2009 Trauma Service Report

Transforming Trauma Care
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Summary

- In 2009, the Trauma Service at OHSU treated 2357 patients. This is 97 patients more than in 2008.
- 1506 (64%) were brought to OHSU directly from the scene of injury.
- 851 (36%) patients were transferred from another hospital; this is an increase in transfer patients of 25% over 2008.
- Overall length of stay for admitted patients has decreased.
- There was a statistically significant decrease in the risk of death as compared to the previous two years.
- Both geriatric and pediatric patient volume increased in 2009.
- Injury Prevention: OHSU and community volunteers signed up, and assisted at ThinkFirst events-logging 317 hours
- The Trauma Research Lab had a productive year, with presentations at the American Association for the Surgery of Trauma, American College of Surgery regional meetings, Portland Surgical Society, and annual Advanced Technology Applications Combat Casualty Care (ATACCC) conference, along with multiple journal publications.
Introduction

Oregon Health and Science University (OHSU) is a Level I trauma center in Portland, Oregon, providing tertiary trauma care for the Pacific Northwest. Designated in 1988 by the Oregon Trauma Systems Section of the Department of Human Services, OHSU has a long history of commitment to the care of injured patients, to training residents and to research. In 2009, OHSU received a three year verification by the American College of Surgeons.

OHSU is able to meet its obligations as a Level I trauma center due to the substantial commitment of a large number of professionals at this institution. Teamwork is an overarching factor that leads to successful treatment of seriously injured patients. Leaders in hospital administration have invested resources, medical school faculty has committed their expertise and time, and hospital employees have chosen to specialize in trauma care, resulting in a broadly based commitment to transforming trauma care.

Trauma Surgeons: (left to right) Drs. John Mayberry, Richard Mullins, Jennifer Watters, Martin Schreiber (Division Chief), L. Bruce Ham and Susan Rowell. Not pictured: Drs. Laszlo Kiraly, Stephanie Gordy and Donald Trunkey.
Background

Oregon’s statewide trauma system is based on landmark legislation. Statutory authority was passed in 1985 by the State Legislature as ORS 431.607 – 431.633 under the leadership of the president of the Oregon Senate, John Kitzhaber, M.D., and signed into law by Governor Victor G. Atiyeh. With the implementation of the trauma system in May of 1988, only two Portland hospitals, OHSU and Legacy Emanuel Hospital were designated as Oregon’s Level I trauma centers. Injured individuals in the four county metropolitan region, identified by pre-hospital rescue personnel or emergency medical technicians meeting the criteria for severe injury are transported to one of the two designated Level I trauma centers.

Oregon’s statewide trauma system was implemented between 1987 and 1991. Research studies before and after the statewide trauma system was implemented has indicated important and beneficial results of the trauma system on inter-hospital transfer practices. Not only were more seriously injured patients transferred to the Level I and Level II trauma centers in the state, but these transfers were accomplished more quickly, resulting in injured patients receiving definitive treatments in a more timely manner.

Trauma Statistics

In 2009 our volume increased by 97 patients over 2008; transfer volume increased by 25%.

Figure 1: Volume

Figure 2: Gender distribution
Figure 3: Blunt versus Penetrating

Figure 4: Age Distribution
Month, Day and Time

*Figure 5: Distribution of Patients by Month*

*Figure 6: Distribution of Patients by Day of Week*

*Figure 7: Distribution of Patients by Time of Arrival*
Length of Stay

Our analysis shows the 2009 length of stay (LOS) for scene patients is significantly lower when compared with 2007 and 2008. Additionally, while not reaching statistical significance, we noted a downward trend in transfer patient LOS (significance about 0.08). There are three nurse case-managers for the trauma and emergency general surgery population - Pam Bilyeu, Tom Kauffman and Lisa Kellogg, assisted by Bernadette Battilega and Peg Turton. This case management team has nearly 30 years combined experience guiding the injured patient and their families through the hospital continuum and discharge process.

Figure 8: Total Hospital Length of Stay 2007-2009
Trauma Team Response

OHSU has a three-level response in the Emergency Department to evaluate the injured patient, based on information provided by the pre-hospital personnel (Table I and II). In the Portland metropolitan area, paramedics evaluate the patient at the scene of injury and enter patients into the trauma system if they conclude the patient meets established triage criteria for being seriously injured. In 2004, OHSU implemented a three-tier system and each year we’ve noted a high proportion of the injured patients fall into the Level 2 or 3 category (Figure 9). Our analyses indicate patients can be effectively and efficiently treated with a limited team response, saving our full trauma team activations for those truly critically injured patients.

Figure 9: Trauma Team Response

Eight percent of our patients bypass the ED and are directly admitted into the hospital, these patients represent the “none” grouping in Figure 9. Three patient’s level of response was not documented and is not represented in Figure 9.

Table I and II below describe the team configuration and the triage criteria used to determine the trauma team response to the ED.
### Table I: Team Composition

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff Trauma Surgeon</td>
<td>Staff Trauma Surgeon</td>
<td>Staff ED Physician</td>
</tr>
<tr>
<td>Staff Anesthesiologist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff ED Physician</td>
<td>Staff Trauma Surgeon</td>
<td>Staff ED Physician</td>
</tr>
<tr>
<td>Trauma Chief Resident</td>
<td>Trauma Chief Resident</td>
<td>Trauma Chief Resident</td>
</tr>
<tr>
<td>Emergency Medicine Resident</td>
<td>Emergency Medicine Resident</td>
<td>Emergency Medicine Resident</td>
</tr>
<tr>
<td>Respiratory Care Practitioner</td>
<td>Respiratory Care Practitioner</td>
<td>Emergency Medicine Resident</td>
</tr>
<tr>
<td>Primary Trauma Nurse</td>
<td>Primary Trauma Nurse</td>
<td>Primary Trauma Nurse</td>
</tr>
<tr>
<td>Trauma Recording Nurse</td>
<td>ED Technician</td>
<td>ED Technician</td>
</tr>
<tr>
<td>Transportation Aide</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table II: 3-Tier Response Triage Criteria

<table>
<thead>
<tr>
<th>Level 1 Criteria</th>
<th>Level 2 Criteria</th>
<th>Level 3 Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physiologic</strong></td>
<td><strong>Anatomic</strong></td>
<td><strong>Mechanism of Injury</strong></td>
</tr>
<tr>
<td>GCS &lt; 9</td>
<td>Intubated patient</td>
<td>Fall &gt; 20 feet</td>
</tr>
<tr>
<td>Inadequate airway/need for emergent airway control OR presence of a supraglottic airway (KING, combitube, etc)</td>
<td>Two or more longbone fractures</td>
<td>Death in same passenger compartment</td>
</tr>
<tr>
<td>Shock as defined as:</td>
<td>Penetrating injury to head, neck or torso</td>
<td>Extrication &gt; 20 minutes</td>
</tr>
<tr>
<td>Systolic BP &lt; 90 (&gt;11 years to adult)</td>
<td>Crush injury to torso or upper thigh</td>
<td>Rollover motor vehicle crash</td>
</tr>
<tr>
<td>Systolic BP &lt; 80 (5-11 years)</td>
<td>Amputation proximal to wrist or ankle</td>
<td>Ejection from motor vehicle</td>
</tr>
<tr>
<td>Systolic BP &lt; 70 (2-4 years)</td>
<td>Pelvic instability</td>
<td>Auto vs. pedestrian &gt; 5 mph</td>
</tr>
<tr>
<td>Systolic BP &lt; 60 (0-2 years)</td>
<td>Paralysis</td>
<td>Special considerations age &lt; 5</td>
</tr>
<tr>
<td>Immediate need for Operating Room</td>
<td>Flail chest</td>
<td>Paramedic discretion:</td>
</tr>
<tr>
<td>OR Patients receiving blood transfusion to maintain blood pressure &gt;90</td>
<td></td>
<td>MCC, ATV, bike crash</td>
</tr>
<tr>
<td>Emergency Medicine Discretion</td>
<td>Emergency Medicine Discretion</td>
<td>Emergency Medicine Discretion</td>
</tr>
</tbody>
</table>
Mechanism of Injury

Although motor vehicle crashes remain the most common mechanism of injury overall, falls are increasing (Figure 10). Falls comprised 35% of the injuries in 2009, compared to 29% in 2007 and 32% in 2008. Falls are the number one most frequent mechanism of injury in both pediatrics and geriatrics (Figures 17 and 19).

Figure 10: Causes of Injury
Body Region of Injury & Injury Severity Score

In the OHSU trauma registry, injuries are recorded using two methods: 1) International Classification of Disease (ICD-9) codes, and 2) Abbreviated Injury Scale. Definitions of these tools can be found in Appendix A.

Table III: Frequency of Injury by AIS Body Region in All Patients

<table>
<thead>
<tr>
<th>AIS Body Region</th>
<th>Number of patients with at least one injury in region</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head &amp; Neck</td>
<td>1177</td>
<td>49.9</td>
</tr>
<tr>
<td>Face</td>
<td>379</td>
<td>16.1</td>
</tr>
<tr>
<td>Chest</td>
<td>493</td>
<td>20.9</td>
</tr>
<tr>
<td>Abdomen</td>
<td>323</td>
<td>13.7</td>
</tr>
<tr>
<td>Extremities &amp;/or Pelvis</td>
<td>683</td>
<td>29.0</td>
</tr>
<tr>
<td>External</td>
<td>1745</td>
<td>74.0</td>
</tr>
</tbody>
</table>

Figure 11: Injury Severity Scores – all patients
Disposition & Outcome

Emergency Observation Unit

The faculty from the Department of Emergency Medicine is responsible for managing patients with minor injuries admitted to the Observation Unit (ED OBS), located within the Emergency Department. Among the hundreds of trauma patients sent to ED OBS in 2009, nine percent subsequently required hospital admission (Figure 12). The ED OBS is an effective strategy for assuring efficient use of inpatient hospital beds while maintaining quality medical care for injured patients.

Figure 12: Emergency Observation Unit
Hospital Admission

1546 (66%) of our patients are admitted into the hospital (Figure 13). Those patients in the age extremes, very young and very old, are more likely to require hospital admission. Most of these patients are able to return home after admission (Figure 14).

Figure 13: Patients requiring Hospital Admission

Figure 14: Inpatient Disposition Distribution (percentage)
Mortality

Seventy patients (2.96%) expired in 2009. Ten patients expired in the Emergency Department and 60 expired after hospital admission (Figure 15). The risk-adjusted odds of death for patients who were admitted to the hospital in 2009 were compared using a logistic regression model to patients from 2007 and 2008. Independent variables included in the model were age, ISS, gender, admission systolic blood pressure, admission Glasgow Coma Score, designation of patients as having blunt trauma, admission endotracheal intubation status and past medical history. Our analyses show that in 2009 for both scene and transfer patient there was a significant difference in the odds of death compared to previous years. There were fewer deaths in both groups in 2009 than in 2007 and 2008.

Figure 15: Mortality
Geriatric Patients - age over 64

In 2009, 370 patients over the age of 64 were treated as trauma system patients at OHSU (up from 349 in 2008). One hundred fifty one (41%) were transferred to OHSU from another hospital or clinic. Of the 370 injured patients, 312 (84%) required hospital admission. Twenty two geriatric patients died as a result of their injuries (5.9%), down from 12% in 2008. Figures 16 and 17 provide additional information regarding geriatric trauma at OHSU.

Figure 16: Disposition from the Emergency Department for geriatric population

Figure 17: Geriatric mechanism of injury
Pediatric Patients -age under 16

In 2009, there were 304 children evaluated as trauma system patients (up from 224 in 2008). Two hundred eight (68%) were transferred to OHSU from hospitals throughout the northwest and many were transported by the Pediatric and Neonatal Transport Team (PANDA). Of the 304 injured children, 201 (66%) required inpatient admission to Doernbecher Children’s Hospital. Fifty-five children were admitted to the ED OBS unit and four subsequently required inpatient admission (7%). Five children died as a result of their trauma, one in the Emergency Department and four after hospital admission. The overall pediatric death rate was 1.6 percent. Figures 18, 19, and 20 provide additional information regarding pediatric trauma at OHSU.

Figure 18: Disposition from the Emergency Department
Figure 19: Pediatric Mechanism of Injury

- Vehicle Collisions (E800-E848)
- Non-intentional falls (E880-E888)
- Mishaps due to natural & environmental factors (E900-E909)
- Mishaps by submersion, suffocation & foreign body (E910-E915)
- Other occurrences (E916-E928)
- Homicide & injury purposely inflicted by others (E960-E969)

Figure 20: Pediatric Disposition after Admission.

- Home
- Home health
- Expired
- Rehabilitation facility
- Other facility
Figure 21: Arrival of Pediatric Patients by Time of Day

Injured children follow the same seasonal variation seen in the general population – more injuries occur in the warm summer months (Figure 22).

Figure 22: Pediatric volume by quarter
Injury Prevention

OHSU has been the statewide leader for ThinkFirst Oregon, part of ThinkFirst National, an award winning brain and spinal cord injury prevention program, for more than 24 years. ThinkFirst Oregon’s award-winning, evidence-based programs are aimed at helping people learn to reduce their risk for injury. Currently free programs and curriculum offered to the public include: ThinkFirst for Kids, ThinkFirst for Youth, and ThinkFirst for Teens. Through innovative classroom presentations and course work, ThinkFirst’s programs are designed to help community members develop lifelong safety habits to minimize their risk of sustaining brain, spinal cord or other traumatic injuries. Additionally, beginning fall 2010, ThinkFirst Oregon will launch “A Matter of Balance” Senior Falls Prevention Program.
ThinkFirst Oregon Summary of Activities for 2009

- Outreach number through school presentations to Oregon children: 5613
- Additional community adults and children reached through ThinkFirst Events: 24,365
- Teachers trained to use ThinkFirst Brain and Spinal Cord Injury Prevention Curriculum: 72
- Safety helmets distributed to children and community members: 2086
- Partnered with injury prevention and community organizations: 30
- OHSU and community volunteers signed up and assisted at ThinkFirst events-logging 317 hours
Research

In 2009, the Trauma Research Laboratory was awarded five research grants for human and animal trials. Dr. Martin Schreiber was awarded $750,000 from the United States Air Force to conduct a 16-month clinical trial to evaluate the safety and efficacy of cyropreserved red blood cells (RBCs) for transfusion purposes. The aim of the study is to compare cyropreserved RBCs to standard RBCs of different ages. Older units of RBCs have been associated with negative clinical effects and determining if cyropreserved RBCs can be shown to be as safe and effective as fresher, or younger, RBCs could prompt a change in the management of blood transfusions in critically injured patients. Ultimately, up to 300 subjects will be enrolled in the study.

Dr. Schreiber was granted $459,330 as a subcontract from the University of Texas Health Science Center at Houston as part of the Prospective Observational Multi-center Massive Transfusion Study (PROMMTT) funded by the Department of Defense. The aim of the study is to prospectively track the transfusions administered to trauma patients during the first 24 hours of admission and to evaluate patient outcomes based on the ratio of blood products received.

Lead investigator Dr. John Mayberry and his physician colleagues on the Trauma service continue to enroll patients into a study titled “Prospective Trial of Operative Management of Rib Fracture Non-Union.” The aim of this research is to learn if the surgical treatment of rib fracture non-union provides a benefit in pain reduction and improves quality of life scores. 50 people with rib fracture non-union will be studied to learn more about this painful and disabling injury. This research is supported by a grant from ACUTE Innovations® and has been underway since 2008.

Injury prevention research continues to be an interest and focus for the Division of Trauma. Research efforts in the summer of 2009 by Dr. Mayberry and his research team included a survey of equestrians injured and treated at OHSU from 2001-2008. The goal of this research was to identify costs, morbidities, and potentially preventable circumstances of equestrian injury at our trauma center. Results are expected in the first quarter of 2011.

In June, Dr. Philbert Van was awarded $20,000 for an Early Clinical Investigator grant from the Medical Research Foundation of Oregon. Dr. Van’s is examining the use of thrombelastography (TEG) to determine enoxaparin (Lovenox) dosing in critical care patients in order to reduce the incidence of blood clots during hospital admission. Up to 200 patients will be enrolled in the trial to determine whether TEG-
guided Lovenox dosing decreases bleeding and clot complications as compared to standard Lovenox dosing.

Additionally in May, Dr. Schreiber and Dr. Jennifer Watters both received funding to evaluate haemostatic dressings in a severe groin injury model in swine. Dr. Schreiber received funding from SAM Medical for $131,995 for 6 months to evaluate a new haemostatic dressing compared to standard gauze and other dressings available for hemorrhage control. Dr. Watters was awarded the annual American Association for the Surgery of Trauma’s Local Wound Haemostatics and Hemorrhage Control Scholarship for $40,000 to compare currently available and upcoming haemostatic dressings.

Three surgery residents won awards during 2009 at scientific meetings. Dr. Chitra Sambasivan won the Resident Award for Excellence in Clinical Research at the 62nd Annual Portland Surgical Society Scientific Meeting in May and the Baker-Moseley Award for Clinical Science at the American College of Surgeons Oregon-Washington Chapter Meeting in June. In November, Dr. Philbert Van and Dr. Modjgan Keyghobadi were awarded the Basic Science Paper Award and the Clinical Paper Award (respectively) at the American College of Surgeons Region X Meeting.

Last, along with presentations at the American Association for the Surgery of Trauma, American College of Surgery regional meetings, Portland Surgical Society, and annual Advanced Technology Applications Combat Casualty Care (ATACCC) conference, 2009 was a productive year for journal publications for the Trauma Research Laboratory. These publications highlight the culmination of many studies conducted by our trauma attending and surgical residents.


Appendix A

The AIS system is used to generate the Injury Severity Score or ISS. ISS has a single value between one and 75 that assigns a numerical value corresponding to a patient’s total severity of injury. The ISS is calculated using the highest AIS score from as many as three of the six body regions. ISS is the sum of the squared highest three AIS scores from three separate body regions. ISS is useful in making risk-adjusted comparisons between groups of patients. For example, based upon analysis of national trauma databases, it can be predicted that patients with an ISS of less than 15 have less than a 5 percent risk of death, and patients with an ISS greater than 40 have greater than 60 percent risk of death.

The American College of Surgeons Committee on Trauma has proposed that for a Level I trauma center to have enough experience to be fully competent, the trauma center should admit more than 1,200 trauma patients each year, and 240 of these patients should have an ISS greater than 15.
GLOSSARY OF TERMS

**Abbreviated Injury Scale (AIS)** is a consensus-derived system that classifies injuries by body region. A numerical value is assigned to individual anatomic injuries based on severity.

0 = no injury; 1 = minor injury; 2 = moderate injury; 3 = severe but not life-threatening injury; 4 = severe life-threatening injury; 5 = critical injury; and 6 = untreatable injury. The six body regions are: head and neck; face; chest; abdomen and pelvic contents; limbs including the bony pelvis; and external.

**E-codes** are supplementary classifications of external causes of injury that describe the circumstances surrounding the cause of injury, such as from what type of firearm (handgun, rifle etc.) the bullet was fired, or from where the patient fell (balcony, steps, etc.). E-codes are used in conjunction with ICD-9-CM scores to provide a more detailed analysis of the mechanism of injury.

**Glasgow Coma Scale (GCS)** is a quantitative measure of the patient’s level of consciousness. It is the sum of scores for three areas of assessment: eye opening, verbal response and motor response. The GCS reported in the tables of this document are the first recorded after the patient arrives in the Emergency Department. Minimum score is 3 and maximum is 15. Patients with endotracheal tubes, some of whom have been pharmacologically paralyzed, cannot be assigned a GCS on admission.

**Hospital Length of Stay (LOS-HOSP)** includes only those patients admitted to the hospital and excludes patients who were discharged to home, observed in the ED Observation Unit or died in the ED. Every patient in this population has a minimum one-day length of stay. Some patients are transported to the operating room from the ED and die during the operation; these patients are considered to have a one-day length of stay.
**International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)** assigns a specific number to a disease or condition experienced by a patient. For example, a spleen injury with a capsular tear is coded as 865.02, and Parkinson’s disease is coded as 332.0.

**Injury Severity Score (ISS)** is an estimate of the overall severity of the patient's injuries. AIS scores are used to calculate the ISS: the squares of the highest AIS code in each of the patient's three most severely injured body regions are squared and then added to produce the ISS. Scores can range from one to 75. An AIS of six in any body region automatically infers an ISS of 75, usually an un-survivable injury. An ISS of 15 or more is considered a serious injury.

**Intensive Care Unit Length of Stay (LOS-ICU)** includes only patients admitted to an ICU at some time during their hospitalization.

**Past Medical History (PMH)** is noted in the Trauma Registry when patients are known to have cardiovascular disease, diabetes, renal or liver disease, are pregnant, have respiratory disease, immunologic disease, or are post-splenectomy or undergoing therapy. An “other” category is included and may indicate a history of chronic alcohol, drug abuse or other relevant conditions.