ADVANCES IN TRAUMA CARE

New and promising therapies
### New and promising therapies

#### Systems
- TQIP
- Telemedicine
- Checklists
- Massive transfusion protocols
- Code crimson

#### Products
- Prehospital ultrasound
- Foam
- Rib fracture fixation
- Anticoagulant reversal
- Topical haemostats
Trauma Quality Improvement Programs

American College of Surgeons NSQIP Surgical Risk Calculator

Enter Patient and Surgical Information

- Procedure
- Age group
- Sex
- Functional status
- Emergency class
- ASA class
- Wound class
- Steroid use for chronic condition
- Acute use within 30 days prior to surgery
- Systemic sepsis within 48 hours prior to surgery
- Ventilator dependent
- Disseminated cancer

[Other fields and options available]

Report Identification Number
N=232

14

dr.amr.moustala.kamel  11/26/2014
Trauma Quality Improvement Program

American College of Surgeons
Committee on Trauma
2014
TQIP components

Risk adjusted inter hospital comparisons:
- Two reports, including the annual TQIP odds ratio benchmark report and additional reports each year on topics of interest.
- Online data analysis tool to drill down into your own TQIP data, obtain patient lists

Education and training:
- Annual meeting
- Online training
- Monthly educational experiences for abstractors
- Monthly open forum calls for Registry Staff

Enhanced data quality:
- Data validation site visit
- Data quality reporting and quarterly submissions
- TQIP Validator

Sharing best practices:
- Annual meeting
- High performers
- Web conferences

American College of Surgeons
Inspiring Quality: Highest Standards, Better Outcomes

ACS TQIP Trauma Quality Improvement Program
TQIP Observations

A high performing center might not be a high performer for all types of patients

- Differences in performance based on patient type (blunt multisystem, single system, or penetrating injury)

Poor correlation across age groups

- Centers might be high performers for the young, yet not the elderly

There are clinically relevant mortality differences across centers
2013 Process of Care Measures

- Hemorrhage Control
  - Including Angioembolization
  - Transfusion blood (both within 4 and 24 hrs)
  - Transfusion plasma (both within 4 and 24 hrs)
  - Cryoprecipitate
  - Surgery for hemorrhage control

- Withdrawal of Care
Australian Trauma Quality Improvement Program (AusTQIP)

The Australian Trauma Quality Improvement Program (AusTQIP) is a collaboration of Australia’s 27 designated trauma centres and two state trauma registries providing a national capability to improve care of the severely injured through the sharing of expertise, lived experience and data.

AusTQIP is underpinned by the development of an Australian Trauma Registry (ATR) to provide an evidence base for trauma quality improvement and scope development of risk-adjusted benchmarking of key performance indicators. Through the ATR, comprehensive data will be available that is essential to ensuring a state of the art, national quality improvement program in which the collaborators can learn about what it is that high performing centres and services do differently, and employ ways of integrating the most effective practices. In doing so, international experience tells that the care provided at every centre is likely to improve.
Telemedicine to a Moving Ambulance Improves Outcome After Trauma in Simulated Patients

William E. Charash, MD, PhD, Michael P. Caputo, MS, Harry Clark, BS, Peter W. Callas, PhD, Frederick B. Rogers, MD, Bruce A. Crookes, MD, Monica S. Alborg, MD, and Michael A. Ricci, MD

METI human patient simulator in a moving ambulance

3 scenarios – 2 MVCs, 1 stab wound
### TABLE 2. Lowest $\text{SpO}_2$, Highest HR, and Lowest Systolic BP

<table>
<thead>
<tr>
<th></th>
<th>Telemedicine*</th>
<th>Nontelemedicine*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low $\text{SpO}_2$ (%)</td>
<td>84 ± 0.7</td>
<td>78 ± 0</td>
</tr>
<tr>
<td>High HR</td>
<td>144 ± 0.9</td>
<td>159 ± 0.5</td>
</tr>
<tr>
<td>Low systolic BP (mm Hg)</td>
<td>70 ± 1</td>
<td>53 ± 1</td>
</tr>
</tbody>
</table>

* $p < 0.001$ Wilcoxon rank-sum test.

### TABLE 3. Correct Identification of Pathologic Signs and Processes, and Appropriate Interventions in Simulated Trauma Patients

<table>
<thead>
<tr>
<th></th>
<th>Telemedicine*</th>
<th>Nontelemedicine*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signs</td>
<td>0.96 ± 0.01</td>
<td>0.79 ± 0.05</td>
</tr>
<tr>
<td>Processes</td>
<td>0.98 ± 0.02</td>
<td>0.75 ± 0.05</td>
</tr>
<tr>
<td>Interventions</td>
<td>0.92 ± 0.02</td>
<td>0.49 ± 0.03</td>
</tr>
</tbody>
</table>

* $p < 0.003$ Wilcoxon rank-sum test.
<table>
<thead>
<tr>
<th>Impending Herniation</th>
<th>Telemedicine, n (%)</th>
<th>Nontelemedicine, n (%)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify blown pupil</td>
<td>11 (100)</td>
<td>7 (88)</td>
<td>0.42</td>
</tr>
<tr>
<td>Identify hypertension</td>
<td>11 (100)</td>
<td>8 (100)</td>
<td>—</td>
</tr>
<tr>
<td>Identify bradycardia</td>
<td>11 (100)</td>
<td>6 (75)</td>
<td>0.16</td>
</tr>
<tr>
<td>Recognize impending herniation</td>
<td>11 (100)</td>
<td>6 (75)</td>
<td>0.16</td>
</tr>
<tr>
<td>High flow oxygen</td>
<td>11 (100)</td>
<td>8 (100)</td>
<td>—</td>
</tr>
<tr>
<td>Reverse Trendelenburg</td>
<td>4 (36)</td>
<td>0 (0)</td>
<td>0.10</td>
</tr>
<tr>
<td>Hyperventilation</td>
<td>11 (100)</td>
<td>0 (0)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Help Is in Your Pocket: The Potential Accuracy of Smartphone- and Laptop-Based Remotely Guided Resuscitative Telesonography

Paul McBeth, MD, FRCSC,1 Innes Crawford, MD,2 Corina Tiruta, MSc,1 Zhengwen Xiao, MD, MSc, PhD,1 George Qiaohao Zhu, MSc,3 Michael Shuster, MD, FRCPC,4 Les Sewell, EMT-P,5 Nova Panebianco, MD,6 David Lautner, MD,7 Savvas Nicolaou, MD, FRCPC,8 Chad G. Ball, MD, FRCSC, FACS,9,10 Michael Blaivas, MD, FACEP, FAIUM,11 Christopher J. Dente, MD, FACS,12 Amy D. Wyrzykowski, MD, FACS,12 and Andrew W. Kirkpatrick, MD, FRCSC, FACS1,9,10
Telemedicine

Fig. 1. Schematic diagram of the very low-cost, portable, remotely mentored tele-ultrasound system.
Fig. 2. Positive depiction of free fluid at Morrison’s pouch. This is a captured screen-shot of the mentor’s smartphone displaying the ultrasound findings with inlaid video depiction of the remote ultrasonographer’s hand holding the ultrasound probe on the patient.
Telesurgery

Brief Communication
Smartphone Surgery: How Technology Can Transform Practice

Teleconsultations with smartphone video made telepresence of the trauma surgeon possible in the rural hospital.
A Surgical Safety Checklist to Reduce Morbidity and Mortality in a Global Population

Alex B. Haynes, M.D., M.P.H., Thomas G. Weiser, M.D., M.P.H.,
William R. Berry, M.D., M.P.H., Stuart R. Lipsitz, Sc.D.,
Abdel-Hadi S. Breizat, M.D., Ph.D., E. Patchen Dellinger, M.D.,
Teodoro Herbosa, M.D., Sudhir Joseph, M.S., Pascience L. Kibatala, M.D.,
Marie Carmela M. Lapitan, M.D., Alan F. Merry, M.B., Ch.B., F.A.N.Z.C.A., F.R.C.A.,
Krishna Moorthy, M.D., F.R.C.S., Richard K. Reznick, M.D., M.Ed., Bryce Taylor, M.D.,
and Atul A. Gawande, M.D., M.P.H., for the Safe Surgery Saves Lives Study Group*
The complication rates decreased from 19.9% to 11.5% ($P < 0.001$), with absolute risk reduction 8.4 (95% confidence interval, 6.3–10.5) from the control to the SSC stages. In-hospital mortality decreased significantly from 1.9% to 0.2% in 1 of the 2 hospitals post-SSC implementation, but the overall reduction (1.6%–1.0%) across hospitals was not significant.
A procedural check list for pleural decompression and intercostal catheter insertion for adult major trauma


Alfred Health Trauma Department, Alfred Hospital, PO Box 315, Prahran 3181, Vic, Australia
Between January 2003 and July 2009 the incidence of empyema was 1.44% (29 in 2009 insertions).

This decreased to 0.57% between August 2009 and December 2011 (6 in 1060 insertions) when the measures described above were introduced \([p = 0.038 \text{ Fisher’s exact test, 2-tailed}]\).
COMPARISON OF DECISION-ASSIST AND CLINICAL JUDGMENT OF EXPERTS FOR PREDICTION OF LIFESAVING INTERVENTIONS

Colin F Mackenzie,†‡ Cheng Gao,§ Peter F Hu,*† Amechi Anazodo,† Hegang Chen,‖ Theresa Dinardo,¶** P. Cristina Imle,† Lauren Hartsky,†‡ Christopher Stephens,*† Jay Menaker,†*** Yvette Fouche,*† Karen Murdock,† Samuel Galvagno,*† Richard Alcorta,†‡ Stacy Shackelford,**†‡‡ and the ONPOINT Study Group

*Department of Anesthesiology, †Shock Trauma Anesthesiology Research Center and Charles McMathias National Study Center for Trauma and EMS, and ‡Department of Physiology, University of Maryland School of Medicine; §Departments of Electrical Engineering, Computer Science, University of Maryland, Baltimore County; ¶Department of Epidemiology, ‡Shock Trauma Nursing, and **Shock Trauma Center, University of Maryland School of Medicine; †‡ USAF C-STARS Baltimore, Maryland Institute for Emergency Medical Services Systems; and ‡‡Department of Surgery, University of Maryland School of Medicine, Baltimore, Maryland
Checklists/decision support

Fig. 1. Comparison of AUROC between photoplethysmograph feature-derived predictions and those of PHPs, RNs, and MDs on the x axis. A combined majority vote clinical judgment (see text for details) is also shown.
Checklists/decision support

Trauma Resuscitation Errors and Computer-Assisted Decision Support

Mark Fitzgerald, MB BS; Peter Cameron, MD BS; Colin Mackenzie, MB, ChB; Nathan Farrow, BN; Pamela Scicluna, BSc; Robert Gocentas, MB BS; Adam Bystrzycki, MB BS; Geraldine Lee, MPhil; O'Reilly Gerard, MB BS; Nick Andrianopoulos, MB BS; Linas Dziukas, MD BS; D. Jamie Cooper, MD BS; Andrew Silvers, MB BS; Alfredo Mori, MB BS; Angela Murray, BN; Susan Smith, CCN; Yan Xiao, PhD; Dion Stub, MB BS; Frank T. McDermott, MD BS; Jeffrey V. Rosenfeld, MD MS

Checklists/decision support

<table>
<thead>
<tr>
<th>Time</th>
<th>HR</th>
<th>BP</th>
<th>RR</th>
<th>GCS</th>
<th>Temp</th>
<th>SpO2</th>
<th>EtCO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prehospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>112</td>
<td>110/80</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>93</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>130</td>
<td>90/80</td>
<td>-</td>
<td>13</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>On Arrival</td>
<td>16:59</td>
<td>120</td>
<td>95/80</td>
<td>22</td>
<td>12</td>
<td>94</td>
<td>-</td>
</tr>
<tr>
<td>Hospital</td>
<td>17:05</td>
<td>110</td>
<td>120/82</td>
<td>18</td>
<td>14</td>
<td>36.5</td>
<td>98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Diagnosis</th>
<th>Fluid and Drug Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>17:00</td>
<td>Crystalloid IV infusion 1000 ml</td>
<td></td>
</tr>
<tr>
<td>17:04</td>
<td>Morphine 5 mg</td>
<td></td>
</tr>
<tr>
<td>17:02</td>
<td>Maxolon 10 mg</td>
<td></td>
</tr>
<tr>
<td>16:59</td>
<td>Needle decompression, R</td>
<td></td>
</tr>
<tr>
<td>17:01</td>
<td>Chest tube insertion, R, Size 32</td>
<td></td>
</tr>
<tr>
<td>17:00</td>
<td>Peripheral IV insertion, R, 14 G</td>
<td></td>
</tr>
<tr>
<td>17:01</td>
<td>Peripheral IV insertion, L, 14 G</td>
<td></td>
</tr>
<tr>
<td>17:02</td>
<td>Dressing, Betadine to right comp</td>
<td></td>
</tr>
</tbody>
</table>

Action Prompts

- External Hemorrhage?
- Is air entry unequal?
- Splint cervical spine
- FAST

☑ = Confirmed  ❓ = Unconfirmed
Checklists/decision support

There was a 26.11% reduction in the shock management error rate per patient in the study group (0.55 error per patient in the study group, 0.58 in the control group, and 0.75 in the baseline control group)

<table>
<thead>
<tr>
<th>Question</th>
<th>Group, No. (%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline Control (n=300)</td>
<td>Control (n=436)</td>
</tr>
<tr>
<td>Was oxygen administered on arrival?</td>
<td>260 (86.7)</td>
<td>388 (89.0)</td>
</tr>
<tr>
<td>Was a pressure dressing applied to external hemorrhage (BP &lt;100 mm Hg)?</td>
<td>48 (92.3)</td>
<td>62 (96.4)</td>
</tr>
<tr>
<td>Was the patient’s known or suspected fractured femur splinted?</td>
<td>22 (59.5)</td>
<td>14 (51.9)</td>
</tr>
<tr>
<td>Were packed red blood cells administered?</td>
<td>81 (94.2)</td>
<td>45 (84.9)</td>
</tr>
<tr>
<td>Was fresh frozen plasma administered?</td>
<td>12 (48.0)</td>
<td>3 (30.0)</td>
</tr>
</tbody>
</table>

Abbreviation: BP, blood pressure.
Massive Transfusion Protocols

ADHB Adult Massive Transfusion Protocol (MTP)

**Team Leader Responsibilities**
- Team leader should be a registrar or consultant
- Notify Coag Lab and send Coag requests on the Labplus Urgent form (orange border)
- Activate protocol by ringing Blood Bank (ext 24015) and say “I am activating the Massive Transfusion Protocol”
- Call for each box as required
- Make a decision to cease MTP and contact Blood Bank

**Blood Bank Responsibilities**

- Massive bleeding with either shock or abnormal coagulopathy
- Ensure delivery of X-match specimen to Blood Bank
- Give 3 Units O-neg or type specific RBC
- Ring Blood Bank to Activate Massive Transfusion Protocol

REQUEST, DELIVER AND TRANSFUSE AS BELOW:
CODE CRIMSON: A LIFE-SAVING MEASURE TO TREAT EXSANGUINATING

If systolic blood pressure < 90 mmHg, Surgical Registrar contacts on-call Trauma Consultant to inform them of the imminent arrival of a potentially haemodynamically unstable trauma patient.
Prehospital ultrasound imaging improves management of abdominal trauma

F. Walcher\textsuperscript{1}, M. Weinlich\textsuperscript{1,3}, G. Conrad\textsuperscript{2}, U. Schweigkofler\textsuperscript{4}, R. Breitkreutz\textsuperscript{5}, T. Kirschning\textsuperscript{5} and I. Marzi\textsuperscript{1}

\textit{British Journal of Surgery} 2006; 93: 238–242
Foam

Diagnosis and deployment of a self-expanding foam for abdominal exsanguination: Translational questions for human use

Adam P. Rago, MS, John Marini, BS, Michael J. Duggan, DVM, John Beagle, BS, Gem Runyan, Upma Sharma, PhD, Miroslav Peev, MD, and David R. King, MD. Boston, Massachusetts

Rib fracture plating

OTA Highlight Paper

Early Surgical Stabilization of Flail Chest With Locked Plate Fixation

Peter L. Althausen, MD, MBA,* Steven Shannon, BS,† Chad Watts, BS,† Kenneth Thomas, MD,* Martin A. Bain, MD, FACS,‡ Daniel Coll, P-AC, MHS,§ Timothy J. O’Mara, MD,* and Timothy J. Bray, MD*

J Orthop Trauma 2011;25:641–648

<table>
<thead>
<tr>
<th>TABLE 3. Operative vs Nonoperative Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>ICU LOS</td>
</tr>
<tr>
<td>Hospital LOS</td>
</tr>
<tr>
<td>Days on ventilator</td>
</tr>
<tr>
<td>Tracheostomy</td>
</tr>
<tr>
<td>Pneumonia</td>
</tr>
<tr>
<td>Reintubation</td>
</tr>
<tr>
<td>Home O₂</td>
</tr>
</tbody>
</table>
Anticoagulant reversal

Managing target-specific oral anticoagulant associated bleeding including an update on pharmacological reversal agents

Deborah M. Siegal

- Idarucizumab (anti-Dabi-Fab; Boehringer Ingelheim, Biberach, Germany) is a humanized monoclonal antibody with high affinity for dabigatran.

- Andexanet alfa (Portola Pharmaceuticals, San Francisco, USA) is a recombinant factor Xa derivative which lacks catalytic and membrane binding activity currently undergoing clinical development for specific reversal of factor Xa inhibitor anticoagulant effect
RE-VERSal trial

- Idarucizumab is a humanized antibody fragment, or Fab, being investigated as a specific reversal agent for the anticoagulant effect of dabigatran. Pre-clinical studies indicate idarucizumab binds specifically to and inhibits dabigatran.

- Phase I data in healthy volunteers demonstrated the potential of idarucizumab to achieve immediate, complete and sustained reversal of dabigatran-induced anticoagulation. In these placebo-controlled studies, idarucizumab did not cause any clinically relevant side effects.
Topical haemostats

Our experience, supported by other reports in the literature, suggests the use of such fibrin patches may provide an effective option in helping to control haemorrhage after trauma.
Topical haemostats

- Liquid fibrin sealants
  - Tisseel/Tissucol Baxter Biosurgery Fibrin sealant with human thrombin and fibrinogen.
  - Evicel/Crosseal/Quixil Ethicon Inc. Evicel is the updated formulation of Quixil (EU)/Crosseal without tranexamic acid. Aprotinin-free fibrin sealant with human thrombin and fibrinogen.
Topical haemostats

- Fibrin patches
  - TachoSil Takeda Pharmaceuticals
    Biodegradable equine collagen patch with fixed combination of human fibrinogen and human thrombin
  - WrapClot St Teresa Medical Inc. Dissolvable dextran dressing embedded with lyophilized salmon thrombin and fibrinogen
Topical haemostats

**Gelatin-thrombin matrix agents**
- FloSeal Baxter Biosurgery Matrix of cross-linked bovine-derived bovine gelatingranules with human thrombin
- Surgiflo Ethicon Inc. Matrix of cross-linked porcine-derived bovine gelatin granules with human thrombin
SUMMARY

- Innovation a common feature of medical practice – sometimes successful, sometimes not
- System innovation has the potential to improve outcomes for many patients in a short period of time
- Product/device innovation more likely to significantly improve outcomes in individual patients