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Trauma Association of Canada

**Combined annual scientific meeting of the TAC and the
Australasian Trauma Society**

**SKYCITY Auckland Convention Centre
Auckland
New Zealand**

Thursday, March 5 to Saturday, March 7, 2008

Abstracts

Trauma Association of Canada abstracts presented at the combined annual scientific meeting of the TAC and the Australasian Trauma Society 2008

10015

Boys and their toys: a review of recreational vehicle trauma in southwestern Ontario. *K.N. Vogt,* T. Charyk-Stewart,** N. Parry,** J. Gilliland,§¶ D. Fraser,§***†† J. Williamson,† S. McKenzie,** M. Girotti.**†* From the *Department of Surgery, Schulich School of Medicine and Dentistry, University of Western Ontario, the †Trauma Program, London Health Sciences Centre, the ‡Division of Critical Care, Schulich School of Medicine and Dentistry, University of Western Ontario, the §Children's Health Research Institute and Lawson Health Research Institute, the ¶Department of Geography, University of Western Ontario, the **Centre for Critical Illness Research, the ††Department of Pediatrics, Schulich School of Medicine and Dentistry, University of Western Ontario, London, and the ‡‡Hotel Dieu Grace Hospital, Windsor, Ont.

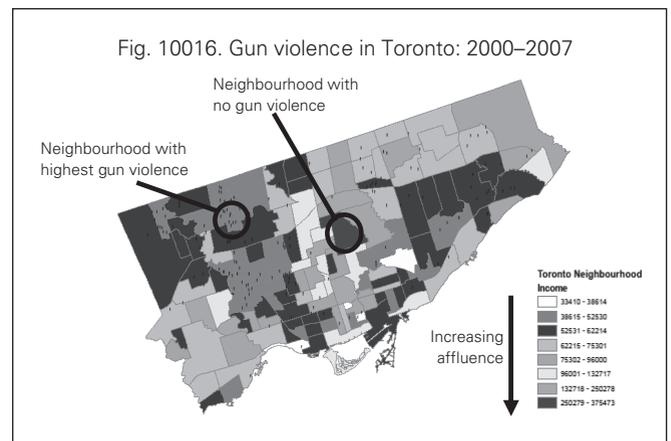
Objectives: To examine the epidemiology of recreational vehicle trauma (RVT) in southwestern Ontario (SWO). Compliance with legislation and recommendations regarding helmets, alcohol and pediatric drivers were determined. Trends were compared between pediatric and adult populations. **Methods:** A retrospective cohort of all trauma patients (1997–2008) admitted with severe injuries (ISS > 12) sustained while riding a recreational vehicle (all-terrain vehicle, snowmobile, dirtbike) was examined. Data were obtained from SWO trauma databases. Cases were mapped within a geographic information system to examine locations of RVT. **Results:** RVT-related injuries occurred in 327 patients; 90% were male and 28% were aged 13–18 years. No difference was found between pediatric and adult patients with respect to ISS and helmet use ($p = 0.88$, $p = 0.89$, respectively), but 63% of children less than 12 years old were drivers. Helmets were worn in 75% of crashes; failure to do so was associated with more severe head injuries ($p = 0.03$). Illegal alcohol use was documented in 28% of cases. Injury locations were overwhelmingly rural (88.5%), most within 15 km from patients' homes. **Conclusion:** The overall incidence of RVT in SWO has increased substantially over the past 11 years. Use of helmets among our population was higher than previously reported. There were no significant differences between the pediatric and adult populations with respect to ISS and risk-taking behaviours. Teens had the greatest proportion of RVT, with significant increases after age 12, coinciding with legislation only requiring supervision for children less than 12 years old. The findings will be used in the creation of strategies to decrease RVT in SWO.

10016

Gun violence in Toronto, Canada: understanding the problem, questioning the causes and implementing solutions. *T.L. Zakrisson,* G. Mojtahedi,† M. Kirst,‡ S.B. Rizoli.** From

the *Sunnybrook Health Sciences Centre, the †Faculty of Medicine, University of Toronto, and ‡St. Michael's Hospital, Toronto, Ont.

Introduction: Intentional violence, including gun violence (GV), is a significant cause of trauma in Toronto, Canada. Sunnybrook Health Sciences Centre (SHSC) sees the largest number of patients affected by trauma, including GV, in all of Canada. Therefore, it is in a privileged position to be able to initiate violence-prevention programs in Toronto and beyond. **Objectives:** Community-based participatory research was used to understand the scope of the problem, explore causal factors and delineate solutions. This is to lay the foundation for injury-prevention strategies in Toronto and Canada. **Methods:** i) Understanding the problem involved quantitative data analysis of basic statistics of GV at SHSC. ii) Exploring causal factors, e.g., survivors of GV home addresses and household income. iii) Proposing future solutions involved qualitative methodology exploring the causes and solutions of GV administered to 3 cohorts: survivors, family members of survivors and community leaders/advocates against GV. **Results:** From 2000 to 2007, SHSC treated 534 survivors of GV (89.9% homicidal intent). The majority were under the age of 30 years. Mapping of patients' addresses revealed that GV is occurring in neighbourhoods with the lowest household incomes compared with the most affluent (Figure). Qualitative interviews highlight recur-

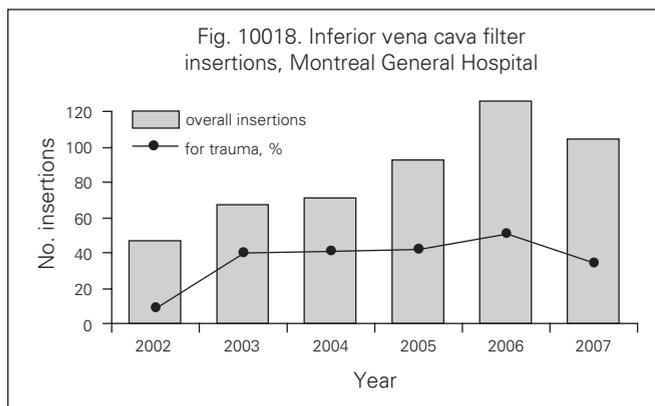


rent themes such as poverty, police brutality, economic marginalization and racism as factors contributing to GV. **Conclusion:** GV continues to be a significant public health issue for trauma surgeons and beyond. Despite fluctuations in the numbers of shootings each year, increasing lethality is seen, affecting mainly youth who experience economic inequality. Potential solutions from affected communities are underway as important initiatives in Toronto and Canada.

10018

IVC filter use: Do they have a role in venous thromboembolism prophylaxis in major trauma? A 10-year experience at the McGill University Health Centre. *B. Kalmovitch,* S. Al-Humayyd,† D. Valenti,† P. Fata,* K. Khwaja,* T. Razek.** From the Departments of *Surgery and †Radiology, McGill University Health Centre, Montréal, Que.

Objective: To examine our institutional experience in the use of inferior vena cava filters (IVCF) in trauma patients. **Methods:** We conducted a retrospective review of the radiology and trauma registry databases at 2 academic university hospital centres, one of which is a level-1 trauma centre, between 1998 and 2008. **Results:** Overall there were 1406 IVCF insertions during the study period. Clinical data could be obtained on 876 patients; 206 of 492 patients (42%) treated at the Montreal General Hospital (MGH) were trauma patients. IVCFs were inserted in 2.4% of all trauma patients admitted to MGH and 6.9% of severe trauma patients (ISS > 13) (Figure). The average ISS for trauma patients



who received IVCF was 30.2. Although IVCF insertion among these trauma patients was almost entirely for venous thromboembolism prophylaxis, 25 patients (12%) had a pulmonary embolism (PE) before a filter was inserted. PE was diagnosed 5.5 days from admission on average, but most occurred in the first 2 days. Average retrieval time was 91 days. The attempted retrieval rate was 63%. The overall complication rate was 9.1%, with no fatal complications recorded. Mortality among trauma patients having IVCF was 16.7% with an average ISS of 38. The mortality rate for matched ISS-score cohorts was lower in patients receiving an IVCF but failed to achieve statistical significance. **Conclusion:** These data demonstrate a trend toward increased IVCF use with retrievable filters and an associated trend toward increased survival. Data systems to improve retrieval rates and evaluate long-term safety are the focus of ongoing work.

10019

Hospitalization due to burns in designated trauma facilities in Canada. *A.C. Moses McKeag, T. Forte, M. Keresteci.* From the Canadian Institute for Health Information, Toronto, Ont.

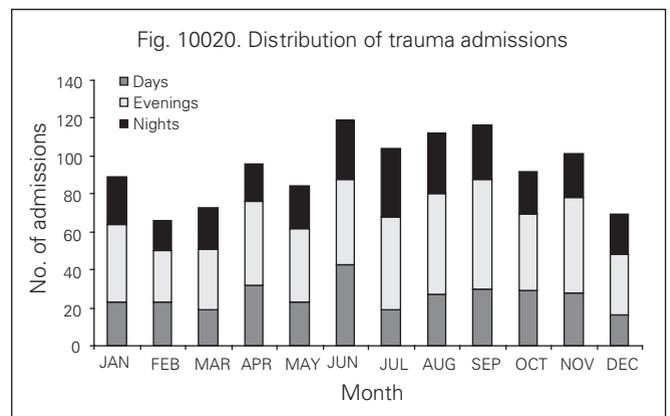
Objective: To identify patients admitted to designated trauma facilities in Canada with injuries due to burns and to determine how many of those patients meet the inclusion criteria of the National Trauma Registry. **Methods:** Canada's 2 National Trauma

Registries were compared to determine the burden of injury due to burn patients. The Minimum Data Set (NTR MDS) holds information on all hospitalizations due to trauma in all acute care facilities in Canada. The Comprehensive Data Set (NTR CDS) is limited to cases with an ISS greater than 12 from designated trauma facilities. **Results:** There were 46 designated trauma facilities submitting data to the NTR CDS in 2004–2005, when 1078 patients were hospitalized in these facilities due to burns. Only 190 patients (18%) met the inclusion criteria for the CDS (ISS > 12). Patients meeting the criteria for the CDS were slightly older than patients in the MDS (mean 39 v. 35 yr). Patient length of stay was longer in the CDS (mean 27 v. 15 d in MDS) and was higher than the length of stay due to all trauma hospitalizations (10 d). Nineteen percent of burn patients in the CDS died while in hospital, whereas 4% in the MDS died during their hospital stay. **Conclusion:** The Canadian NTR CDS does not capture the majority of patients admitted to designated trauma facilities due to burn injuries. Using ISS greater than 12 as an inclusion criterion may exclude a substantial number of burn cases. Caution must therefore be used when using the CDS to evaluate incidence, morbidity and mortality due to burns.

10020

Logistics of trauma research at a major academic centre: strategies for overcoming research barriers. *V.R. Speers,* S.B. Rizoli.**†* From the *Sunnybrook Health Sciences Centre and the †University of Toronto, Toronto, Ont.

Aims: Traumatic injury is the leading cause of death in young people; however, research remains a significant challenge, since it does not conform to traditional management concepts. This study serves to investigate patient distribution and communication barriers in trauma research. **Methods:** Data from the trauma data bank were retrospectively reviewed from Jan. 1 to Dec. 31, 2007, for number of admissions, month and time admitted, according to shift: 08:00–15:59 days (D), 16:00–23:59 afternoons (A) and 24:00–7:59 nights (N). Glasgow Coma Scale scores (GSC) was also reviewed as an indicator of ability to provide informed consent. GSC less than 8 defined coma, between 8 and 13 abnormal and greater than 13 normal. **Results:** Analysis of 1115 patients demonstrated the majority of trauma patients were admitted during the A shift (45.5%), followed by D shift (27.8%) and N shift (26.7%). June had the highest number of admissions (119), with June–September as peak period. February had the lowest number of admissions (66) (Figure). Across 12 months and



3 shifts, the GCS revealed that 21.5% of patients were in a coma, 26.3% were abnormal and 52.2% were normal. **Conclusion:** Trauma research is challenging because of variable patient distribution and levels of consciousness. Distribution reveals resources should be focused during A shift, especially from June to September. Adjustments in availability, such as pager coverage, vacation schedules and study on-call teams can help to meet this demand. In addition, 48% of trauma patients can't consent due to decreased GCS. Consequently, delayed consent, combined with independent physician authorization, is a practical option for patient enrollment.

10023

Resuscitation with hypertonic saline-dextran influences the coagulation profile in severe traumatic brain injury patients. *S.B. Rizoli,^{*,†} S.G. Rhind,^{†‡} S. Scarpelini,^{*,¶} A.J. Baker,^{†§} N.T. Crnko,[‡] L.J. Morrison,^{*,†} P.N. Shek.^{†‡}* From the ***Sunnybrook Health Sciences Centre, the †TOPHR HIT investigators, ‡Defence Research and Development Canada, §St. Michael's Hospital, Toronto, Ont., and the ¶Universidade de São Paulo, Ribeirao Preto, Brazil.**

Background: Traumatic brain injury (TBI) is a leading cause of death/disability in civilian and combat casualties. Coagulopathy is common in TBI, leading to poor neurologic outcome and mortality. The current view is that the injured brain releases tissue factor (TF), initiating a consumptive coagulopathy and progression of the initial injury. Hypertonic solutions are effective in cerebral edema and raised intracranial pressure, but their effect on coagulopathy is mostly unknown. We investigated this effect using data from a prehospital randomized controlled trial on hypertonic saline (7.5% NaCl 6% dextran-70; HSD) versus placebo resuscitation. **Methods:** Adult patients with isolated severe TBI (Glasgow Coma Scale score < 9) received 250 mL HSD or placebo within 4 hours of trauma. Samples obtained on arrival were analyzed: red blood cell (RBC), platelet (Plt), hemoglobin (Hb), hematocrit (Hct), prothrombin time (aPTT), international normalized ratio (INR), D-dimers (DD) and soluble TF. Values are mean ± standard error of the mean and range. **Results:** All 54 patients (HSD = 26, placebo = 28) displayed hemostatic abnormalities compared with 10 healthy volunteers. RBCs ($3.7 \pm 0.1 \times 10^{12}/L$, 2.4–5.9), Hb (116.3 g/L, 81–143), Hct (0.32 L/L, 0.23–0.42) were below normal, but not different between treatment groups. aPTT (25.1 s, 3–41), INR (1.13 ± 0.03, 0.9–1.95) were minimally prolonged and Plt lower ($219.5 \pm 13.7 \times 10^9/L$, 135–315) compared with healthy controls (265.7 ± 8.6). Plasma TF was significantly higher in placebo (73.4 ± 10.9 pg/mL) than HSD (39.3 ± 4.0) and controls (36.4 ± 7.8). DD (10.3 ± 1.5 ng/L) was dramatically higher in placebo versus HSD (5.9 ± 0.9) and controls (0.28 ± 0.03). **Conclusion:** Many TBI patients have activation and impairment of coagulation, with hypocoagulability and fibrinolysis independent of resuscitation fluid. HSD patients exhibited minor changes in TF and DD, suggesting a protective effect. Future studies on HSD hemostatic properties are warranted.

10024

Moving from evidence to action: prioritization of pediatric injury issues for focused injury prevention programming. *T. Charyk Stewart,^{*,†} D. Polgar,^{*} N. Parry,^{*,†} M.J. Girotti.^{*,†}* From the ***Trauma Program, London Health Sciences**

Centre, and the †Department of Surgery, Schulich School of Medicine and Dentistry, University of Western Ontario, London, Ont.

Objective: To develop a prioritized, evidence-informed list of pediatric injury issues to be addressed through injury-prevention initiatives. **Methods:** A quantitative review of trauma data with qualitative stakeholder discussions. Data representing all levels of severity from emergency department visits to deaths were reviewed and ranked by age (< 1, 1–4, 5–9, 10–14, 15–17 yr). Specific topics for each of the top issues (motor vehicle crashes, recreational, falls, intentional, drowning and other) were discussed based on qualitative criteria (i.e., effectiveness, opportunity gaps) and individually scored on a 5-point Likert scale. The sum of these scores was ranked. This qualitative rank was added with the quantitative rank from the data to determine the overall ranking, with the lowest rank sum as the top priority. **Results:** Shaken baby syndrome (SBS) was ranked as the top priority. The top 5 ranking injury issues are presented in the Table. Other issues

Table, abstract 10024. Top 5 ranking pediatric injury issues

Overall rank	Topic	Age group, yr	Quantitative rank	Qualitative rank +	Rank sum =
1	SBS	< 1	2	1	3
2	Bullying	5–17	3	2	5
2	Drugs and driving	15–17	1	4	5
2	MVC and speeding	15–17	1	4	5
5	Suicide/self mutilation	10–17	4	3	7

MVC = motor vehicle crash; SBS = shaken baby syndrome.

included all-terrain vehicle safety, playground falls and farm injuries. **Conclusion:** With competing demands and limited resources, this method utilizes data and stakeholder input to decide where to focus efforts. It allowed us to move from evidence to action, by implementing and evaluating new programs including a SBS-prevention program for all new families.

10025

"Shaking" up the system: lessons learned from the implementation and evaluation of a shaken baby syndrome prevention program. *D. Polgar,^{*} M.J. Girotti,^{*,†} K. Grant,^{*} T. Charyk Stewart.^{*,†}* From the ***Trauma Program, London Health Sciences Centre, and the †Department of Surgery, Schulich School of Medicine and Dentistry, University of Western Ontario, London, Ont.**

Objective: Shaken baby syndrome (SBS) is a devastating societal issue for infants. Given that 43% of the London Health Sciences Centre's (LHSC) severe infant injuries were intentional and a prioritizing exercise found SBS to be the leading priority for future initiatives, we implemented an SBS-prevention program for all new families. The objective of this study is to describe the implementation and evaluation of this program. **Methods:** LHSC adopted the Period of PURPLE Crying[®] program, which helps parents understand the features of infant crying that are frustrating and the main trigger for shaking. A mixed-method survey was used with quantitative and qualitative components to evaluate the implementation of this program. A pre-post test of health care

professionals' (HCP) knowledge of SBS and crying patterns and a questionnaire on HCP perceptions were developed, pretested and used. **Results:** A multidisciplinary SBS committee developed an implementation plan. Fifty HCPs were trained on consequences of SBS, program components and strategies. Knowledge testing revealed a mean correct response rate of 38% pretest versus 85% post-test ($p < 0.001$). HCP (88%) rated SBS as a very important issue, and 68% rated the quality of the program as very high. Since April 2008, we have obtained 87% penetration rate, with 96% recommending this program. **Conclusion:** The implementation of a SBS-prevention program is an innovative change in the delivery of health care that includes a proactive approach to prevent injuries. We have identified lessons learned and factors critical to our success to aid other trauma centres in implementing this groundbreaking initiative.

10030

An economic evaluation of prophylactic vena cava filters in critically ill trauma patients. C. Chiasson, B.J. Manns, H.T. Stelfox. From the University of Calgary, Calgary, Alta.

Objective: Patients with major traumatic injuries are simultaneously at high risk for venous thromboembolism (VTE) and bleeding. We estimated the cost effectiveness of 3 VTE prophylaxis strategies in patients admitted to an intensive care unit (ICU) with major traumatic injuries and a contraindication to pharmacological prophylaxis: pneumatic compression devices (PCD), serial Doppler ultrasound (SDU) screening and prophylactic insertion of a vena cava filter (VCF). **Methods:** Data on the probability of deep vein thrombosis (DVT), pulmonary embolism (PE) and effectiveness of the prophylactic strategies were taken from a systematic review of the literature. The probabilities of in-hospital death, ICU and hospital discharge rates and resource use were taken from a population-based cohort of patients with major traumatic injuries (ISS > 12) admitted to the ICU of a regional trauma centre. **Results:** The incidence of DVT at 12 weeks was similar for the PCD (14.9%) and SDU (15.0%) strategies, but higher for the VCF (25.7%) strategy. Conversely, the incidence of PE was highest in the PCD strategy (2.9%), followed by the SDU (1.5%) and VCF (0.3%) strategies. Mortality (24.5% v. 24.4% v. 24.5%) and expected quality-adjusted life years (6.9 in all strategies) were similar for all 3 treatment strategies. Health care costs at 12 weeks were \$55 831, \$55 334 and \$57 377 for the PCD, SDU and VCF strategies, respectively. **Conclusion:** Prophylactic placement of VCF in patients at high risk for VTE who cannot receive pharmacological prophylaxis is expensive and associated with increased risk of DVT. SDU screening was associated with better clinical outcomes and lower costs.

10031

A scoping review of quality indicators in trauma care. H.T. Stelfox,* SE Straus,† A.W. Kirkpatrick,* A.B. Nathens,† From the *University of Calgary, Calgary, Alta., and the †University of Toronto, Toronto, Ont.

Objective: Trauma care cannot be improved until it is measured with evidence-based quality indicators (QI). We describe a systematic search of the literature to identify QIs and evaluate their supporting evidence base. **Methods:** We searched MEDLINE, EMBASE, CINAHL, the Cochrane Library, the Grey Literature

and select journals by hand to identify articles on QIs in trauma care. Research and nonresearch articles that identified or proposed QIs for patients with major traumatic injuries were eligible for inclusion. Two reviewers independently appraised study quality and extracted relevant data. **Results:** A total of 143 articles, 95 research and 48 nonresearch, published in 5 languages (91% English) identified or proposed 1307 QIs in trauma care for adults (89%) and children (8%). Ten categories of QIs were identified, each addressing 1 of the 3 Donabedian components of healthcare quality (structure [s], process [p], outcome [o]): 1) criteria for trauma centre/system designation [s], 2) trauma registries [s], 3) American College of Surgeons (ACS)-based audit filters [p], 4) non-ACS audit filters [p], 5) clinical guideline adherence [p], 6) peer review [p], 7) injury scoring systems to identify preventable deaths [o], 8) adverse events [o], 9) autopsy to identify preventable deaths [o] and 10) patient mortality [o]. Measures of prehospital and hospital processes (53%) and outcomes (29%) were the most common QIs identified. Post-acute care QIs accounted for less than 5% of QIs. **Conclusion:** A substantial and heterogeneous body of literature exists to guide development of evidence-based QIs for acute trauma care. Limited literature is available for post-acute care QIs.

10032

Capture-mark-recapture as a stopping rule for systematic reviews in trauma care. H.T. Stelfox,* SE Straus,† A.B. Nathens,† A.W. Kirkpatrick,* C.H. Goldsmith,‡ From the *University of Calgary, Calgary, Alta., the †University of Toronto, Toronto, and ‡McMaster University, Hamilton, Ont

Objective: Researchers have no empirically-based search-stopping rule when looking for candidate articles for inclusion in systematic reviews. We tested a stopping strategy based on capture-mark-recapture (CMR, i.e., the Horizon Estimate) statistical modelling to estimate the total number of articles in the domain of quality indicators (QIs) for trauma care by using 3 large bibliographic databases. **Methods:** The process of CMR involves capturing an initial sample, marking the elements in the sample with a tag, and then placing the sample back into the population so that the marked elements are available to be recaptured in subsequent samples. We searched MEDLINE, EMBASE and CINAHL and performed a prospective evaluation of the Horizon Estimate using a systematic review of articles on QIs in trauma care at 2 levels of article screening: title and abstract (403 candidate articles) and full text (143 candidate articles). **Results:** The CMR model suggests that the total number of candidate articles were 1657 (95% CI 1043–2863) for the first level of screening and 275 (95% CI 208–412) for the full text level. The 3 databases provided 24% (95% CI 14%–39%) of known articles for the first level of screening and 52% (95% CI 35%–69%) for full-text screening. **Conclusion:** The CMR technique can be used in systematic reviews to estimate the closeness to capturing the total body of literature on a given topic. Future systematic reviews may consider including Horizon Estimates as possible stopping rules.

10033

Cervical spine clearance in obtunded blunt trauma patients: a multicentre study. Trauma Association of Canada, Canadian Trauma Trials Group. D. Hennessy,* S. Widder,* D. Zygun,* J. Hurlbert,† J. Kortbeek.** From the Departments

of *Critical Care and †Surgery, University of Calgary, Calgary, Alta.

Objective: Clearance of cervical spines (C-spines) in the obtunded trauma patient can be difficult. To further evaluate the accuracy of CT in C-spine clearance of obtunded trauma patients, we included the use of flexion–extension (F-E) plain radiographs. We hypothesized that F-E views would not identify additional clinically significant injuries. **Methods:** A prospective cohort study conducted from December 2004 to April 2008 at the Foothills Medical Centre (FMC) in Calgary, Alberta. All blunt trauma patients 18 years and older admitted to the intensive care unit at FMC were screened for inclusion. Inclusion criteria were completion of both forms of imaging. Exclusion criteria were known C-spine injury or death before imaging completion. **Results:** Of 908 patients screened, 425 met our inclusion criteria. Four hundred and twenty-four patients (99.8%) had both a negative CT and F-E views with no evidence of C-spine pathology. One patient had a “normal” CT but positive F-E finding significant for an unstable C-spine injury that was stabilized surgically. When the CT was retrospectively reviewed by the neurosurgical team, an abnormality was seen. **Conclusion:** CT can be used as the sole modality to clear C-spines in the obtunded trauma patient. F-E views are difficult to obtain in this patient population and should be pursued only under special circumstances.

10035

Rapid sequence intubation by nonphysician air medical crews: an 8-year province-wide evaluation. *D.A. Petrie,* S.A. Karim,† J.M. Ahmed,‡ M.P. Vu,§ J.M. Tallon.*** From the *Department of Emergency Medicine, Dalhousie University, the †Nova Scotia Trauma Program, ‡Dalhousie University, Halifax, NS, and §Vancouver General Hospital, Vancouver, BC.

Purpose: This study prospectively assessed implementation of a rapid sequence intubation (RSI) protocol into a Canadian provincial air medical system staffed by nonphysician air medical crews (AMCs). The goal was to assess RSI performance in the context of advance airway management decision-making. **Methods:** An 8-year retrospective review of all patients 16 years and older who had intubations by AMCs in the province of Nova Scotia (August 1999 to August 2007) was performed. Airway interventions were prospectively recorded in a database including indications, medical/trauma cases, age, gender, number of intubation attempts, airway adjuncts used and surgical airways performed. The primary process of care outcome was successful tracheal intubation. Data analysis was conducted using SPSS 15.0. Descriptive statistics were used to define the characteristics of patients who had airway interventions. **Results:** During the study period (8 yr), AMCs carried out 2497 missions with a total of 189 airway interventions. Trauma accounted for 48.1% of cases. There was a 98.9% intubation (procedural) success rate (187/189) and a 100% clinical airway management success rate (oxygenation). AMCs, as sole airway managers, had a 98.7% success rate (147/149), with a first-attempt RSI success rate of 84.1%. There were no surgical airways or deaths attributable to failed airway management. Intubations performed without RSI (21.4%), due to relative contraindications, were all performed successfully. **Conclusion:** RSI and advanced airway management decision-making by nonphysicians has been introduced into our

provincial air medical system with success rates equal to those reported in the anesthesia literature.

10037

The use of clinical process indicators for trauma system evaluation: What do we really know? *A. Lavoie,**† R. Amini,* J. Lapointe,‡ G. Bourgeois,‡ N. Le Sage,**† M. Emond,**† E. Bergeron.*§* From the *Centre de recherche du CHA–Enfant-Jesus, the †Université Laval, the ‡Société de l'assurance de l'Automobile du Québec, Québec city, and the §Hôpital Charles-LeMoine, Greenfield Park, Que.

Introduction: Clinical indicators are used to assess trauma system performance in various settings and countries. However, the literature offers very little evidence to support this. **Objective:** To document and support the use of evidenced-based medicine in trauma system performance surveillance. **Methods:** Websites of trauma systems (i.e., trauma centres, health authorities and professional associations) were visited to identify clinical indicators used for system performance. A literature search was then launched to identify published articles on these topics, and class of evidence was assessed. Indicators were retained if they were either a) used in at least 1 system and were sustained by at least 1 published study or b) were used by at least 2 systems without sustaining studies. **Results:** Of the 17 clinical indicators identified and retained, only 11 were sustained by at least 1 published article. Of these, only 3 were sustained by class II evidence, 1 of which is challenged by conflicting class III evidence. Of the 8 indicators with only class III evidence, 2 are also challenged by conflicting results. **Conclusion:** The literature sustaining the use of clinical indicators for trauma system performance offers at best limited evidence as to what really works.

10039

Are we ready for the worst? Disaster preparedness of Canadian trauma centres. *D. Gomez, B. Haas, N. Ahmed, A.B. Nathens.* From St. Michael's Hospital, Toronto, Ont.

Objective: Due to their constant readiness to treat injured patients, trauma centres (TCs) are integral in the regional response to mass casualty incidents (MCIs). To respond appropriately, however, TCs must have adequate structures and processes in place and be appropriately integrated into a regional disaster response plan. The objective of this study was to identify existing vulnerabilities in the planned response of Canadian TCs to MCIs. **Methods:** A survey of trauma directors of Canadian TCs ($n = 27$) is being conducted in order to address several domains identified during previous MCIs as consistent system-wide deficiencies. **Results:** Thus far, 14 surveys (52%) have been received. The majority of centres reported having a disaster preparedness committee (79%). However, less than half reported that trauma directors were members of these committees (42%), and 55% of trauma directors believe the committees have inadequate stake-holder representation. Only half of TCs have an all-hazards emergency plan, and one-third have not had a practise drill in the last 2 years. No TC reported having estimated its surge capacity. Fewer than half of TCs have participated in regional disaster drills, and only 21% have collaboration agreements with regional stakeholders. A minority (1/3) of TCs can sustain peak operations for 72 hours during a MCI, and one-third of TCs report no interoperable communication

resources. **Conclusion:** Significant deficiencies in Canadian disaster preparedness have been identified, many of which have been well described in previous MCIs. The main areas of vulnerability identified include disaster planning, regional integration, sustainability of peak operations and communication.

10040

The experts can't agree: controversies in splenic trauma identified using the Delphi method. *D. Gomez,* K. Ali,† B. Haas,* A.B. Nathens,* O. Monneuse,‡ N. Ahmed.** From *St. Michael's Hospital and the †University of Toronto, Toronto, Ont., and the ‡CHU, Lyon, France.

Background: Despite 3 decades of innovation in the management of splenic trauma, there continues to be a lack of high-quality evidence to guide practice. With this mind, we sought to explore areas of ongoing controversy in the management of these injuries with the aim of identifying future research priorities. **Methods:** Opinion leaders in trauma care from North and South America, Europe, Australia and New Zealand were invited to participate in a Delphi survey examining key issues in the management of splenic trauma. Consensus was defined as 70% agreement or greater among participants. **Results:** Sixty-two percent of participants responded to at least 1 round of the survey. There was a lack of consensus in areas related to acute management of patients with splenic injuries, including the indications for splenorrhaphy and angioembolization. Furthermore, opinions regarding the optimal management of penetrating injuries varied significantly. Clear regional clustering of practice preferences were observed as North and South American surgeons were more likely to manage isolated penetrating splenic injuries nonoperatively. **Conclusion:** The ideal algorithm for the management of splenic injuries remains undefined. This Delphi study highlights the controversies among experts, particularly related to processes of care that constitute the optimal approach to nonoperative management of these injuries.

10041

Field intubations in need of an overhaul: unnecessary field intubations. *D. Gomez, A.B. Nathens, W. Xiong, N. Ahmed.* From St. Michael's Hospital, Toronto, Ont.

Introduction: There is little evidence to support the use of field intubation in trauma, with selected studies suggesting either no benefit or the potential for harm. Further, unnecessary intubations might play a role in increasing the utilization of scarce intensive care unit (ICU) resources. We set out to evaluate the relative rate of unnecessary intubations among trauma patients intubated in the field or the emergency department (ED). **Methods:** The National Trauma Databank was used to identify adult patients who were intubated in the field (FI) or the ED (EDI) from 2002 to 2006 across facilities who routinely reported Abbreviated Injury Scale codes (121 centres, 25 539 patients). Unnecessary intubations were defined as patients who were mechanically ventilated for 1 day or less (excluding patients who were dead on arrival and those who died within 24 hours). The adjusted odds ratio of unnecessary intubations as a function of site of intubation was estimated by logistic regression. **Results:** Eighteen percent ($n = 4597$) of intubations were FI; patients were younger, had higher ISS, a higher proportion of shock and higher

mortality rates. However, after adjustment for differences in case mix, the odds of unnecessary intubation was 30% (odds ratio 1.3, 95% CI 1.2–1.5) greater in FI compared with EDI. **Conclusion:** The liberal use of FI may generate a great burden on one of the trauma centre's most important resources: the ICU. Furthermore, in light of recent evidence that suggests possible harm to trauma patients with prehospital advanced life support interventions, basic life support might be the more appropriate level of care in the field.

10043

Pediatric trauma rate secondary to all-terrain vehicles in Newfoundland before and after ATV legislation. *T.K. Chuah, D.I. Price.* From Memorial University, St. John's, NL.

Background: Pediatric trauma from all-terrain vehicles (ATVs) is a serious health concern. The province of Newfoundland enacted legislation prohibiting persons under 16 years of age from driving ATVs unless supervised by an adult. **Objective:** This study investigated the rate of pediatric ATV injury before and after the introduction of the ATV legislation in Newfoundland within a 5-year period. It is hypothesized that the legislation has been effective in reducing the ATV-related trauma rate in people under the age of 16. **Method:** A tertiary pediatric hospital's medical records were reviewed for major ATV trauma, defined as that needing admission to the tertiary children's hospital for a 2.5-year period before and a 2.5-year period after the introduction of the legislation. **Results:** Thirteen major ATV traumas were admitted in the prelegislation period versus 14 in the postlegislation period. There was no statistically significant difference. In the prelegislation period, 12 of the 13 ATV trauma patients were drivers of the ATV, compared with 6 of the 14 ATV trauma patients in the postlegislation period. The remaining patients were ATV passengers. This is a statistically significant difference. **Conclusion:** Current ATV legislation in Newfoundland is effective in reducing pediatric ATV trauma secondary to pediatric ATV drivers, but it has not affected overall pediatric ATV trauma rates. Legislation should be modified to disallow children from riding in ATVs as passengers.

10044

The implementation of a chest tube protocol reduces time to removal without increasing complications. *S. Khetarpal, M. Wilson, M. Swaroop, L. Llerena, D. Ciesla, D. Shapiro.* From the University of South Florida, Tampa, USA

Objective: To determine the safety of an aggressive chest tube removal protocol in trauma patients with a traumatic pneumothorax or hemothorax requiring a chest tube, and to evaluate if such a protocol would reduce pulmonary complication rates in this population. **Methods:** As part of the trauma quality management program at a major university-based trauma program, a review of current literature and recommendations regarding chest tube management was developed, presented and subsequently adopted. The principle of the protocol was as follows: after chest tube placement for blunt trauma, tubes were to be placed to suction for 6 hours; if there was no air leak, this should be changed to water seal with the goal of removal within 24 hours unless prescribed contraindications existed. The trauma registry for 6 months after the adoption of the protocol was used to track

complications, specifically the need for reinsertion secondary to recurrent hemo- or pneumothorax. The trauma registry was also used to capture major pulmonary complications. Penetrating injuries were excluded, as were chest tubes placed at the time or in conjunction with thoracotomies. **Results:** In the 6-month period after the initiation of the protocol, a total of 67 chest tubes were included in the registry. During that time period, no patients met criteria dictated by the protocol for removal of a chest tube that subsequently needed replacing for recurrent pneumothorax. Despite the adoption of the protocol, there was no measurable difference in the number of ventilator days, the rate of respiratory failure or the pneumonia or empyema rates in our trauma population. **Conclusion:** An aggressive chest tube removal protocol can be implemented in a major trauma program without increasing the rate of recurrent pneumo- or hemothorax. While such a protocol is likely to have benefit on patient care and comfort, it is difficult to identify a direct correlation with decreased complication rates.

10045

Antibiotic crop rotation for ventilator-acquired pneumonia with carbapenems increases the rate of resistant organism in a trauma ICU. S. Khetarpal, M. Swaroop, L. Llerena, D. Shapiro, D. Ciesla. From the University of South Florida, Tampa, Fla.

Objective: To evaluate the impact of an antibiotic crop rotation for the treatment of ventilator-acquired pneumonia (VAP) on the flora of a surgical/trauma intensive care unit. **Methods:** An antibiotic crop rotation for the treatment of VAP was initiated at a major university trauma centre. The antibiotics used were rotated on a 3-month basis. Rotations included a piperacillin/tazobactam in conjunction with empiric methicillin-resistant *Staphylococcal aureus* coverage (MRSA), cefepime + MRSA coverage and meropenem + MRSA coverage. The hospital infection-control program was used to monitor the flora, the presence of resistant organisms and antibiotic gram of the surgical trauma intensive care unit (SICU). Empiric therapy for VAP was started on the judgment of the clinician, and quantitative lower respiratory tract secretions were used to confirm the diagnosis. If cultures were not diagnostic for VAP, antibiotics were stopped. After final cultures and sensitivities were obtained, de-escalation of antibiotics was done where clinically indicated. Duration of antibiotics varied according to the clinician, but the protocol called for cessation at 8 days. There were no cases where antibiotics were continued for greater than 14 days without a clinical indication. **Results:** During the rotations consisting of piperacillin/tazobactam + MRSA coverage and cefepime + MRSA coverage, there were no significant changes in the flora in the SICU. In particular there was no increase in resistant organisms including vancomycin-resistant *Enterococci* (VRE), *Acinobacter* or *Stenotrophomonas*. During the 3-month rotation in which meropenem was the gram-negative coverage, there was an increase in the incidence of *Stenotrophomonas* from a baseline of 1 per 100 ventilator days to 3 per 100 ventilator days. The incidence of *Stenotrophomonas* returned to baseline at the completion of the crop rotation. There was no increase in VRE or *Acinobacter* during this 3-month period. **Conclusion:** An antibiotic rotation consisting of meropenem is more likely to result in the selection of resistant organisms compared with other recommended combinations.

10046

All-terrain vehicle crashes in an unregulated environment: a prospective study of 56 cases. M. Alani,* A. Zarour,* A. Almadani,* A. Al-aieb,* H. Hamzawi,* K.I. Maull,* D.S. Mulder.† From the *Trauma Center at Hamad General Hospital, Doha, Qatar and †Montreal General Hospital and the Department of Surgery, McGill University Health Centre, Montréal, Que.

In this affluent country, recreational activities make up a significant part of daily life. All-terrain vehicle (ATV) use is increasing at a rapid pace in a setting without safety regulations. While the trauma consequences are severe, the potential for risk reduction is also significant. **Aim:** To define injury patterns, impairments and outcomes among patients injured in ATV crashes; to determine the prevalence of protective equipment use; and to define the potential role of injury prevention in addressing the problem. **Methods:** During a recent 10-month period, 56 patients were injured in ATV crashes seriously enough to require admission and were prospectively entered into a study-specific database. Patient demographics, site of crash, prior ATV experience and use of safety equipment were recorded. Injuries were characterized by body system and tabulated. Outcome, including deaths and impairments, were defined. **Results:** There were 47 males (84%) and 9 females (16%). Most injuries occurred in patients older than 18 years (60%), but 20% occurred in children less than 14 years of age. No protective equipment was used in 88%. Most injuries occurred at recreational sites. Three patients died (5% mortality). Significant disability occurred in 19 patients (35%) and was permanent in 4 (7%). Injuries are listed by body system in the Table. Head and face injuries were more common in the

Table, abstract 10046. Injuries sustained in all-terrain vehicle crashes in a 10-month period

Injury system	No. injuries (%)
Head and face	25 (46)
Torso	18 (32)
Spine	10 (18)
Musculoskeletal	24 (43)

childhood group. More experienced riders (> 5 times riding an ATV) appeared to receive less severe injuries compared with those with no previous ATV experience. **Conclusion:** ATV crashes can cause serious injuries including death and permanent disability. The lack of awareness of the injury potential for this popular recreational activity has escalated the risk of injury, and the absence of safety programs and/or regulation has further aggravated the problem. Based on these data, a public education program, requirements for use of helmets and other protective garb and penalties for noncompliance should be implemented. Interventions at recreation sites and the point of ATV sale may be most beneficial.

10049

Educational needs assessment of early trauma management skills in residents. A. Pandya,* R. Velani,† N. Ahmed,* A Nathens.* From *St. Michael's Hospital and the †Sunnybrook Health Sciences Centre, Toronto, Ont.

Aim: In Canada there are 17 university-based family medicine programs that train approximately 967 physicians per year. An educational program for family medicine physicians should provide adequate exposure, training and ongoing educational resources to continue to maintain competency in managing trauma patients. However, outside the Advanced Trauma Life Support course, very few educational resources exist for training physicians in the triage and early management of trauma patients. In this study, we survey family medicine residents and emergency medicine fellows to determine their training, perception of trauma skills, confidence levels in trauma management and preferences for educational programs. **Methods:** A web-based survey tool was developed to assess the current state of resident training, perception of trauma skills, management of complex trauma cases and need for further education and training. **Results:** This survey is currently in the recruitment and data-collection phase. **Significance:** Family physicians are frequently the first-line providers in the care of severely injured patients, yet their training curriculum might lack the content required to assure a level of competence and confidence. Given their role in initial management, we believe an understanding of family physicians' level of preparedness and their perceived educational needs might inform curriculum development of residency training and continuing medical education programs.

10050

Hypertonic saline-dextran resuscitation quiets sympathetic storming and modulates inflammatory cytokine production after traumatic brain injury. S.G. Rhind,^{*,†} A.J. Baker,^{*,†} P.N. Shek,^{*,†} N.T. Crnko,^{*} L.J. Morrison,[†] S.B. Rizoli.^{†§} From the University of Toronto and *Defence Research and Development Canada, the †TOPHR HIT investigators, ‡St. Michael's Hospital and §Sunnybrook Health Sciences Centre, Toronto, Ont.

Background: Severe traumatic brain injury (TBI) leads to sympathetic nervous system (SNS) activation with massive release of catecholamines (epinephrine, E; norepinephrine, NE) and pro-tumour necrosis factor α , TNF) and anti-inflammatory (interleukin, IL10) cytokines. Hypertonic fluids reduce intracranial pressure following TBI. We examined the effects of hypertonic fluid resuscitation on catecholamine and cytokines release. **Methods:** Sixty adult severe TBI patients (Glasgow Coma Scale score ≤ 8) were randomized to a 250-mL infusion of hypertonic (7.5% NaCl) saline dextran (HSD) or placebo in a prehospital randomized controlled trial. Plasma E, NE, TNF and IL10 (pg/mL) were measured on admission and at 12, 24 and 48 hours. Twenty-five healthy volunteers served as controls. **Results:** On arrival mean (\pm standard error of the mean) E (665.3 ± 188.2) and NE (671.6 ± 85.2) were high, up to 18 times higher in all patients compared with controls (E 36.8 ± 2.6 ; NE 311.8 ± 21.0). Placebo patients massively released E (1082.7 ± 291.3) and NE (823.7 ± 124.8), up to 30 times higher than controls. HSD patients had only slightly elevated E (195.8 ± 60.1) and NE (500.5 ± 85.9), that by 12 hours normalized (E 55.0 ± 16.2 ; NE 474.3 ± 169.6). Placebo patients' E and NE continued to rise up to 24 hours. TNF was higher than controls' (0.32 ± 0.07) in all TBI patients on admission. In placebo, TNF (10.3 ± 1.2) was twice that of HSD (5.1 ± 1.4). TNF remained higher throughout the study, with no difference between groups. IL10 was high at all time

points in all patients (0.77 ± 0.24). Peak IL10 (25.0 ± 3.7) occurred on admission in placebo patients, whereas HSD patient levels were half those of placebo. **Conclusion:** HSD resuscitation of severe TBI patients has significant neuroendocrine-immunomodulatory properties, including attenuation of catecholamine and cytokine disequilibrium with less release of TNF and IL10. Our study suggests that HSD may be a superior resuscitation fluid that lessens the profound neuroinflammatory responses after TBI.

10051

Severely injured geriatric population: risk factors for death. S. Winocour, N. Labib, P. Fata, T. Razek, K. Khwaja. From the Department of Surgery, McGill University Health Centre, Montréal, Que.

Objectives: With an increasing life expectancy and more active elderly population, management of geriatric trauma patients continues to evolve. The aim was to describe the mechanism and injuries of severely-injured geriatric patients and to identify risk factors associated with mortality. **Methods:** The trauma registry at a Canadian level-1 trauma centre was queried for all trauma patients with age greater than 65 years and ISS greater than 15 from 2004 to 2006, resulting in a retrospective chart review of 276 patients. The data were subsequently analyzed using univariate and multivariate analysis. **Results:** The average age was 81.5 years (mean ISS 25). The most common comorbid illness was hypertension (57.3%), and the most frequent mechanism of injury was falls (72.3%). Overall mortality was comparable to that in the US National Trauma Data Bank (26.8% v. 32.0%, 95% CI 0.00–0.10). However, among patients aged 75–84 years, the mortality rate was lower (31% v. 45% (95% CI –0.25 to –0.03)). Geriatric patients requiring intubation, blood transfusions or suffering from head, C-spine or chest trauma had an increased likelihood of death (Table). In-hospital respiratory, gastrointestinal or infectious com-

Table, abstract 10051. Univariate analysis for mortality in a geriatric trauma population

Variable	OR (95% CI)
Intubation	12.6 (6.3-24.8)
Blood transfusions	3.1 (1.6-6.1)
Trauma	
Head	3.8 (1.1-13.0)
C-spine	2.6 (1.1-5.9)
Chest	2.3 (1.3-4.2)
In-hospital complication	
Respiratory	2.7 (1.5-4.9)
Gastrointestinal	4.4 (1.6-11.9)
Infectious	4.2 (2.4-7.5)

CI = confidence interval; OR = odds ratio.

plications also had higher likelihood of death on univariate analysis. Multivariate analysis identified intubation and respiratory complication as important risk factors. **Conclusion:** Falls continue to be the most frequent mechanism of injury in severely-injured geriatric patients. Risk factors associated with a higher likelihood of death are identified. More research is needed to better understand this important and growing group of trauma patients.

10052

Screening for alcohol in trauma care: current practice in Ontario. *D.B. Rootman,^{**†} C. McAlister,^{**†} A. White McFarlan,^{*} R. Mustard,^{**†} N. Ahmed.^{**†}* From ^{*}St. Michael's Hospital and the [†]University of Toronto, Toronto, Ont.

Background: Despite clear evidence that universal alcohol screening of severely injured patients followed by a brief in-hospital intervention decreases trauma-related recidivism and mortality, clinicians remain ambivalent about universal screening of this high-risk population. The purpose of this investigation is to document screening rates and to understand clinicians' attitudes and perceptions concerning the goals of screening for alcohol in patients presenting to trauma centres in Ontario. **Methods:** Physicians with primary responsibility for the care of acutely injured patients (trauma team leaders) in Ontario were surveyed for their attitudes and beliefs related to rates, biases and goals in alcohol screening among trauma patients. **Results:** Sixty percent of the survey population responded. Three-quarters of respondents reported that 80% of patients were being screened in their centre. Respondents tended to cite substance abuse treatment (74.5%) and the prevention of injury-related harm (96.1%) as the prime utilities of screening. The majority of clinicians believed that substance abuse treatment is effective in preventing trauma recidivism (75.5%) and that such services would be used if they were expanded in their institution (80.4%). **Conclusion:** The majority of physicians surveyed possess the knowledge that alcohol screening followed by a brief counselling-typed intervention is an effective way to reduce trauma-related harm. However, we demonstrate a deficiency in knowledge translation in that universal screening is not uniformly practised. There is a need for improving clinician practice in this domain as well as expanding in-hospital intervention services for such patients.

10058

Outcomes in seriously head-injured patients undergoing prehospital tracheal intubation versus emergency department tracheal intubation. *J.M. Tallon.* From the Departments of Emergency Medicine and Surgery, Dalhousie University, Capital Health, Halifax, NS.

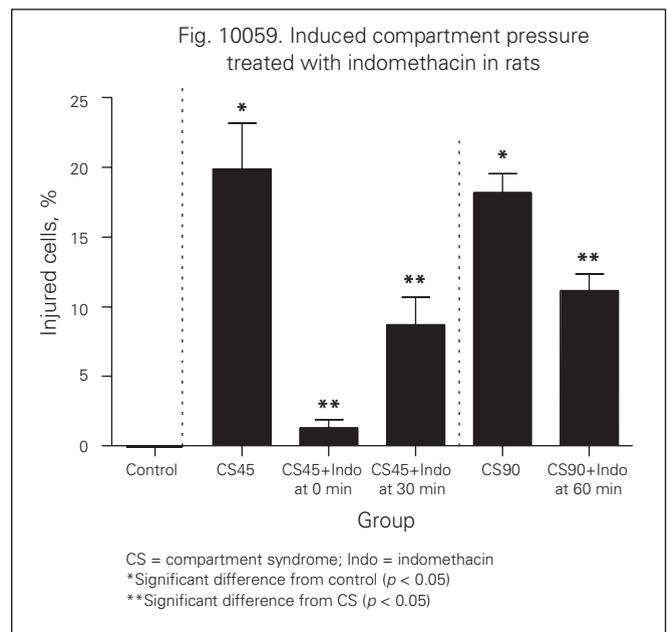
Objectives: This study measured the effect on mortality of pre-hospital intubation (PHI) versus emergency department intubation (EDI) in seriously head-injured patients. **Methods:** In the single emergency medical services system for this Canadian province and using a population-based trauma database, conventional logistic regression, with and without the use of a propensity score to control for treatment effect bias, was used to evaluate the effect of PHI versus EDI on mortality. Inclusion criteria were age 16 years and greater, serious head injury (Abbreviated Injury Scale score ≥ 3 , nonpenetrating trauma) and resuscitative intubation (PHI or EDI). **Results:** A total of 283 patients admitted over 5 years (2000–2005) met inclusion criteria. Conventional unconditional logistic regression modelled on mortality with intubation forced in the model as the intervention of interest showed an odds ratio (OR) of 2.015 (95% CI 1.062–3.825) for improved survival if these patients were intubated in the ED rather than in the prehospital phase of care. A propensity score adjustment demonstrated a similar but more conservative point estimate (OR 1.727, 95% CI 0.993–3.004). **Conclusion:** This observational

study demonstrated a survival advantage with EDI in seriously head-injured patients versus PHI in a mature province-wide Emergency Medical Services system.

10059

Indomethacin intervention may preserve muscular integrity during compartment syndrome. *A. Manjoo,^{**†} A. Lawendy,^{**†} D.W. Sanders,^{**†} D.K. Gray,^{**†} N.G. Parry,^{**†§} A. Badhwar.^{**†}* From the ^{*}Department of Surgery, Schulich School of Medicine and Dentistry, University of Western Ontario, the [†]Centre for Critical Illness Research, the [‡]Trauma Program, London Health Sciences Centre, and the [§]Division of Critical Care, Schulich School of Medicine and Dentistry, University of Western Ontario, London, Ont.

Introduction: We have previously demonstrated through the use of our novel animal model of skeletal muscle compartment syndrome (CS) that, along with a massive inflammatory response, there is also a drastic reduction in capillary reflow and an increase in acute cellular injury. We investigate here the effect of indomethacin (a potent antioxidant/anti-inflammatory) on controlling the pathophysiology associated with CS. **Methods:** Rats were randomized to receiving either 45 or 90 minutes of elevated pressure in the anterior compartment of the hind limb (containing the extensor digitorum longus [EDL] muscle) before fasciotomy. Control animals experienced no elevation in compartment pressure. The animals were further randomized to either receiving no indomethacin or at 0 minutes or 30 minutes of CS (for the 45-minute CS group) or 60 minutes (for the 90-minute CS group). Intravital videomicroscopy (IVVM) of the EDL was used to assess microvascular perfusion, cellular injury and inflammatory response following fasciotomy. Ex vivo ELISA analysis was used to measure caspase activity in the EDL to determine the level of apoptotic versus necrotic cell injury. **Results:** IVVM demonstrated that CS resulted in a dramatic increase in cellular injury (Figure), a decrease in microvascular perfusion and a profound inflammatory response in all animals.



Those receiving indomethacin showed an improvement in these pathologies with diminishing efficacy as time before administration increased (Figure, Table). Indomethacin failed to reduce

Table, abstract 10059. Representative data for the effects of 45 minutes compartment syndrome and indomethacin

Group	Injury (%)	Apoptosis (fold increase to control)
Control	0.007 (0.003)	–
CS	19.889 (3.312)*	2.41*
CS + Indo	1.318 (0.575)**	2.15*

CS = compartment syndrome; Indo = indomethacin.
 *Significantly different from control ($p < 0.05$).
 **Significantly different from CS ($p < 0.05$).

the increase in apoptotic cell injury seen during CS. **Conclusion:** These observations have led us to formulate a new model for the pathophysiology of CS and have also shown that antioxidant/anti-inflammatory treatments may be a useful tool in preserving the integrity of the skeletal musculature before and following fasciotomy.

10060

The role of telemedicine in trauma education. A. Pandya, J. Ali, A. Nathens. From St. Michael's Hospital, Toronto, Ont.

Aim: The Advanced Trauma Life Support (ATLS) course plays an important role in trauma education by providing a framework for the resuscitation of injured patients. So far, the ATLS course has been taught mainly in urban teaching hospitals, therefore limiting its accessibility to rural medical personnel. Telemedicine technology offers the advantage to educate from a distance and provide training to rural communities. The aim of this pilot project is to assess the effectiveness of telemedicine technology in teaching the Advanced Trauma Life Support course. **Methods:** Two groups of students will undergo the ATLS lecture series using the classroom-based versus the telemedicine approach. The effectiveness of both methods will be objectively evaluated through post-test scores, performance in skill stations and initial assessment exams. A survey tool will be developed to assess the participants' rating of each component and satisfaction with the course conduct. **Results:** The ATLS course was provided to residents in 2 formats, the classroom-based ($n = 16$) and the telemedicine format ($n = 14$). There was no statistical difference between the 2 groups in the post-test multiple choice questionnaire scores, performance in skill stations and feedback of the lectures. **Conclusion:** Data from this pilot project validate that the telemedicine format is equally as effective as classroom teaching for the ATLS lecture series. This knowledge will help to promote the delivery of the ATLS course to rural communities.

10063

Management of pediatric splenic injuries in Canada. L.A. Grandy, N.L. Yanchar. From the Department of Surgery, Dalhousie University, Halifax, NS.

Background: Nonoperative management (NOM) of blunt splenic injuries has become the standard of care in hemodynamically stable children. This study compares the management of

these injuries between pediatric and nonpediatric hospitals in Canada. **Methods:** Data were obtained from the Canadian Institutes of Health Research on all patients aged 2–16 years admitted to a Canadian hospital with a diagnosis of splenic injury between May 2002 and April 2004. Variables included age, sex, associated major injuries, splenic procedures, intensive care unit (ICU) admissions, blood transfusions and length of stay. Hospitals were coded as either pediatric or nonpediatric. Univariate analysis and logistic regression were used to determine associations between hospital type and outcomes. **Results:** Of 1284 cases, 654 were managed at pediatric hospitals and 630 at nonpediatric centres. Patients at pediatric centres tended to be younger and were more likely to have associated major injuries. Controlling for covariates, including associated major injuries, patients managed at pediatric centres were less likely to undergo splenectomy compared with those managed at nonpediatric centres (odds ratio [OR] 0.2, 95% CI 0.1–0.4). However, the risk of receiving blood products, admission to the ICU and staying in hospital for more than 1 week were associated only with having associated major injuries (OR 10.1, 95% CI 5.2–20; OR 3.7, 95% CI 2.0–6.7; OR 7.4, 95% CI 4.2–13), not hospital type. **Conclusion:** Even in the presence of other major injuries, successful NOM of blunt splenic injuries occurs more frequently in pediatric hospitals in Canada. This has policy relevance regarding education of adult surgeons about the appropriateness of NOM in children and developing guidelines on appropriate regional triaging of pediatric patients with splenic injury in Canada.

10065

We treat the bleeding we see: the use of fresh frozen plasma in trauma. J.B. Rezende-Neto,*† R. Pinto,* J. Hoffmann,* H. Tien,* L. Tremblay,* V. Speers,* S.B. Rizoli.* From the *Sunnybrook Health Sciences Centre and the University of Toronto, Toronto, Ont., and the †Federal University of Minas Gerais–Risoleta Tolentino Neves University Hospital Trauma Centre and CAPES, Belo Horizonte, Brazil.

Aim: Fresh frozen plasma (FFP) is indicated to treat coagulopathy (to correct clotting factor deficits) whereas surgery is to control mechanical sources of bleeding. Distinguishing coagulopathic from mechanical bleeding is often unachievable. We examined FFP use in trauma resuscitation by measuring clotting factor levels in trauma patients. **Methods:** A total of 319 patients (267 with blunt and 42 with penetrating injuries) underwent multiple measurements of clotting factors, partial thromboplastin time (PTT), international normalized ratio (INR), platelets, fibrinogen, hemoglobin, all analyzed against FFP transfusion. **Results:** A total of 56 blunt (21%) and 9 penetrating (21.4%) trauma patients had critical clotting factor deficits ($< 30\%$) and were thus coagulopathic. PTT, INR, platelets and fibrinogen were equally abnormal in both groups. In contrast, analyzing the mechanism, almost twice as many penetrating trauma patients as blunt trauma patients received FFP (19.1% v. 11.2%). Red blood cell transfusion and crystalloids infusion were similar in both groups. Adjusting for ISS, INR, activated PTT and platelets, penetrating trauma patients were 8 times more likely to received FFP (odds ratio 8.4, 95% CI 2.71–26.25, $p = 0.0002$). Among 31 patients who had low clotting factors at baseline, only 36% corrected within the first 24 hours after receiving FFP. **Conclusion:** Objective measurements of clotting factor deficit

demonstrate that only 1 in 4 coagulopathic patients receive FFP, and only 4 in 10 have the critical deficit corrected. Our results also suggest that FFP is being used to treat mechanical bleeding. We speculate that the more visible the bleeding to the surgeon from penetrating injuries (compared with blunt), the more likely the surgeon is to administer FFP.

10066

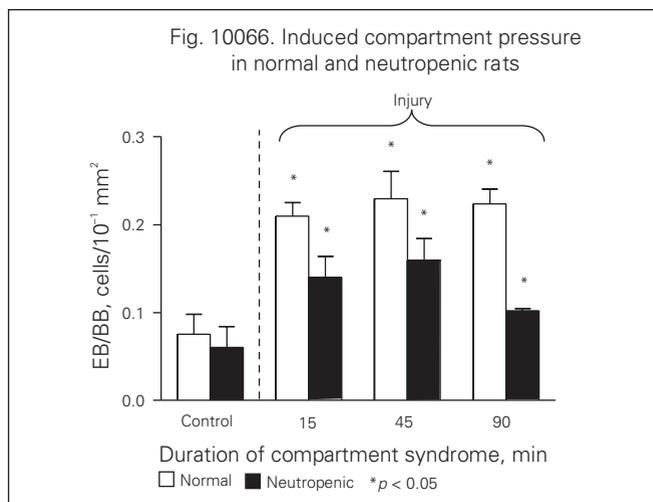
Inflammation causes muscle injury in compartment syndrome: a leukocyte deplete rodent model. A. Lawendy,^{*†} A. Manjoo,^{*†} A. Bihari,^{*} D.W. Sanders,^{*†} N.G. Parry,^{*†‡§} D.K. Gray,^{*†‡} A. Badhwar.^{*†} From the ^{*}Centre for Critical Illness Research, the [†]Department of Surgery, Schulich School of Medicine and Dentistry, the [‡]Trauma Program, London Health Sciences Centre, and the [§]Division of Critical Care, Schulich School of Medicine and Dentistry, University of Western Ontario, London, Ont.

Introduction: Increased intracompartmental pressure results in tissue ischemia and cell death. The pathophysiologic mechanisms of compartment syndrome (CS) are not well understood. Inflammatory pathways have been postulated to cause injury in CS. As such, this study was designed to measure the effects of increased intracompartmental pressure on skeletal muscle microcirculation, inflammation and cell viability using intravital videomicroscopy (IVVM) in a neutropenic rodent model. **Methods:** Male Wistar rats were randomized into 2 groups: control and neutropenia. Neutropenia was established with an injection of high-dose cyclophosphamide (250 mg/kg). CS was induced by saline infusion into the anterior compartment of the hind limb. Compartment pressure was controlled between 30 and 40 mmHg and maintained for 0, 15, 45 or 90 minutes. Following reperfusion via fasciotomy, microvascular dysfunction, inflammatory response and parenchymal injury were assessed in the extensor digitorum longus (EDL) muscle. **Results:** CS resulted in a significant reduction in the capillary perfusion in both neutropenic animals and non-neutropenic animals with increasing severity as the duration of CS increased (Table). Importantly, neutropenia protected the muscle from injury as evidenced by a reduction in injury of up to 50% compared with controls (Figure). **Conclusion:** This study demonstrates the importance of inflammation to the injury seen in CS. A 50% reduction in cellular injury was noted in the neutropenic group as compared with controls with intact inflammatory pathways. CS resulted in a reduction in microvascular perfusion that was more severe with increased duration of CS. Neutropenia was protective against cell injury in all experimental groups.

Table, abstract 10066. Number of continuously perfused capillaries per mm in EDL

Compartment pressure	Group; mean (SD)	
	Normal	Neutropenic
Control (none)	76.6 (3.3)	78.7 (4.3)
15 min	45.7 (10.1)*	48.3 (11.1)*
30 min	39.8 (9.6)*	35.9 (6.6)*
45 min	27.2 (7.9)*	24.2 (9.9)*

EDL = extensor digitorum longus muscle.
*p < 0.05 relative to control.



10068

Compartment syndrome causes a systemic inflammatory response and remote organ injury. A. Lawendy,^{*†} G.W. McGarr,^{*} J.T. Phillips,^{*} D.W. Sanders,^{*†} N.G. Parry,^{*†‡§} D.K. Gray,^{*†‡} A. Badhwar.^{*†} From the ^{*}Centre for Critical Illness Research, 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, Schulich School of Medicine and Dentistry, University of Western Ontario, London, Ont.

Introduction: Severe compartment syndrome is associated with end organ damage and systemic inflammatory response syndrome (SIRS). Intravital videomicroscopy (IVVM) is a useful tool to study SIRS and its effect in end organs. In this study, the systemic effect of hind limb compartment syndrome was studied using hepatic IVVM. The purpose was to measure the effect of increased intracompartmental pressure on hepatocyte viability, inflammation and blood flow in a rodent model. **Methods:** Wistar rats were randomized into control (C) and compartment syndrome (CS) groups. Elevated intracompartmental pressure was induced by saline infusion into the anterior compartment of the hind limb and maintained for 2 hours between 30 and 40 mmHg in the CS group. Two hours following fasciotomy, the liver was analyzed using IVVM to quantify capillary perfusion as a measure of microvascular dysfunction. The numbers of adherent and rolling leukocytes in venules and sinusoids were quantified to measure the inflammatory response. Irreversible hepatocyte injury was measured using a dye that labels severely injured cells. **Results:** Hepatocellular injury was significantly higher in the CS group compared with controls

Table, abstract 10068. Compartment syndrome resulted in an increase in hepatocyte injury and inflammation

Group	Response; mean (SD)	
	Injury, no. cells/100 μm ²	Inflammation, no. WBCs/FOV
Control	30 (12)	0.2 (0.2)
CS	325 (103)*	5.0 (2.0)*

CS = compartment syndrome; FOV = field of view; SD = standard deviation; WBC = white blood cells.
*p < 0.05.

(Table). Inflammation, as assessed by the number of adherent venular white blood cells (WBC) was significantly higher for the CS group than controls. Volumetric blood flow was not significantly different between CS and controls. **Conclusion:** After only 2 hours of CS, the number of activated WBCs increased 25-fold, and liver cellular injury increased 10-fold compared with controls. Marked systemic inflammation and hepatocellular damage was detected in response to isolated limb CS. CS is a low-flow ischemia/reperfusion injury with a profound inflammatory response. Further research into the severe end-organ damage associated with compartment syndrome is required.

10069

Evolving trends in hepatic trauma management: a 10-year review from a provincial trauma referral centre. *M. Goecke,* R.K. Simons,* P. Brasher,† S.M. Hameed.** From the *Department of Surgery, University of British Columbia, and the †Centre for Clinical Epidemiology and Evaluation, Vancouver, BC.

Objectives: Nonoperative management (NOM) is successful in the majority of patients with hepatic injuries, though surgery, including occasional heroic interventions unfamiliar to many surgeons, may be required. New approaches to complex hepatic trauma have emerged recently, including damage-control concepts, veno-venous bypass and stapled nonanatomic resection. This study reports on evolving trends in hepatic trauma management, the impact on overall survival and predictors of failure of nonoperative management at a provincial trauma referral centre. **Methods:** A 10-year retrospective review of the British Columbia Trauma Registry (BCTR) was performed to identify all patients who sustained a liver injury and were admitted to the provincial trauma referral centre. Chart review identified management strategy (operative or NOM) and outcomes. Data were analyzed for trends in management and outcome, predictors of failure of nonoperative management and analysis of mortality risk factors. **Results:** A total of 389 patients sustained a hepatic injury; 81% resulted from a blunt mechanism. The average age was 36 years; 65% were male. Liver-related mortality was 1%. NOM was attempted in 56% and was 95% successful. Penetrating trauma comprised 2% of the NOM group in comparison with 60% of the operative group. Operative techniques included packing (77%), hemostatic agents (46%), cautery (44%) and stapled nonanatomic resection (8%). Surgical adjuncts included the Pringle manoeuvre (13%) and veno-venous bypass (2%). Increasing age, need for surgical intervention and gunshot wounds were independently associated with higher mortality risk. **Conclusion:** Blunt trauma accounted for the majority of hepatic injury; NOM has a low failure rate in this population. Simple surgical techniques such as packing, cautery and hemostatic agents can be used to effectively control bleeding in the majority requiring surgery. Stapled, nonanatomic resection offers a rapid, damage-control, hemostatic technique for liver débridement with good results.

10070

Prototype C-spine traction device for closed reduction, stabilization, and transport of unstable C-spine injuries: a bio-mechanical cadaveric study. *M.A. Boitano,* R. Lodewyks,† R.B. Dunlop,‡ F.G. Baillie.‡* From *Hamilton Health Sciences Trauma Services, and the Departments of †Engineering and ‡Surgery, McMaster University, Hamilton, Ont.

Objective: Awake, closed reduction with traction of facet dislocations is preferred over open reduction as neurologic status can be monitored. The current method using free weights and pulleys has several drawbacks, notably an inability to maintain constant force when the patient is being transported on a stretcher and incompatibility with CT imaging and MRI. The objective was to improve the apparatus used in the closed reduction, decompression, stabilization and transport of unstable C-spine injuries using a prototype variable force traction device. **Method:** Using fresh frozen cadavers, unilateral and bilateral facet dislocations were created at the C5–6 level. Inline traction with the traditional free weights method was used for baseline measurements followed by placement of the prototype traction device. Fluoroscopic imaging was used for documentation. Statistical analysis between the prototype and traditional method was performed with regard to weight required for reduction using the Student *t* test. **Results:** Fluoroscopic imaging demonstrated reduction of the instability patterns created in the cadavers using both methods. Comparing the weight required for reduction, a $p < 0.05$ was obtained. **Conclusion:** The prototype traction device met the objective of being a viable replacement to the traditional closed reduction method. Additionally, being self-contained, it allows for safe transport by air or ground. It also permits CT imaging and MRI-guided reduction.

10071

Outcomes of the implementation of a new trauma transfusion pathway in a canadian lead trauma hospital. *K.N. Vogt,* L. Minuk,† K. Eckert,† I. Chin-Yee,† D. Gray,** N. Parry.**‡§* From the *Department of Surgery, the †Division of Hematology, Schulich School of Medicine and Dentistry, University of Western Ontario, the ‡Trauma Program, London Health Sciences Centre, the §Division of Critical Care, Schulich School of Medicine and Dentistry, University of Western Ontario, and the Centre for Critical Illness Research, London, Ont.

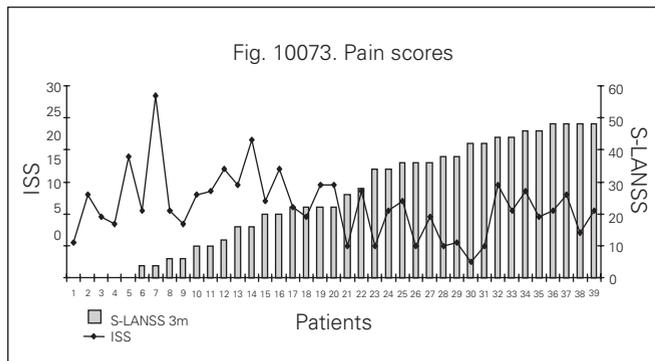
Objectives: To describe clinical outcomes and blood product utilization after implementation of a new trauma transfusion pathway (TTP) in a lead trauma centre. **Methods:** Our TTP was created based on published military experience, advocating for physiologic replacement of blood products early in trauma resuscitation (1:1:1 packed red blood cells [PRBC]:fresh frozen plasma [FFP]:platelets). Analysis included all patients receiving massive transfusions (MT) of more than 10 units PRBCs after severe trauma (ISS > 12) from April 2007 to September 2008. Comparison was made to a historic cohort of patients receiving MT before the implementation of the TTP. **Results:** Seventeen trauma patients who received MT via the TTP were compared with 17 pre-TTP controls, with no significant difference in baseline characteristics. Five mortalities occurred in the TTP group and 9 in the pre-TTP group ($p = 0.16$). No difference in the amount of PRBCs, FFP, platelets and cryoprecipitate given was seen ($p = 0.48$, $p = 0.88$, $p = 0.21$ and $p = 0.20$, respectively); however, the first unit of FFP was given significantly earlier in the TTP group ($p < 0.01$). Though the initial international normalized ratio (INR) was not significantly different between groups ($p = 0.22$), the peak INR in the initial 24 hours was significantly lower in the TTP group ($p = 0.005$). **Conclusion:** Early results from our TTP show a trend toward decreased mortality with no increase in blood product utilization. Patients receiving MT via

the TTP also had a lower peak INR over the initial 24 hours. These results suggest that a TTP helps prevent the development of significant coagulopathy and may improve mortality for severely injured trauma patients requiring massive transfusions.

10073

The experience of pain after a traumatic injury. L. Haslam, J. Sawyer, H. Tien, C. Restrepo. From the Sunnybrook Health Sciences Centre, Toronto, Ont.

Aim: Studies have demonstrated that patients who experience moderate to severe pain during their hospital stay are at high risk for developing chronic pain (Edwards, 2005), and that certain populations are at high risk for developing persistent pain (Hayes, 2002). Trauma and surgery are the leading causes of neuropathic pain (Hayes, 2002). Insight into the trauma patient's experience of pain after discharge is sparse. This project aims to gain insight into the experience of persistent pain following a traumatic injury. **Method:** A total of 113 patients (52% female, mean ISS = 23) consented to complete a Brief Pain Inventory, a short-form of the McGill Pain Questionnaire and the S-LANSS questionnaire. The questionnaires were administered at time of enrollment, at 4 weeks and at least 3 months postinjury. **Results:** Of the 44 patients who completed the 3-month survey, 80% answered "yes" to experiencing pain on the day they completed the survey (Figure). Significant positive correlations exist between the ISS



and length of stay, as well as between the ISS and number of operating procedures. A significant negative correlation was found between the ISS and the average pain score at 3 months. The mean S-LANSS score was 12.42 (SD 8.3). A score of 12 or more suggests pain of predominantly neuropathic origin. **Conclusion:** These preliminary findings suggest that there is a high incidence of neuropathic pain at 3 months following a traumatic injury. Ongoing investigation is warranted to identify if early intervention can prevent persistent neuropathic pain. An S-LANSS score of 12 or more indicates pain of predominantly neuropathic origin: 47% of patients scored 12 or greater at 3 months postinjury.

10074

IVC filters in a Canadian trauma patient population: Are they really retrievable? W.R. Leeper,* D.K. Gray,* S.W. Kribs,† N.G. Parry.* From the Departments of *Surgery and †Radiology, University of Western Ontario, London, Ont.

Background: Retrieval inferior vena cava filters (IVCF) are often used; however, concern has been raised about low rates of

filter retrieval. We examined the rate of IVCF retrieval in our Canadian level-1 trauma hospital. **Hypothesis:** Dedicated follow-up by a full-time trauma nurse practitioner would result in higher rates of IVCF retrieval. **Methods:** Retrospective analysis of all patients who had IVCF placement at our level-1 trauma centre between 2000 and 2008 was performed. Data were collected on demographics, reason for filter placement, filter removal, dwell time and reasons for nonremoval of filters. Pearson χ^2 was used for statistical analysis. **Results:** Of the 175 IVCFs placed, 27 were placed in trauma patients, and there was no loss to follow-up. Eighty-five percent ($n = 23$) were successfully removed with an average dwell time of 21.3 (range 10–36) days. Of the 4 patients who did not have their IVCF removed, 2 (7.5%) died due to their injuries before retrieval and 2 (7.5%) had retrieval aborted due to trapped clot. There were no complications associated with filter insertion or retrieval. IVCFs were removed in only 42% (62/148) of nontrauma medical and surgical patients ($p < 0.05$ v. trauma retrieval rate). **Conclusion:** A dedicated program with a nurse practitioner can ensure complete follow-up and a high retrieval rate. IVCFs really are retrievable.

10078

Outcomes following angioembolization for high-grade blunt splenic injury: assessment of splenic function and time to splenic healing. J. Grushka, T. Razek, K. Khawja, P. Fata. From the Department of Surgery, McGill University Health Centre, Montréal, Que.

Background/Purpose: Splenic artery angioembolization (EMBO) has been reported to increase the success rate of non-operative management of blunt high-grade splenic injury. The aim of this study is to compare the clinical outcomes of both main splenic artery (MSA) and selective distal splenic artery (SSA) embolization in terms of morbidity, splenic function and time to splenic healing. **Methods:** We prospectively followed all patients identified at a level 1 trauma centre with high-grade blunt splenic injury who underwent EMBO beginning in September 2004 to January 2007. All patients underwent CT of the abdomen at initial presentation, at discharge, and at 6 weeks, 10 weeks and 14 weeks postdischarge or until the spleen was completely healed on CT. Circulating immunoglobulin levels were evaluated post-EMBO and after radiologic evidence of complete splenic healing. **Results:** Seventeen patients underwent EMBO (MSA or SSA) for blunt splenic injury during the study period at the discretion of the trauma surgeon and interventional radiologist. Mean time to splenic healing was longer with MSA (136 d) compared with SSA (81 d) ($p < 0.05$). Mean circulating IgG and IgA levels were decreased with MSA (7.7 g/L, 0.9 g/L) compared with SSA (11.9 g/L, 3.9 g/L) at the time of complete splenic healing ($p < 0.05$). **Conclusion:** Immunologic function of the spleen is conserved after EMBO. SSA results in superior residual splenic function and allows for faster healing of the spleen compared with MSA. The longer healing time with activity restriction associated with MSA severely impacts quality of life, since the majority of trauma patients are otherwise young and healthy.

10079

Is computed tomography overused in the management of blunt thoracic trauma in children? B. Sweeney, M. Brennan-Barnes.

From the Children's Hospital of Eastern Ontario, Ottawa, Ont.

Background: The role of computed tomography (CT) in blunt thoracic trauma (BTT) in children has yet to be defined. Risks of missing a life-threatening injury must be weighed against exposing pediatric patients to high radiation doses. **Objective:** To help define the role of CT in the management of BTT in a pediatric population. **Methods:** Data from 1996 to 2008 were extracted from the Trauma Registry of the Children's Hospital of Eastern Ontario. Patients with an Injury Severity Score of 12 or greater with BTT were included. Injuries as determined by chest x-ray, CT, ultrasound and post mortems were reviewed. **Results:** A total of 129 patients were studied; 76 boys and 53 girls (1–18 yr). Motor vehicle crashes accounted for 63 patients, pedestrians (21), falls (16), cyclists (9), off-road vehicles (10) and other (10). Ninety-six patients did not undergo CT. In this group, chest x-ray detected 142 injuries: pulmonary contusion (53), hemopneumothorax (41), pneumomediastinum (7) and rib fractures (41). Forty-five patients underwent a chest CT and had a total of 58 injuries detected: lung contusion (28), hemopneumothorax (17), pneumomediastinum (2), rib fractures (10) and aortic injury (1). Two of 129 patients sustained cardiac injuries detected by ultrasound. Six patients died during resuscitation. Autopsy revealed major thoracic vessel injuries in 2 of these patients. In survivors, there were no cases of delayed presentation of a thoracic aortic injury. **Conclusion:** Routine use of CT in this population is not justified. Prospective evaluation and possible rationalisation of current CT indications is warranted.

10080

Holiday long weekend trauma in Ontario. P.W. Sharkey, L. Tremblay, C. Rogers, F.D. Brenneman, J. Banfield, S.B. Rizoli. From the Sunnybrook Health Sciences Centre, Toronto, Ont.

Holiday long weekends (HLW) are believed to be associated with an increase in motor vehicle-related (MVR) trauma and death. To educate the public on the dangers of driving, a multitude of media launches from police, television advertisements and injury-prevention programs have been developed. This study looks at the difference in MVR trauma admissions, mortality and seat belt use over holiday long weekends in comparison with nonholiday long weekends (N-HLW). The HLW was defined as a 4-day (Friday–Monday, inclusive) time period during an Ontario holiday, whereas a N-HLW was defined as a 4-day long weekend period occurring 1 week before (B-HLW) or 1 week after the holiday weekend (A-HLW). Statistical significance was accepted at $p < 0.05$. Canadian Institute for Health Information data revealed there have been 3537 MVR trauma admissions (ISS > 15) in Ontario over the last 10 years (1997–2006). The number of trauma admissions on B-HLW was 1222, whereas A-HLW admissions equaled 1182 patients. Differences in MVR admissions, seat belt use and mortality were not found to significantly differ between the HLW and N-HLWs. In addition, HLW and N-HLW trauma admissions were significantly higher on Saturday and Sunday ($p < 0.05$), whereas Monday had the lowest volume of admissions. Trauma admissions were highest during warm-weather holidays. This analysis demonstrates that MVR trauma volumes

on holiday weekends are similar compared with nonholiday weekends. Future interventions to reduce MVR trauma should focus on all weekends.

10081

Massage therapy as an adjunct in inpatient care. A.M. Dawson, L. Budd, T. Taulu, A. Papp, R. Simons. From the Vancouver General Hospital, Vancouver, BC.

Aim: The inpatient massage therapy project provides an alternative treatment modality for burn and trauma patients in our inpatient Burn, Plastic and Trauma Unit. Our patients deal daily with pain, anxiety and at times sleep disorders, which have effects on their outcomes and healing process. Literature shows that massage therapy is helpful preprocedure, and it is reported that patients in therapy have decreased pain and anxiety. The purpose of this project is to demonstrate the effectiveness of massage therapy on decreasing patient pain and anxiety as an adjunct to traditional therapies presently provided. **Methods:** Employing a qualitative approach, using a 1–10 graphic rating scale (GRS), patients are asked to rate their pain, anxiety levels and sleep patterns pre- and post-therapy. Massage therapy is offered weekly by massage therapy students and supervised by a registered massage therapy instructor. Patients are assessed for suitability before treatment by a physician. **Results:** Preliminary results from the first 4 weeks using the GRS suggest that massage therapy has a positive impact on burn and trauma patients. Scatter graphs show moderate to high correlations between pre- and post-rating scales for pain and anxiety. **Conclusion:** Judging from the preliminary results, it is expected that final data from the project will confirm the utility of massage therapy as an adjunct to traditional inpatient therapies, decreasing pain, anxiety and promoting the overall well being of the injured patient. Ideas for future studies are being discussed with regard to whether massage therapy is effective on range of motion in keloid scars, muscle contractures and chronic muscle pain.

10082

Has access to care for the major trauma patients changed over the last decade? A. Lester, J. Trickett, N. Shore, H. Knight, A. Keenan, D. Charbonneau, G. Pagliarello, J.D. Yelle. From The Ottawa Hospital, Ottawa, Ont.

Previous research has shown that trauma-related mortality decreases with regionalization of trauma systems and reduction of time from injury to definitive care. In 1988, regionalization of trauma care occurred in the Ottawa area. With hospital amalgamation in 1998, The Ottawa Hospital became the designated regional trauma centre. In the 10 years since amalgamation, The Ottawa Hospital and our community stakeholders have implemented and updated processes to improve access to care. The policies and processes include revision of prehospital field triage guidelines, improvements in ambulance transportation by land and air, resuscitation protocols and outreach education sessions in community hospitals. Reducing prehospital time was associated with improved access to care in the mid-90s with the enhancement of 911 services, on-scene care and modified scene response. Did we see improved access to care with an associated decrease in mortality in trauma cases where the patient was first treated in a

community hospital and subsequently transferred to The Ottawa Hospital, during the last decade? A review of major trauma patients who were transferred to The Ottawa Hospital's regional trauma centre following treatment at a primary centre was performed. A comparison of data between 1997 and 2007 was completed to determine if access to care had improved. **Method:** A review of all major trauma patients transferred to The Ottawa Hospital regional trauma centre was completed. The Ottawa Hospital has over 3000 trauma-related admissions per year with greater than 600 major trauma patients with an ISS greater than 16. The trauma registry was searched for all patients transferred in from a community hospital in 1997 and 2007. Prehospital time, primary hospital time, ISS, Abbreviated Injury Scale score, age, gender, mode of transport and mortality were studied. **Results:** In 1997/2007 there were 181/233 patients transferred in to The Ottawa Hospital from a community hospital with an ISS of 24/23, respectively. The average time in the primary hospital was 3 hours 48 minutes in 1997 and has increased to 4 hours, 50 minutes in 2007. The Glasgow Coma Scale score on arrival was 12 in 1997 and 13 in 2007. Nine percent of the patients transferred in by air ambulance in 1997 and 18% in 2007. Mortality at the trauma centre was 9.9% in 1997 and 8.1% in 2007. **Conclusion:** The average time spent by major trauma patients in community hospitals before transfer to the regional trauma centre has increased over the last 10 years despite increased availability of air ambulance, enhancements to land ambulance services and ongoing education sessions. An annual regional trauma conference, outreach education sessions as well as established communication patterns and referral protocols have not decreased the average time a major trauma patient spends in a referring hospital. More research is warranted to examine the reasons responsible for delay in a transfer.

10085

Alcohol use increases diagnostic testing, procedures, costs and the risk of hospital admission in injured, emergency department patients: a population-based study from the United States. *T. O'Keeffe,* S. Shafi,† L.M. Gentilello.†* From the *University of Arizona, Tucson, Ariz., and †UT Southwestern Medical Center, Dallas, Texas.

Aim: Alcohol (ETOH) use may alter mental status and vital signs in injured patients. This can lead to more frequent need for ambulance transport and increased tests and procedures during emergency department (ED) evaluation. The additional financial burden of alcohol use in trauma patients has not been previously documented. We hypothesized that ETOH use significantly increases the cost of initial care. **Methods:** The National Hospital Ambulatory Medical Care Survey collects population-based estimates of ED utilization in the United States. Using the 2003 data set, we compared resource utilization and hospital admission rates between ETOH-positive and -negative injured patients. Costs were estimated using 2003 Medicare allowable fees. **Results:** In 2003, there were 21 million adult injury-related ED visits, with alcohol involved in 830 000 cases. ETOH-positive patients were more likely to arrive by ambulance (47.7% v. 18.5%), had a 50% longer ED stay (248 v. 162 min) and underwent more tests and procedures (Table, $p < 0.001$ for all). Alcohol generated an added financial burden of \$247 million, not including the costs of in-patient care. ETOH-positive patients were twice as likely to be

Table, abstract 10085. Excess health care costs incurred by alcohol-positive versus alcohol-negative injured patients

Test or procedure	Cost, \$	Injured patients, %		Excess costs, \$
		ETOH ⁺	ETOH ⁻	
Ambulance transportation	600.00	47.7	18.5	138 264 600
CBC	8.97	32.6	11.7	1 894 879
Electrolytes	9.80	16.0	4.0	1 364 854
Blood glucose testing	5.48	17.2	5.2	654 657
Urinalysis	4.43	18.0	7.2	430 196
Chest radiograph	26.88	19.2	10.0	2 474 298
CT/MRI	440.21	29.4	8.7	93 313 836
EKG	17.01	16.6	6.4	1 224 264
Urinary catheterization	90.38	3.8	1.3	1 726 077
IV fluid administration	40.23	28.8	9.9	6 643 060
Total added costs				247 990 721

CBC = complete blood count; CT = computed tomography; EKG = electrocardiogram; ETOH = alcohol; IV = intravenous; MRI = magnetic resonance imaging.

admitted to hospital (14.2% v. 6.1%, $p < 0.001$). **Conclusion:** Patients with alcohol-related injuries have significantly increased resource utilization, a longer ED stay, more frequently require in-patient care and add a financial burden of nearly \$250 million annually for ambulance and ED care alone. In many US states, insurance companies can deny coverage for injuries sustained due to alcohol, shifting these costs to trauma centres, taxpayers or government programs.

10089

Undertriage of elderly trauma patients. *H.C. Wilson,* J.J. Oucharek,* J.M. Tallon.*†* From the *Department of Surgery and the †Department of Emergency Medicine, Dalhousie University, and the Nova Scotia Trauma Program, Halifax, NS.

Background: Trauma systems have physiologic, anatomic and mechanistic criteria established to identify patients who warrant trauma team activation (TTA). Age is not an activation criterion in most centres. The objective of this study is to identify patient and injury characteristics predictive of TTA and to determine whether existing TTA criteria appropriately capture elderly patients. **Methods:** This study examines a population of consecutive major injury cases at a regional trauma centre from 1997 to 2004. Exclusion criteria include age less than 16 years, transfer to trauma centre more than 24 hours postinjury, isolated femur fracture, burn and unknown mechanism of injury (MOD). Associations between TTA and patient/injury characteristics are modelled using logistic regression. **Results:** There were 1617 cases meeting inclusion criteria; 1377 patients aged less than 70 years (85%) and 240 (15%) elderly patients (ages ≥ 70). There were 1026 TTAs, of which 9.6% occurred in the elderly. Tachycardia, hypotension, neurologic deficit and transport to hospital via air ambulance were positively associated with TTA. Age 70 or greater was associated with decreased odds of TTA (odds ratio [OR] 0.73, 95% CI 0.58–0.93), as was MOI of fall (OR 0.10, 95% CI 0.08–0.14). Fall was the MOI in 59% of elderly patients. Falls account for 69% of trauma-related deaths in the elderly and 27% of trauma deaths overall. **Conclusion:** Criteria such as hypotension and neurologic deficit mandate TTA, and patients with these

physiologic derangements are appropriately receiving TTA. Elderly patients and patients sustaining a fall are, however, considerably less likely to receive TTA. Elderly patients exhibit blunted physiologic responses to injury despite sustaining severe injuries from low-velocity trauma. This high-risk population thus tends to escape standard TTA criteria. Consideration should be given to including age greater than 70 years with low-velocity mechanism of injury as a trauma team activation criterion.

10090

Planning for an aging population: gender is associated with different trauma resource requirements. *C.D. Rogers,* P.W. Sharkey,* F.D. Brenneman,**† L.N. Tremblay.**†* From the *Sunnybrook Health Sciences Centre and the †University of Toronto, Toronto, Ont.

Background: The male:female ratio is roughly 1:1 for ages under 64, after which women outnumber men (Census Canada). Trauma patients tend to be male. Given that the population is aging, there is a need to plan future trauma resources and injury prevention strategies. **Objective:** This study explores whether older men remain disproportionately at risk of injury and if there are gender differences in mechanism of injury (MOI) and resource utilization (e.g., rehabilitation). **Methods:** A retrospective review of trauma registry data from a major urban centre including MOI, injuries, ISS, demographics and resource utilization. Patients were stratified into 5 age categories. Parametric and nonparametric statistics were used, with significance at $p < 0.05$. **Results:** Although the gender gap in trauma decreases with age (Table), men continue to predominate despite the higher number

Table, abstract 10090. The gender gap in trauma resource requirements by age

Age, yr	Mortality, %		ISS, mean (SD)		Rehabilitated, %		
	Male, %	M	F	M	F	M	F
<20	75.5	2.4	5.9	19.4 (14.4)	24.8(14.4)	4.8	20.6
20–39	77.2	7.8	6.9	20.5 (14.1)	21.1(12.6)	15.9	21.6
40–59	67.1	6.5	9.5	22.6 (13.6)	23.9(13.2)	23.4	27.6
60–69	68.1	14.5	10.3	22.7 (9.3)	26.4(14.1)	29.0	24.1
70+	51.7	24.6	28.1	27.0 (12.5)	25.3(11.9)	24.6	38.6

F = female; ISS = Injury Severity Score; M = male.

of women in the elderly population. No significant differences in mortality or ISS were noted, but men had different patterns of injuries, MOI and discharge dispositions with, for example, fewer women going home at the extremes of age. **Conclusion:** In planning for the needs of an aging population, trauma systems must take into account the different characteristics of male versus female trauma, particularly with regards to injury prevention and discharge planning.

10091

The role of TraumaMan model in the Advanced Trauma Life Support course. *A. Pandya, J. Ali.* From St. Michael's Hospital, Toronto, Ont.

Aim: The Advanced Trauma Life Support (ATLS) course plays an important role in trauma education by providing a framework for the resuscitation of injured patients. An important part of the

course involves the teaching of trauma resuscitative skills such as chest decompression, cricothyroidotomy, pericardiocentesis and diagnostic peritoneal lavage. Traditionally, a live animal model has been used for teaching these surgical skills. However, due to increasing ethical concerns a nonanimal model has been developed as an alternative. The purpose of this study is to evaluate the effectiveness of learning surgical skills using the TraumaMan simulator model compared with the animal model. **Methods:** Instructors and students of the Advanced Trauma Life Support Course evaluated the TraumaMan model by performing chest decompression, cricothyroidotomy, pericardiocentesis and diagnostic peritoneal lavage. A survey was developed to assess the effectiveness of the TraumaMan model compared with the animal model. **Results:** The TraumaMan model was evaluated by 32 participants (14 instructors, 18 students). Survey data showed there was no statistical difference between the TraumaMan and the animal model in learning the surgical skills of the ATLS course. Eighty-five percent of the participants recommended the TraumaMan as a substitute for the animal model. **Conclusion:** The TraumaMan model is an effective alternative for learning the surgical skills in the ATLS course. Given the ethical concerns, these data will help support the use of nonanimal models in ATLS education.

10092

Selective nonoperative management of abdominal gunshot wounds: When is it safe to discharge? *K. Inaba, G. Barmparas, R. Barbarino, T. Lustenberger, P. Talving, D. Plurad, D. Green, D. Demetriades.* From the Los Angeles County Medical Center, University of Southern California, Los Angeles, Calif.

Purpose: For patients sustaining abdominal gunshot wounds undergoing selective nonoperative management, the optimal observation time required before discharge is unknown. **Methods:** This is a retrospective analysis of a continuous series of patients assessed at a level 1 trauma centre undergoing nonoperative management of their abdominal gunshot wounds from 2004 to 2007. After institutional review board approval, injury demographics, operative procedures, time to operation, CT imaging results and outcomes were abstracted. **Results:** During the 4-year study period, 808 patients sustaining truncal gunshot wounds were identified: 97 (12%) died in the emergency room and 20 (2.5%) had no admission data available. This left 691 patients available for analysis: average age was 27.3 (\pm standard deviation 10.3, range 16–81) years, 93.9% male, average ISS was 12.2 \pm 12. Of these, 164 (23.7%) underwent immediate laparotomy based on their clinical presentation. The remaining 527 (76.3%) patients underwent a trial of nonoperative management: 473 (89.8%) of these patients were successfully managed nonoperatively; 54 (10.2%) of these patients failed nonoperative management while being observed and required a delayed laparotomy. The most common injury in this group was a colon or rectal injury (26/54 or 48.1%). Three (5.6%) patients undergoing delayed exploration had a nontherapeutic laparotomy. For patients undergoing nonoperative management, the time to failure ranged from 1 hour, 2 minutes to 23 hours, 8 minutes. **Conclusion:** For patients undergoing selective nonoperative management of their abdominal gunshot wounds, all patients who failed and required a laparotomy did so within 24 hours of admission. Patients undergoing selective nonoperative management require a minimum of 24 hours of close observation before discharge.

10094

Identifying the needs of family members of severe traumatic brain injured patients: a pilot study. *A.K. Keenan, J.D.Y. Yelle, L.J. Joseph.* From The Ottawa Hospital, Ottawa, Ont.

Objective: Traumatic brain injury is a devastating injury for both patients and their family members. The goal of this study is to identify the needs of family members as the patient progresses through their recovery. **Methods:** A prospective longitudinal descriptive study using mixed methods was initiated to examine the level of anxiety, the types of needs expressed by the family member and the degree to which these needs are met. An association between these factors and the severity of injury and subsequent degree of recovery of the patient's injury was explored. Repeated-measures were used at 3 different time periods: upon discharge from the intensive care unit; discharge from the acute facility to home or the rehabilitation setting; and at 6 months post-discharge. These reflect transition points in the patient and family's experience. **Results:** Twenty-two family members were interviewed at 3 different time periods. Results indicate that the need for information is one of the primary needs of the family. The needs for hope and for supportive care of the family are also primary concerns in the acute care stage. Managing the changes in the patient's behaviour and managing the complexities within the family become important challenges as time progresses. **Conclusion:** Family members of severe traumatic brain injured patients have intensive needs in the acute phase of the injury. Rich qualitative data exemplify the challenges families face. Further research is needed to determine the association between anxiety, severity of injury and the family's needs.

10095

A comparative study of geriatric trauma in the past decade. *J.D.Y. Yelle, A.K. Keenan, H.K. Knight.* From the Ottawa Hospital, Ottawa, Ont.

The typical trauma patient has traditionally been young and male, with injuries resulting from high-risk activities. These demographics are changing, however, and the number of elderly trauma patients continues to increase annually. **Methods:** A retrospective review of trauma registry data from The Ottawa Hospital was collected over 2 different time periods and data comparison was undertaken. Data were collected for the 5-year period from April 2003 to March 2008 (Time 2) and compared with a previous analysis done for data collected between April 1996 and March 2001 (Time 1). Variables collected include age, mechanism of in-

jury, ISS, length of stay and mortality. **Results:** The average age of trauma patients has continued to increase over the past decade. The mechanism of injury has remained consistent, with the vast majority of patients over 75 years sustaining injuries from falls. There is a direct correlation between increasing age and length of stay (LOS) in hospital, although LOS has decreased across all age groups over time. Both Time 1 and Time 2 data show that the mortality rate increases with age, despite similar ISS. However, mortality has decreased from 80% to 60% in patients over 75 years with an ISS over 45. **Conclusion:** Elderly patients sustaining major traumatic injury are hospitalized for longer periods of time and have higher mortality than younger patients, despite the fact that younger patients sustain more numerous injuries. The decrease in mortality for older patients indicates that programs implemented in the past 5 years have produced positive results.

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Effect of a flight program on the process of care of trauma patients. *C. Smith, D. Boone.* From Memorial University, St. John's, NL.

Objective: To evaluate the efficacy of a newly introduced trauma flight program in a rural Canadian province, hypothesizing a reduction in transport time and an improvement in process of care. **Methods:** Observational study using data from the provincial trauma registry comparing the process of care of trauma patients before and after the institution of an air transport program. We compared patients transported to the provincial trauma centre since the start of the flight program from July 2007 to August 2008 (group B) with those transported in the previous year (group A). The primary outcome measure was time from dispatch to arrival at the provincial trauma centre. Other process of care measures were studied as secondary outcome measures. **Results:** There were 25 patients in group A and 41 in group B; 55 patients were male (83.3%) and 11 female (16.7%); mean age was 42.7 years. Mean time (\pm standard deviation) from dispatch to actual transport and total transport time were 100.41 ± 67.9 and 285.6 ± 126.7 minutes, respectively, for group A, and 253.2 ± 108.1 and 400.0 ± 118.6 minutes for group B ($p = 0.000$ and 0.001). All patients with a Glasgow Coma Scale score less than 9 were intubated. Sixty-seven percent of patients with a pneumothorax in group A had a chest tube placed compared with 100% of patients in group B ($p = 0.346$). Two large-bore IVs were used in 73% and 80% of patients in groups A and B, respectively ($p = 0.530$). **Conclusion:** Flight team mobilization has prolonged transport times of severely injured trauma patients. There has been a trend toward improvement in process of care.