:** Using a process-based approach, a collaborative was created between 2 high-performing trauma centres. This included a redesign of the Trauma and Acute Care Surgery Fellowship training program into a single joint program across the 2 sites, the review and harmonization of trauma specific protocols, initiation of joint centre case reviews and the use of social media to disseminate program information. **Results:** Collaborations between trauma centres create opportunities to share data and exchange information and develop communities of practice for trauma care. This establishes a process for deeper understanding, quality improvement and better utilization of trauma resources. Thus far, external stakeholder input has been positive, along with strong support from senior leadership. **Conclusion:** Collaborations between high-performing trauma centres provide opportunities for continuous quality improvements through the collection of high quality standardized data, the sharing of implementation strategies, and the constant review and comparison of processes and outcomes.

**Predictors of acute stress response in adult polytrauma patients following injury. N. Bell, K. George, L. Quinn, C. Babcock, M. Hameed, R. Simons. From Trauma Services, Vancouver General Hospital, Vancouver, BC**

**Background:** Acute stress disorder (ASD) as a risk factor for posttraumatic stress disorder (PTSD) has been investigated, but there is little information as to which variables predict ASD. By defining risk factors for ASD at discharge, we may be able to identify patients who are likely to develop PTSD and would benefit from early intervention. **Methods:** Between June and November 2011, a total of 94 polytrauma patients treated at a level 1 trauma centre elected to participate in a follow-up study to monitor emotional and physical health after injury. At discharge,

each patient was assessed for ASD symptoms using the Stanford Acute Stress Reaction Questionnaire. Symptoms of ASD were assessed against a patient socio-demographic questionnaire, injury event characteristics, a health status survey, as well as health-related quality of life. **Results:**

**Table. Polytrauma/truncal trauma patients at discharge: acute stress response scores on the Stanford Acute Stress Reaction Questionnaire**

Variable	ASD symptoms; no. (%)*		p value
	Yes, n = 23	No, n = 71	
<b>Health status</b>			
History of anxiety/depression	6 (26)	9 (13)	0.187
Recreational drug use	10 (43)	17 (25)	0.093
<b>Injury event characteristics</b>			
Perceived life was in danger	22 (96)	43 (61)	0.005
Perceived event could reoccur	14 (61)	22 (32)	0.016
Was warned before event occurred	13 (56)	13 (18)	0.000
<b>Socio-economic characteristics</b>			
No high school	6 (27)	5 (7)	0.019
Unemployed	5 (22)	2 (3)	0.009
<b>Health-related quality of life, mean (SD)</b>			
EQ-5D visual analogue scale	38.1 (19.4)	52.6 (21.3)	0.010
EQ-5D index score	0.29 (0.29)	0.35 (0.26)	0.418

ASD = acute stress disorder; SD = standard deviation.  
\*Unless otherwise indicated.

**Conclusion:** Persons who develop ASD are a distinct patient population and likely to be more disadvantaged both previous to and following their injury than other survivors. Ongoing surveillance of whether socio-economic circumstances and levels of social and care support influence participation in treatment services will help identify factors that modify long-term emotional responses to trauma.

**Patterns of outdoor recreational injury in northern British Columbia. F. Besserer, N. Caron. From the University of Northern British Columbia, Prince George, BC**

**Background:** Millions of dollars are spent annually on outdoor recreational activities (ORA) across British Columbia (BC). BC's Northern Health Authority (estimated population of 300 000) spans more than half the province. With frequent marginalization of northern populations in trauma research, this was an initial examination of the patterns of severe injury documented at a regional trauma centre (Prince George, BC) based on month of year, injury type, activity type, age and sex, as they relate to participation in ORA. **Methods:** Data were abstracted from the BC Trauma Registry (BCTR) for injuries occurring between April 2004 and April 2007 while engaged in ORA in northern BC. Inclusion criteria for the BCTR are admission for treatment of injuries sustained from the transfer of external energy or force, admission to the facility within 7 days of injury, and length of stay longer than 2 days or in-hospital mortality. **Results:** In all, 158 patients met BCTR criteria. August and September were peak injury months (mean 7.3 and 7.0/mo, respectively). Blunt trauma comprised 98% of injuries. The highest injury patterns involved cycling (n = 31), all-terrain vehicle (ATV) operation

( $n = 30$ ), horseback riding ( $n = 22$ ) and snowmobiling ( $n = 22$ ); 77% of patients were male with a peak age distribution between 10 and 19 years (22%). **Conclusion:** This study emphasizes the need for rapid translation of research into injury prevention awareness and programming in northern BC, particularly relating to cycling, ATV operation and targeted to young male populations. Further investigation is required to analyze long-term outcomes for this common injury population.

**Risk factors for loss-to-follow up among trauma patients include functional, socio-economic, and geographic determinants: Would mandating opt-out consent strategies minimize these risks?** *N. Bell, M. Hameed, R. Simons.* From Trauma Services, Vancouver General Hospital, Vancouver, BC

**Background:** Few longitudinal trauma outcome studies identify whether there are systematic differences among patients who elect to discontinue follow-up after consent. We sought to identify risk factors that predict loss to follow-up in order to identify strategies to reduce risk of attrition and control for bias caused by attrition. **Methods:** Between June and October 2011, a total of 83 polytrauma patients treated at a level 1 trauma centre elected to participate in a follow-up study to monitor emotional and physical health after injury. Measures of association and relative risk estimations between patients who were and were not lost to follow-up are reported. **Results:** At 1 month, 33% of all patients had refused further participation, could not be located at follow-up, did not respond to attempts to contact, or had died. Individuals who resided in rural communities, lived alone, reported having no mobility to some mobility and self-care limitations at discharge (as opposed to extreme) were lost to follow-up at 1 month ( $p < 0.05$ ). **Conclusion:** Trauma outcomes researchers need to pay greater attention to patient populations at risk of attrition from follow-up. Functional, emotional, socio-economic and geographic determinants influence attrition rates, which may affect measurements of recovery following injury. Strategies to minimize attrition could include pre-discharge identifiers, opt-out consent practices or less frequent follow-up contact among high-risk groups.

**Med-evacs and mortality rates for trauma from Inukjuak, Nunavik, Quebec.** *M. O'Neill Trudeau, F. Prévost, T. Razek, K. Khwaja.* From McGill University, Montréal, Que.

**Background:** This study aims to provide, first, a demographic analysis of traumas med-evaced from Inukjuak, Nunavik, and second, Inukjuak mortality rates owing to traumatic injuries. This is one of the first demographic studies concerning Northern Canadian med-evacs using data collected from a remote area. **Methods:** A representative study was conducted involving a chart review of med-evacs from Inukjuak and, when possible, received at the McGill University Health Centre. In all, 339 patient charts were sampled and reviewed from the 2152 charts in the Inukjuak nursing station, giving a confidence interval greater than 95% and a sample error less than 5%. All med-evacs from 1990 onwards were included in the study. The study also involved coding the mortality data in their entirety as recorded by a staff at the Inukjuak nursing station from 1993 onwards. **Results:** Of 271 med-evacs identified, 27 traumas met our criteria, accounting for 9.96% of med-evacs. Percentage (with overlap) by type of injury was: motor vehicle col-

lision, 8 of 27 (29.6%); mechanical fall, 6 of 27 (22.2%); gunshot wound, 5 of 27 (18.5%); physical violence, 3 of 27 (11.1%); intentional self-harm, 3 of 27 (11.1%); accidental self-harm, 2 of 27 (7.4%); and other 3 of 27 (11.1%). Of recorded mortalities since 1993, 48 of 159 were trauma-related (30.2%). Suicide (hanging, firearm) accounted for 31 of 48 (64%), motor vehicle collisions for 8 of 48 (17%), drowning for 7 of 48 (15%) and homicide for 2 of 48 (4%). **Conclusion:** Trauma mortality rates were found to be significantly higher in the Inukjuak population (30.2%) than national averages (7.1%). Though etiologies are multifactorial, this suggests that more extensive research concerning Northern med-evacs is warranted, with the goal of optimizing surgical outcomes in Northern communities. With the data collected concerning med-evacs, specific areas of improvement can be targeted.

**Review of open abdomens in McGill University Health Centre.** *M. Alhabboubi, M. Sudarshan, T. Razek, P. Fata, D. Deckelbaum, K. Khwaja.* From the McGill University Health Centre, Montréal, Que.

**Background:** The open abdomen (OA) is a powerful strategy in the management of critical ill patients. However, optimal technique and timing of closure remains fraught with controversy. Our objective is the analysis of OA management at a level 1 trauma centre. **Methods:** We conducted a retrospective review of all admissions between 2008 and 2011 where OA was conducted, identifying 45 cases. Data were analyzed for several factors including technique, timing of closure and laboratory measures. **Results:** In all, 66.6% of OAs were secondary to trauma, with an overall mortality of 23.8%. Primary closure was performed for 42.8%, component separation for 14.2% and skin coverage for planned ventral hernia (PVH) for 19%. The average international normalized ratio (INR) was 1.38 for the primary closure group and 1.76 for PVH group. Average INR was 1.49 for survivors and 2.02 for nonsurvivors. Higher creatinine was observed for patients who had closure after 3 days (170 v. 140). Creatinine was 152 for survivors and 175 for nonsurvivors. Lactate in the PVH group was higher at 3.38 versus 2.86 for primary closure, with a similar trend observed between survivors and nonsurvivors (8 v. 3.9). Patients in the PVH group received more blood products (12.5 v. 10.5) and had longer operative duration during initial surgery (167 v. 121 min). **Conclusion:** Our results suggest it is possible to correlate factors such as blood product transfusion, operative time and laboratory values such as INR, creatinine and lactate to nonclosure of OA and a higher mortality rate in this patient population.

**Are surgical interventions for trauma associated with the development of posttraumatic retained hemothorax and empyema?** *J. Rezende-Neto,\* E. Maria Savio de Abreu,† C. Neto,\* T. Almeida,\* M. Pastore,\* V. Taranto,\* M. Fernandes,\* S. Rizoli.‡* From the \*Federal University of Minas Gerais, the †Risoleta Tolentino Neves University Hospital, Belo Horizonte, Brazil, and the ‡Sunnybrook Health Sciences Centre, Toronto, Ont.

**Background:** The factors associated with the development of retained hemothorax (RH) and posttraumatic empyema have not been well defined, including the influence of a surgical intervention. The purpose of this study was to investigate if a surgical

intervention for trauma is a risk factor for posttrauma RH or empyema in patients who undergo chest tube replacement. **Methods:** We conducted a retrospective study of patients who underwent chest tube placement for trauma during a 6-month period. **Results:** A total of 58 patients were studied (mean age 30.4 yr), 75% with penetrating trauma; 35% had an Injury Severity Score of 16 or greater. A posttraumatic RH or an empyema was diagnosed in 28% of the patients and resulted in an average length of stay of 21 days versus 6 days for patients without that complication ( $p < 0.05$ ); 26% had other complications. Trauma surgery was performed in 55% of the patients (34% laparotomies, 21% other operations). A logistic regression model showed that the probability of a chest tube patient having posttraumatic RH or an empyema was 19 times greater if the patient underwent a trauma laparotomy or had a complication. **Conclusion:** Trauma patients who undergo a chest tube placement in association with a laparotomy are at a greater risk of developing a posttraumatic RH or an empyema than those who undergo chest tube placement only.

**A major step in understanding the mechanisms of traumatic coagulopathy: the possible role of thrombin activatable fibrinolysis inhibitor. S. Rizoli, B. Nascimento, A. Sankarankutty, R. Pinto, J. Callum, L. Tremblay, H. Tien. From the Sunnybrook Health Sciences Centre, Toronto, Ont.**

**Background:** Early traumatic coagulopathy appears to result from excessive release of activated protein C (APC) and tissue plasminogen activator (tPA), leading to anticoagulation and hyperfibrinolysis. The physiopathology of traumatic coagulopathy is certainly more complex. We hypothesized that besides the excessive tPA and APC levels, inappropriate release of counterbalancing mechanisms (plasminogen-activator inhibitor-1 [PAI-1], thrombin activatable fibrinolysis inhibitor [TAFI], tissue factor pathway inhibitor [TFPI]) might also have a role. **Methods:** In all, 212 blood samples were collected over the first 24 hours of admission from 36 severely injured patients enrolled in a research ethics-approved trial on massive transfusion (TRFL trial). The APC, tPA, PAI-1, TAFI and TFPI levels were measured by enzyme-linked immunosorbent assay or immunofluorescence. Coagulopathy was defined as endogenous thrombin potential (ETP) of 250 or less (thrombin generation measurement) at any time. Parameters were graphed using cubic splines and associations by Spearman correlation. **Results:** In contrast to noncoagu-

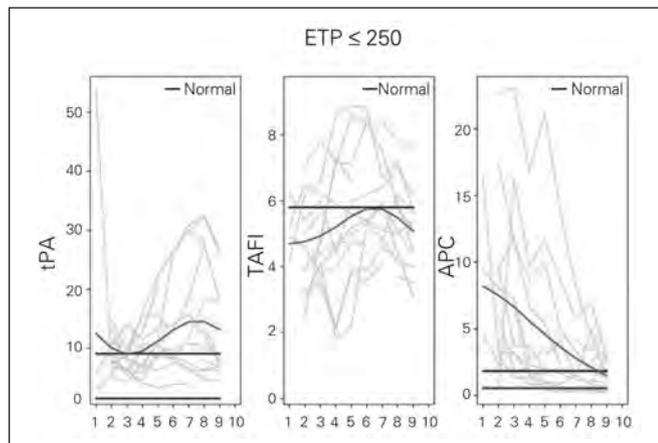
lopathic patients, patients with an ETP of 250 or less had mean tPA and APC levels higher than normal and TAFI below normal (see Figure). The PAI-1 and TFPI levels had similar curves regardless of ETP. Correlations were strong between ETP and tPA, APC and TAFI, TAFI and APC, but not between PAI-1 and APC or tPA, or TAFI and tPA. **Conclusion:** This is the first study to suggest that TAFI plays a major role in early traumatic coagulopathy. Thrombin activatable fibrinolysis inhibitor affects and is affected by both tPA and APC, and its failure to amount an appropriate response explains the ensuing coagulopathy. Coagulopathy (ETP) was also strongly associated with TAFI levels.

**Access to trauma centre care for patients with major trauma. A. Hill,\* R. Fowler,\* R. Pinto,\* A. Nathens.† From the \*Sunnybrook Health Sciences Centre and †St. Michael's Hospital, Toronto, Ont.**

**Background:** Trauma care organization varies across Canadian provinces, resulting in differences in the ways severely injured patients are triaged to trauma centres. The impact of this variation of access to care is unknown. We sought to examine how often patients with major trauma receive care in a trauma centre. **Methods:** We conducted an analysis of the National Trauma Registry Minimum Data Set for fiscal years 2002–2009, for all provinces except Quebec. A validated ICD-10-to-Abbreviated Injury Scale crosswalk was used to generate Injury Severity Scores (ISS) for patients. The study included patients older than 16 years with an ISS greater than 15. Hospitals were coded as nontrauma/trauma centres using information from a national survey. **Results:** Of the 95 191 major trauma hospitalizations identified, 59.4% were treated in a trauma centre. Of patients 75 years and older, 39.5% were treated in a trauma centre compared with 52.5% and 68.6% of patients aged 65–75 years and those younger than 65 years, respectively. In analysis controlling for sex, ISS, mechanism of injury and time of admission, patients younger than 65 years were more likely to be treated in a trauma centre (OR 1.80, 95% CI 1.74–1.86). Less than half (46.6%) of patients with falls as a mechanism of injury were treated in a trauma centre. **Conclusion:** A considerable proportion of patients with major trauma are not managed in a trauma centre. Our preliminary observation suggests that older patients may be at increased risk of under triage; however, this must be interpreted in light of other potential confounders that may influence this association. Notwithstanding, these findings suggest that there may be opportunities to improve the organization of trauma services for patients. To guide these efforts, we are conducting follow-up studies to examine the system, provider and patient factors related to trauma centre access.

**Repeat head computed tomography in anticoagulated traumatic brain injury patients: still warranted. B. Joseph, M. Sadoun, J. Harris, R. Friese, N. Kulvantunyou, T. O'Keeffe, J. Wynne, A. Tang, D. Green, P. Rhee. From the University of Arizona Medical Center, Tucson, Ariz.**

**Background:** Anticoagulation agents are proven risk factors for intracranial hemorrhage (ICH) in traumatic brain injury (TBI). The aim of our study is to describe the epidemiology of prehospital CAP (Coumadin, ASA, Plavix) patients with ICH and evaluate the utility of repeat head computed tomography (CT) in this



group. **Methods:** We performed a retrospective study from our trauma registry. A total of 1606 blunt TBI patient charts were reviewed. All patients with intracranial hemorrhage on initial CT with prehospital CAP therapy were included. Demographics, CT scan findings, number of repeat CT scans and neurosurgical intervention were abstracted. **Results:** A total of 508 patients had intracranial bleeding on initial CT scan: 72 patients were on pre-hospital CAP therapy (Table). Their mean age was 72 (SD 13) years, 67% were male, their median Glasgow Coma Scale score was 15 (3–15). In all, 84% of patients were on antiplatelet therapy, and 56% of patients presented with subdural hematoma.

**Table. Repeat head computed tomography in patients with a traumatic brain injury who were or were not administered prehospital anticoagulants\***

Group	LOC	Abnormal neuroexam	RHCT	> 2 RHCT	Progression on RHCT	Neurosurgery intervention
CAP, n = 72	52.8	15.3	86.1	15.4	22.2	12.5
No CAP, n = 351	55.8	6.0	69.5	6.6	8.2	6.0
p value	0.34	0.004	0.004	< 0.001	< 0.001	0.05

CAP = Coumadin, ASA and Plavix; LOC = loss of consciousness; RHCT = repeat head computed tomography.  
 \*Data shown in % unless otherwise indicated.

**Conclusion:** Patients on prehospital CAP therapy have a higher rate of neurosurgical intervention and progression of intracranial bleeding. Although the use of routine repeat head CT is often questioned, there is a need for it in patients on anticoagulation therapy including ASA.

**Improving trauma system governance. B. Lawless,\* J. Trpkovski,† V. Blount.†** From the \*St. Michael's Hospital and the †Ontario Ministry of Health and Long-term Care, Toronto, Ont.

**Background:** Inclusive trauma systems have well described components. Governance, including a group with content expertise to function in an advisory and consulting capacity, is a key component of an inclusive trauma system. Canada's largest province, Ontario, can improve alignment of system elements to support an integrated system to care for injured patients. This paper describes a process to evolve an existing trauma networking group into a trauma advisory committee as a key element of governance in Canada's largest trauma system. **Methods:** A mixed methods approach was used to evaluate the current trauma networking group. A literature review was completed to identify main areas of focus in a questionnaire. The questionnaire was completed by current network members and results analyzed. An item pool including mandate and areas for improvement was generated for one-on-one interview with the network members. Responses were collated into themes and analyzed. **Results:** The response rate for the survey was 56% (n = 28). Fifteen current network members agreed to participate in the one-on-one interviews. Key themes that emerged include the following: the mandate of the network needs to be updated and priority on quality improvement included; a stronger bidirectional accountability with the lead agency (Ministry of Health) needs to exist; and the membership of the network needs to be updated to successfully carry out new accountabilities. **Conclusion:** Improved structure and function of a trauma network group can position it as a key element of overall improved governance in an inclusive trauma system.