Trauma 2010

Trauma Association of Canada (TAC)
Annual Scientific Meeting

The Marriot Halifax Harbourfront Hotel
Halifax, NS

Thursday, May 6 to Friday, May 7, 2010

Abstracts
Trauma Association of Canada Annual Scientific Meeting abstracts

**Tertiary survey: for all trauma patients. R. van Heest,† N. Garraway,† N. Lakha,† R. Simons.† From the †Department of Surgery, Royal Columbian Hospital, New Westminster, and the †Division of Trauma, Vancouver General Hospital, Vancouver, BC**

**Background:** Missed injuries occur in 9%–65% of trauma patients. Studies have demonstrated the benefit of a trauma tertiary survey (TS) in reducing medical errors. Our trauma service implemented a TS form, and we wanted to know if the beneficial effect of a TS was maintained. **Methods:** Trauma patients with missed injuries were identified by the BC Trauma Registry over 3 periods. Separate chart reviews were performed to determine clinical significance of error and compliance with the TS form. **Results:** A significant reduction in diagnostic delay and unacceptable errors was identified before and after implementation of a TS (see Table). Implementation of a TS form did not further reduce the error rate despite a 77% compliance rate. The 2 unacceptable errors in 2007 occurred when trauma patients were admitted to a nontrauma service and a TS was not completed. **Conclusion:** A TS reduces clinically significant diagnostic errors. Once a trauma service routinely performs a TS, the effect is long lasting. To improve patient safety, a TS should be routinely performed within 24 hours of admission regardless of the admitting service.

**Bearing surfaces: Who gets what hip? A literature review. C. Menakaya, B. Ilango. From the Liverpool Heart and Chest Hospital, Liverpool, United Kingdom**

**Background:** The hip is a ball-and-socket joint (bearing), and arthroplasty is one of the most common orthopedic procedures. The choice of material used in the bearing affects the long-term durability of the joint replacement. Current results show about 95% implant survival after 10 years, which further “technical development” will only marginally improve. The choice of bearing used is still controversial and most interesting in the field of hip replacement. Our aim was to determine how surgeons choose the implant used. We looked at implant choices in terms of sizes, availability and durability of implants and fixation techniques based on patient sex and age. **Results:** Studies in Sweden showed that factors affecting implant choices are limited by the variables available and recorded in databases, with continued work on “case-mix” variables being of greatest importance. The study divided the outcomes based on age intervals, and all observations were reported by sex and causes of revision. Women under 50 years had poorer results than men; however, when diagnosis and other contributory factors in a regression analysis were adjusted, the sex difference disappeared. The results improved using cemented fixation for both sexes. A study in Australia revealed that differences in outcome were age related. In patients 75 years and older, cementless fixation had over twice the risk of revision compared with cemented or hybrid fixation. In patients under 55 years, there was no difference. In the United Kingdom, the choice of bearing surface is dependent on surgeon and implant design availability. **Conclusion:** Choices are dependent on surgeon training, colleagues’ preferences, trust policies and implant costs. Age and sex also affect the patient-related outcome; however, none of the existing implants or methods of fixation has shown to be better in terms of implant survival.

**Alcohol-related history in trauma patients. B. Tsang,* J. Mckee,† D. Sutherland.† From the †Department of Surgery and †Trauma Services, University of Alberta Hospital, Edmonton, Alta.**

**Background:** The purpose of this research initiative was to investigate the quality of alcohol-related histories in adult major trauma patients (ISS > 12) with a positive blood-alcohol concentration (BAC). **Methods:** A retrospective chart review was performed for patients admitted to the University of Alberta Hospital from June 1, 2008, to Aug. 31, 2008. **Results:** Three (4.3%) patients (n = 70) did not have a BAC drawn on presentation, and of the 27 patients transferred from peripheral hospitals, 11 (40.7%) had no BAC available. Most charts contained histories that documented the use of alcohol before the traumatic incident; however, only 7 (10%) charts (n = 70) had clear documentation of the amount of daily alcohol use. Twenty-six (37.1%) patients (n = 70) did not receive any form of alcohol withdrawal prophylaxis. The 44 patients who did receive alcohol withdrawal prophylaxis received various combinations and doses of thiamine, folate, multivitamin and benzodiazepines. Six (8.6%) patients (n = 70) were diagnosed with alcohol withdrawal syndrome, and 2 (33.3%) of these patients suffered from complications as a result. **Conclusion:** This study demonstrates a clear gap in the way alcohol-related histories are obtained on trauma patients. More interestingly, a large portion of these high-risk patients were not given any form of alcohol withdrawal prophylaxis at all. Changes in the current system are needed to address these problems to better prevent alcohol withdrawal syndrome and the associated mortality and morbidity.

**Infrequent temperature monitoring in major trauma patients. D. Al-Adra,* J. Mckee,† G. Hickey,† D. Sutherland.†**
Access to trauma systems in Canada. S. M. Hameed, N. Schuerman, R. K. Simons, T. Taulu, D. Dyer, A. W. Kirkpatrick, J. B. Kortbeek, T. Stelfox, M. Stephens, S. Loggetty, T. Charyk-Stewart, A. Nathens, S. Rizoli, L. Tremblay, F. Brennanman, E. Galbraith, N. Parry, M. Girotti, G. Pagliarello, T. Razek, N. Tze, N. Yancher, J. Tallon, A. Trenholm, D. Boone, U. Hameed, O. Amrau, M. Berube, for the Research Committee of the Trauma Association of Canada

Background: Trauma is a leading cause of morbidity, potential years of life lost and health care expenditure in Canada and around the world. Trauma systems have been established across North America to provide comprehensive injury care and to lead injury control efforts. This study describes the current status of trauma systems in Canada and examines Canadians’ access to acute, multidisciplinary trauma care. Methods: A national survey was used to identify the locations and capabilities of trauma centres across Canada and to identify the catchment populations they serve. Geographic information science methods were used to map the locations of level 1 and level 2 trauma centres, and to define 1-hour road travel times around each trauma centre. Data from the 2006 Canadian census were used to estimate populations within and outside 1-hour access to definitive trauma care. Results: Trauma centres and systems have evolved across the country in response to local health care, economic and geographic considerations. Whereas all Canadian trauma systems have established high standards for multidisciplinary trauma care, each is unique and faces distinct challenges. Access to definitive trauma care is high, with 77.5% of Canadians residing within 1-hour road travel catchments of level 1 or level 2 centres. However, marked geographic disparities in access persist. Of the 22.5% of Canadians who live more than an hour away from a level 1 or level 2 trauma centre, all are in rural and remote regions. Moreover, reasonable access to trauma care is limited to 5 provinces: British Columbia, Alberta, Ontario, Quebec and Nova Scotia. Conclusion: Access to high-quality acute trauma care is well established across parts of Canada, but a clear urban/rural divide persists. Regional efforts to improve short- and long-term outcomes after severe trauma should focus on the optimization of access toprehospital care and acute trauma care in rural communities using locally relevant strategies.

TRAUMA ASSOCIATION OF CANADA

Access to high-quality acute trauma care is well established across parts of Canada, but a clear urban/rural divide persists. Regional efforts to improve short- and long-term outcomes after severe trauma should focus on the optimization of access to prehospital care and acute trauma care in rural communities using locally relevant strategies.
Using Web 2.0 technologies for injury surveillance in low-resource settings. J. Cinnamon,* N. Schuurman,* S.M. Hameed,† From *Simon Fraser University, Burnaby, and †Vancouver Coastal Health, Vancouver, BC

**Background:** More than 90% of injury-related deaths occur in low- and middle-income countries (LMIC). Injury surveillance is rare in LMIC; thus, little is known about its causes, the spatial context or the populations at risk. Two traditional barriers to data collection and analysis are access to software and availability of trained personnel. With free and easy-to-use Web 2.0 technologies, there is the potential to develop injury surveillance systems that can be managed by existing staff in low-resource settings.

**Methods:** A pilot study was conducted in Cape Town, South Africa, in October 2008 to assess the feasibility of using Web 2.0 tools for injury surveillance. Epidemiological data were collected at a major hospital’s trauma unit. Free and simple Web 2.0 tools were used for all aspects of the study, including Google Spreadsheet for data entry and management and Google Earth for basic spatial analysis and visualization. **Results:** Google Spreadsheet was useful for managing the collected data, particularly because it allows for multiple people to refine, edit and access the data set from any Web-enabled computer at anytime. Free online geocoding tools proved to be easy to use and reasonably accurate. Google Earth was useful for developing a basic geospatial analysis system for Cape Town. **Conclusion:** The findings of the study suggest that Web 2.0 can facilitate streamlined data collection, management and visual analysis. This presents the possibility for hospitals with constrained resources to engage in injury surveillance. Overall, this exploratory study presents a step toward the development of injury surveillance systems that are appropriate for low-resource settings.

Injury surveillance in low and middle income countries: the Cape Town trauma registry. N. Schuurman,* S.M. Hameed,† J. Cinnamon.* From *Simon Fraser University, Burnaby, and †Vancouver Coastal Health, Vancouver, BC

**Background:** Injury is a major public health issue, responsible for 5 million deaths each year worldwide, equivalent to the total mortality caused by HIV, malaria and tuberculosis combined. The World Health Organization estimates that of the total worldwide deaths due to injury, more than 90% occur in low- and middle-income countries (LMIC). Despite the burden of injury sustained by LMIC, there are few, if any, continuing injury surveillance systems designed to collect and analyze injury data. **Methods:** We developed a hospital-based trauma registry form, known as the Cape Town Trauma Registry (CTTR). A data capture pilot study at Groote Schuur Hospital in Cape Town was conducted for the month of October 2008 to demonstrate the utility and feasibility of systematic data collection and analysis and to explore challenges of implementing a trauma registry in a low-resource environment. **Results:** Information collected during the pilot study included patient demographic details, spatial and temporal information, injury mechanism and type, patient vital signs, diagnostic and treatment information and patient outcome. A high rate of data capture was possible for most of the fields, although data capture rates for a small number was poor. Locations where injuries were sustained were aggregated to postal code areas to provide a simple visualization of areas with a high number of incidents. The cartographic evidence clearly pointed to the need for geographically specific intervention. **Conclusion:** Evidence-based injury control, established by rigorous data collection, is urgently needed in LMIC. The CTTR, a trauma unit–based injury database, is a feasible strategy to describe the distribution and consequences of injury in a high-trauma volume, low-resource environment.

Occult pneumothoraces: Truly occult or simply missed? Redux. M.S. Brar,* L. Kmet,* G. Brunet,† S. Nicolau,‡ I. Bains,* C.G. Ball,* K.B. Laupland,† A.W. Kirkpatrick,** From the Departments of *Surgery, †Radiology and ‡Critical Care Medicine, University of Calgary, Calgary, Alta., and the †Department of Radiology, University of British Columbia, Vancouver, BC

**Background:** As the use of CT scans in the evaluation of trauma patients increases, pneumothoraces (PTXs) seen on CT but not on chest radiography (CXR), known as occult pneumothoraces (OPTXs), are becoming more prevalent. The incidence of PTXs simply missed on CXR among OPTXs is unclear. A previous retrospective review of CXR images at our institution generally confirmed the occult versus missed designation, but lower-fidelity images may have biased this determination. We thus repeated this evaluation using the highest-quality images and improved methods. **Methods:** Seventy DICOM-quality CXR images were randomly selected from 2 prospectively-collected trauma databases, including 22 normal, 5 overt PTX and 43 OPTX images. All CXR images were corroborated with multidetector CT imaging. Two blinded fellowship-trained radiologists reviewed and evaluated all the images on an IMPAX viewer. **Results:** All images were deemed “adequate” except for 1 CXR scan by a single reviewer. For PTX diagnosis, agreement was 60% for overt PTXs, 86% for normal CXRs and 81% for OPTXs, yielding a kappa statistic of 0.51 (95% CI 0.22–0.81) and indicating moderate agreement. Considering only the cases where the reviewers agreed, 80% of the OPTXs were truly occult versus missed (95% CI 63%–92%). In the 7 missed PTXs, subcutaneous emphysema (4), pleural line (3) and deep sulcus sign (2) were detected. **Conclusion:** We estimate that 80% of PTXs considered occult in the trauma room were truly occult. The most common missed sign was subcutaneous emphysema. Pneumothoraces are poorly assessed by CXR, and accurate diagnosis should focus on other imaging modalities.

Facts survey: FAST use among Canadian residents training in general surgery. L. Dubois,* K. Leslie,* N. Parry,** From the *Division of General Surgery, Department of Surgery, and the †Department of Biostatistics and Epidemiology, Schulich School of Medicine and Dentistry, University of Western Ontario, and the †Trauma Program, London Health Sciences Centre, London, Ont.

**Background:** A survey of all Canadian general surgery residents was conducted to determine the prevalence of focused assessment with sonography for trauma (FAST) training, the nature of the training and their level of comfort with the technique. The presence of potential barriers to FAST training was also assessed. **Methods:** A cross-sectional survey of all 549 residents in 16 Canadian general surgery programs was administered using the Tailored Design Method between December 2008
and February 2009. Results: With a response rate of 58.5% (321/549), the prevalence of FAST training among Canadian residents was 21.2% (68/321, 95% CI 17.2–25.2). The median number of practice exams completed was 5 (interquartile range 2–10.5), and the median number of patients examined was 11.5 (interquartile range 1.75–50). Only 38.8% of residents with FAST training felt comfortable with their exams. Those residents who were comfortable had completed more practice and patient exams (median 12.5 v. 4, p = 0.001 and 30 v. 4.5, p < 0.001, respectively) when compared with those who were uncomfortable. Most residents (80%) indicated they would need 20 exams or more before they would feel comfortable with the technique. Residents with FAST training were more likely to be from a program that offered FAST training (54.5% v. 10%, p < 0.001) and were less likely to perceive a turf war with other specialties (emergency, radiology) over FAST use (29.9% v. 48.2%, p = 0.007) than residents without training. Conclusion: Only 21% of Canadian general surgery residents surveyed have FAST training, and most remain uncomfortable with this technique. If FAST skills are to be expected of future surgeons, initiatives must be put in place to address barriers and improve training opportunities.

Is the Kampala Trauma Score a useful triage tool for North America? H. Gill,1 M. Rousseau,2 J. Ng,1 R. Boniface,1 K. Khwaja,1 T. Razek.1 From the *Department of Surgery, McGill University, Montréal, Que., and the †Department of Anaesthesia, Muhimbili Medical College, Dar es Salaam, Tanzania

Background: In North America, trauma systems have been shown to improve outcomes after injuries. Different injury severity scores have been used for the purpose of triage; however, there is no gold standard. The Kampala Trauma Score (KTS) is a simplified score created for use in under-resourced areas. It accurately predicts death and hospitalization at 2 weeks in both low- and high-income countries. There are no studies looking at the KTS as a triage tool in resource-rich environments; however, one study proved it was not useful for triage in Uganda. We sought to determine if the KTS could be a useful triage tool in North America. Methods: Patients older than 16 with ISS scores of 16–74 from blunt trauma at a Canadian urban centre from November 2005 to July 2008 were identified using a prospective database. Outcomes measured were mortality and hospitalization status at 2 weeks. The sensitivities and specificities of the KTS were calculated for all cutoff values using a receiveroperator curve analysis. Results: A KTS cutoff of 13 was associated with a sensitivity of 90% and a specificity of 58% for predicting mortality. For hospitalization status, the KTS had a 69% sensitivity and 74% specificity. Higher cutoff values resulted in unacceptably low specificities, whereas lower cutoffs were associated with unacceptably low sensitivities. Conclusion: The KTS is not an effective triage tool for North American. It is, however, a useful, simple method for gathering data for quality control and injury prevention efforts in under-resourced areas.

Thromboprophylaxis use and clinical outcomes after isolated traumatic brain injury. A. Mamtani,1 S. Rizoli,1 W. Geerts.1 From the *Trauma Program and the †Department of Medicine, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ont.

Background: Patients with severe traumatic brain injury (TBI) have increased risk for venous thromboembolism (VTE). We assessed the relation between VTE and thromboprophylaxis in patients with severe, isolated TBI. Methods: Patients admitted to our level 1 trauma centre between 2002 and 2008 with frank intracranial hemorrhage and Abbreviated Injury Scale (AIS) head scores 3 and greater were included. Patients with lower extremity or spine fractures were excluded. Demographics, admission Glasgow Coma Scale, ISS and AIS scores, type of intracranial hemorrhage, details on timing and modality of thromboprophylaxis, and proven VTE were gathered. We assessed possible predictive factors in patients with and without VTE. Results: Among the 522 patients with isolated TBI, 17 (3.3%) developed symptomatic VTE during their acute hospitalization. Higher ISS (p = 0.005, OR 1.07, 95% CI 1.02–1.12) and older age (p = 0.017, OR 1.03, 95% CI 1.00–1.05) were independent predictors of VTE. Severity of the head injury (AIS head), type of intracranial bleed and admission GCS were not predictive. Thromboprophylaxis use was similar in both groups; most patients were prescribed thrombolytic deterrent stockings on admission (77% in VTE group v. 92% in non-VTE group). Low-molecular-weight heparin was the preferred anticoagulant (47% v. 46%), whereas low-dose heparin was prescribed occasionally (6% v. 9%). The mean delay from admission to initiation of anticoagulant prophylaxis in patients without VTE was 6.3 days versus 7.4 days in patients with VTE (p = 0.07). Conclusion: Patients with TBI have a high risk of VTE despite the use of thromboprophylaxis. Higher ISS and older age were independent predictors of VTE in this group.

Spatial modelling of patient evacuation and allocation to definitive care in mass casualty situations. O. Amram,1 N. Schuurman, R.K. Simons, T. Taulu, S.M. Hamed. From Vancouver Coastal Health, Vancouver, BC

Background: The survival or recovery of people critically injured in incidents involving mass casualties is directly related to their access to timely and appropriate treatment. The management of mass casualty evacuation priorities has been underexplored from a spatial perspective. Methods: We have created a model for decision-making for evacuation and definitive care priorities. Using a geographic information system, the model incorporates hospital capacity in addition to injury type and severity as the basis for decisions about which patients are sent to which facilities. The model incorporates specialized hospital services and driving distances as key components. A flowchart based on decision trees is the basis for rules about evacuation and allocation to various facilities. Results: The analysis and visualization associated with the model incorporates spatial network analysis as well as specialized algorithms for calculating travel times. Modelling complex evacuation priorities using a geographic information system enables the examination of different scenarios in multiple mass casualty circumstances at varying locations. Conclusion: This tool will potentially assist emergency service personnel to optimize decision-making processes during critical stages of evacuation.

Are both obstructive uropathy and lower extremity compartment syndrome associated with pelvic compartment syndrome? Report of 2 cases and literature review. H.P. Huynh, B. Felemban, B. Lawless, R. Meek, D.R. Brown,
ASSOCIATION CANADIENNE DE TRAUMATOLOGIE

R.K. Simons. Division of General Surgery, Vancouver General Hospital Trauma Services, University of British Columbia, Vancouver, BC

Background: Obstructive uropathy due to pelvic hematoma has been previously described, although, to our knowledge, it has not been previously linked to the secondary development of bilateral lower extremity compartment syndrome, nor to the need for urgent pelvic hematoma decompression. Our objective is to describe a new syndrome: pelvic compartment syndrome, comprised of obstructive uropathy and bilateral lower extremity compartment syndrome associated with massive retroperitoneal hematoma following traumatic pelvic ring disruption, unresponsive to decompressive laparotomy and requiring pelvic hematoma decompression. Methods: We conducted a retrospective case analysis and literature review. Results: Two patients sustained pelvic ring disruption after blunt trauma with resultant massive retroperitoneal hematoma. Subsequently, both developed compressive bilateral ureteral obstruction with anuria and symptoms of bilateral lower extremity compartment syndrome associated with iliac vein compression. Neither patient responded to decompressive laparotomy, both requiring surgical decompression of the hematoma after pelvic stabilization with on-table reversal of anuria and lower extremity compartment syndrome. Conclusion: We describe a previously unrecognized syndrome: pelvic compartment syndrome due to massive retroperitoneal hematoma. Although the obstructive uropathy from distal ureteral compression has been previously described, the associated bilateral lower extremity compartment syndrome has not. We believe that this pelvic compartment syndrome, which may mimic abdominal compartment syndrome, may remain largely unrecognized. Surgical decompression of the pelvic hematoma remains the treatment of choice and not decompressive laparotomy, which has no therapeutic value.

Serum S100B levels in isolated head injury versus hemorrhagic shock patients: a randomized controlled trial. S.B. Rizoli,* S.G. Rhind,† P.N. Shek,‡ A.J. Baker,‡ A.D. Romaschin,§ W.G. Junger,¶ J. Cusciheri,¶ E.M. Bulger.¶ From the Departments of Surgery and Critical Care Medicine, Sunnybrook Health Sciences Centre, Defence Research and Development Canada, the Cara Phelan Centre for Trauma Research, St. Michael’s Hospital, University of Toronto, Toronto, Ont., the Departments of Surgery at Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Mass., and the University of Washington, Harborview Medical Center, Seattle, Wash.

Background: S100B is an established biomarker of traumatic brain injury (TBI) that is commonly used for assessment of primary and secondary insults and prognosis. Recent studies suggest extracellular release of S100B, which may limit its prognostic utility in neurotrauma. We evaluated serum S100B in patients with isolated TBI, hemorrhagic shock (HS) or a combination of both. Methods: This ancillary study of the Resuscitation Outcomes Consortium enrolled adult patients (n = 81) with severe TBI (Glasgow Coma Scale score ≤ 8) or HS (systolic blood pressure ≤ 90 mm Hg), receiving prehospital treatment of normal saline or 7.5% hypertonic saline ± 6% dextran 70. Blood samples were collected within 4 hours of injury for determination of S100B concentrations using electrochemiluminescent immunoassay (Elecsys 2010; Roche Diagnostics). Values above a cut-off of 0.105 µg/L were considered abnormally high. Healthy participants (n = 25) served as controls. Results: On admission, 95% of patients had significantly (p < 0.05) elevated levels (2.370 ± 0.313) of S100B compared with controls (0.012 ± 0.008). Isolated TBI patients displayed higher S100B (2.257 ± 0.299) than HS (1.656 ± 0.448), but peak S100B values were observed in the combined injury cohort (3.635 ± 1.047) (see Figure). Conclusion: Our findings support the use of S100B to distinguish severe TBI from HS. Compared with isolated TBI, extracranial injury caused modest elevation of serum S100B, with the greatest increases in patients sustaining both insults, which may reflect the combined pathophysiology of severe tissue hypoxemia and hypotension and should be considered when S100B is used as biomarker.

Emergency thoracotomy in the emergency department versus operating room: 17-year comparison in a level 1 trauma centre. E.M. Passos,* A.C. Amaral,* S.B. Rizoli.† From the Departments of General Surgery and Critical Care Medicine, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ont.

Background: The outcome of emergency thoracotomy for trauma is a source of controversy. We hypothesize that survival rates are higher for thoracotomies performed in the operating room (OR) compared with those in the emergency department (ED). Methods: The study reviewed 17 years of emergency thoracotomy for trauma at Sunnybrook. Only patients who had surgery for life-threatening injuries within 3 hours of admission were included. Univariate analysis was performed with Stata and Student t tests for continuous variables. Adjustment was performed with logistic regression, forcing a model including both clinically relevant variables and Student t tests for continuous variables. Results: Over the 17-year study period, 136 patients underwent emergency thoracotomy in the ED and 190 in the OR within 3 hours of admission.
Survival was 2% (95% CI 0.5%–6%) versus 48% (95% CI 41%–55%), respectively (p < 0.0001). After adjusting for age, type of injury, time elapsed from trauma to hospital admission, prehospital arrest, ISS, hospital Glasgow Coma Scale score and thoracic injuries, OR thoracotomy remained associated with lower mortality compared with ER thoracotomy (ER thoracotomy odds ratio for death was 55 [95% CI 6–530]). Conclusion: Our findings suggest that survival following ED thoracotomy is infrequent, whereas OR thoracotomy carries significantly lower mortality, even after adjustment for major differences. The retrospective nature of the study did not allow adjustment of all confounders, thus the conclusion should be interpreted cautiously.

Rural trauma teaching in Newfoundland: initial experience with the rural trauma team development course. A.N. Porte, M.P. Hogan, J. Hapgood, D.C. Boone. From the Discipline of Surgery, Memorial University of Newfoundland and Eastern Health, St. John’s, NL

Background: The goals of optimal rural trauma care include rapid assessment, diagnosis and intervention for life-threatening injuries and timely transfer to definitive care. The Rural Trauma Team Development Course (RTTDC) was developed by the Rural Subcommittee of the American College of Surgeons Committee on Trauma to foster these goals. This study assessed the initial value of RTTDC as an educational tool for hospital staff in rural Newfoundland, a province with twice the landmass of Great Britain and less than 1% the population. Methods: The RTTDC courses were conducted using rural hospital emergency departments for simulated clinical scenarios. Performance was evaluated by scoring team Situation Awareness Global Assessment Technique (SAGAT), pre- and postcourse written tests and post-course participant evaluation surveys (Likert 5-point scales). Results: Three courses were completed (26 participants). The mean Likert score for the evaluation surveys was 4.56. Level 1 postcourse SAGAT scores showed 11% improvement (SD 23%); postcourse test scores improved 6% (SD 13%). Conclusion: The RTTDC increased participant confidence in managing rural trauma as manifested by positive feedback and postcourse test improvement. Teamwork performance scores using team SAGAT improved after the course was completed. Indices of provider performance improved with this course. Further work will be necessary to determine if these changes will result in enhanced patient care.

Comparing thromboelastography and international normalized ratio: diagnosing Coumadin-induced coagulopathy in trauma. M. Al Mahroos, J. Pacher Hoffmann, S. Scarpenini, B. Nascimento, V. Speers, S. Rizoli. From the *Department of Surgery, Sunnybrook Health Science Centre, Toronto, Ont., and the †Faculty of Medicine of Ribeirão Preto, University of São Paulo, São Paulo, Brazil

Introduction: Many trauma patients die of coagulopathy. The care of trauma patients on Coumadin is challenging, and early identification is crucial since drug-induced coagulopathy is reversible. Coumadin affects vitamin K–dependent clotting factors. Thromboelastography (TEG) has been proposed but scarcely investigated as a diagnostic test in trauma. We studied TEG and international normalized ratio (INR) values in diagnosing Coumadin-induced coagulopathy in trauma. Methods: Posthoc analysis of a large observational study enrolling all adult trauma patients admitted to Sunnybrook between February and October 2007, undergoing TEG, INR and clotting factors (CF) assays. All patients with coagulopathy due to vitamin K–dependent CF deficit (< 50% activity), on Coumadin or not, were analyzed using TEG (TEG-R parameter) and INR (abnormal ≥ 1.3) to calculate sensitivity and specificity. Ongoing bleeding was recorded. Results: Of 628 patients enrolled, only 8 used Coumadin: whereas only 7 had CF deficit, all had abnormal INR and TEG-R. Thirteen other patients not taking Coumadin had vitamin K–dependent CF coagulopathy: TEG-R diagnosed 10 (77%) and INR diagnosed 12 (92%). Thus, TEG-R has a sensitivity of 85% and specificity of 96.5%, whereas INR has a sensitivity of 90% and specificity of 94%. TEG-R did not identify any coagulopathic patients not detected by INR. All patients with bleeding were identified by both. Estimated time from sampling to results was similar for both: 45–50 minutes. Conclusion: TEG-R is useful to diagnose Coumadin-induced coagulopathy in trauma. However, INR had better sensitivity and specificity and identified more coagulopathic patients. Since INR is universally available and less costly, adding TEG to identify Coumadin-induced coagulopathy is not justified by our findings.

Coagulopathy: a predeath event in traumatic brain injury. M. Al Mahroos, V. Speers, A. Capone Neto, L. Tremblay, H. Tien, S. Scarpenini, S.B. Rizoli. From the *Department of Surgery and Critical Care Medicine, Sunnybrook Health Sciences Centre, Toronto, Ont., and the 1Department of Cirurgia, Faculdade de Medicina de Ribeirão Preto, São Paulo, Brazil

Introduction: Traumatic brain injury (TBI) and bleeding are the leading causes of death following trauma. It is widely accepted that coagulopathy is common in TBI, caused by the release of tissue factor leading to systemic consumptive coagulopathy. We hypothesize that TBI is not associated with higher incidence of early coagulopathy; however, when present, TBI-associated consumptive coagulopathy is a predeath event. Methods: We performed a retrospective chart review (January 2001 to December 2008) of all patients admitted to Sunnybrook within 6 hours of injury with severe isolated TBI (Abbreviated Injury Scale [AIS] head score ≥ 3 and nonhead < 2) or severe non-TBI trauma (AIS head < 2 and nonhead ≥ 3). Coagulopathy was defined as international normalized ratio (INR) greater than 1.3, activated partial thromboplastin time (aPTT) greater than 40 or a platelet count less than 150 × 10⁹/L; consumptive coagulopathy was deteriorating coagulation tests with INR prolonging greater than 1.3 and platelets dropping below 150 × 10⁹/L. Univariate analysis and logistic regression modelling included clinically relevant variables and statistically associated (p < 0.2) variables; p < 0.05 was considered significant. Results: A total of 1696 patients met the inclusion criteria: 641 severe isolated TBI, 1055 severe non-TBI. Fewer TBI patients had coagulopathy on admission than non-TBI patients (6.6% vs. 10%, p < 0.0159). Analyzing isolated severe TBI patients, those who died within 24 hours were significantly more coagulopathic than survivors. Consumptive coagulopathy was strongly associated with death (OR 75, 95%CI 10–566). In multivariate analysis, age, Glasgow Coma Scale score, ISS and abnormal INR, aPTT and platelet counts were independent
ASSOCIATION CANADIENNE DE TRAUMATOLOGIE

predictors of death among TBI patients. **Conclusion:** Patients with severe TBI do not have a higher incidence of coagulopathy compared with non-TBI patients. Coagulopathy is an independent predictor of death in severe TBI, in which TBI-associated consumptive coagulopathy is almost always a predeath event.

When minutes count: regional variations in transfer times of severely injured patients. **D. Gomez,** *B. Haas,* †B. Zagorski,‡ J. Ray,§ G. Rubenfeld, A.B. Nathens. *From the *Department of Surgery, St. Michael’s Hospital and University of Toronto, the †Institute for Clinical Evaluative Sciences, the ‡Department of Medicine, St. Michael’s Hospital and University of Toronto, and the §Department of Medicine, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ont.

**Background:** As a result of geographic isolation and the predominantly urban distribution of trauma centres (TC), not all injured patients can be transported directly from the scene to a TC. These patients receive initial care at nontrauma centres (NTC) and subsequently undergo transfer to a TC. Significant transfer delays exist, with a mean time at NTCs of 3 hours. We sought to evaluate whether there is regional variation in transfer times of injured patients. **Methods:** A population-based data set was used to identify severely injured adults (ISS > 15), who were transferred from an NTC to a TC in Ontario (2002–2007). Emergency department length of stay at an NTC (ED-LOS) was calculated and aggregated at the census division level. Census division population density was used as a measure of rurality. **Results:** There were 3476 patients transferred from 160 NTCs to 9 TCs across 48 census divisions. The median ED-LOS was 3.1 hours. There was significant variation across census divisions, with a range of median ED-LOS from 1.6 to 5.6. Spatial representation of the 90th percentile of ED-LOS identifies areas with significant challenges: the far north, both eastern and western borders and selected metropolitan areas (see Figure). There was a strong relation between rurality and ED-LOS, with the longest LOS in the most urban census divisions. **Conclusion:** Considerable delays before transfer were identified. Moreover, we identified significant disparities: ED-LOS at NTCs in the most urban census divisions was significantly longer than in the most rural census divisions. Availability of ED resources may be driving prolonged ED-LOS at urban census divisions.

Falls from height: injury characteristics and health care costs. **M.A.M. Tuma,** *A.I. Al-Hassani,* †J. Acerra,‡ S. Khoschnau,* J. Recicar,* M. Sebastian,* K.I. Maull.* From the *Section of Trauma Surgery, Department of Surgery, Hamad General Hospital, Doha, Qatar, and the †Department of Emergency Medicine, University of Pittsburgh Medical Center, Pittsburgh, Pa.

**Background:** Falls from height account for 16% of injured patients and are second only to motor vehicle crashes as a cause of trauma deaths. In an effort to reduce this preventable injury, a study was designed to quantify both clinical characteristics and actual costs to the health care system. **Methods:** During a recent 12-month period, all construction workers (n = 281) falling more than 3 m and requiring hospital admission were included. Seventeen died at the scene. Demographics, nationality, injuries by location and ISS, length of stay in intensive care and in hospital, resource use and costs were recorded. Actual costs were obtained using established methods. **Results:** All patients were male and almost exclusively expatriate workers (97%). Average age was 33 years. The most common injury was to the spine, followed by the head and chest. Spine injuries were more commonly accompanied by permanent neurologic loss (7% v. 1% other causes). Mean ISS was 13. There were 12 additional in-hospital deaths (mortality 10%). Total acute care costs are cited in the Table.

**Table. Total acute care costs of falls from height**

| Service                        | Cost, US$1000s* |
|--------------------------------|-----------------|
| Prehospital                    | 123             |
| Resuscitation room             | 82              |
| Radiology and imaging          | 106             |
| Operating room                 | 130             |
| Intensive care unit            | 496             |
| In-hospital                    | 3040            |
| Rehabilitation services        | 434             |
| Mean cost per patient          | 15 697          |
| **Total cost, US$**            | **4 410 000**   |

*Unless otherwise indicated.
Conclusion: Falls from height at construction sites cause serious injury and place a significant burden on the health care system. Spinal injuries place the patient at risk for lasting neurologic impairment. Coordinated injury prevention efforts directed at reducing the risk of falls from building sites are warranted to reduce these preventable injuries.

Undertriage of major trauma: a population-based analysis. B. Haas, D. Gomez, B. Zagorski, T. A. Stukel, G.D. Rubenfeld, A.B. Nathens. From the Departments of Surgery, Health Policy, Management and Evaluation and Medicine, University of Toronto, and the Institute for Clinical Evaluative Sciences, Toronto, Ont.

Background: Undertriage of severely injured patients to non-trauma centres (NTC) leads to the potential for delays to definitive care, with estimates of excess mortality in the range of 40%. Accurate estimates of rates of undertriage are an essential component of ongoing quality assurance within a trauma system. In this study, we produced population-based estimates of undertriage in Ontario's trauma system. Methods: We performed a retrospective cohort study of severely injured adults presenting to an emergency department (ED) in Ontario (2002–2007). Severe injury was defined as ISS greater than 15 or death within 24 hours of presentation. Patient and injury characteristics, undertriage to NTC and subsequent transfer to a trauma centre were recorded. Results: There were 19,541 patients who met the inclusion criteria, 3,125 (16%) of whom died within 30 days of injury. Over half (56%) of the severely injured patients were initially undertriaged to NTC. Undertriaged patients were likely to be older, female, to have blunt injuries and to have a lower ISS. Seventy-one percent of undertriaged patients were never transferred to the NTC; 448 (4%) of undertriaged patients died in the ED of the NTC. Overall, 48% of deaths in the study period occurred at the NTC. Conclusion: Undertriage rates in Ontario's trauma system are significant. Factors that contribute to the high rates of primary and secondary undertriage in Ontario's trauma system must be identified to improve access to trauma centre care.

Innovative assessment of injury burden in remote settings where there is no trauma registry. M. Aboutanos, F. Mora, L. Wolfe, M. Duong, R. Ivatury. From the Division of Surgery, Faculty of Medicine, Virginia Commonwealth University Medical Center, Richmond, Va.

Background: To evaluate the usefulness of local aerial transport data to assess the burden of trauma and its appropriate management in remote settings where there is no formal injury surveillance system or trauma registry. Methods: Aerial data were analyzed from 2 humanitarian flight companies servicing a remote region in the Amazon jungles of Ecuador (population of 11,000 inhabitants). The incidence of traumatic injuries warranting aerial transfer to traumatic centres, patient demographics, diagnosis, appropriateness and timeliness of transfer were assessed. Results: Between January 2003 and December 2005, 12,510 fixed-wing flights were carried out in the region. There were 5,716 aeromedical transfers. The average patient age was 20. The male to female ratio was 2:1. Trauma was the third highest reason for aeromedical transfer (1,176 patients, 20%), after infection (1,541, 23%) and respiratory disease (1,229, 21%). Snake bites (356 cases, 30%) were the main reason for transfer of traumatic injuries. Other causes included fractures, burns and multiple injuries. In total, 50% and 26% of patients were under the age of 20 and 10, respectively. Flight time ranged between 36 minutes and 6 hours and differed by mechanism and site of injury, with head and neck, trunk, upper extremities and lower extremities averaging 101, 111, 72 and 68 minutes, respectively. Less than 50% of transfers were appropriate. Conclusion: In remote settings where there is no effective injury surveillance system, innovative means to assess the burden of injury and promote basic health initiatives are feasible and may serve as the sentinel step for improved injury surveillance in remote areas.

Hypertonic resuscitation of traumatic brain injury attenuates cellular and molecular inflammatory and coagulation responses: a randomized controlled trial. J. Ng, N. T. Crnko, A. J. Baker, L. J. Morrison, S. B. Rizoli. From the Department of Surgery and Critical Care Medicine, Sunnybrook Health Sciences Centre, the Department of Critical Care and the Keenan Research Centre, Li Ka Shing Knowledge Institute, St. Michael's Hospital, University of Toronto, Toronto, Ont.

Background: Traumatic brain injury (TBI) triggers widespread activation of leukocyte and endothelial cell-adhesion molecules and release of inflammatory mediators. Current TBI prehospital resuscitation focuses on optimizing cerebral perfusion and reducing secondary neuroinsults. Research suggests that hypertonic saline (HS), an effective osmotherapeutic agent in the management of intracranial hypertension, may confer neuroprotection through its immunomodulatory properties. We investigated the impact of prehospital HS on cellular and soluble inflammatory markers in severe isolated TBI. Methods: A prospective randomized controlled trial of 65 adult patients with severe isolated TBI (Glasgow Coma Scale score ≤ 8), receiving prehospital 250 mL of 7.5% NaCl in 6% dextran 70 (hyper-tonic saline–dextran [HSD]) or normal saline (0.9% NaCl). Blood samples were drawn at 0, 12, 24 and 48 hours following fluid administration. Flow cytometry was used to analyze leukocyte cell surface adhesion (CD62L, CD11b) and degranulation molecules (CD63, CD66b). Enzyme-linked immunosorbent assays compared soluble L- and E-selectins, vascular and intercellular adhesion molecules (sVCAM-1, sICAM-1) and pro/anti-inflammatory cytokines (TNF-α, IL-10). Twenty-five healthy participants were controls. Neurological outcome was evaluated using the Glasgow Outcome Score (GOS). Results: Patients treated with normal saline had a 2-fold higher surface expression of CD62L, CD11b and CD66b on both neutrophils and monocytes up to 48 hours. HSD blunted activation of adhesion molecules, degranulation, TNF-α and IL-10 levels at all time points, approaching control values. sVCAM-1, sICAM-1 and sE-selectin were reduced, whereas sL-selectin, initially lower, exhibited a delayed rise with HSD. HSD-reduced molecular marker expression was associated with better outcome (GOS). Conclusion: This study suggests prehospital HS resuscitation of patients with severe isolated TBI has a potent anti-inflammatory effect and may confer neurologic protection.

Penetrating trauma in Nova Scotia: a 5-year review. A. Beckett, S. Minor, R. Green, J. Tallon. From the Department of
ASSOCIATION CANADIENNE DE TRAUMATOLOGIE

Surgery and the Division of Emergency Medicine, Faculty of Medicine, Dalhousie University, Halifax, NS

Background: Firearm injury in Canada has been called the “new public health issue.” In 1990, firearm-related deaths in young adults aged 15–24 years were the third leading cause of death in Canada. The epidemiology and demographics of penetrating trauma in Nova Scotia has not been studied. Methods: Data were obtained by retrospective database review using the Nova Scotia Trauma Registry (NSTR) to identify all adults over age 16 who sustained penetrating trauma (ISS > 9) from Apr. 1, 2001, to Mar. 31, 2007. Demographic variables, temporal variables, injury characteristics, anatomical location of injury and type of weapon, initial vital signs, ISS, length of stay (LOS), number of days in the intensive care unit (ICU) and discharge status were evaluated. Volume, type of resuscitation fluid, type of imaging done and time to operating room were examined. Results: In total, 350 penetrating trauma patients were reviewed; there were 176 deaths at the scene, 15 deaths in the emergency department (ED), 3 deaths in the operating room, 5 deaths in ICU and 1 on the ward. Predictors of prehospital mortality were age (OR 1.035, CI 1.016–1.054), rural location (OR 5.255, CI 2.645–10.444), gunshot wound (OR 14.837, CI 7.169–30.704) and intentionality (OR 37.819, CI 4.202–340.412). Predictors of inhospital mortality were age (p = 0.0226), gunshot wound (p = 0.0005), systolic blood pressure less than 100 (p = 0.0008), ISS (p = 0.0001) and blood products given in the ED (p = 0.0001). Conclusion: Penetrating trauma is major cause of mortality and morbidity in Nova Scotia, especially in rural areas. Predictors of prehospital mortality are age, rural location, gunshot wound and intentionality. Predictors of inhospital mortality are age, initial systolic blood pressure, ISS and blood products given in the ED.

Alcohol levels in pediatric trauma patients: a retrospective study. J. Mckee, H. Austin, S. Widder, I. Bratu. From *Trauma Services and the *Department of Surgery, University of Alberta Hospital, Edmonton, Alta.

Background: In Canada, $1.3 billion in health care costs are associated with alcohol use each year, and 27% of patients admitted for alcohol-related injuries are between the ages of 10 and 24 years. Sixty-two percent of trauma deaths involving alcohol are related to motor vehicle collisions, and 30% of these involve minors. Sixty-two percent of 7–12th graders report drinking, 23% binge monthly, 16% drink weekly and 16% drink to hazardous levels. Global screening and brief intervention can decrease injury and alcohol recidivism in pediatric trauma.

Methods: Information was retrieved from the Alberta Trauma Registry on all pediatric (age 10–17 yr) major trauma (ISS ≥ 12) patients admitted to an Alberta trauma centre from January 2000 to December 2008. Data were analyzed to determine alcohol-level screening rate, prevalence of alcohol use in those screened, mechanism of injury and outcomes following trauma in Alberta.

Results: Of the 1672 patients who met the inclusion criteria, only 607 (36.3%) were screened for alcohol. Of those tested, 27.3% (n = 166) tested positive for alcohol use, with 70% (n = 116) being over the legal limit and 3% (n = 5) at lethal levels. There was no difference in age, sex, ISS or length of stay (LOS) between those who tested positive or negative for alcohol consumption. Of those tested, the median age was 16 years, median ISS was 25 and median LOS was 7 days. Conclusion: The known risks associated with alcohol consumption such as violence, suicide and alcohol issues continuing into adulthood should be an impetus for standardized alcohol screening for pediatric trauma. Global screening and immediate focused education may decrease injury and alcohol recidivism in pediatric trauma.

Early traumatic coagulopathy is associated with coagulation factor deficiency and may not be detected by prothrombin time measurement. J. Jansen,* S. Scarpelini,** H. Tien, J. Callum,* S. Rizoli. From the Department of *Critical Care Medicine, †Surgery and ‡Blood Bank and Transfusion Medicine, Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: Early traumatic coagulopathy, defined by prothrombin time (PT/international normalized ratio [INR]) greater than 1.4, is present in 25% of trauma patients and is associated with increased mortality. Recent studies suggest it is triggered by hypoperfusion and/or mediated by protein C, rather than coagulation-factor depletion. This study (1) examined changes in clotting factor activity, (2) determined the effects of critical deficiencies on transfusion requirements and mortality, and (3) compared the performance of PT/INR with coagulation factor activity.

Methods: We measured PT/INR and coagulation factors II, V, VII, VIII, IX, X, XI and XII activity in 151 trauma patients admitted to Sunnybrook within 2 hours of injury between February and October 2007. Differences in proportions were evaluated (χ² tests). Associations were analyzed using product moment correlation coefficients. Results: Factor activity correlated inversely with hypoperfusion (base deficit) but only weakly with injury severity. Stratification by adequacy of perfusion revealed significant differences for factors II, VII, IX, X, XI and XII, but not V or VIII. Reductions in factor activity below critical levels occurred in 27 patients (18%) and were associated with increased red blood cell (16.4 v. 5.7 units), frozen plasma (11.8 v. 5.4 units) and platelet (20.4 v. 9.3 pools) transfusions and mortality (26% v. 7%, p = 0.04). The sensitivity of INR greater than 1.4 in detecting factor deficiency was only 37%. Conclusion: Most trauma patients have normal coagulation factors after trauma. Deficiencies relate to degree of hypoperfusion rather than injury severity, increased transfusion requirements and mortality. PT/INR is not sensitive in measuring clinically significant factor deficiency. Previous studies may have underestimated the prevalence of early traumatic coagulopathy.

Preliminary data from a new trauma registry in Colombia. C.A. Clarkson,* A.M. Rubiano.† From the *Department of Surgery, Memorial University of Newfoundland, St. John’s, NL, and the †Departments of Surgery and Critical Care, Neiva City University Hospital, Neiva, Huila, Colombia

Background: The global burden of trauma is high, and injuries are expected to continue increasing within low- and middle-income countries. Trauma registries are one tool used to help design injury-prevention strategies. At present there is no organized system of hospital-based trauma registries in Colombia. Methods: Preliminary data are presented from a newly implemented trauma registry in Colombia. Results: Data are provided on 2220 trauma patients. Average age was 30 years. Men accounted for 76% of trauma patients. Eighty-three percent of
Missed injury in trauma patients: the utility of the tertiary survey in Alberta. K. Haugrud,* J. McKee,† K. Fathimani,* S. Widder.* From the *Department of Surgery and †Trauma Services, University of Alberta Hospital Edmonton, Alta.

Background: Technological and medical advancements have enhanced the care and survival of trauma patients. However, missed injuries still occur, increasing the morbidity and mortality from trauma. The tertiary survey examination that is performed within 24–48 hours of admission in an awake, alert patient includes a head-to-toe physical examination, a review of laboratory work and radiology. As per the new Advanced Trauma Life Support guidelines, the tertiary survey should be used as “standard of care” in trauma. However, it has not yet been implemented in all major Canadian trauma centres. The purpose of this study was to determine the frequency and type of injuries that are missed on initial evaluation but are later picked up by the tertiary survey. Methods: A retrospective chart review was performed for all major trauma adult patients who presented to the University of Alberta Hospital in Edmonton in 2009. The study compares the summary of injuries initially documented at the time of admission to those recorded on the tertiary survey assessment form. Results: Data collection and analysis are currently underway. Preliminary results show a 30% rate of missed injuries, several of which are clinically significant, including a brachial plexus injury, aortic arch injury and cervical spine fractures. Conclusion: Given the rate of missed injuries detected by the tertiary survey, the tertiary survey is important in preventing unnecessary morbidity to the trauma patient. Our data suggest that the tertiary survey be used at all major trauma centres, including Canadian sites.

Does screw orientation play a role in fracture fixation? A sawbone study using a transverse patella fracture model. M. Boitano,‡ D. Sherman,‡ C. Bir,‡ F. Baillie.* From the Departments of Surgery, *McMaster University, Hamilton, Ont., and ‡Wayne State University, and the ‡Department of Biomedical Engineering, Faculty of Engineering, Wayne University, Detroit, Mich.

Background: The most common and challenging fracture of the patella for fixation is the transverse fracture. Recently, momentum is shifting from the traditional modified tension band technique using parallel K wires to parallel screw fixation using cannulated cancellous screws with a tension band construct (wire or suture). It is theorized that the orientation of the screws could directly affect the failure rate of the fixation technique. The objective of this study was to compare the traditional 0° parallel screw orientation to a 180° screw orientation. Methods: The 4.5-mm cannulated cancellous screw was selected for testing from 3 manufacturers demonstrating 3 different designs. Homogenous polycarbonate foam with a density compatible with the cancellous bone of the patella was cut into blocks, and a transverse fracture was created. The blocks were tested in tension and 3-point bending. Results: The TriMed screw had the highest load to failure with a mean tensile load of 1465 (SD 139) N at 0° and 1435 (SD 155) N at 180°. Regarding 3-point bending, the Acutak screw had the highest mean compressive load for crack initiation of 670 (SD 139) N at 0° and 715 (SD 157) N at 180° (see Table).

Conclusion: The data reflect screw design, as screw fixation depends on the purchase of threads in the cancellous bone of the patella.

Evaluating the impact of AIS 2005 on the population of the Ontario Trauma Registry comprehensive dataset. M. Brennan-Barnes,* A. Nathens,* A. Moses McKeag,‡ S. Chandra.* From the *Division of Trauma, Children’s Hospital of Eastern Ontario, Ottawa, the ‡Division of General Surgery, St. Michael’s Hospital, and the ‡Department of Trauma, Canadian Institute for Health Information, Toronto, Ont.

Background: Since its inception, the Ontario Trauma Registry (OTR) has been using the Abbreviated Injury Scale (AIS) 1990 to code injury severity. The AIS 2005 is the most recent version. The purpose of this study was to evaluate the impact of the AIS 2005 on the population of the OTR Comprehensive Data Set (CDS). Inclusion into the OTR requires an Injury Severity Score (ISS) 13 or greater. Methods: Trauma records were coded using AIS 2005 and 1990 at 11 Ontario trauma centres by trained coders using coding software by Digital Innovations Inc. A staggered implementation of the dual coding occurred beginning in April 2008. Data between April 2008 and June 2009 were analyzed. Results: Sixty-two percent (2713) of the 4366 records were coded in both AIS 2005 and AIS 1990; 29% had an equal ISS in both systems. The concordance of cases with an ISS of 13 or greater in AIS 1990 and 2005 was 85% (417 cases with AIS 1990 ≥ 13 had AIS 2005 < 13). Cases with an AIS 2005 of 13 or greater were more likely to require a special care unit stay (p = 0.0003), have a longer hospital stay (p = 0.00959) and a higher mean ISS score (p < 0.0001) than those in the group with an AIS 1990 of 13 or greater. Conclusion: The AIS 2005 appears to more accurately reflect the severity of the injured patient. The adoption of the AIS 2005 coding in the OTR CDS will exclude 15% of trauma patients presently included in the registry. Decreasing or eliminating the ISS value as criteria for inclusion in the OTR CDS should be considered.

Medicine versus surgeons/anesthesia intensivists: a comparison of outcome in trauma patients admitted to a mixed...
medical–surgical–trauma intensive care unit. J. Lee, S. Iqbal, A. Gursahanye, T. Nouch, T. Razek, K. Khwaja. From the Department of Surgery and Critical Care Medicine, Montreal General Hospital, McGill University, Montréal, Que.

Background: In a tertiary-level intensive care unit (ICU), it is common to have intensivists with core training in internal medicine, surgery or anesthesia. In a mixed medical–surgical–trauma ICU at the Montreal General Hospital, trauma patients are cared for by intensivists with different core background training, all with critical care fellowships. We hypothesized that there should be no difference in patient mortality with respect to the core training of the intensivist. Methods: Using an electronic database, we conducted a retrospective study of all trauma patients admitted during a 1-year period to a 22-bed mixed ICU. Patients were assigned to 1 of 2 treatment groups based on the treating intensivist’s training background, group A being internal medicine and group B being surgery/anesthesia. Allocation was conducted in 2 ways: intensivist treating the patient over 50% of the ICU length of stay (LOS) and over 50% of the first 72 hours in ICU. Results: In total, 395 trauma patients were admitted from Jan. 1 to Dec. 31, 2007, with 34 deaths. We found no significant difference in mortality between groups when allocating patients to group based on the treating intensivist’s background over 50% of LOS (HR 1.59, 95% CI 0.73–3.49, p = 0.2469) or over 50% of the first 72 hours in ICU (HR 1.39, 95% CI 0.66–2.94, p = 0.3861). Conclusion: In a large university trauma centre that operates a mixed medicine–surgical–trauma intensive care unit, there was no significant difference in mortality rates for trauma patients managed by either intensivists with core training backgrounds in internal medicine or in surgery/anesthesia.

Complete reversal of anuric renal failure after operative evacuation of extraperitoneal hematoma induced abdominal compartment syndrome. P.B. McBeth,* A.W. Kirkpatrick."t From the *Department of Surgery and the †Department of Critical Care Medicine and Regional Trauma Program, Foothills Medical Centre, University of Calgary, Calgary, Alta.

Background: With the growing use of anticoagulation therapies, spontaneous hematoma formation within the extraperitoneal abdominal spaces are increasingly being recognized from the entities of both retroperitoneal and rectus sheath bleeding. Overt abdominal compartment syndrome (ACS) is a rare but devastating complication of extraperitoneal compression of the intra-abdominal space in such cases as retroperitoneal hematoma (RH) or rectus sheath hematoma (RSH). Classically, both RH and RSH are managed conservatively, with operative intervention discouraged. Methods: A retrospective review of 2 cases involving the operative evacuation of the extraperitoneal compression on the intra-abdominal space resulting in an ACS with overt renal failure are presented. A comprehensive review of the literature using PubMed was conducted. Results: Despite the rarity of recognized ACS from extraperitoneal hematoma, limited precedents exist to support both operative intervention after correction of the coagulopathy. Two cases of extraperitoneal hematoma–induced ACS responded dramatically and completely to operative decompression and evacuation of the extraperitoneal space. Both patients were anuric, requiring renal replacement therapy preoperatively, but had complete reversal of renal function postoperatively, as well as significantly improved pulmonary functions (see Figure). Conclusion: Abdominal compartment syndrome is a rare but completely reversible complication of both RH and RSH. Organ failure such as anuria should not be accepted as inevitable, however. Patients with large RH or RSH should have intra-abdominal pressure monitoring and aggressive operative drainage after correction of the coagulopathy.

All-terrain vehicle injuries in Alberta. J.S. Pelletier,† J. McKee,‡ D. Paton-Gay,‡ S. Widder.* From the *Department of Surgery and †Trauma Services, University of Alberta Hospital, Edmonton, Alta.

Background: The growing popularity of all-terrain vehicles (ATVs) is a serious risk to our society. It has been argued that because of their inherent instability, increasing speed and power and complexity of operation, ATVs are more difficult to operate than automobiles. In spite of this and the numerous papers published advocating further legislation, there is a lack of regulations regarding their use. Methods: The objective of this research project was to study the frequency, severity and nature of injuries sustained on ATVs in Alberta. Secondary objectives include correlation between helmet use and injury pattern/severity, and injury, mortality and helmet use in the pediatric population. Results: In total, 435 patients met our inclusion criteria: 81.6% were male (average age 33.2 yr, average ISS 22.8). Overall mortality was 4.6%, and 54.6% of the patients were not wearing
helmet use was also associated with a lower risk of intubation (15.9% v. 26.0%) and injury to the head and/or c-spine (45.5% v. 72.1%). The pediatric population accounted for 18.9% of all patients as well as 15% of the deaths in this study. Conclusion: Use of ATVs in Alberta carries a significant risk of injury and of mortality. Most of the deaths were associated with a lack of helmet use. We propose making helmet use mandatory during the use of an ATV as well as increasing the minimum age of use to at least 16 years of age.

**Ten years of all-terrain vehicle injury, mortality, and healthcare costs in Alberta. E.M. Krauss, R. Buckley, D.M. Dyer, K. Laupland.** From the *Faculty of Medicine, University of Calgary, the †Division of Orthopedics and ‡Critical Care Medicine, Foothills Medical Centre, and the §Rockyview Hospital, Calgary, Alta.

**Background:** All-terrain vehicles (ATVs) have increased in popularity in Canada over the past 10 years. The province of Alberta accounts for 25% of all ATV sales in the country. The popularity of ATVs is accompanied by a pattern of significant injury and mortality. This study describes a decade of ATV injury and mortality in the province of Alberta. Methods: Data were obtained from the Alberta Trauma Registry and the Office of the Chief Medical Examiner of Alberta. Individuals aged 18 years and older who suffered injuries with an injury severity score (ISS) 12 and over or died in ATV incidents in Alberta between Apr. 1, 1998, and Mar. 31, 2008, were included in the analysis. Descriptive statistics included individual, injury and incident demographics. Costs were extrapolated from figures for the Foothills Medical Centre, Calgary, a subset of the total population. Results: ATV trauma primarily affects males aged 18–55. Twelve percent of patients wore helmets, and 23% were intoxicated at the time of injury. Incidents commonly occurred on weekends during summer months. Alcohol use, riding without helmets and travel on unfamiliar terrain were common factors in fatal ATV incidents. Injuries or cause of death were primarily head, c-spine and thoracic injuries. The estimated 10-year cost of ATV injury exceeded Can$5 million. Conclusion: ATV trauma is a disease of young people. Despite recent publicity on the dangers of ATVs, people continue to ride without protective equipment and under the influence of alcohol. ATV injury and mortality represent significant and preventable health care costs and years of life lost.

**Does the presence of a dedicated trauma surgeon as trauma team leader influence the time to CT scan for serious head injuries? A. Rados, K. Stevenson, K. Musselwhite, C. Vis, D. Zygun, V.A. Ciura, B. Matiakis, A.W. Kirkpatrick.** From the *Regional Trauma Program and Departments of †Surgery, ‡Critical Care Medicine and §Radiology, Foothills Medical Centre, University of Calgary, Calgary, Alta.

**Background:** Serious head injuries constitute the leading cause of posttraumatic mortality. Practically, the major interventions required to treat serious head injuries require expedited transfer for computed tomography (CT) scanning after ruling out other immediately life-threatening conditions. At our centre, trauma responses vary depending on either full activation (FA) with trauma attendings or a nonsurgical response (NSR). With continuing human resource restrictions, we sought to clarify whether FAs expedited the time to CT head (TTCTH).

**Methods:** Chart review augmented demographics of 88 serious head injuries identified from a regional trauma database. Results: There were 58 FAs and 30 NSRs; 91% of FAs and 17% of NSR were intubated before hospital admission. Although FAs were more seriously injured (mean ISS 32), NSRs were still severely injured (mean ISS 25, Abbreviated Injury Scale [AIS] head score 20) and older (median 54 v. 26 yr). Median TTCTH was double without dedicated FA (median 26 v. 33 minutes, p < 0.001), despite similar justifiable delays (48% FA, 53% NSR). Without FA, most delays (69%) were for emergency room intubation after which TTCTH was longer (median 33 v. 16 min). After definitive airway control, TTCTH were 25 versus 33 minutes for FA. With FA, delays were for chest tubes (32%), intubation (21%) and administration of blood products or pressors (7%). Conclusion: Full trauma activations involving attending surgeons were quicker at transferring serious head injuries to CT. Patients with FA were younger and more seriously injured. Discerning the reasons for delays to CT should be used to refine protocols aimed at minimizing unnecessary delays and maximizing workforce efficiency.

**A tertiary hospital alcohol screening/intervention program: preliminary results. R. Saybel, J. Mckee, G. Hickey, K. Kostiuk, I. Brown, M. Stephens.** From the Department of Surgery, Faculty of Medicine, University of Alberta, Edmonton, Alta.

**Background:** Our tertiary hospital commenced an alcohol screening/intervention program in 2008. Severely injured patients were to have alcohol (ETOH) levels measured on admission. All patients were asked to participate in a screening process. The AUDIT tool, created by the World Health Organization, was used as a screening tool for alcohol abuse/addiction. Based on AUDIT scores, patients were informed of their alcohol risk and provided with an interventional pamphlet. Methods: Over 9 months, 1032 patients were screened; 376 surveys were completed (36%). Patients were not captured for the following reasons:

---

**Table 1. AUDIT completed**

| Characteristic | ETOH positive (n = 95) | ETOH negative (n = 162) | p value |
|---------------|-----------------------|------------------------|---------|
| Age, mean yr  | 35.2                  | 39.4                   | 0.02    |
| ISS           | 21.3 (66/98)          | 20.9 (78/162)          | NS      |
| Male          | 86 (89)               | 127 (78)               | 0.02    |
| ETOH level, mean | 37.9               | 0                      |         |
| AUDIT score, mean | 16                  | 5.9                    | < 0.001 |

ETOH = alcohol; NS = not significant.

**Table 2. AUDIT score**

| Level of risk | No. (E) | ETOH drawn | ETOH positive | Mean ETOH |
|---------------|---------|------------|---------------|-----------|
| Severe risk (20–40) | 46    | 36 (78)    | 28 (78)       | 44        |
| High risk (16–29)    | 28    | 19 (68)    | 14 (74)       | 43        |
| At risk (8–15)      | 105   | 72 (69)    | 38 (65)       | 37        |
| Low risk (1–7)      | 150   | 103 (69)   | 14 (114)      | 24.2      |
| No risk (0)        | 47    | 27 (57)    | 0             | 0         |

ETOH = alcohol.
Research challenges, this study investigates weekday versus weekend periods of the day: daytime (08:00–15:59), evenings (16:00–23:59), and nights (24:00–7:59).

Conclusion: Trauma systems and prevention programs must consider population shifts, particularly for injuries that are rapidly fatal, as most severe traumas occur close to home.

Outcomes of elderly trauma patients admitted to the intensive care unit. K.N. Vogt,* M. Swart,* T. Charyk Stewart,*† M. Girotti,*† D. Gray,*† N. Parry.*†‡ From the *Department of Surgery, Schulich School of Medicine and Dentistry, University of Western Ontario, the †Trauma Program, London Health Sciences Centre, and the ‡Division of Critical Care and Department of Paediatrics, Schulich School of Medicine and Dentistry, University of Western Ontario, London, Ont.

Background: To determine the mortality in elderly trauma patients admitted to the intensive care unit (ICU) and explore factors associated with mortality. Particular attention was paid to the relation between preinjury anticoagulation and mortality.

Methods: A retrospective cohort of all elderly (age ≥70) trauma patients admitted to the ICU from 1997 to 2008 was identified. Data were obtained from the London Health Sciences Trauma database. Therapeutic international normalized ratio (INR) levels on admission (INR ≥2.0) were used to identify preinjury therapeutic warfarin use.

Results: Of the 906 elderly patients admitted after trauma, 248 were admitted directly to the ICU. Patients had a mean age of 79 years (SD 5.6) and a mean ISS of 26 (SD 11.2). Overall mortality was 50% (124 patients), with a mean time to death of 8 days. Univariate analysis identified increased mortality among patients with therapeutic INR (49% v. 69%, p = 0.04). Logistic regression identified the following factors associated with mortality: age (OR 1.08, 95% CI 1.02–1.14), ISS (OR 1.06, 95% CI 1.03–1.09), INR (OR 5.13, 95% CI 3.86–6.40) and need for operative intervention (OR 2.37, 95% CI 1.72–3.02). Among patients who survived, only 27 (10.9%) were discharged home.

Conclusion: In contrast to the overall elderly population, elderly patients requiring admission to the ICU after trauma have high mortality and morbidity rates, with very few patients returning home. This study highlights the importance of therapeutic anticoagulation as a predictor of mortality. With the rising proportion of elderly patients, strategies will be required to manage the burden of injury in this population.
Determinants of inferior vena cava filter insertion in trauma: retrospective cohort study. J. Yan,†,‡ A. Karamaoun,†,‡ E. Villeneuve,‡ T. Razek,‡ M.M. Perreault.† From the *Department of Pharmacy Services, McGill University Health Centre (MUHC), the tFaculté de Pharmacie, Université de Montréal, and the tDepartment of Trauma, MUHC, Montréal, Que.

Background: The trauma population is at high risk of thromboembolism and bleeding. Availability of retrievable inferior vena cava (IVC) filter and lack of evidence-based guidelines leads to variable practice. This study aimed to describe such variability and investigate determinants of their insertion. Methods: Trauma patients admitted over 3.5 years who satisfied our inclusion criteria (age ≥ 18, ISS ≥ 15, head injury and/or spinal cord injury and/or pelvic fracture and/or multiple long bone injuries and/or thoracic injury) comprised 1595 patients. Patients with an IVC filter were selected (IVC group) and a comparative cohort was randomly selected (2:1 ratio of controls:IVC). Data collected underwent univariate analysis followed by multivariate logistic regression to determine predictors of filter insertion. Results: Demographics of the IVC group (n = 103) and control group (n = 192) were compared. The IVC group was significantly younger (42.8 yr), had a greater number of injuries, greater maximum Abbreviated Injury Scale (AIS) score of 5 and over (60.2%), more shock on admission (8.7%), required intensive care unit (ICU) admission (98.1%), intubation (88.4%) and 4 or more transfusions of packed red blood cells (27.2%) over the first day more frequently than controls. Nine variables from univariate analysis were selected for identifying determinants of filter insertion. Multivariate regression analysis revealed that the number of injuries, maximum AIS score, type of injury with maximal AIS score, number of transfusions over 3 in the first day, admission to ICU and need for intubation were such determinants. Conclusion: The number and severity of injuries, the need for transfusions, intubation and ICU admission were significantly associated with filter placement.

Hypertonic resuscitation reduces catecholamine and troponin release after severe traumatic brain injury. A.N. Capone,*, S.G. Rhind,† A.J. Baker,‡ P.N. Shek,§ L.J. Morrison,§ S.B. Rizoli. From the *Sunnybrook Health Sciences Centre, †Defence and Development Canada, the ‡Brain Injury Laboratory, Cara Phelan Centre for Trauma Research Keenan Research Centre, the tRESCU, Keenan Research Centre, Li Ka Shing Knowledge Institute, St. Michael’s Hospital, University of Toronto, Vancouver, Ont.

Background: Severe traumatic brain injury (TBI) elicits profound sympathetic nervous system activation with enhanced release of catecholamines, which can impact upon cardiovascular and inflammatory responses and patient outcome. Hypertonic fluids improve cerebral hemodynamics and may blunt catecholamine release following TBI. We examined the effects of prehospital resuscitation with hypertonic saline of severe TBI on catecholamine and cardiac troponin-T (cardiac TnT) release, within a larger prehospital randomized controlled trial. Methods: Sixty-five adult severe TBI patients were randomized to a 250-mL infusion of 7.5% hypertonic saline in dextran-70 (HSD) or normal saline (NS). Plasma epinephrine (E), norepinephrine (NE) and dopamine (DA) concentrations (pg/mL) were measured on admission, at 12 hours and at 24 hours. Cardiac TnT was also measured on admission. Twenty-five healthy volunteers served as controls. Results: On arrival, mean E (665.3, SD 188.2) and NE (671.6, SD 85.2) were significantly higher in all patients compared with controls. NS patients massively released E (1082.7, SD 291.3, up to 30 times more than controls) and NE (823.7, SD 124.8). HSD patients had slightly elevated E (195.8, SD 60.1) and NE (500.5, SD 85.9), which normalized by 12 hours. In NS-treated patients, catecholamines remained elevated. cardiac TnT concentrations significantly correlated (p = 0.0002) with the injury severity. Those who died had significantly higher concentrations of catecholamines and cardiac TnT than those who lived. The NS-resuscitated patients who died had the highest cardiac TnT concentrations, whereas the lowest concentrations were evident in surviving HSD patients. Conclusion: Our study confirms that catecholamine levels can be used as prognostic biomarkers in severe TBI and suggests that HSD may be a better resuscitation fluid for TBI, in part because of its significant attenuation of injury-induced catecholamine release. Funded by Defence R&D Canada.

Fragility fractures: an audit of posttraumatic osteoporosis management. S.S. Goonewardene, K. Mangat, I.D. Sargeant, K. Porter. From the University Hospital Birmingham NHS Foundation Trust, Birmingham, United Kingdom

Background: Fragility fractures are an increasingly common problem, especially in the elderly population, and may indicate underlying pathological processes (e.g., osteoporosis). It is estimated that 1.2 million women in the United Kingdom have osteoporosis. National Institute for Health and Clinical Excellence (NICE) guidelines recommend specific investigation and treatment options for the secondary prevention of osteoporotic fragility fractures. However, these guidelines, even though present, are not closely followed. We wished to investigate our compliance level with these recommendations and if necessary propose changes to increase compliance. Methods: We conducted a retrospective audit collecting data on patient demographics; prior osteoporosis history and treatment; investigations, diagnosis and treatment of osteoporosis during hospital admission, communication of information to general practitioners (GPs) and refraction rate to see whether we are complying with these guidelines. Results: We demonstrated that the majority of patients are admitted without a history of osteoporosis or treatment regardless of primary osteoporosis guidelines, yet we are not properly investigating or treating patients for secondary prevention of osteoporotic fractures or adequately informing GPs to do so, which can result in fractures occurring. Conclusion: We discuss these results and develop recommendations based on the results including changes to the patient information computer system that would increase medical professionals’ compliance with guidelines and reduce the risk of refraction, reducing strain on resources.

Hip fracture surgery: an audit of blood product use. S.S. Goonewardene, K. Mangat, I.D. Sargeant, K. Porter. From the University Hospital Birmingham, NHS Foundation Trust, Birmingham, United Kingdom

Background: Hip fragility fractures are common, with over 364 admitted over the past year to University Hospital Birmingham, NHS Foundation Trust. Different types of implants are use to
correct this injury (e.g., dynamic hip screws, hemiarthroplasties and AO screws). There are mixed guidelines available nationally for blood product order for these procedures, resulting in wastage of resources, delays to surgery and increased morbidity and mortality. We aimed to determine current practice of blood product ordering and usage in hip fracture surgery and to develop guidelines for preoperative blood product ordering according to type of hip implant used and preoperative hemoglobin.

Methods: A retrospective review of 84 cases was carried out after gaining audit registration within the trust. Information on demographics, surgical procedure, pre- and postoperative hematology, blood product ordering and usage was collected. Results: We demonstrated that the most common fixation method is with dynamic hip screws. Over-ordering of blood for both dynamic hip screws and hemiarthroplasties occurred (cross-match to transfusion ratio 1.74). These 2 types of hip replacement also had the highest rate of blood loss. The majority of patients in each category of hip implant were grouped and saved preoperatively with a large proportion requiring conversion to cross-matching. Conclusion: We discuss these results, comparing them to other studies and with the results available, develop new guidelines for blood product ordering based on preoperative hemoglobin and type of hip implant used, that can be used on a national basis.

Causes of death in Canadian Forces members deployed to Afghanistan. D. Pannell, † H. C. Tien. From the *2 Field Ambulance, Petawawa, the †Department of National Defence, Ottawa, and the ‡Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: In January 2006, the Canadian Forces (CF) initiated its combat operations in Kandahar, Afghanistan. We studied the causes of deaths sustained by the CF during a 28-month period. The purpose of this study was to identify potential areas for improving tactical combat casualty care (TCCC). Methods: We analyzed autopsy reports of Canadian soldiers killed in Afghanistan between January 2006 and April 2008. Demographic characteristics, ISS, location of death within the chain of evacuation and cause of death were determined. We also determined whether the death was potentially preventable using both explicit review and implicit review by a panel of trauma surgeons. Results: During the study period, 73 Canadian Forces members died as a result of service in Afghanistan. Their mean age was 29 (SD 7) years, and 98% were male. The predominant mechanism of injury causing death was blast injury, resulting in 81% of overall deaths during the study period. Gunshot wounds and non-improvised explosive device-related motor vehicle collisions were the second and third leading mechanisms of injury causing death. The mean ISS was 57 (SD 24) for the 63 autopsy reports analyzed. The most common cause of death was hemorrhage, followed closely by neurologic injury and then by blast injuries. Panel review identified several interventions that are not currently part of TCCC that may prevent future battlefield deaths. Conclusion: The majority of combat-related deaths occurred in the field. Comparatively few deaths were preventable with current TCCC interventions. We propose novel TCCC interventions to prevent deaths of soldiers engaged in Afghanistan.

Reducing response times to major trauma: Autolaunch of helicopter emergency medical services in British Columbia. S. Wheeler, † R. L’Heureux, ‡ K. Danielsson, ‡ N. Lhaka, ‡ R. Simons. From the *Department of Emergency Medicine, Vancouver Island Health Authority, the †BC Ambulance Service, Victoria, the ‡School of Population and Public Health, Simon Fraser University, Burnaby, the BC Trauma Registry and the ‡Department of Emergency Medicine, Vancouver Coastal Health, Vancouver, BC

Background: Autolaunch of helicopter emergency medical services (HEMS) before the arrival of ground ambulances based on information provided by 911 callers is an innovative way of reducing response times to major trauma. This study sought to determine the changes in response times to major traumas in southwestern British Columbia since the inception of the Autolaunch dispatch strategy in 2004. Methods: This is a retrospective trauma database review involving all adult (> 18) major trauma patients (ISS > 15) who were transported by BC HEMS within the Autolaunch response area during the study time periods. Two cohorts were compared: one from July 1, 2003, to June 15, 2006, when the traditional HEMS dispatch strategy was used, and one from June 15, 2006, to June 15, 2008, when Autolaunch came into effect. Data were obtained from the BC Trauma Registry and the BC Ambulance Service. The mean activation time and total response time was calculated for each cohort and then compared. The
TRAUMA ASSOCIATION OF CANADA

Student t test was used for significance testing. For all tests, statistical significance was set at p ≤ 0.05. **Results:** Mean response time from injury to definitive care using the Autolaunch method was 128 minutes (SD 79 min) versus 240 minutes using the traditional dispatch method (SD 157 min, p < 0.0001). The mean activation time using Autolaunch was 26 minutes (SD 46 min) versus 112 minutes (SD 109 min, p < 0.0001) using the traditional dispatch method. **Conclusion:** This study demonstrated significant reductions in response times to major trauma when Autolaunch was used.

Outcomes of homeless people who sustain injury in trauma. **E. Simoneau, S. Iqbal, T. Razek, K. Khwaja. From the Department of Trauma Surgery and Critical Care Medicine, McGill University Health Centre, Montréal, Que.**

**Background:** Patients with no fixed address who sustain injury can be a challenging population to manage, especially with respect to recidivism, disposition and follow-up. The objective of this study was to identify risk factors associated with this population in trauma and to determine clinical outcomes. **Methods:** A retrospective study of 63 homeless patients admitted with trauma from 2003 to 2008 was conducted using our trauma registry and chart review. Descriptive and logistic regression analysis was performed. **Results:** Alcohol abuse was present in 54.8% of patients and hepatitis C, intravenous drug use and HIV were found in 28.6%, 14.3% and 14.3%, respectively. The median Glasgow Coma Scale scores on arrival and ISS were 14 (range 3–15) and 14 (range 1–66). The most common mechanisms of injury were falls (38.1%), blunt assault (25.4%) and pedestrian versus car injuries (20.6%). Traumatic brain injury represented 53.9% of injuries. Trauma recidivism was present in 42.9% of patients. The median hospital stay was 8 days (1–254), median intensive care unit stay was 1 day (0–8), and the overall mortality was 3.2%. Factors associated with a prolonged length of stay (≥14 d) were pedestrians versus car injuries (OR 16.7, p = 0.0002), respiratory infections (OR 25, p = 0.0018) or having delirium (OR 12.5, p = 0.0103) as complications. A majority of patients (71.7%) was lost to follow-up. **Conclusion:** Homeless trauma patients make up an important and understudied population. They commonly present with falls, assault or pedestrian versus car injuries contributing to prolonged hospital stay. They are at high risk for trauma recidivism and being lost to follow-up. Strategies focused on the homeless population are needed to improve patient outcomes in this challenging group of trauma patients.

In-hospital triage of a mass casualty incident following a school shooting in a Canadian regional trauma system. **J. Spicer, T. Razek, P. Fata, B. Bernardin, A. Gursahaney, D. Mulder, K. Khwaja. From the Department of Surgery, McGill University Health Centre, Montréal, Que.**

**Background:** Mass casualty incidents (MCI) such as school shootings cause major stress on regional trauma systems. This study focuses on the in-hospital triage and trauma centre response following a MCI resulting from a school shooting in a large Canadian city. **Methods:** A retrospective review was conducted with McGill University Health Centre’s institutional review board approval. Clinical data were extracted. Interdisciplinary debriefings elucidated system successes and failures. **Results:** Eleven gunshot wound (GSW) victims arrived at the emergency department within 50 minutes of the shooting and were triaged using a physiologic- and anatomic-based colour classification (red, yellow, green, black). The mean Injury Severity Score was 12.5. An intervention (operation or angiography) was required in 7 of 11 patients. Mean time from admission to intervention was 103 minutes. Those triaged with highest priority had the shortest time to imaging and surgical intervention. Resources were available in a timely fashion with sufficient capacity to accommodate 5 more urgent cases to the operating room and 10 additional admissions to the intensive care unit. The telecommunication system failed because of 100% use for a 2-hour period after the event. All 11 patients are alive at 3 years of follow-up. **Conclusion:** A regionalized trauma system with a defined external disaster protocol contributes to successful outcomes. A robust telecommunication system with large capacity is essential for coordination of the trauma system response. In our hands, a novel triage system based on physiology and anatomic location of GSWs was effective to assign patients rapidly to appropriate care.

Hip fracture in the elderly: identifying vulnerable populations to target intervention. **D.A. Tanner, R.G. Crilly,** M. Kloseck, B.M. Chesworth, J. Gilliland, T. Charyk Stewart. From the *Faculty of Health Sciences, University of Western Ontario, the †Trauma Program, London Health Sciences Centre, London, the ‡Division of Geriatric Medicine, Parkwood Hospital, the §Department of Geography, University of Western Ontario, the ¶Lawson Health Research Institute and Children’s Health Research Institute and the **Department of Surgery, Schulich School of Medicine and Dentistry, University of Western Ontario, London, Ont.**

**Background:** Hip fractures increase with age and are associated with adverse outcomes for older adults. This study examined the relation between hip fracture and place of residence (community dwelling v. institutionalization) in a cohort of older adults. **Methods:** Hip fracture events from discharge abstract records (2002–2006) for residents of London, Ontario, were obtained from 2 acute care hospitals. Data on patients 65 years and older were analyzed by age, sex and residence type, and were integrated into a geographic information system for mapping. **Results:** A total of 1209 fracture events (mean age 83.5, SD 7.09 yr; 75% female; 69% community dwelling) were analyzed. Eighty-eight (7.3%) patients died in hospital and 11% (n = 94) of those living in the community before fracture were transferred to long-term care at discharge. Crude fracture rates were elevated in the institutionalized population (23.3/1000, n = 373) compared with the community population (4.0/1000, n = 836) and remained 1.8 times greater after correcting for age and sex. In-hospital mortality rates among institutionalized patients were almost 2 times higher than community dwellers and were elevated in older male community dwellers. Consistent with this, mapping analysis identified fracture “hot spots” in the city which coincided with the distribution of residential institutions and senior-dense neighbourhoods. **Conclusion:** Hip fractures are a significant injury for older adults and rise markedly with age. They are most common in women but are more likely to be fatal in men and the institutionalized population. They are a major cause of loss of independence in all. The use of descriptive and geographic methods isolated high-risk populations and locales that may benefit from targeted preventive interventions.
Intensive care unit intensive glucose control is associated with in-hospital mortality in patients with severe trauma. L.F. Ferri," M.B. Ferri," B. Shah," S. Rizoli.15 From the *Department of Health Policy, Management and Evaluation, and the Departments of 1Critical Care Medicine, 1Medicine and 1Surgery, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ont.

Background: Hyperglycemia is common in critically ill trauma patients and has been independently associated with increased mortality. Intensive glucose control (IGC) has become the standard of care in intensive care unit (ICU) patients, including trauma patients. However, the role of IGC in severe trauma has not been established and often causes hypoglycemia, which may adversely affect outcome. We hypothesized that the IGC protocol in ICU trauma patients leads to large blood glucose variations and worsens outcomes. Methods: We conducted a retrospective cohort study of all adult trauma patients admitted to Sunnybrook ICU between 2005 and 2007. The IGC protocol was introduced in 2005. The IGC was nurse-driven and automatically initiated after 2 measurements greater than 8 mmol/L, to a target of 4.1–8 mmol/L. Hyperglycemia (> 7 mmol/L) and hypoglycemia (< 4 mmol/L) were measured. Our primary outcome was in-hospital all-cause mortality. A conservative approach for logistic regression model was performed for in-hospital mortality. Results: In total, 1150 trauma patients were admitted to Sunnybrook ICU between 2005 and 2007. Their mean age was 42 years, ISS was 29.75 (SD 12.37) and Abbreviated Injury Scale head score was 2.72 (SD 1.8). The primary outcome initially was investigated using a χ² test (hyperglycemia, p = 0.00021; hypoglycemia, p = 0.0101). Our logistic regression model included the main confounders associated with mortality: severity (ISS), age, sex, trauma mechanism and presence of head injury. Hyperglycemia, minimal and maximal glucose level, age, ISS and head injury were independently associated with mortality. The hyperglycemia odds ratio for mortality was 4.51 (95% CI 2.12–9.64).

Conclusion: This study demonstrates that hyperglycemia but not hypoglycemia is independently associated with in-hospital mortality in severe trauma patients.

Prehospital care pathways for major head injury. G. Thibault-Helman," J.M. Tallon," S. Ackroyd-Stolarz," L. Fenerty," B. Sealy," S. Karim," D.B. Clarke." From the *Division of Neurosurgery, Department of Surgery, the †Department of Emergency Medicine, Dalhousie University, and the ‡Nova Scotia Trauma Program, Halifax, NS

Background: Timely access to tertiary care is vital following major traumatic brain injury. A head injury guideline was implemented in Nova Scotia to streamline prehospital management of these patients. The guideline advises use of the provincial transport and trauma hotline for arranging expeditious transport to tertiary care for patients with major head injury, following intubation or oxygen mask, spine immobilization and 2-minute neurologic exam. The impact of the guideline on timely access to care has been evaluated. Methods: Data from the Nova Scotia Trauma Registry and the Emergency Health Service Communications and Dispatch Centre database were analyzed for patients with an Abbreviated Injury Scale (AIS) head score of 3 or greater. Time elapsed before calling the trauma hotline and time required
to gain access to tertiary care were determined. Time elapsed was compared for the period before guideline implementation, the implementation phase and after implementation. Results: The time elapsed before the call to the trauma hotline was not statistically different following guideline implementation. This was true for the cohort which included all patients with an AIS head score of 3 or greater (including polytrauma, n = 388) and for the subset cohort (n = 99) with isolated head injuries (Kruskal–Wallis test, p = 0.247 and p = 0.874, respectively). Similarly, time elapsed before accessing tertiary care was not influenced by the guideline for both cohorts (Kruskal–Wallis test, p = 0.297 and 0.229, respectively). Conclusion: Times to tertiary care have not been reduced by guideline implementation. System changes beyond guideline implementation may be required to provide timely access to tertiary care.

Computed tomography and not chest radiography should be used to screen for blunt thoracic aorta injuries. S. Tacic, H. Shulman, S. Rizoli, J. Ng, F. Spencer. From the Department of Surgery and Medical Imaging, Sunnybrook Health Sciences Centre and University of Toronto, Toronto, Ont.

Background: In blunt trauma, chest radiograph (CXR) findings such as widened mediastinum are commonly used to screen for thoracic aorta injuries (TAI). However, normal CXR findings do not exclude TAI, and chest computed tomography (CT) scans are superior in detecting TAI. Despite wide availability, CT scans are not used to screen for TAI. We hypothesized that CT scans, and not CXR, should be recommended to screen for TAI. Methods: We conducted a retrospective study at Sunnybrook Trauma Centre, where multislice 64-slice CT scans have been used since 2003. We included all adult patients with blunt chest trauma admitted between July 2003 and June 2005 who underwent both CXR and chest CT scan-angiography on arrival. A senior radiologist dedicated to the chest reviewed all CXR images for widened mediastinum, which he subsequently compared with CT scans that were performed simultaneously. TAI was defined by conventional angiography, surgery or autopsy. Results: A total of 847 patients were included. Of the 11 patients with TAI, CXR showed widened mediastinum in 7, whereas CT detected the aortic injury in all 11. Even after meticulous review, 4 CXR scans showed a normal mediastinum, thus failing to identify TAI. CXR sensitivity was 63%, whereas CT scan sensitivity was 100%. Both had a specificity of 100%. Conclusion: In our trauma centre, 37% of all patients with blunt TAI would be missed and not submitted to further investigation had plane supine CXR been used as the sole screening tool. In contrast, CT scans correctly identified all TAI, suggesting that CT should be used to screen and identify blunt thoracic aorta injuries wherever available and not chest radiography.

Evaluation of a massive transfusion protocol. A.W. McFarlan,† S. Canzian,† K. Pavenski,‡ A.B. Nathens.† From the Departments of †Trauma, ‡Neurosurgery and †Transfusion Medicine, St. Michael’s Hospital, University of Toronto, Toronto, Ont.

Background: In 2008, a massive transfusion protocol (MTP) was introduced at our hospital for use in trauma patients with significant anticipated blood loss. The MTP goal was to provide timelines, transfusion thresholds and essential monitoring parameters for the management of patients requiring large blood volume replacement. Desired outcomes of the MTP included reducing the incidence of intractable coagulopathy, decreasing time to transfusion, avoiding wastage of blood and improving team communication. Methods: We conducted a retrospective chart review of patients from December 2008 to October 2009 who had an MTP called (n = 18) and also those (n = 14) who received 5 or more units of packed red blood cells (PRBC) in a 2-hour period and met the MTP inclusion criteria (but MTP not called). Results: Of the MTP-called cases, 13 (72%) were appropriate; 5 patients did not meet MTP inclusion criteria and were deemed inappropriate. Average time to issue of the first unit of plasma (MTP-called group) was 60 minutes compared with 75 minutes in the not-called group. Average time to issue of the first unit of platelets was 120 minutes compared with 198 minutes in the MTP not-called group. Conclusion: Average time to issue of the 7th unit of PRBCs in the MTP-called group was 107 minutes compared with 101 minutes in the not-called group. Pretransfusion laboratory work was completed on 14 (77%) MTP-called patients and 100% of the not-called group. Sixty-one percent of the MTP-called group were coagulopathic on arrival compared with 46% in the not-called group. Use of the MTP improved transfusion times and team communication.

Penetrating injuries in eastern Ontario: The Ottawa Hospital experience. L. Perron,† D. Kim,† A. Lester,† J. Trickett,† N. Shore,† M. Martin,† H. Knight,‡ G. Pagliarello,‡ J.-D. Yelle.‡ From the †Department of Surgery, The Ottawa Hospital Trauma Services, University of Ottawa, the ‡Regional Paramedic Program for Eastern Ontario and the †Ottawa Paramedic Service, Ottawa, Ont.

Background: Recent media reports have suggested there is an increasing prevalence of street violence in urban metropolitan centres in Canada, specifically with respect to violence involving penetrating injuries. The present study approximates a population study, insofar as the majority of adult patients from eastern Ontario with penetrating injuries are transferred to Ottawa. Objective: The overall purpose of the current study was to evaluate and describe our experience with patients who had penetrating injuries treated at The Ottawa Hospital’s tertiary trauma centre. More specifically, we performed both a descriptive and quantitative analysis of patients with penetrating injuries while reporting the demographics of the patient population. Furthermore, mortality rates and factors influencing mortality are analyzed and reported. Methods: A retrospective review of the period from 1998 to 2008 was performed using locally collected data on patients with penetrating injuries at The Ottawa Hospital. Our primary outcome was all-cause mortality. Several system enhancements were initiated in 2002, therefore a preplanned analysis of 2 distinct periods was also performed: period 1 (1998–2002) and period 2 (2003–2008). We performed Student t and Fisher exact tests and logistic regression for secondary analysis. Results: Most patients were male (89%) with a mean age of 33 years. The mechanism of penetrating trauma included 54 gunshot wounds (GSW), 183 stab wounds, 93 self-inflicted wounds and 32 other incidental penetrating injuries not resulting from violence or self infliction. There were 142 (39%) patients who required surgical intervention. The average Injury Severity Score
ASSOCIATION CANADIENNE DE TRAUMATOLOGIE

(ISS) was 14. The mortality rate observed for the time period from 1998 to 2008 was 13% (49/362) with 6% (21) of the deaths occurring in the emergency department (ED). Variables affecting mortality were analyzed. ISS odds ratio 0.9 (95% CI 0.87–0.94) and Modified Abbreviated Injury Score (MAIS) head and neck 0.8 (95% CI 0.64–0.94) were found to be statistically significant (p < 0.001). No significant increase in the number of patients treated for penetrating injuries was observed when comparing the 2 study periods. The observed mortality rate decreased from 19% (31/162) in period 1 to 11% (18/169) period 2. This was statistically significant (p < 0.05). For both periods, mortality was associated with a statistically significant higher ISS and MAIS scores (p < 0.001). In period 1, the ISS odds ratio was 0.9 (95% CI 0.85–0.95) and MAIS head and neck was 0.85 (95% CI 0.7–1). Similar results were observed from period 2, with ISS odds ratio 0.9 (95% CI 0.88–0.98) and MAIS head and neck 0.7 (95% CI 0.5–0.91). The reduced mortality for period 2 is most likely attributed to the trauma system enhancements implemented in 2002 that provided an opportunity for improved responsiveness, organization and coordination of care for the patients with penetrating injuries in eastern Ontario. Conclusion: We are not seeing an increased number of patients presenting with penetrating injuries at The Ottawa Hospital. We have observed significantly improved mortality rates in the cohort of patients with penetrating injuries, which we attribute to improvements and enhancements to the trauma system in eastern Ontario.

Outcome analysis of 160 trauma patients with flail chest. M. Ellabib, S. Faidi, N. Sne, M. Ben-Ibrahim, F. Baillie, M. Sagar. Trauma Program, Hamilton General Hospital, McMaster University, Hamilton, Ont.

Background: Flail chest is the most serious form of blunt thoracic trauma that occurs as a result of fracture of 3 or more ribs from at least 2 places resulting in a paradoxical movement of the chest wall, and it carries a high morbidity and mortality rate. The outcome of flail chest injury is a function of associated injuries. Early intubation and mechanical ventilation is vital in patients with refractory respiratory failure. Prolonged mechanical ventilation is associated with the development of pneumonia and a poor outcome. Methods: All patients who presented with blunt chest trauma from January 2000 to December 2006 were identified from the trauma registry at Hamilton General Hospital. Patients who had flail chest served as the study population. Mechanism of injury, site of injury, complication of injury and mortality were analyzed. Results: Out of 3369 patients admitted with thoracic injury, 160 (5%) patients had flail chest injuries. Seventy-seven percent of the patients were male with mean age of 54 years. Eighty-one percent of the flail chest injuries were due to motor vehicle accidents, 14% due to falling down and 5% due to other causes. Sixty percent of the injuries were on the left side, 26% were on the right side and 14% on both sides of the chest wall. Twenty-four percent of patients had hemopneumothorax, 20% had pneumothorax and 8% had hemothorax. Eighty-two percent of patients were intubated and admitted in the intensive care unit (ICU). The mortality rate was 25%, and most of the deaths occurred in the ICU because of pneumonia. Conclusion: The most common cause of injury is motor vehicle collision, and the most common site of injury is left side. Most of the deaths occurred because of pneumonia as a complication of prolonged intubation and mechanical ventilation.

Long-term functional outcomes following major traumatic brain injury. G. Thibault-Halmans, J.M. Tallon, S. Walling, S. Ackroyd-Stolarz, L. Fenerty, P. Taylor, D.B. Clarke. From the "Division of Neurosurgery, Department of Surgery and the Department of Emergency Medicine, Dalhousie University, Halifax, NS".

Background: Patients who suffer brain trauma can have significant and long-lasting cognitive, psychosocial, physical and functional sequelae. Despite this, few Canadian studies have prospectively examined long-term functional outcomes following major traumatic brain injury (TBI). Methods: Fifty-one patients with major head injury (Glasgow Coma Scale score 3–12) were recruited. These patients were evaluated at 6, 12 and 24 months after injury and were subjected to a clinical assessment, imaging studies and a battery of testing that included a Glasgow Outcome Scale (GOS) score. Results: In all, 28 follow-ups were completed; 23 patients withdrew before their 24-month follow-up. Among those who completed the study, 50% had a GOS of 5 at 6 months; by 24 months, 75% had reached a GOS of 5. Age appears to play a role in the rate of recovery: 59% (10/17) of patients younger than 25 had a 6-month GOS of 5, whereas only 24% (5/21) of those older than 25 had a score of 5, despite similar injury severity. By 24 months, however, 75% of both groups had achieved a GOS of 5. All (8/8) moderate TBIs, but only 65% (13/20) of severe TBIs, had achieved GOS of 5 at 24 months. Conclusion: A significant segment of this population remains unable to return to work or school, or is unable to live independently in the long term. However, important gains in functional independence can be achieved during the first 2 years after injury. The rate of recovery appears to be influenced by age. At 2 years, most patients in our cohort had a good recovery.

A new device for percutaneous tracheostomy. J.B. Rezende-Neto, S.B. Rizoli. From the "Department of Surgery Universidade Federal de Minas Gerais, Belo Horizonte, Brazil, and the Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ont.".

Background: Percutaneous tracheostomy (PT) has become an alternative procedure to conventional surgical tracheostomy. Percutaneous dilatational tracheostomy, Ciaglia technique, is the most popular. Griggs’ technique uses a Howard–Kelly forceps for blunt dilatation of the trachea; we describe a similar procedure. Methods: We designed a curved, self retaining retractor with an opening for a J-tipped guidewire, a short metal dilator and a blunt-tipped flexible metal introducer. The procedure consists of midline incision and a 16-gauge (Jelco) intravenous catheter introduced into the trachea, confirmed by aspiration of air. A J-wire is threaded through the catheter and the tip of the metal dilator is slid over the J-wire 2–3 mm into the trachea and removed. The self retaining retractor is slid over the J-wire to maintain the trachea open. A tracheostomy tube, slid over a flexible metal introducer, is placed inside the trachea under direct vision. Results: From July 2009 to October, 65 trauma patients underwent PT at the bedside (89% in the intensive care unit). Sixty-one percent had sustained a head trauma and 20% a thoracic...
trauma. The average time for the procedure was 5 minutes; no fiberoptic bronchoscopy was used. More than 2 attempts to insert the intravascular catheter into the trachea were necessary in 6 patients; this was solved by pulling back the endotracheal tube. There were no cases of tracheostomy tube misplacement. There were 2 complications (3%); both were incision bleeding that resolved with pressure. There were no conversions to open tracheostomy. **Conclusion:** The device provides a safe and quick means for PT, with the advantage of tracheostomy tube placement under direct vision.

Assessment of regional blood flow with fluorescent microspheres during permissive hypotension in hemorrhagic shock. B. Rezende-Neto,* B. Schmit, M.V. Andrade,* J.R. Cunha-Melo,* S.B. Rizoli.† From the *Department of Surgery Universidade Federal de Minas Gerais, Belo Horizonte, Brazil, and the †Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ont.

**Background:** Severe hemorrhage is the second most common cause of death in trauma patients and the leading cause of preventable death. We have previously shown that permissive hypotension (PH) enhances clot formation and decreases blood loss in hemorrhagic shock (HS). However, concerns of possible harm caused by tissue under perfusion with that strategy exist. The purpose of this study was to investigate regional perfusion with fluorescent microspheres in HS during PH. **Methods:** Thirty rats were randomized to 3 groups: sham, PH, and normotensive resuscitation (NR). The effects of introducing mandatory helmet use for skating. T. Charyk Stewart,*† D. Tanner,* G. Thibault-Halman,* K. Whealon-Hore,† L. Sangster,‡ J. Heath. From the *Division of Neurosurgery, Department of Surgery, the †Department of Athletics and Recreational Services and the 14th Year Nursing Program, Dalhousie University, Halifax, NS

**Background:** In Nova Scotia each year, 434 people die, 89,979 visit emergency departments and 5518 are hospitalized due to injury. Falls account for $175 million of the total $518 million per year price tag for injury in Nova Scotia. The human costs of injury are incalculable, leaving many health professionals in trauma care at the forefront of innovative injury prevention programs. As part of our strategy to develop initiatives that will prevent head trauma through promotion of helmets, we have developed a collaborative research project with Dalhousie University to examine the effects of introducing mandatory helmet use for skating. **Methods:** Mandatory helmets go into effect on Jan. 1, 2010, at Dalhousie Memorial Arena. Observational studies for falls and helmet use, qualitative surveys as well as educational programs leading up to the helmet rules have been completed. Enforcement consists of all skaters wearing Canadian Standards Association–approved hockey helmets to enter the ice surface for skating. **Results:** We are now completing observational studies before implementation of mandatory helmets. Of the 361 skaters observed (51.0% male), 46.2% wore helmets. **Conclusion:** We are in the process of implementing mandatory helmet use for skating at Dalhousie. Observational studies indicate that fewer than half of skaters wear helmets. We look forward to reporting the postimplementation data.

**The walk-in clinic that never closes:** primary care delivered by a dedicated trauma nurse practitioner embedded into a regional trauma service. N. Biegler,* P.B. McBeth,† A.W. Kirkpatrick. From the *Regional Trauma Program and the Departments of †Surgery and ‡Critical Care Medicine, Foothills Medical Centre, University of Calgary, Calgary, Alta.

**Background:** Obtaining consistent primary medical care is ever more challenging in Canada. Thus, infrequent primary care coupled with an increasing rate and scope of anatomic diagnostic imaging after injury and more diligent clinical examinations (tertiary surveys) has resulted in increased rates of new and unexpected diagnoses unrelated to the injury, known as incidental findings (IF). Although appropriately managing IFs poses risks and demands, there is also an opportunity to improve the overall health of all managed by the regional trauma service (RTS). We thus sought to characterize the volume and nature of primary care delivered by an embedded trauma nurse practitioner (TNP). **Methods:** A prospective log of IFs and follow-up details was maintained by the TNP. This was supplemented by demographic details obtained from both hospital administrative databases and a regional trauma database. **Results:** From September 2008 through March 2009, 425 RTS patients were cared for on the RTS ward. A minimum of 57 patients had IFs recorded. Of these, 3% required urgent intervention, 6.8% required specific follow-up consultations or investigations, and 3.5% required communication and education of the patient. Thirty percent of this group had no primary care physician. **Conclusion:** IFs are frequent in modern trauma care. The appropriate management and follow-up required is a major undertaking that can be well managed by a TNP. This service to the community, often involving those without any other primary care, is an unrecognized consequence of an organized RTS and needs consideration when assessing human resources and program support.

**Injury and spatial epidemiology of severe adult trauma: implications for prevention.** T. Charyk Stewart,* D. Tanner,* J. Gilliland,* M. Healy, J. Williamson,* S. McKenzie,* M.J. Girotti,* D.D. Fraser. From the *Trauma Program, London Health Sciences Centre and Children’s Hospital, the †Department of Surgery, Schulich School of Medicine and Dentistry, the ‡Human Environments Analysis Laboratory, Department of Geography, University of Western Ontario,
Calcium management during massive transfusion in trauma: reassessing medical practice. B. Nascimento,²,† S. Rizoli,²,† E. Passos,¹ L. Tremblay,²† M. Reis,² A. Capone,² J. Callum,² From the Departments of *Surgery, †Critical Care and ‡Clinical Pathology, Sunnybrook Health Sciences Centre, University of Toronto, Ont.

Background: There is no agreement among guidelines on whether or how calcium should be replaced during massive transfusion. The goal of this study is to review the medical practice on calcium management and to assess the need for calcium replacement during massive transfusion in trauma. Methods: We looked at trauma patients who received transfusions of 8 or more units of red cells (RCs) within 12 hours of hospitalization between January 2000 and November 2006. The rate of transfusion (RCs/h) was calculated for the first 6 hours of hospitalization. Serum calcium levels, time to first calcium level, and dose, type and time to calcium replacement were recorded. Parametric tests were used to analyze differences between groups. Results: In total, 43 massively transfused trauma patients (≥ 3.5 units of RCs/h) were included. Calcium was replaced in 84% of the cases at 2.5 hours of hospitalization. The first corrected calcium level was 2.6 mmol/L and obtained only at 4.1 hours after admission (see Table). Conclusion: Calcium is empirically replaced during massive transfusion in trauma. Massive transfusion does not deplete calcium to critical levels, and its replacement might not be necessary in most cases.

| Characteristic | Calcium group (n = 32) | No calcium group (n = 11) |
|---------------|-----------------------|--------------------------|
| Rate of RC transfusion, RCs/h | 4.6 | 4.0 |
| Serum calcium, mmol/L | 2.7 | 2.2 |
| Time to serum calcium, h | 4.1 | 3.4 |

RC = red cells.

**Calcium management during massive transfusion in trauma: reassessing medical practice. B. Nascimento,²,† S. Rizoli,²,† E. Passos,¹ L. Tremblay,²† M. Reis,² A. Capone,² J. Callum,² From the Departments of *Surgery, †Critical Care and ‡Clinical Pathology, Sunnybrook Health Sciences Centre, University of Toronto, Ont.**
and *Clinical Pathology, Sunnybrook Health Sciences Centre, University of Toronto, Ont.

**Background:** The use of recombinant factor VII activated (rFVIIa) in trauma is controversial, particularly in the context of severe metabolic acidosis. The goal of this study is to determine critical degrees of acidosis at which the use of rFVIIa may be deemed futile. **Methods:** Massively transfused trauma patients receiving rFVIIa (January 2000 to November 2006) were included. Demographics and baseline characteristics were obtained. The rate of red blood cell transfusion in the first 6 hours of hospitalization was calculated. Univariate analysis was performed to assess for differences between survivors and nonsurvivors. Receiver-operator curve analysis was performed to determine the cut-off for pH value associated with no survival. **Results:** In total, 72 patients received rFVIIa. Survivors were less acidotic and coagulopathic and had higher bleeding rates. There were no survivors when the drug was used for patients with pH less than 7.03. The projected cost for each adult treatment with rFVIIa would be about US$6300 (see Table). **Conclusion:** The use of rFVIIa for the management of coagulopathy in extremis of acidosis seems to be futile. rFVIIa is expensive and should be used wisely for a selective group of patients.

| Table. Characteristics and 24-hour survival of massively transfused trauma patients receiving recombinant FVIIa |
|-----------------|-----------------|------------------|
| Characteristic  | Alive (n = 48)   | Dead (n = 24)    | p value |
| pH              | 7.3 (0.1)        | 7.1 (0.2)        | 0.0002  |
| INR             | 1.34 [1.17–1.93] | 1.51 [1.35–1.93] | 0.06    |
| Total dosage    | 89.5 [80–146.75] | 71.3 [65–117.95] | 0.08    |
| Transfusion rate| 2.7 (1.6)        | 4.00 (1.7)       | 0.0002  |

fVIIa = factor VII activated; INR = international normalized ratio; SD = standard deviation.

use of rFVIIa for the management of coagulopathy in extremis of acidosis seems to be futile. rFVIIa is expensive and should be used wisely for a selective group of patients.

**The Trauma- Formula-Driven versus Lab-Guided Study (TRFL Study): preliminary results of a clinical trial. B. Nascimento,**1*† J. Callum,*‡ H. Tien,* V. Speers,* Y. Lin,* G. Rubenfeld,*‡ S. Ricolfi,*‡ From the Departments of *Surgery, †Critical Care and *Clinical Pathology, Sunnybrook Health Sciences Centre, University of Toronto, Ont.

**Background:** Recent retrospective studies report impressive survival advantages of early use of fresh frozen plasma (FFP) at a 1:1 ratio with packed red blood cells (RBC) in trauma. However, these studies have innate limitations that discredit their validity. The phrase “trauma is a team sport” rings true for health care providers who understand first-hand the challenges of caring for severely injured trauma patients. The Advanced Trauma Care for Nurses (ATCN) course, offered in collaboration with the Advanced Trauma Life Support (ATLS), provides the opportunity to build this team approach to care in the collaborative forum. In June 2008, the inaugural ATCN course was held in Toronto, Canada. ATCN is an internationally recognized course, and Canada is the 16th country to offer this unique approach to trauma education that intertwines the leadership and
ASSOCIATION CANADIENNE DE TRAUMATOLOGIE

The effects of enforcement and education on helmet use in rural and urban Nova Scotia. L. Fenerty,* S. Huybers,* S. Walling,* N. Boutilier,† J. LeBlanc.‡

Background: In December 1996, Nova Scotia enacted mandatory helmet use for cyclists. Revisions to the legislation added all ages, all wheels (2003) and all locations (2007). This places Nova Scotia in the position of having one of, or the most, aggressive and comprehensive helmet legislations in Canada. Enforcement has been in place since September 1997. Since 2004, formalized active enforcement programs (Operation Headway) and diversion education sessions (Noggin’ Knowledge) have occurred throughout Nova Scotia, along with helmet observation studies.

Methods: This study replicated the methods used to conduct an earlier (1995–1999) longitudinal helmet observational survey that took place in Halifax. The goals of the study were to examine and compare helmet use rates in metropolitan Halifax (population 373,000) and in the town of Pictou (population 3800) as well as to determine the amount of education and enforcement taking place.

Results: Helmet use increased during and after active enforcement in Halifax from 36% (1995 before legislation) to 84% (1999 after legislation). With consistent enforcement and education programs, Halifax (urban centre) had an increase in helmet use from 82% (2006) to 92% (2008), and Pictou (rural centre), with minimal enforcement, saw gains from 69% (2006) to 77% (2008).

Conclusion: Regular, ongoing education and enforcement has led to increased rates of helmet use for Halifax. The significant increase in helmet use in Pictou indicates that enforcement may contribute to higher rates of helmet use (for children), and the continued increase in helmet use in Halifax indicates that ongoing enforcement is effective (for all age groups).

Blunt carotid and vertebral artery injuries after cervical spine fracture: 10-year experience at a Canadian level trauma hospital. L. VanHouwellingen,* K.N. Vogt,* T.G. Stewart,** J. Williamson,† N. Parry,**†† G. DeRose,* D. Gray.†† From the *Department of Surgery, Schulich School of Medicine and Dentistry, University of Western Ontario, the †Trauma Program, London Health Sciences Centre, the ‡Department of Paediatrics and the $Division of Critical Care, Schulich School of Medicine and Dentistry, University of Western Ontario, London, Ont.

Background: The impact of screening for blunt carotid and vertebral artery injuries (BCVI) after trauma in the Canadian population remains unclear. Patients with cervical spine (c-spine) fractures are at high risk of BCVI. We undertook this study to determine whether the implementation of computed tomographic angiography (CTA) in patients with c-spine fracture has changed the rate of detection of BCVI as well as whether it has improved patient outcome.

Methods: We conducted a retrospective cohort of all trauma patients who sustained a c-spine fracture from 1999 to 2008 was identified from our trauma database. Data on injury and complication rates were compared before and after the availability of CTA.

Results: Of the 5533 trauma patients admitted during the study period, 569 (10.3%) sustained c-spine fractures and 19 (3.3%) sustained BCVI. BCVI was identified in 4 of 273 (1.5%) of patients before the use of CTA and in 15 of 296 (5.1%) of patients after its implementation (p = 0.04). After the introduction of CTA, 71 of 296 (24%) of patients underwent screening. A comparison of overall stroke rate revealed no difference between the pre- and post-CTA groups (1.8% vs. 3.0%, p = 0.44).

Conclusion: The availability of screening CTA significantly increased the rate of detection of BCVI in patients with c-spine fractures; however, this has not resulted in a decrease in stroke rate. Implementation of effective management strategies for patients with BCVI may be required to justify the use of screening in this population.