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AMERICAN COLLEGE OF SURGEONS COMMITTEE ON TRAUMA
VERIFICATION, REVIEW, & CONSULTATION PROGRAM FOR HOSPITALS

Level I Trauma Center Consultation Site Visit Report

Rigshospitalet Trauma Center
Copenhagen, Denmark
July 9-12, 2012

AMERICAN COLLEGE OF SURGEONS

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Rigshospitalet, Copenhagen University Hospital
Copenhagen, DK
July 9-11, 2012
Consultation, Level I Trauma Center
Site Visit Report

EXECUTIVE SUMMARY

Rigshospitalet, Copenhagen University Hospital in Copenhagen, Denmark was reviewed on July 9-11, 2012 by Drs. Christoph Kaufmann, Chris Cribari, Robert Winchell, and Nels Sanddal for consultation as a Level I trauma center. This hospital provides trauma care for adults and children. The findings of the reviewers are as follows:

Variance from Trauma Center Standards:

Due to the differences between the Danish health care system and that in United States, it is not possible to directly apply the specific criteria used for verification of U.S. trauma centers. The review team and the Verification Review Committee evaluated the degree to which the Rigshopitalet trauma program met the general principles and functional intent of these criteria within the context of the Danish system. Using this approach, Rigshospitalet was found to be functioning at a level consistent with that of a Level I center.

Strengths:

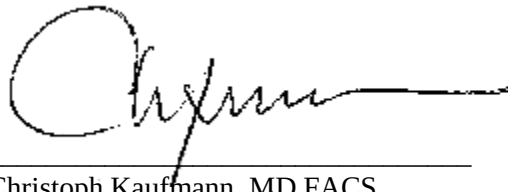
1. Dr. Claus Falck Larsen's leadership.
2. Strong trauma administrative team.
3. Robust nature of trauma resuscitation room/process.
4. Large team size, meaning that the team leader is not required to be hands-on, and can better supervise the trauma resuscitation.
5. Depth and nature of the physical plant and clinical resources.
6. Prompt availability of specialties and esprit de corps.
7. A system that ensures the distribution of less severely injured patients to surrounding acute care facilities, reserving the trauma center for the most severely injured.
8. Availability and use of emergency doctors for prehospital response according to perceived patient acuity.
9. Robust research activities and publications.
10. MD/PhD program, with a large proportion of medical staff having MD/PhD degrees.
11. Blame-free, self-reporting performance improvement and patient safety culture across the entire hospital and national health care system.
12. ATLS and PHTLS requirements for trauma center and prehospital personnel, respectively.
13. The evolution of the trauma center, which has had a positive impact across the entire hospital, a "halo effect."
14. Central and regional planning, guidance, and regulation of trauma system activities and patient flow.
15. Strong disaster preparation.

Weaknesses:

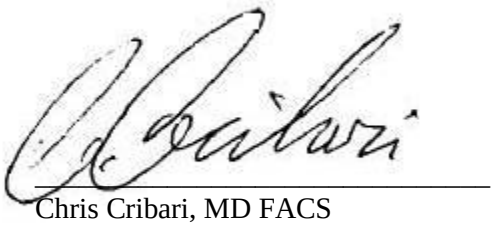
1. A compartmentalized process of care that creates the potential for inconsistencies in the continuity of care.
2. Suboptimal use of the TARN database to serve as a basis for ongoing performance improvement, to inform administrative and clinical decision making, and for research purposes.
3. Absence of performance benchmarks (audit filters) and processes.
4. Inadequate personnel and resources for support of the trauma program including data entry, queries, performance improvement, and outreach activities.
5. Although interventional radiology is available 24 x 7, the timeliness of the response is questionable.
6. Solid organ injuries are not graded by radiology.
7. Lack of assurance that all post splenectomy patients are appropriately vaccinated.
8. Lack of access to all autopsy results, which hampers performance improvement activities.

Recommendations:

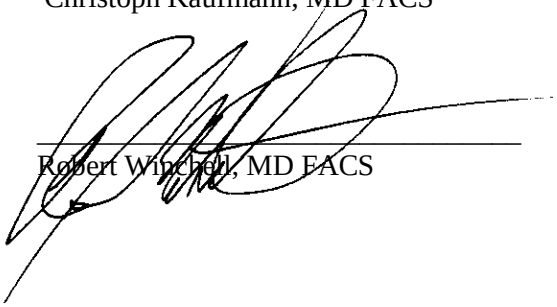
1. Continue to develop processes to enhance continuity of care. These should include additional personnel to assure daily rounds by trauma center care providers are completed on all injured patients throughout their hospital stay.
2. Continue to expand the use of the TARN database to include all injured patients seen in the hospital.
3. Continue to expand the use of custom fields in TARN to track local process measures and audit filters.
4. Increase fiscal resources for additional personnel for data abstraction, entry and reporting.
5. Explore ways to use existing medical records to assist in concurrent and retrospective data analysis for quality assurance purposes.
6. Monitor all admissions to ensure that all injured patients are appropriately identified and included in concurrent performance improvement initiatives.
7. Establish and continuously monitor various process and clinical benchmarks for the trauma program.
8. Develop an injury prevention plan that focuses on injuries commonly seen in the trauma center.
9. Complete the proposed remodeling/building of the trauma resuscitation area with the inclusion of the central computerized tomographic scan and adjacent angiography suite.
10. Establish a system that ensures the timely availability of interventional radiology 24 x 7; track time from request for angiography to procedure start.
11. Continue to promulgate the concept that the Rigshospitalet trauma center is a regional and national resource, but that all acute care facilities, prehospital and other resources also play an important role within the trauma system.
12. Radiologists or other appropriately trained personnel should grade solid organ injuries.
13. Establish a process to ensure that all post splenectomy patients receive adequate vaccinations.
14. Develop a methodology to demonstrate to government authorities that trauma patients treated at Rigshospitalet are more seriously injured and require a higher level of resources.
15. Better document time intervals during trauma resuscitations.
16. The trauma program should be elevated to hospital center status, like the other six treatment centers.



Christoph Kauffmann, MD FACS



Chris Cribari, MD FACS



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Rigshospitalet, Copenhagen University Hospital
Copenhagen, Denmark
July 9-11, 2012
Consultation, Level I Trauma Center
Site Visit Report

I. PURPOSE OF REVIEW

Rigshospitalet, Copenhagen University Hospital (RCUH) in Copenhagen, Denmark was reviewed on July 9-11, 2012 by Drs. Christoph Kaufmann, Chris Cribari, Robert Winchell, and Nels Sanddal for consultation as a Level I trauma center. This hospital provides trauma care for adults and children. A simultaneous focused trauma system consultation was performed. The review was requested by RCUH, which has the Capital Region as its designating agency. The reporting year for the review was October, 2010 to November, 2011. During the prereview meeting, the site surveyors met with the members of the trauma program including trauma service leadership and staff, surgical and medical specialists, nursing, hospital performance improvement staff, and senior administrators.

II. HOSPITAL INFORMATION

RCUH is a 255-year-old university hospital. It has an affiliation with Faculty of Health Sciences, University of Copenhagen. As RCUH is the only hospital owned by the federal government (the others are owned by the Regions), it is the national hospital of Denmark. RCUH is the only Level I trauma center for 1.6 million inhabitants of the Capital Region (Capital Region has 15 hospitals, but not all are acute care facilities). RCUH covers all medical specialty areas (except for patients requiring interventional stroke care). It has 1,120 beds, and sees 65,000 inpatients and 420,000 outpatients annually. There are 7,000 full-time employees. There are 11,470 annual ED visits. Joint Commission International has accredited RCUH since 2002 (most recently in March, 2011). The hospital is divided into six treatment centers and two interdisciplinary centers. There are 57 ORs.

The trauma center at RCUH was established in 1999, at which time the busy ED was closed. RCUH now provides care for only the most critical EMS-transported patients. Walk-in patients are told to go to a different hospital. The trauma admitting area became known as "The Trauma Center" – a highly specialized ED. RCUH is one of only four trauma centers in Denmark (population 5.5 million) and admits more than 900 trauma patients a year (the busiest in Denmark) with 7% being penetrating.

All transport and treatment is free of charge throughout Denmark. For trauma and other emergencies, transport to a hospital and required hospital care is automatic. In non-acute cases, initial treatment is by a general practitioner with specialist care requiring referral from the general practitioner. All of the trauma activities at RCUH are on one campus. The bed status for the hospital is as follows:

Hospital Beds	Adult	Pediatric	Total
Licensed	982	110	1092
Staffed	981	110	1091
Average Census	87%	109%	88%

The hospital has the commitment of the institutional governing body and the medical staff to become a trauma center. There are resolutions supporting the trauma program from both the hospital administration and the medical executive committee. The trauma center is a separate clinic (department-equivalent) with personnel, education, and equipment, based on a DRG-driven budget.

The trauma center has a trauma medical director (head of clinic), Claus Falck Larsen, MD, and a head nurse, Kim Bo Christensen, RN, who together comprise the management team. The management team of the trauma center is responsible for the budget (monetary and activity).

In addition to the management team, there are three consultant-level medical doctors (emergency anesthesiologists) with 50% of their duty in the trauma center. A staff nurse is in charge of the nursing staff, and a lead secretary is in charge of the secretaries. Apart from the head of clinic and the three consultant anesthesiologists mentioned above, all other medical staff are called to the emergency room and/or trauma resuscitation area as needed. The trauma manual dictates the response and the level of the medical staff to respond in specific situations (including disasters).

There is involvement by the trauma program staff in state/regional trauma system planning, development, and/or operation. There is a regional Prehospital and Acute Board for the Capital Region responsible for regional trauma system planning, development, and operation. The head of clinic, the head nurse and the head of the acute coordination center represent the trauma center. The head of clinic participated in the development of the 2007 National "Acute Plan" describing the (then) future trauma system of Denmark.

III. PREHOSPITAL

Healthcare in Denmark is the responsibility of the Danish Health and Medicine Authority. This system is operationalized at five regional authorities. Trauma care is provided by trauma centers identified and designated by the regional authorities. RCUH operates within the Capital Region and is the only Level I trauma center serving the region. The region encompasses 2,561 km^2 that is the equivalent of approximately 1,000 mi^2. The population of the region is approximately 1.6 million. RCUH also serves an adjacent region, Region Zealand.

The day-to-day authority over EMS is assigned to the region. Only injured patients meeting high-level triage criteria are transported to RCUH. Patients with minor injuries are transported to one of four other acute care facilities with EDs that also serve the region. There is centralized dispatch of prehospital resources including the response of emergency doctors (subspecialty-trained anesthesiologists) to incident scenes of high acuity.

Air medical support services for the hospital includes military rotor wing support by the Royal Danish Army search and rescue, which is able to operate in IFR conditions, and is available 24/7/365. Regional helicopters that operate only during daylight VFR conditions serve the Capital Region and Region Zealand. Anesthesiologists with special prehospital training staff these services. Fixed-wing aircraft are occasionally utilized for patients repatriated from abroad and for transport from the island of Bornholm. The hospital does not serve as a base station for EMS operations. Medical control is provided by the regional dispatch/communication center. Emergency doctors respond to the scene for approximately 10% of ambulance calls.

The trauma program is involved in prehospital training. Emergency doctors (anesthesiologists) work both in the prehospital setting and in the hospital, providing anesthesia and as team leaders of the trauma resuscitation team. This group also serves as educators for the other prehospital providers. All paramedics are provided PHTLS training. All prehospital employees are required to participate in regularly scheduled full-scale training exercises and disaster drills.

The trauma program team also participates in prehospital care protocol development and the prehospital PIPS program. Prehospital documentation is continuously evaluated by the trauma center physicians.

IV. TRAUMA SERVICE

A. TRAUMA MEDICAL DIRECTOR (HEAD OF CLINIC)

The head of clinic (head of the trauma center and the department of orthopaedic surgery), Dr. Claus Falck Larsen, graduated from the University of Southern Denmark and University of Copenhagen in 1982, and completed his residency in orthopaedic surgery at the University of Southern Denmark, Odense Hospital in 1991. He also completed a hand and microvascular fellowship at Christine Kleinert Institute in Louisville, KY. Dr. Falck Larsen is certified by the Danish specialty board in orthopaedic surgery, and holds the additional degree of master of public management (DMSci). He is a Fellow of the American College of Surgeons, and is current as an ATLS instructor. His external trauma CME for the last 3 years is adequate. The head of clinic is a member and active participant in international, national and regional trauma organizations. He serves as the Region Chief of COT Region 15 and has been very active in the international promulgation of ATLS. The head of clinic participates regularly in trauma call. As of the dates of this site visit, the nature of record keeping at RCUH and the lack of ISS scoring for a subset of patients in the trauma registry makes it impossible to calculate admission volume, severity and the number of operative cases for each surgeon.

The head of clinic reports to the chief medical officer of the hospital, and has the authority and administrative support to lead the program. The head of clinic has sufficient authority to set the criteria for the trauma center members. He also has the authority to correct deficiencies in trauma care or exclude from trauma call any trauma team members who do not meet specified criteria and to recommend changes in the composition of the trauma panel based on performance review through the trauma PIPS program and hospital policy. The head of clinic has the responsibility and authority to ensure compliance with verification requirements.

B. TRAUMA SURGEONS

In the Danish model, the roles within the resuscitation area are substantially different than in the United States. The resuscitation team leader is an anesthesiologist with additional training in emergency and prehospital care (emergency doctor). All anesthesiologists in Denmark have completed a fellowship in critical care, emergency medicine, or anesthesia. The team leader remains in charge through the resuscitation phase and through any acute surgical intervention. Other members of the team include attending abdominal surgeons, attending orthopaedic surgeons, and surgical trainees. Some doctors in each specialty are additionally trained in trauma (such as the thoracic surgeons and abdominal surgeons).

Patients are subsequently admitted to the specialty service primarily responsible for the patient's major problems. In the case of patients with multiple severe injuries, an anesthesiologist with additional training in critical care will primarily manage the patient in the multidisciplinary ICU. In other circumstances, the patient may be admitted to a specialty ICU service or to a ward service. The orthopaedic service admits the majority of non-ICU patients and, as such, is the service most closely related to the trauma service in a U.S. hospital. The orthopaedic surgeons are most closely matched to the role of the U.S. trauma surgeon. Indeed, in other Danish trauma centers, the orthopaedic surgeons are in charge of trauma resuscitation. Abdominal and thoracic surgeons tend to manage patients with isolated injuries on the ward, and ICU care is the responsibility of critical care-trained anesthesiologists. Though the provision of services is compartmentalized to a higher degree than in the U.S., there is very good communication between physician groups and good continuity of care – as proven during the chart review process.

Including Dr. Larsen, there are 16 board-certified orthopaedic surgeons currently taking trauma call. There is also a full panel of abdominal surgeons and thoracic surgeons on call at all times, all of whom

are board certified. The equivalent of trauma-related CME (or internal educational process) over the past 3 years is adequate for the orthopaedic/trauma surgeons on the call panel. All of the surgeons on the call panel have successfully completed the ATLS course at least once.

While on call, the orthopaedic/trauma surgeon is dedicated to the trauma center, and may care for non-trauma emergencies. An attending level orthopaedic surgeon, abdominal surgeon and thoracic surgeon are available for major resuscitations in-house 24 hours a day. There is a published backup call schedule for the orthopaedic/trauma surgeons. All members of the resuscitation team respond promptly to activations, and are knowledgeable in trauma care principles.

C. TRAUMA PROGRAM MANAGER (TPM)

Jacob Steinmetz, MD, PhD, the TPM, is an anesthesiologist with special training in emergency and prehospital medicine (an emergency doctor). In addition to his duties as program manager, he works as a field emergency doctor and also manages resuscitations in the trauma bay. Dr. Steinmetz reports to the head of clinic. The TPM position has a well-defined job description, and is staffed at the equivalent of one FTE. Dr. Steinmetz works in this post part-time, sharing program management and coordination duties with another anesthesiologist with an emergency focus, Dr. Anne-Marie Sorensen. The TPM has an additional 1.5 FTEs in supporting roles; Jan Olsen, RN (and medical student), as 0.5 FTE trauma registrar, and Margrethe Lomholt, RN, as clinical quality assurance nurse. The TPM is actively involved in the care of injured patients, and has appropriate continuing education (a minimum of 16 hours of trauma-related continuing education per year). Dr. Steinmetz is effective in the role of TPM. Because of the different inpatient care model, in which patients are treated primarily on specialty services, the TPM is actively involved in care coordination and in the maintenance of continuity throughout the hospital stay, functioning as a trauma patient advocate and consultant. Danish laws regarding patient privacy have created some barriers to the performance of this integrative function, but the trauma service has been able to demonstrate the benefit of the process and gain acceptance of this clinical function that is generally unknown in the Danish system.

D. TRAUMA SERVICE

There is a trauma service at RCUH, and the head of clinic is involved and provides oversight for all aspects of care. The care model in Denmark is significantly different than in the U.S., and as a result, the staffing and responsibilities are different though the functional elements are all present. The clinical service known as the trauma unit is a separate area within the ED that includes a resuscitation space, an emergency OR, and an observation ward used to house patients with more minor injuries along with the personnel to staff these areas. There is no separate specialty of emergency medicine; the role of emergency physician is filled by anesthesiologists with special training in emergency care (emergency doctor), which includes both trauma resuscitation in the hospital and response to calls in the field (not on the same day). An anesthesiologist/emergency doctor serves as leader of the resuscitation team and is in charge of the patient until an inpatient team assumes care. There is strong surgical commitment to the trauma center across the full breadth of surgical specialties, and strong surgical presence on the resuscitation team. The abdominal surgeon trauma team member performs the FAST exam for trauma patients.

Patients requiring emergency surgery can be cared for in the trauma unit OR, or in the OR suite of the involved specialty. Patients requiring ICU care are admitted either to a multidisciplinary ICU service (if there are multiple issues) or to a specialty ICU service. Critical care is provided by anesthesiologists with special training and interest in critical care. Within the multidisciplinary ICU there is a subgroup of providers with a focus on the care of the injured. If ICU care is not required, or after the ICU phase, the patient will be cared for on a specialty service, most often orthopaedics (with the TPM providing the

continuity). Abdominal surgeons (the Danish equivalent of U.S. general surgeons) function in a consultant role, assuming primary care only in patients with isolated or predominantly abdominal injuries.

This compartmentalized care model establishes a need for consistent hand-offs and frequent multidisciplinary care conferences, which are a regular part of the Danish medical culture. The head of clinic oversees all aspects of care as described, including: administration, protocols, M&M, trauma coordination committee, accreditation (Joint Commission International), and clinical involvement. The usual role of the trauma service in ensuring coordinated overall care is performed by the ED-based trauma service, with two anesthesiologist/emergency physicians in the program management role who help ensure continuity and consistency between the resuscitation team and the hospital teams, as well as to help coordinate care between the specialty services.

The Danish model provides several advantages, especially with respect to the depth of senior specialty expertise, but also carries the inherent risk of discontinuity in care, as patients are admitted to critical care and various specialty services. As a result, seriously injured patients are admitted to an identifiable surgical service staffed by credentialed trauma providers, though not to a single trauma service. The trauma service, however, does provide the integrative and process improvement functions spanning these specialty services. There is sufficient infrastructure and support for the trauma service to ensure adequate provision of care, but given the critical and expanding role of the TPM, it is likely that additional staff in this role will be required.

The standard trauma resuscitation team is very robust, with strong senior surgical involvement. The team consists of 16 members including: two anesthesiologists (one emergency doctor attending/one resident), one abdominal surgeon (attending), two orthopaedic surgeons (one attending/one resident), one nurse anesthetist, two nurses (critical care/emergency room), one social worker/nurse in charge of family, two radiology technologists, two orderlies/security officers, one secretary/recorder, and two laboratory technicians. The team manages the patient based on a trauma manual. The hospital has appropriate credentialing criteria for serving on the trauma resuscitation team.

E. TRAUMA RESPONSE/ACTIVATION

There is only one level of trauma team response (full team). The trauma team can be activated by EMS personnel, by the field emergency doctor, by ED nursing, the ED emergency doctor, or the orthopaedic trauma surgeon. The majority of activations are initiated from the field. The full team activation is instituted via group pager and telephone page; the trauma team is paged before arrival of the patient. The criteria for activation are clearly defined by the trauma center and include the six minimum criteria of the COT for the highest level of activation. The surgical members of the team are present in the ED on patient arrival, or within 15 minutes of notification 100% of the time, as monitored by the PI process.

The statistics for each level of response are tabulated below:

Level	Number	Response
Highest	1,004	100%
Total	1,004	100%
Direct Admits	Data not available	

As noted above, RCUH uses the shared Trauma Audit and Research Network (TARN) registry housed in the United Kingdom as its primary trauma registry. Due to TARN-defined entry criteria, some RCUH trauma patients are not entered into the registry; a substantial number of trauma patients not meeting entry criteria do not have ISS scores and there is no field to conveniently track direct admissions. Therefore, the data reporting below is not fully complete or consistent. During the site visit, the review team

discussed registry use and the importance of ISS scoring on all patients. The trauma service has subsequently created custom fields within their implementation of TARN to allow for tracking of all ISS scores and other pertinent data.

The personnel on the trauma team for each level of activation include the following:

Responder	Activation Level		
	Highest	Alert	Lowest
Anesthesiologist attending (team leader)	X		
Abdominal surgeon attending	X		
Orthopaedic surgeon attending	X		
Anesthesia resident	X		
Orthopaedic resident	X		
CRNA Nurse	X		
Trauma Nurse 1	X		
Trauma Nurse 2	X		
Trauma Nurse 3	X		
Orderlies 1 + 2	X		
X-ray Technicians 1 + 2	X		
Laboratory Technician 1 + 2	X		
Secretary	X		

A thoracic surgeon or neurosurgeon can also be called to be present at patient arrival.

F. TRAUMA/HOSPITAL STATISTICAL DATA

The ED activity and trauma demographics are summarized below:

Total ED Visits	11,470
Trauma ED Visits	
Blunt trauma	66%
Penetrating trauma	7%
Burns	23%

The trauma-related ED activity led to the following trauma admissions:

Service	Number
Trauma	N/A
Orthopaedic	536
Neurosurgical	156
Other Surgical	202
Burn	131
Non-Surgical	98
Total	1,135

These data are slightly below ACS Level I hospital volume criteria, but given the limitations of the TARN database, it is extremely likely that the actual number is above the threshold. This is consistent with the observation of the review team with respect to clinical activity.

The disposition of trauma admissions from the ED is shown below:

Disposition	Number	Admitted to Trauma Service
ED to OR	85	N/A
ED to ICU	258	N/A
ED to Floor/Ward	549	N/A
Total	892	

These totals do not match the total admission numbers above due to previously described limitations in TARN database utilization.

The ISS and percent mortality are as follows:

ISS	Trauma Admissions	Deaths	Mortality	Admitted to Trauma Service
0-9	694	12	2%	N/A
10-15	62	0	0	N/A
16-24	141	11	8%	N/A
>25	100	19	19%	N/A
Total	997	42	4%	N/A

Due to limitation in TARN implementation, the 0-9 category contains 580 patients who have no ISS score, many of whom would likely have scored in higher categories, thus skewing the results. This is also the reason for a mismatch between the totals.

The numbers of trauma transfers are as follows:

Transfers	Air	Ground	Total
Transfers In			134
Transfers Out			4
Total			138

The TARN database did not differentiate between air and ground transfers for the reporting period.

A mechanism for direct physician-to-physician contact is present for arranging patient transfer. RCUH is the designated tertiary hospital for the Capital Region, and patients are rarely transferred out for specialty needs. The decision to transfer an injured patient to a specialty care facility in an acute situation is based solely on the needs of the patient.

G. TRAUMA BYPASS

RCUH as the single high-level trauma center in the region does not go on bypass as a matter of policy. As a result, the hospital does not have a bypass protocol, and during the reporting year was not on bypass.

H. NEUROSURGERY

Dr. Vagn Eskesen, the neurosurgical liaison to the trauma program, graduated from Copenhagen University in 1978, and completed his residency training at RCUH in 1990. Dr. Eskesen is certified by the Danish Board of Medical Specialties. Dr. Eskesen is an ATLS instructor. He is a member of the Danish Neurosurgical Society and has adequate trauma CME over the past 3 years.

Including Dr. Eskesen, there are 16 board-certified neurosurgeons on the call panel. Trauma-related CME (or internal educational process) over the past 3 years is adequate for the neurosurgeons on the call panel.

While on call, the neurosurgeon is dedicated to the hospital, and is promptly and continuously available for severe traumatic brain injury and spinal cord injury, and for less severe head and spine injuries when necessary. An attending neurosurgeon is promptly available to the hospital's trauma service when neurosurgical consultation is requested.

During the reporting year, the neurosurgeons performed >100 emergency craniotomies within 24 hours of admission. Qualified neurosurgeons are regularly involved in the care of head and spinal cord-injured patients and are credentialed by the hospital with general neurosurgical privileges. The hospital provides an on-call neurosurgical backup schedule with formally arranged contingency plans in case the capability of the neurosurgeon, hospital, or system to care for neurotrauma patients is overwhelmed. All neurosurgical transfers/diversions are monitored in the PIPS program and convincingly demonstrate appropriate care. RCUH is the primary referral center and there were no neurosurgery-driven transfers out. There is a neurosurgical residency program at this institution.

I. ORTHOPAEDIC SURGERY

Dr. Henrik Eckhardt, the orthopaedic liaison to the trauma program, graduated from Odense University in 1995, and completed his residency training at Aarhus University Hospital in 2007, and has additional fellowship training. He is certified by the Danish Board of Medical Specialties. Dr. Eckhardt is an ATLS provider. He is a member of the European Society of Trauma and Emergency Surgery (ESTES). Dr. Eckhardt has adequate external trauma CME over the past 3 years.

Including Dr. Eckhardt, there are 16 board-certified orthopaedic surgeons on the call panel. Trauma-related CME (or internal educational process) over the past 3 years is adequate for orthopaedic surgeons on the call panel.

During the reporting year, over 1,000 operative cases were done within 24 hours of admission by the orthopaedic service. Also during the reporting year, there were 100 pelvis and acetabular cases performed at this institution, and none of these cases transferred out. There are seven orthopaedic surgeons who have completed at least 1 year of orthopaedic trauma fellowship involving operative care of fractures. There is an orthopaedic surgery residency program, but there is not an orthopaedic trauma fellowship.

The orthopaedic service is the nearest functional equivalent of the trauma service found in U.S. trauma centers. The head of clinic is an orthopaedic surgeon, and the majority of non-ICU trauma patients are admitted to the orthopaedic service. Orthopaedic surgeons are present on the primary resuscitation team and are involved with the care of patients throughout their hospital stay if orthopaedic injuries are present. During a resuscitation witnessed by the review team, the orthopaedic surgeon performed a tube thoracostomy. If there are not orthopaedic injuries, continuity is provided through the care coordination functions of the TPM.

An orthopaedic team member is promptly available in the trauma resuscitation area for all trauma activations. Orthopaedic team members have dedicated call at their institution. The design of the backup call system is the responsibility of the orthopaedic trauma liaison and has been approved by the trauma program director.

The trauma center provides sufficient resources including instruments, equipment, and personnel for modern musculoskeletal trauma care, with readily available ORs for musculoskeletal trauma procedures. Physical and occupational therapists, and rehabilitation specialists are involved in the acute and rehabilitation phases of care. ORs are promptly available to allow for emergency operations on musculoskeletal injuries, such as open fracture debridement and stabilization, and compartment decompression. There is a mechanism to ensure OR availability without undue delay for patients with

semi-urgent orthopaedic injuries. Plastic surgery, hand surgery, and spinal injury care capabilities are present.

V. HOSPITAL FACILITIES

A. EMERGENCY DEPARTMENT

RCUH does not have a general visit ED, but rather has a trauma-receiving center staffed by the trauma team. Emergency medicine as a separate specialty does not exist in Denmark.

There are 20 board-certified/eligible emergency doctors who treat trauma patients. All of these physicians have successfully completed the ATLS course at least once.

The roles of the members of the trauma team are well defined, agreed upon, and approved by the head of clinic. While on call (in-house), the trauma team leader does not have responsibilities outside the trauma receiving area. Residents are involved in the care of patients in the trauma center receiving area, and are supervised at all times by in-house attending physicians.

RCUH has a docking site approach that is covered and well-protected, with capacity for at least six ambulances. The resuscitation area is located down a 200-foot hallway. The helipad is located on top of the building and is accessed via two sequential keyed elevators. The helipad has fire suppression personnel present for all landings.

The main trauma resuscitation bays are configured as follows: the trauma resuscitation bay is a large room, which can be divided into four patient treatment areas. State-of-the-art monitoring, warming, and resuscitation equipment is present. An overhead x-ray machine is used for initial radiographs. Anesthesia machines and OR equipment and instruments are located within the area. Emergent damage control surgery can be immediately performed in the trauma bay when necessary. A satellite laboratory point-of-care testing area is located within the resuscitation bay. Adjacent to the trauma resuscitation bay is a burn resuscitation bay. This room is kept heated and humidified and has state-of-the-art stretchers for use in burn resuscitation. Additionally, a separate emergency OR is located on the other side of the trauma resuscitation bay. A 256-slice CT scanner is also located within the resuscitation area adjacent to the emergency OR. There are plans to begin an expansion project to enlarge the trauma receiving area to include four separate resuscitation bays surrounding a central work area, incorporating an angiography suite.

The reviewers judged the trauma flow sheet to be of good quality. Credentialing requirements for nurses who treat trauma patients in the trauma receiving center and resuscitation area include a minimum of three years of experience at another ED or ICU. Nurses in the department are required to have trauma-related continuing education. This includes regularly scheduled trauma team training sessions, ATCN, and ongoing theoretical and practical supervision. Nurses in the department have an average of 7 years' experience, with an annual turnover rate of 0%. Extra certifications for the nursing staff includes 81% ATCN, and 100% Audit ATLS.

The hospital does not have a separate area in the ED for pediatric resuscitation, but has all the appropriate age and size-specific equipment to provide trauma care for pediatric patients in the trauma resuscitation bay.

B. RADIOLOGY

There is a radiologist appointed as liaison to the trauma program. Radiology does participate in the trauma PIPS program by involvement in protocol development and trend analysis that relate to diagnostic imaging. Radiologists are promptly available, in person or by teleradiology, when requested, for the interpretation of radiographs and performance of complex imaging studies. Although interventional procedures are able to be performed 24/7, the timeliness of emergency angiography was of concern to some of the trauma team members. Response times for emergency angiography are not yet being tracked by the trauma PI process. Radiologists are not in-house 24/7, but typically respond promptly when requested. In addition, radiologists can review studies via teleradiology. Diagnostic information is communicated in a written form and in a timely manner. Critical information is verbally communicated to the trauma team. Final reports accurately reflect communications, including changes between preliminary and final interpretations. Changes in interpretations are not monitored currently through the PIPS program. When an error is identified, the corrective policy is by immediate contact to the responsible doctor or team leader.

The primary CT scanner and plain film capability are in immediate proximity to the resuscitation space, and the full radiology department is within a reasonable distance. There is appropriate resuscitation equipment in all imaging spaces. There are policies designed to ensure that trauma patients who may require resuscitation and monitoring are accompanied by appropriately trained providers during transportation to, and while in, the radiology department. Conventional radiography and CT are available 24 hours per day. There is an in-house radiographer.

The CT technician is available in-house 24/7. Conventional catheter angiography and sonography are available 24 hours per day. MRI capability is available 24 hours a day and the PIPS program documents the appropriate timeliness of the arrival of the MRI technologist. Afterhours, expected response time for starting procedures for angiography is 30 minutes, for MRI is 60 minutes, but it was not evident that the PI program currently tracks these response times.

C. OPERATING SUITE

The 57 operating suites include:

- One OR in the ED
- 3rd floor: Orthopaedics: 7 ORs; Plastic surgery: 5 ORs
- 4th floor: Neurosurgery: 4 ORs; Abdominal surgery/Urology: 10 ORs; Cardiac surgery: 6 ORs; Pulmonary surgery: 2 ORs; Pulmonary scopes: 1 OR
- 6th floor: Ophthalmology, Oral surgery, Breast: 5 ORs
- 7th floor: Otorhinolaryngology: 5 ORs; Obstetrics and gynecology: 11 ORs

Six surgical teams are in-house 24/7 to start an operation; additional on-call teams are also available as needed. The trauma team leader personally coordinates opening a second or additional OR for emergency trauma operations, taking into account the primary surgical specialty involved and patient need. The OR team does not have functions requiring their presence outside the OR. Emergency doctor anesthesiologists routinely work only in prehospital and ED settings.

The mechanism to obtain an OR for a non-urgent or urgent trauma case during the daytime is to use the ED operating room or communicate with the OR coordinator for the most appropriate room. Additionally, there is an online system (Orbit) to view the current and planned utilization for all ORs. There is a

mechanism for documenting the trauma surgeon's presence in the OR. The OR has all essential equipment, including necessary equipment for craniotomy and cardiopulmonary bypass. An operating microscope is available 24 hours per day.

The anesthesia liaison to the trauma program, Dr. Jacob Steinmetz, graduated from Århus University in 1998 and completed his training in Copenhagen. He is an ATLS provider. All of the anesthesiologists taking call have successfully completed an anesthesia residency program. RCUH utilizes CRNAs, and they are involved in the care of the trauma patient, with five providing in-house call and five on backup.

Anesthesiology services are promptly available for emergency operations and for airway problems. There are anesthesia services in-house 24 hours a day. At night, there is a minimum of nine anesthesiologists in house to cover the ORs (including residents) plus five CRNAs. When anesthesiology chief residents or CRNAs are used to fulfill availability requirements, the staff anesthesiologist on call is advised, promptly available at all times, and present for all operations. The availability of the anesthesia services and the absence of delays in airway control or operations is documented by the hospital PIPS process.

D. PACU

The PACU contains 40 beds. The PACU has in-house qualified nurses available 24 hours per day as needed during the patient's postanesthesia recovery phase. The PACU has the necessary equipment to monitor and resuscitate patients. The PIPS process ensures that the PACU has the necessary equipment to monitor and resuscitate patients. The PACU occasionally serve as an overflow for the ICU.

All PACU nurses are educated in airway management and cardiovascular resuscitation including defibrillator use. They also complete further goal-directed courses to meet Danish standards.

E. ICU

The ICUs provide 84 beds, including 16 pediatric, and 68 adult. Drs. J. Bonde, M. Wanscher, J. Brennum, and V. Eskesen are the surgical co-directors of their respective ICU's, and are responsible for setting policies and administration related to trauma ICU patients. The surgical directors do not have certificates of added qualifications in surgical critical care, but do have appropriate training in residency or fellowship and experience for their role as surgical ICU directors. The trauma ICU (multidisciplinary ICU) is 19 beds (soon to be 22) with average LOS of 5.6 days. There are also a thoracic ICU and a neurosurgical ICU.

Critical care is a sovereign part of anesthesiology in Denmark. The anesthesiologist-led ICU team manages the ICU patients. The immediate response for life-threatening injuries in the ICU is provided 24/7 by an in-house critical care attending and house staff. There are in-house surgeons from all specialties immediately available to cover the ICU at all times. Physicians covering critically ill trauma patients respond rapidly as urgent problems arise. Quality of care issues in the unit are resolved by concurrent identification of issues, daily team rounds, and weekly conferences. Surgeons remain involved in the care of ICU patients.

The trauma service retains responsibility for patients in the ICU and coordinates all therapeutic decisions appropriate for the level of the trauma program. The trauma surgeon is kept informed of all therapeutic and management decisions made by the ICU team and are given the opportunity to concur with those decisions.

Qualified nurses are available 24 hours per day to provide care in the ICU. The credentialing requirements for nurses working in ICU are: a minimum of 1 year experience in critical care and the completion of an orientation program. The nurses working in the ICU have an average of 8 years of experience, with an annual turnover rate of 3%. The hospital always maintains a one-nurse-to-two-patients or better staffing pattern for patients in an ICU. Extra certification for ICU nurses includes: 1% PALS and 8% ACLS.

The ICU's have all of the necessary equipment to monitor and resuscitate patients. Intracranial pressure monitoring equipment is available. There is a respiratory therapist available to care for trauma patients 24 hours per day. Hemodialysis is available.

F. BLOOD BANK

The source of blood products is hospital processed.

There is a massive transfusion protocol, and uncrossmatched blood is immediately available. Briefly, the massive transfusion protocol targets a roughly 1:1:1 ratio of PRBC, FFP and platelets, and includes early use of tranexamic acid. Thromboelastography is used to monitor ongoing coagulation status and to guide therapy. Factor concentrates are used according to local guidelines in close collaboration with blood bank.

The average turnaround time for type-specific blood is 20 minutes, and for full crossmatch, 40 minutes. The blood bank has an adequate supply of red blood cells, fresh frozen plasma, platelets, cryoprecipitate, and appropriate coagulation factors to meet the needs of injured patients.

VI. SPECIALTY SERVICES

A. PEDIATRIC TRAUMA

The trauma program defines an injured pediatric patient as <16 years old. The number of pediatric trauma admissions to the specific services during the reporting year is summarized below:

Service	Number of Admissions
Trauma	71
Orthopaedic	9
Neurosurgical	11
Other Surgical	
Non-Surgical	
Total Trauma Admissions	91

The ISS and mortality rates for these patients are shown below:

ISS	Trauma Admissions	Deaths	Mortality (%)	Admitted to Trauma/Pediatric Surgery	Admitted to Non-Surgical
0-9	15 (46 no ISS)	0	0	15 (46 no ISS)	
10-15	0	0	0	0	
16-24	6	0	0	6	
>25	4	1	25	4	
Total	71	1	1	71	

The results in these two tables do not match as mortality data was only provided for the 71 children admitted to pediatric surgery. ISS is not available for all patients. This adult trauma center that admits fewer than 100 injured children annually does review the care of the injured children through the PIPS program. There is not a separate pediatric admitting area. When a pediatric trauma case arrives, the trauma team is upgraded to include both a pediatrician as well as a pediatric anesthesiologist.

The director of the pediatric ICU is Professor Gorm Greisen, while the surgical director is Professor Jørgen Thorup. The pediatric surgical director does not have added qualifications in surgical critical care. The pediatric ICU intensivists maintain primary responsibility for the care of the patient while in the PICU. The number of physicians with additional pediatric training include: six with training in general surgery, three with training in neurosurgery, and four with training in orthopaedic surgery.

The nurses working in the unit have an average of 8 years of experience, and an annual turnover rate of 1%. Extra certification for PICU nurses does not include any U.S. courses.

During the reporting year, RCUH admitted three pediatric trauma patients (< 15 years of age) with a splenic injury. One underwent splenectomy, and two were managed without intervention.

B. REHABILITATION SERVICES

Dr. B. Strange is the director of the rehabilitation program and is not board certified. Rehabilitation services play an integral part in the care of the injured patient at RCUH. Rehabilitation consultation services, occupational therapy, speech therapy, physical therapy, and social services are available during the acute phase of care in the ICU and on the floor. There is not an inpatient rehabilitation unit. In Denmark there are specialized rehabilitation hospitals. Patients requiring inpatient rehabilitation stays are transferred to either Hvidovre Hospital or Hornbæk Hospital (22 and 45 beds respectively). If outpatient therapy is required, this is provided at various rehabilitation clinics throughout the region depending on the patient's home address. The system used to measure rehabilitation is GOS. There is a separate pediatric rehabilitation service available within the hospital.

C. BURN PATIENTS

RCUH is the national burn center. During the reporting year, the hospital admitted 294 burn patients, and there is a separate burn team. The hospital is a verified burn center. The number of patients transferred in was 200, and no burn patients were transferred out. The hospital has transfer arrangements for burn patients.

D. VERTEBRAL COLUMN INJURIES

During the reporting year, the hospital admitted 112 patients with spinal column injuries, and these included 30 with neurological deficits. Twenty-four were transferred in, and none were transferred out. There are transfer agreements in place.

E. ORGAN PROCUREMENT

RCUH has an organ procurement program. This program led to 147 trauma referrals during the reporting year, which in turn resulted in 32 donors. The trauma center has an established relationship with the national organ procurement organization (OPO). There are written policies for triggering notification of the OPO. The PIPS process reviews the organ donation rate. There are written protocols for declaration of brain death.

F. SOCIAL SERVICES

The social worker team is actively involved with injured patients. A social worker is available for all patients. The trauma program does not have a social worker dedicated to the injured patient. There are support services available 24/7 for crisis intervention, and individual/family counseling. This is provided by crisis psychologists. Individual/family counseling is also available as needed.

G. DISASTER PLANNING AND MANAGEMENT

The trauma center has a hospital disaster plan described in the hospital disaster manual. The hospital meets the disaster-related requirements of international JCAHO. A trauma orthopaedic surgeon is a member of the hospital's disaster committee. Hospital wide disaster drills are conducted at least every 6 months. The hospital is able to respond to the following hazardous materials: radiation, chemical, and biological.

H. OTHER SURGICAL SPECIALISTS AND MEDICAL CONSULTANTS

The trauma center has available a full spectrum of surgical and medical specialists, and their respective support teams.

VII. PERFORMANCE IMPROVEMENT AND PATIENT SAFETY

A. PIPS

There is a hospital quality council chaired by the hospital CEO, which creates, approves, and monitors the hospital-wide quality plan and makes decisions for monitoring and improvements. Subordinate to the hospital quality council is a multidisciplinary quality committee. This committee is chaired by the hospital quality manager and it functions to filter issues and make recommendations to the quality council. Each center within the hospital (such as the trauma center) has a quality coordinator that reports to the management of the individual center. Each center quality coordinator is also a member of the hospital quality committee and is responsible for representing the perspective of the center to the hospital-wide process. Finally, all centers also have a number of patient safety managers.

The PI process is based, in part on an “adverse events” approach that involves both a “local function” component focused on the trauma center function as well as a “cross-disciplinary function” which involves other centers within the hospital (the adverse events can be submitted anonymously). The intent of the process is to avoid future incidents by changing daily routines. Also, lessons learned at monthly M&M meetings are disseminated via a trauma coordination group into the PI process.

(A quality secretariat within the hospital development department exists, which serves multiple functions within the hospital quality, processes including making surveyors available for Joint Commission International and Danish Quality Model surveys.)

The trauma center does demonstrate a clearly defined PIPS program for the trauma population, though the process is relatively new and actively evolving. The concept of an over-arching and unifying service responsible for all injured patients (or all patients in any category of illness involving multiple specialties) is not common in Denmark. The trauma service has successfully overcome both legal and operational barriers related to patient confidentiality and customary practice. Utilizing the TPM role, the trauma service has undertaken an active case management and process improvement role consistent with that seen in U.S. trauma centers.

The PIPS program is supported by a reliable method of data collection that consistently gathers valid and objective information necessary to identify opportunities for improvement. The trauma program is still learning how best to utilize the TARN database, including the incorporation of suggestions given by the review team. The process of analysis includes multidisciplinary review, occurs at regular intervals to meet the needs of the program, defines corrective strategies, and the corrective strategies are documented. There is also identification of specific system problems.

The trauma program has adequate administrative support and defined lines of authority that ensure comprehensive evaluation of all aspects of trauma care. As noted above, the establishment of a process for comprehensive evaluation crossing specialty service lines has been a challenge, but the process is in place and improving with time. The trauma program is empowered to address issues that involve multiple disciplines. Identified problem trends undergo multidisciplinary peer review by the trauma peer review committee. The trauma center is able to separately identify the trauma patient population for review.

Overall, the reviewers judged the performance improvement to be adequate, and expect it to improve substantially with accumulated experience. Even having started off with a strong model that is novel within the Danish system, there is already evidence of ongoing maturation. Identification and correction of problems was consistently done, and specific system problems and patient care problems were routinely associated with loop closure. As discussed below, several recommendations were made with respect to utilization of the TARN registry in a more robust way to assist in tracking process of care.

B. TRAUMA REGISTRY

The trauma program utilizes the Trauma Audit and Research Network (TARN) shared registry, which is housed in the United Kingdom. TARN has a set of entry criteria similar to Major Trauma Outcome Study (MTOS) and National Trauma Data Bank (NTDB) criteria, though individual hospitals can enter patients who do not meet criteria and can define custom fields. Although TARN does not routinely provide ISS scoring for added patients, the trauma service has now added fields for the collection of ISS data on these additional patients. Trauma registry data is collected and analyzed. The data entry is completed within 2 months of discharge in at least 80% of the patients. The selection criteria for entry include: length of stay is 72 hours, ICU admission, deaths, and patients transferred in for specialty care whose combined length of stay is over 72 hours. Patients transferred in for rehabilitation only are not submitted to TARN.

The registrar was able to demonstrate rapid facility with data retrieval. The registry data are not currently submitted to the NTDB, but TARN offers a similar benchmarking function utilizing a sample of European hospitals. RCUH appears to be in a good position among contributing European hospitals on examining the probability of survival “caterpillar graph” of TARN trauma centers. The trauma registry is supportive of the PIPS program, and the trauma program does ensure that trauma registry confidentiality measures are in place. There are strategies for monitoring data validity for the trauma registry.

C. TRAUMA DEATH AUDITS

During the reporting year, the hospital had a total of 49 trauma deaths. The categorization of deaths according to COT categories was not routinely performed prior to the reporting year, and so this process is not yet perfected. As physicians respond to major trauma in the prehospital setting, and are able to pronounce death, there were no patients reported as DOA. There were 12 deaths in the ED and 37 in-hospital deaths. There were two unanticipated mortality with opportunity for improvement deaths, five anticipated mortality with opportunity for improvement deaths, and the remainder were reported as

mortality without opportunity for improvement. The autopsy rate was 90%, but autopsy findings are not available to the trauma service under Danish law (if the autopsy was requested by the police). The trauma service is able to get summary reporting in specific requested cases.

D. MULTIDISCIPLINARY TRAUMA COMMITTEE

The multidisciplinary trauma program continuously evaluates its processes and outcomes to ensure optimal and timely care. There is a multidisciplinary peer review committee chaired by the head of clinic or designee, with participation from abdominal surgery, orthopaedic surgery, neurosurgery, and anesthesiologists, both emergency-medicine-focused and ICU-focused. This committee meets bimonthly. Adequate attendance of at least 50% by each of the core group of participating surgeons at the multidisciplinary peer review committee is documented. The attendance by the head of clinic and the specialty representatives is at least 50%. The head of clinic ensures and documents dissemination of information and findings from the peer review meetings to the involved surgeons on the trauma call panel.

There is a committee that is functionally equivalent to the trauma program operational process performance improvement committee (TPOPPIC). This committee addresses the trauma program operational issues. There is documentation reflecting the review of operational issues and, when appropriate, the analysis and proposed corrective actions.

Nursing performance improvement issues are reviewed by the trauma PI program.

E. PROTOCOL MANUAL, EVIDENCE-BASED GUIDELINES AND BENCHMARKS

The trauma program has a protocol manual for trauma. During the past 3 years, the trauma program has instituted evidence-based trauma management guidelines. The trauma program benchmarks their trauma care as part of the TARN network (see above).

F. RECOMMENDATIONS FOR PIPS PROGRAM

As outlined in the comment section above, the review team recommends that the custom fields of the TARN database be used to track ISS scores and locally important process measures on all patients, including those that do not meet TARN entry criteria. In addition, the reviewers suggest strengthening the role of the TPM in oversight of clinical care on specialty services.

VIII. EDUCATIONAL ACTIVITIES, OUTREACH PROGRAMS, AND PREVENTION

The hospital provides a mechanism for trauma-related education for prehospital providers (emergency doctors and paramedics), hospital-based physicians, and nurses involved in trauma care. The budget includes funding of educational activities such as ATLS, ATCN, ALS, EPLS, and PHTLS. RCUH has been providing ATLS courses since 1998. During the report year, RCUH provided 11 ATLS provider and three ATLS instructor courses. ATCN is also routinely offered.

The trauma center is engaged in public and professional education, including an annual trauma conference. The trauma center provides referral and access to trauma center resources. RCUH has a trauma injury prevention (including public education activities) program. Dr. Claus Falck Larsen represents the hospital in national, regional, and local injury prevention initiatives. The trauma center does demonstrate the presence of prevention activities that center on priorities based on local data. The trauma center demonstrates collaboration with and participation in national, regional, or state programs.

Examples of injury prevention include studies involving: right turning accidents by trucks; violence involving penetrating trauma; drowning; taxi-related injuries in Copenhagen; motorcycle crashes; pediatric falls from windows; scaffold-related injuries; and burns.

The trauma center has a mechanism to identify patients who are problem drinkers and the capability to provide intervention or referral. The mechanism for providing brief intervention is: positive screens are referred to trauma nurse/nurse practitioner/physician assistant/social worker or to the on-site consult service (psychiatry or psychology or substance abuse counselor).

IX. RESEARCH

RCUH has a trauma research program. There are seven ongoing projects with IRB approval. 41 peer-reviewed trauma publications are listed for the last 3 years that resulted from work at RCUH. There is at least one that includes authorship or co-authorship by an orthopaedic/trauma surgeon and at least one each from three of six disciplines: neurosurgery, emergency anesthesiology, abdominal surgery, radiology, anesthesia, and rehabilitation. The hospital administration demonstrates very strong support for research activities.

X. CHART REVIEW PROCESS

The requested charts were fully provided by the trauma team. These charts were appropriately subdivided by the requested categories (although several charts were listed in multiple categories). Trauma team members provided medical record translation from Danish to English. The EMR charts were more than 90% complete as it relates to OR reports, EMS run sheets, discharge summaries, ED flow sheet, history/physical examinations, and specialty consults. The chart review process demonstrated that the quality of patient care was excellent. The surgical response times to the ED were excellent.

XI. EXIT INTERVIEW

The exit interview was attended by many of the same members who were present at the prereview dinner. The VRC statement was read verbatim. The summary was then presented and various aspects of the review were discussed by the site visitors and the trauma team members. There were no disagreements with the summary report expressed by the trauma team members.

XII. CASE REVIEWS

CASE 1 – Death, anticipated

82-year-old patient, from nursing home, blowing out candle when the robe caught fire, est 40% TBSA deep burns. Stable VS and neurological status in transport. Reported to be highly functional.

Resuscitation team present at patient arrival, Pt found to have 26% deep burns of shoulder and arm, R back, flank, bilateral buttocks. Awake GCS 15 Good VS. Burns debrided but received no topical treatment awaiting demarcation, consistent with local management. Pt received fluid resuscitation per Parkland formula, with plan for OR for excision and grafting in 2-3 days. Initial course complicated by delerium and atrial fibrillation with rapid ventricular rate. Treated with beta blockade and digoxin. To OR on HD #4, over 4 hour operation, 14 u PRBC, fully excised, partially grafted. Extubated and taken to PACU. Had anticipated problems with ongoing fluid loss, pulmonary deterioration and olgiuria. On HD #5 (POD 1) decision made that patient was not a candidate for ICU treatment. She followed an expected course of further deterioration and died on HD #7. She was given an ISS of 9

PI activity: The case was discussed with members of the burn team, who report that the case was discussed at burn rounds with the senior consultants involved, and the conclusion was reached that this was an anticipated mortality. The clinical decision making around initial aggressive therapy was also discussed, and felt to be appropriate.

Comments: This certainly represents an anticipated mortality. In many, if not most, burn centers the patient would likely have been treated expectantly without surgical intervention. Once a plan for intervention had been made, the decision to proceed with a very extensive initial debridement rather than a series of smaller staged excisions and the decision not to utilize the ICU immediately post-op despite aggressive surgical intervention are both controversial. The depth of discussion around these issues cannot be determined, as the burn service PI records were not available. This case probably does not belong with trauma service deaths.

CASE 2 – Anticipated mortaltiy

69-year-old patient with advanced cancer, jumped from 3rd floor of an outside hospital in suicide attempt. Hypotensive in the field, with GCS 11.

Full resuscitative team was present on arrival, initial VS p 76, BP 80/60 GCS 11. Clinical impression of L wrist fx, L facial fx BP 80/60 p 76 Seen by abdominal surgeon immediately, FAST negative. Pt already had a no code order, and was receiving hospice level care. Once this had been verified, case was managed expectantly and the Pt died shortly after admission.

PI: Briefly reviewed, classified as an anticipated mortality.

Comments: Appropriate care.

CASE 3 - Unanticipated mortality with opportunity for improvement

(Case also reviewed by Dr. Kaufmann as a head injury)

22-year-old Pt, driver of an auto struck by bus in R front. Pt was awake, confused, complaining of head and neck pain, Initially GCS 14, good VS. Hematoma over eye. Pt suffered a seizure in field, decreased level of consciousness and difficulty breathing. Decision made by emergency doctor in attendance not to intubate in field due to proximity (less than 2 minutes) to hospital.

Resuscitation team was present on arrival. Pt has having seizure activity and noted to have extensor posturing in trauma unit. Intubated, FAST negative, adequate pulse and BP. To CT about 20 minutes after arrival, found to have large EDH. Chest CT showed an anterior mediastinal hematoma, possible pericardial effusion, felt worrisome for Aortic injury. This was further evaluated with TEE which did not show an effusion or clear injury. Pt went to OR about 30 minutes after CT, and operation commenced about 30 minutes after arrival in OR. Post-op CT showed adequate decompression, but patient continue to have a very poor GCS, and developed ICP problems. Repeat CT showed worsening edema and evidence of early infarction. Decompressive craniectomy done on POD #2, along with high-dose barbiturates. ICP could not be controlled and Pt developed exam consistent with clinical brain death, confirmed by transcranial Doppler and cerebral angiography due to presence of barbiturates. Went on to become an organ donor. ISS 29

PI: Case reviewed as a death. Judged to be unexpected with opportunity for improvement. Issues identified included delay in OR availability and excess pre-op prep time which were felt to have caused about 60 minutes delay to OR. In addition, the neurosurgeon did not convey the urgency of the planned operation to the team. Corrective actions included reminding the resuscitation team of the damage control OR adjacent to the resuscitation space, and in working with the OR staff to avoid unnecessary steps in critical circumstances.

Comment: Though the patient did have a GCS of 14 at the scene, the classification of this case is probably correct, though given the timing and the rapidity of the patient's neurological deterioration, the probability of functional survival was low. There was some delay in getting to the OR, but even with these delays, the operation was underway in less than 90 minutes from the patient's arrival. The issues involved were appropriately identified, and corrective actions undertaken

CASE 4 – Death, unanticipated, with opportunity for improvement

68-year-old Pt fall from standing, known meningioma, initial GCS 8 seen at another hospital, transferred to RCUH, found to have acute on chronic subdural hematoma. To OR about 2 hours after admission for evacuation of acute and chronic SDH. Pt was extubated post-op, moving all four and making eye contact, but had significant deficits. Pt went to neurosurgical IMC with significant aphasia some motor weakness, not following commands. Worsened over post-op period, progressive neuro deterioration. On day 2 he was found to have a large recurrent hematoma, with big midline shift and deterioration of MS, went back for evacuation, returned to ICU intubated. SDH re-accumulated again on day 4, drained a third time. Did not get better, made CMO, died after several days. ISS 25

PI: Case was briefly reviewed as a death, classified as unanticipated death with opportunity for improvement. Reportedly discussed at neurosurgical conference, but no minutes available.

Comments: Overall, patient with significant co-morbidities and known meningioma. Initial acute and chronic SDH drained, but it re-accumulated twice, associated with progressive neurological deterioration. Without input from neurosurgical team, it is difficult to assess the potential opportunities for improvement.

CASE 5 - Transfer Out

67-year-old Pt with hand injury from table saw, traumatic amputation of 2 fingers, transferred for re-implantation. Resuscitation team was present on arrival. Isolated injury, decision to transfer appropriate.

PI: None

Comments: Care appropriate

CASE 6 Transfer out

64-year-old Pt suicide attempt by slashing L wrist, initially resisted treatment. Large blood loss at scene. Hypotensive in field, but responded to resuscitation. Nearly severed L wrist, held only by extensor tendons.

Resuscitation team present on arrival. Pt hypotensive with BP 65/38 up to 80/65 then back down, transient responder to transfusion. 4 u PRBC transfused. Timely transfer and treatment. Good documentation.

PI: None.

Comment: Appropriate care.

CASE 7 - Chest

22-year-old Pt with multiple stab wounds to the bilateral chest and flanks. Awake, BP 107/70 pulse 106 in field, short transport time, minimal scene time

Resuscitation team present on arrival. Pt awake, alert, not hypotensive. CXR and FAST done, small L ptx, chest tube places. Felt by general surgeon to have indications for laparotomy (abdominal pain, peritoneal signs) CT done first to "rule out retroperitoneal injury". CT showed renal injury, liver injury, and splenic injury, all without extravasation. To lap within 90 minutes of admission, found to have small bilateral diaphragmatic lacerations which were repaired, a splenic laceration treated topically, and a non-bleeding liver laceration. Kidney injury treated expectantly. No enteric injury. Pt then had intra-op angio and embolization of liver. Also had a right chest tube placed. Kept intubated overnight, extubated following day, Small ptx after chest tube removal, kept another day, but stable. Home on POD 6.

PI: No activity

Comment: Overall, care appropriate. Decision to do intra-op angio and embolization of non-bleeding liver injury is debatable. Equally, utility of pre-op CT is debatable. Operative findings inconsistent with peritonitis, so decision initially may have been based on erroneous data. Pt kept in ICU for 2 days post extubation, with seems fairly conservative in this young patient with relatively minor injuries.

CASE 8 - Chest

15 year-old Pt fell 6-8 meters through roof. Emergency doctor on scene 1 hr. Intial GCS 8 p 131, BP 140/91 Intubated on scene, sedated with propofol and fentanyl. VS OK enroute.

Resuscitation team was present on arrival. Pt became profoundly hypotensive shortly after arrive, had pressors started, short period of CPR, 5 u PRBC, with return of VS. Then went to CT at about minute 50. Found to have pulmonary contusion, multiple intra-abdominal injuries with hemoperitoneum. To OR at about 2 hours 45 minutes, where splenectomy and distal pancreatectomy were done. Pt also had severe TBI with CT findings of DAI, facial fractures, bilateral wrist fx, kidney injury, and avulsion of L body wall muscles from L pelvis with traumatic hernia. ICP monitor placed. Pt developed severe ICP problems, necessitating ventriculostomy, osmotic therapy and high-dose barbiturates, with poor control. CPP moderately well maintained. Overall poor neurological recovery, plan for neuro rehab, but no bed was found at rehab so after about 2 weeks was transferred to local hospital for rehab. Uneventful recovery from initial abdominal surgery. Traumatic hernia never addressed. ISS = 36

PI: None, case discharged less than 2 weeks prior to site visit, PI process incomplete.

Comment: Pt with severe TBI, progressive ICP problems, poor neurological outcome. Initial arrest and hypoxemic insult are possibly contributory. Timely and appropriate care for intra-abdominal injuries, and aggressive care for TBI. Issues around preventability of initial hypotensive episode, relation if any to propofol and delay to rehab are pending discussion. Perhaps due to poor level of neurological function at discharge, the traumatic hernia was not addressed.

CASE 9 Unanticipated Mortality with Opportunity for Improvement ISS = 9

This 79-year-old man with history of psychiatric disorder, epilepsy, and stable CLL was burned while smoking in a chair at his nursing home. At the scene, his GCS was 15 and he was found to have suffered substantial second and third degree burns of his face and neck. The emergency doctor on scene (a subspecialty-trained anesthesiologist) intubated the patient. Transport time, with the physician in attendance, to RCUH was 34 minutes. As this was considered a simple burn, the full trauma team was not activated and the ED trauma flowsheet not completed. [Burns and drownings are not full team activations, but are counted as trauma admissions.] A specialty burn surgeon saw him in the ED and estimated his burns at 15% TBSA including 10% third degree. A neck escharotomy was performed. After his endotracheal tube was replaced with a larger 8.5 tube, thoracic surgery also saw him in the ED for bronchoscopy with findings of a sharp carina and little evidence of inhalation damage. The patient was admitted to the multidisciplinary ICU in a burn-specific room with DNR status. He expired on hospital day four after discussions between the family and treating team resulted in the decision for palliative care.

PI: Anticipated mortality with opportunity for improvement. Although all trauma deaths are discussed monthly, classification of deaths, as in this case, was done especially for this site visit. It is not yet routine. The PI discussion documentation appears appropriate.

Comment: An additional potential for improvement was in prehospital documentation: no repeat GCS was recorded at the scene following intubation and vital signs were only recorded twice during an hour of pre-hospital care. The early involvement of multiple specialties resulted in good hospital care and was appropriate for this system and hospital.

CASE 10 Death, non-preventable ISS = 25

This 37-year-old male was stabbed in the left chest with a knife. The police were nearby and initially observed signs of life, but then the patient lost pulses and CPR was started. EMS personnel arrived in 2 minutes with the emergency doctor arriving nearly at the same time. The patient as found to be in PEA, which rapidly progressed to asystole. He was made a "load and go" patient with CPR continued en route. Intubation was performed en route as was a left chest tube with 500mL blood output. Transport time was 20 minutes with massive emesis and suspected aspiration. An intraosseus catheter was placed and one milligram of epinephrine administered. On ED arrival, FAST performed by the abdominal surgeon demonstrated no fluid in the abdomen, but the pericardial space was "difficult" to assess. A cardiologist rapidly determined that tamponade was present. Thoracic surgery performed a left anterior thoracotomy with finding of blood in the left chest and the pericardial space. The heart was empty and there was a hole in the left ventricle with no cardiac motion. The patient was pronounced 13 minutes after arrival.

PI: This case was discussed at morbidity and mortality conference. Discussion included the following: The incident occurred only 1 minute from an area hospital (not a trauma center), but there was no doctor there that could do an ED thoracotomy.

Comment: The scene and en route care was excellent. Pericardiocentesis may have been an option but would not have made a difference in outcome with this ventricular injury. As anesthesiologists do not do ED thoracotomies in Denmark but are responsible for emergency care, it was appropriate to travel the

farther distance to the trauma center, rather than go to the closer hospital that did not have adequate resources to manage this patient. Conversely, the specialty resources immediately available for this patient's care at RCUH are impressive.

CASE 11 Spleen, Transfer In ISS not recorded

This 23-year-old unhelmeted male was involved in a bicycle crash with the handlebars striking his abdomen. He was awake and alert at the scene and was transported by non-physician EMS to the closest hospital (which is not one of the four regional hospitals). He complained of severe abdominal pain and shortness of breath; he was suspected to have a costal margin fracture and pneumothorax. Vital signs: HR 85, BP 95/45, O2 SAT 100%, GCS 15. It was rapidly determined at the first facility that the patient should be transferred to the trauma center and an emergency doctor was called to transport the patient. He was given tranxemic acid, fluid, and pain meds and transported to RCUH (5-minute transport time). On arrival at the trauma center, BP was 130/80 and FAST exam demonstrated free fluid in the pelvis and splenic injury with question of subcapsular blood; no fluid in Morison's pouch. The abdominal surgeon was present on patient arrival. In 25 minutes, the patient was taken to CT scan where a fragmented spleen without extravasation was found (not graded). He was also found to have a mandible fracture. The patient was taken to the ICU pending embolization which was performed 2 hours after patient arrival – he remained hemodynamically stable throughout. In interventional radiology, no active bleeding was found and no embolization performed. His length of stay was 5 days by protocol. With care provided by the abdominal surgery team following transfer out of the ICU. Repeat CT at 5 days demonstrated no extravasation and no pseudoaneurysm.

PI: None.

Comment: Appropriate care. Missed opportunities for PI discussion include:

- EMS made a poor triage decision for this patient. A physician usually reviews each of these EMS cases with a follow-up letter being sent to the medical director of EMS providers needing education. The letter for this particular case could not be found during the trauma center site visit.
- Waiting 2 hours after patient arrival for emergency angiography is not appropriate for a Level I trauma center. 30 minutes is the standard.

CASE 12 Epidural ISS = ?

This 22 year-old male was hit by a bus. An emergency physician transported him to RCUH. His GCS score at the scene had been 14, but he developed seizures en route. Bag-valve-mask ventilation was used for the last two minutes of the transport. He arrived with GCS 5 and was intubated immediately on arrival in the ED. BP was 160/80 and HR 64. Within 19 minutes, he was in CT scan and found to have an epidural hematoma with a 13 mm shift and suspected traumatic rupture of the aorta. He returned to the ED for 30 minutes awaiting transport to the neurosurgery OR where the prep then took an additional 30 minutes prior to incision. Postoperatively, he was provided care in the ICU (with thoracic surgery, cardiology, and neurointensivist involvement) where TEE demonstrated no aortic injury. Indeed, a second radiologist said the original finding on the chest CT had been an artifact. The patient expired from sequelae of his initial brain injury after 6 days. A flow study demonstrated no flow.

PI: PI discussion focused on the delay to decompressive craniotomy. There were many factors involved in this delay:

- The "aortic injury" was a distraction to the team leader - who did not want to put a "D" problem before a "C" problem.

- There was a wait for the neurosurgery OR – while there is an OR always ready next to the resuscitation bay in the ED that should have been used.
- The positioning and prep in the OR was as for a standard craniotomy, including time to place an arterial line - rather than as rapidly as possible, given the emergent nature of this injury.

Not only was this patient discussed in detail at M&M, but this case was also reported to the Danish Patient Safety Database. Additionally, as regards loop closure, this case was referred to neurosurgery PI to make them more aware of the OR always ready in the ED. Finally, the trauma team leader was educated that it is sometimes OK to prioritize a "D" problem above a "C' problem.

Comment: This PI discussion was excellent, but there remain additional factors that should be covered:

- Is 19 minutes to CT scan the best that could have been done, given the tremendous resources available in this trauma center?
- What steps might radiology take to prevent a similar interpretation error in future patients?
- Was discussion held with the anesthesiologist responsible for this patient in the OR in order to educate him/her about waiting to place the arterial line?

CASE 13 Pediatric ISS = ?

This 4-year-old male fell approximately 3-5 meters onto concrete. He was found to be alert, crying, cooperative, and bleeding from his left ear. During emergency doctor transport to the trauma center, his vital signs were stable and intravenous access was established. Admission vital signs included: BP 126/79, HR 124, SAT 100%; he was awake and crying but not consolable. Contusions of the left chest wall and right forehead were identified. Rectal midazolam was administered. FAST was not performed, as the patient was not cooperative. CT scans were started 27 minutes after arrival. Findings were: skull fracture with fracture line extending through the middle ear. Neurosurgery was consulted in the ED and the patient was admitted to the neuro-ICU. Pediatric consultants were also involved early in his care. ENT consultation resulted in plan for audiogram. On day three, the patient was transferred to a hospital closer to his home. This was apparently in response to parental concern that he not be sent all the way home directly from Copenhagen.
PI: None.

Comment: Good care. Appropriate multispecialty involvement. Two issues that should be considered for trending by the PI program:

1. How long does it take to get a head-injured patient to CT scan? In this particular case it was reasonable to wait for the rectal midazolam to take effect.
2. Would another mechanism have allowed the patient to be discharged directly home? Perhaps a home nurse visit for one or two days would have been acceptable to the parents and more economical.

CASE 14 Pelvic Fracture ISS = 41

This 30 year-old female was involved in a motorcycle crash at 90 miles per hour wearing a helmet and leathers. Her past medical history is significant for a recent 80 kilogram weight loss following gastric bypass surgery. The emergency doctor was on scene in 10 minutes. The patient's vital signs included: BP (systolic) 136, HR 120, GCS 15. The patient complained of back pain and right arm pain. Diazepam and ketamine were given for pain – first IM then via IO. Additionally, tranexamic acid was administered by protocol at the scene for suspected pelvic fracture. Scene time was 30 minutes; followed by a 17-minute transport. Full team activation was called. FAST was negative per the abdominal surgeon. She

was taken to CT scan in 23 minutes. Her identified injuries included: free fluid around the injured spleen without extravasation (suspicious for intercostal artery injury), left kidney injury with question of associated vascular injury, 6 rib fractures, pulmonary contusion, pelvic fractures (sacrum and pubis), C7 transverse process fracture, and right forearm fracture. The FAST exam was repeated with findings of blood in Morison's pouch. The patient had decrease in BP with concomitant increase in her heart rate, so transfusion was initiated and she was taken to the OR for exploratory laparotomy by the abdominal surgeon and the urologic surgeon. Splenectomy was performed and colonic serosal tears repaired. The thoracic surgeon placed a chest tube for hemothorax and the orthopaedic surgeon placed an external fixator on the pelvis. Pelvic ORIF was performed later. The patient was admitted to the ICU for one day, then transferred to the orthopaedic ward for 13 days. Additional injuries included a left brachial plexus injury and suspected left renal artery intimal damage. This was discussed by a multidisciplinary team consisting of urology, vascular surgery, and interventional radiology with decision made for observation (successful). Her discharge plan included pneumococcal vaccine to be administered one week later (then repeated at 5 years). No complications noted.

PI: None.

Comment: The scene time of 30 minutes seems long, but the prehospital care appears excellent. The ED multidisciplinary team performed well. The decision to take the patient to the OR was timely and appropriate with excellent multispecialty surgical care. Teamwork was evident throughout her hospitalization.

One potential opportunity for PI discussion would be the choice and timing of post-splenectomy immunizations. Haemophilus influenzae vaccination is given to all children in Denmark, but not repeated after splenectomy. Meningococcal vaccination is not used in Denmark post-splenectomy. However, given that the patient was in the hospital for 14 days following her splenectomy, why was her pneumococcal vaccine not administered prior to discharge?

CASE 15 **ISS > 25 with Survival** **ISS = 26**

This 63 year-old female unrestrained passenger was involved in a single car (versus wall) crash. She was transported via emergency doctor-accompanied helicopter which required 36 minutes to the scene following notification. Scene time was 31 minutes including extrication; concerns at the scene included head and thorax injuries. Transport time to the trauma center was 20 minutes (total time from crash to ED was approximately 90 minutes). Full team activation was called (which occurs for every helicopter trauma patient transport). Five minutes prior to arrival, her vital signs were: BP 138/100, 96, O2SAT 97%. Initial ED vital signs were: BP 115/68, HR 105, O2SAT 100%, GCS 13. As is standard the orthopaedic surgeon was present at patient arrival and completed the standard ATLS initial assessment. She was intubated for agitation and pain. 25 minutes later she was transported for CT scans. Her initial diagnoses included: Type III dens fracture, right rib fractures 1-7, left rib fractures 6-10, C7 transverse process fracture, right clavicle fracture, small amount of fluid in the pelvis, mesenteric bleeding, liver and lung metastases. The patient became hypotensive with an associated decrease in her hemoglobin, but responsive to fluid. She was taken to exploratory laparotomy for splenectomy (as both upper and lower poles were injured with bleeding) and repair of mesenteric bleeding. Postoperatively she was taken to the ICU. On hospital day 6 she was discharged from the ICU to a hospital closer to home, where her inpatient course continued on an orthopaedic ward. Meningococcal vaccination was ordered for later administration.

PI: None.

Comment: Good care. Helicopter EMS transport is routinely used for daylight transports longer than 30 minutes. The routine crew consists of a pilot, paramedic, and an emergency doctor and there are two

units of PRBCs on board. A good performance improvement study would be to see if all these patients with meningococcal vaccination ordered for post-discharge actually receive it as intended.

CASE 16 Thoracic ISS = 19

This 22-year-old man was stabbed in the chest bilaterally and in the abdomen (left epigastrium). He complained of abdominal pain at the scene; breath sounds were present bilaterally. Scene time was 12 minutes. Vital signs at the scene were: BP 107/70, HR 106, RR 20, O2SAT 99%, GCS 15. Transport time was 7 minutes, with arrival in the ED approximately 25 minutes after the incident occurred. The full team plus a thoracic surgeon was present on patient arrival. Arrival vital signs were: BP 130/70, HR 62, RR 16, O2 SAT 100%, GCS 15. FAST was negative. Chest x-ray revealed a left pneumothorax for which a left tube thoracostomy was placed. CT of the chest and abdomen revealed: residual left pneumothorax, bilateral hemothoraces (right greater than left), 6 centimeter bleeding liver laceration, and a spleen injury without bleeding. The trauma flowsheet in this case was not adequate to determine time to CT or time to the OR, but it appears that the patient was taken rapidly to the OR. The abdominal surgeon and thoracic surgeon operated together. Procedures performed included: right tube thoracostomy, repair of liver laceration, repair of diaphragm laceration, confirmation of non-bleeding splenic laceration, and placement of drains. The patient was then taken to angiography for coiling of liver segment VII. He was managed in the ICU postoperatively on the ventilator for two days, and then managed on the ward by the abdominal surgery department. After a seven-day hospital stay, he was discharged home with plan for follow-up at a local hospital in 2 weeks with a repeat chest x-ray.

PI: None.

Comment: Good care. The trauma flowsheet documentation should be monitored to ensure that accurate times are consistently recorded to be able to follow team response times and important patient care intervals (such as time to OR).

CASE 17 Death with opportunity for improvement ISS: 13

This 95-year-old driver of a vehicle was struck by a bus. EMS found the patient complaining of leg and chest pain. There was history of loss of consciousness. The patient was noted to be incontinent. Glasgow Coma Score was 14. Initial pulse was 44, respirations 18 and no blood pressure was recorded. The patient was extricated and spinally immobilized. An obvious open left knee injury was noted. High-flow oxygen was administered. The patient received 500 mL of normal saline en route. Scene time was 23 minutes. Transport time was 5 minutes. A full trauma team was activated. The patient was noted to have a blood pressure 176/77 and was bradycardic with heart rate in the 30s. One mg of atropine was administered with an increase in heart rate to 45. GCS was recorded at 15. Chest x-ray and pelvic films were performed. In addition, an x-ray of the left knee was performed. This patient was found to have a fractured sternum, multiple rib fractures as well as a fractured left proximal tibia and patella. Orthopaedics was present during the resuscitation. The abdominal surgeon proceeded with FAST exam within 11 minutes of arrival. No evidence of hemoperitoneum was noted. Chest x-ray showed no hemothorax. No obvious pelvic fracture was noted despite the physical finding of a left iliac crest hematoma. The left leg was noted to have good cap refill though no pulses were noted. Initial blood gas was 7.32 with a lactate of 0.8. The patient was then taken for a CT scan 20 minutes after arrival. This did confirm a right 1st rib fracture and left 3rd through 4th rib fractures as well as noting the sternal fracture. There was a small amount of right pleural fluid noted. The patient was taken off the backboard and the cervical spine was cleared with the collar removed. An echocardiogram was performed which showed normal ejection fraction. Thoracic surgery was present and recommended telemetry with a repeat hemoglobin and hematocrit. Orthopaedics proceeded with repair of the knee laceration. They were able to detect a dorsalis pedis pulse. A CT of the knee was ordered. The recommendation by orthopaedics was that the patient will eventually need a total knee replacement. They recommended a subcutaneous

low molecular weight heparin for VTE prophylaxis. The patient remained relatively bradycardic and cardiology was consulted. Cardiology was concerned that this may represent a propranolol overdose. The patient's hemoglobin was 6 and patient received 2 units of blood. The patient was then admitted to the intensive care unit. The patient was started on dicloxacillin for empiric therapy for the knee wound. This was then changed the following day to Zinacef. Orthopedist noted the foot to remain cool with prolongation of the capillary refill. Vascular surgery was consulted. The patient was noted to have a dorsalis pedis which was biphasic by Doppler. Orthopaedic surgery also noted a right calcaneal fracture which they recommended repair in 2 weeks to allow the swelling to dissipate. While in the hospital, the patient developed a urinary tract infection and was begun on appropriate antibiotics. Physical therapy was consulted. The patient had a nonweightbearing status both extremities. The patient's hemoglobin remained low despite the 2 units of blood and 2 additional units of blood were transfused. The patient was started on nutrition. The patient requested that she be made DNR. The patient developed progressive shortness of breath. BiPAP was ordered though the patient refused. A chest x-ray showed no obvious infiltrate. A CT of the chest was repeated which was suspicious for pulmonary embolus. The patient was begun on empiric heparin. The patient remained tachypneic. An EKG was ordered which showed AV block. A repeat echocardiogram confirmed an approximately 60% ejection fraction. The patient was noted to slowly develop a right pleural effusion. Thoracic surgery placed a chest tube with 100 mL of blood returned. Followup chest x-ray showed that the lung was not fully expanded. The patient continued to be dyspneic with saturations in the 80 percentile. Later the following morning, the patient developed an idioventricular rhythm and arrested. The patient was pronounced dead.

PI: This case was not reviewed in M and M but was reviewed by the head of clinic. Care was felt to be adequate; however, the opportunity for improvement identified was more aggressive transfusion.

COMMENT: Care appearred to be quite timely and seemed to be well orchestrated with multiple services involved.

CASE 18 Thoracic ISS: 22

This 58-year-old fell approximately 8 meters from a tree. There was no loss of consciousness. The patient was found by EMS to be complaining of left chest and back pain. Initial EMS providers summoned a helicopter for transport. The helicopter arrived 30 minutes later. The patient spent 17 minutes on the scene awaiting arrival of the helicopter. GCS was 15. Blood pressure was 120/65, pulse was 82. Upon arrival of the air medical team, the patient was noted to have absent left breath sounds. A left chest tube was inserted. The patient was administered fentanyl and Zofran as well as tranexamic acid. A full trauma team was awaiting the patient's arrival. A chest x-ray was performed which showed a right pneumothorax. The patient received Zinacef and metronidazole. The thoracic surgeon placed a 2nd chest tube. The abdominal surgeon proceeded with a FAST examination which was reported as negative. The patient remained hemodynamically stable with a blood pressure of 142/73 and pulse of 86. The patient was taken for CT scans, which were remarkable for transverse process fractures as well as a left scapular fracture. Orthopaedics evaluated the patient and recommended nonoperative management. The patient was admitted to the intensive care unit in less than 2 hours. A repeat dose of tranexamic acid was provided. The patient remained stable in the ICU. The patient was transferred to the floor. The following evening, the patient developed increasing shortness of breath. A chest x-ray showed evolving bilateral pulmonary contusions. General diuresis was begun. The patient was transferred back to the ICU and an epidural catheter placed for pain control. The patient was also started on cefuroxime. The patient again improved and was transferred back to the floor. Two days later, the patient was again noted to have evidence of tachypnea. The patient required return back to the ICU. The epidural catheter was bolused and his pulmonary toilet was initiated. The patient began complaining of abdominal pain. The patient did vomit. The patient was noted to have an increased albumin to creatinine ratio. The patient was administered CPAP and chest physiotherapy. The white blood cell count elevated to 20.8 and C-reactive

protein to 227. Despite a noninvasive ventilation with BiPAP, patient required intubation and ventilation. A question was raised whether or not the patient had subclinical aspiration. The patient's antibiotics were broadened to vancomycin and metronidazole after a blood culture was noted to be positive for gram-positive cocci. While on the ventilator, the patient was sedated with propofol. The patient's blood pressure did become labile and norepinephrine drip was initiated. A chest x-ray showed increasing subcutaneous air. The chest x-ray progressed to a complete whiteout of the left chest. The patient's antibiotics were changed to meropenem, Cipro, Flagyl and vancomycin. The patient underwent bronchoscopy with a BAL quantitative culture sent. This was performed by the thoracic surgeon. The patient made slow improvement with antibiotic therapy. The patient still had not yet been weaned from the ventilator and did eventually undergo tracheostomy on post injury date #16. A Lasix drip was initiated. The epidural catheter was removed for a 24-hour period and a new epidural catheter placed for continued pain control. The patient was gradually weaned after an effective diuresis with the Lasix drip. Interval nutrition had been started early in the patient's course and continued. Despite the Lasix and diuresis, patient's renal function continued to deteriorate and required dialysis. The low molecular weight heparin was changed to unfractionated heparin. The patient's respiratory status continued to deteriorate and actually required a short period of nitric oxide ventilation. The patient did eventually regain renal function, dialysis was stopped. The patient was slowly weaned from the ventilator. The patient remained febrile and ID consult was obtained. The patient was changed to a Diflucan, vancomycin, meropenem and ciprofloxacin. Left pleural effusion slowly developed and a left thoracentesis was performed. This returned 200 mL of serosanguinous fluid. The patient was started on Coumadin. Once the INR was therapeutic, the heparin was discontinued. The patient then developed a right pleural effusion which was drained with a pigtail catheter. The patient was slowly weaned using pressure support weaning trials. One month after the patient's injury, this patient was transferred from the ICU. The patient did require extensive physical therapy. It was felt that the patient would need long-term inpatient rehab. Arrangements were made for the patient to be transferred to the rehab hospital nearest his home.

PI: This case was not reviewed though the ventilator-associated pneumonia was tracked.

COMMENT: The patient received good care. I believe this case had several minor opportunities for improvement which might have been captured if the case was reviewed at PI. The complications this patient sustained during hospitalization were treated well.

CASE 19: Subdural hematoma ISS: 16.

This 51-year-old was intoxicated and fell. Apparently, the patient struck his head on the concrete. There was history of loss of consciousness. EMS found the patient to have blood from the left ear. GCS was 13. Blood pressure was 98/68, pulse of 68 and oxygen saturation of 99%. Scene time was 13 minutes. The patient had a 19 minute transport to the trauma center. A full trauma team was awaiting the patient's arrival. The patient had a chest x-ray as well as pelvic film which were unremarkable. A FAST exam was negative. The patient was taken to the CT scan where a CT of the head showed a left subdural hematoma with subarachnoid hemorrhage and left temporal lobe contusion with an overlying left temporal fracture. Neurosurgery was consulted. They recommended that the patient be admitted to the neuro intensive care unit. GCS had improved to 14. ENT was consulted regarding the temporal bone fracture. They recommended outpatient evaluation with an audiogram in 2 weeks. The patient was appropriately administered thiamine and multivitamins due to the history of alcohol abuse. Ophthalmology was also consulted who found no evidence of eye injury. The following morning, the patient was taken for repeat CT scan. This showed no progression. The patient was begun on a diet and transferred to the floor. The patient was noted to develop a delayed 7th nerve palsy. The patient was started on steroids. The patient made a slow recovery and was transferred to a hospital closer to home.

PI: This case was not reviewed.

COMMENT: Care was appropriate and timely.

CASE 20: Subdural hematoma ISS: 16

This 49-year-old was in an altercation with his girlfriend. The patient was struck in the back of the head with a bottle. There was loss of consciousness. The patient's initial vital signs were blood pressure 157/100, pulse of 89, respirations of 20. The patient was initially evaluated in Region Zealand. Arrangements were made for transfer to the trauma center. The patient arrived to the trauma center where a full trauma team was awaiting the patient's arrival. The patient was noted to have poor airway control and it was opted to proceed with a rapid sequence induction and orotracheal intubation. A urinary catheter was placed. The patient was started on Zinacef, metronidazole and gentamicin. A chest x-ray was then performed which showed the endotracheal tube to be in good position. Neurosurgery recommended a repeat CT scan. This showed a small subdural hematoma. The patient was admitted to the ICU. The patient did gradually awaken and was able to be weaned from the ventilator and extubated the following day. Once extubated, a more detailed neurologic assessment did detect some left-sided neglect and decreased strength 4/5 in the left leg. An MRI was performed which failed to show convincingly the etiology for this neurologic deficit. The neurologists were consulted. They performed a motor and sensory evoked potential. It was felt that this may represent a partial spinal cord injury. The patient remained stable and was moved out of the ICU. Physical therapy was initiated. Seven days later, the patient was cleared by physical therapy and neurology to return home. Followup was arranged with neurology.

PI: This case was not reviewed.

COMMENT: There seemed to be adequate communication among the many services involved in the care of this patient. Aggressive prophylactic antibiotics with the patient receiving Zinacef, metronidazole and gentamicin.

CASE 21: Pelvic fracture ISS: 29

This 19-year-old was transferred from an outlying hospital from Region Zealand. He had been involved in a rollover motor vehicle crash in which he was a passenger and was ejected. The driver was dead on scene. The patient was evaluated with CT scan prior to transfer. The patient was found to have a left retroperitoneal hematoma related to left kidney injury. In addition, patient had a splenic injury. Of note is that this splenic injury was not graded. In addition, the patient had a normal CT of the head. The patient was found to have bilateral femur fractures. In preparation for transfer, the patient was intubated. The patient had received 5 units of packed red blood cells, 3 units of fresh frozen plasma and 1 unit of platelets. The patient arrived hemodynamically stable. A full trauma team was awaiting the patient's arrival. Blood pressure was 115/65, pulse of 90, saturations were 100%. Physical exam at that time was remarkable for a distended abdomen with abrasions. Chest x-ray was normal. Of note was the patient had bloody urine. The abdominal surgeon recommended a repeat CT scan to followup the splenic injury. In addition, urology was consulted. They also agreed with the plan to repeat the scan. No mention was made regarding the need for a formal retrograde cystogram. The patient was admitted to the OR where orthopaedics proceeded with placement of external fixators on both femur fractures. Plastic surgery was consulted intraoperatively for repair of a scalp and facial laceration. Postoperatively, the patient was admitted to the ICU. The patient did receive Zinacef and Metronidazole. The patient was extubated the following day. The patient was started on low molecular weight heparin for VTE prophylaxis. The following day, the patient was transitioned to a step down unit. The patient was noted to have myoglobinuria. Therapeutic diuresis and hydration was initiated. The patient was noted to have obvious posttraumatic stress disorder due to the fact that the patient's friend died in the accident. Psychiatry was

consulted and provided an extensive evaluation. On post injury day 6, the patient was then taken to the OR for removal of both external fixators and ORIF was performed with intramedullary rod. The patient had an epidural catheter placed postoperatively for pain control. The patient was seen by physical therapy. It was felt the patient would require inpatient rehabilitation and the patient was transferred to the rehabilitation hospital closest to his home.

PI: There was no evidence this case was reviewed in committee.

COMMENT: Care appeared to be timely and appropriate. The use of external fixators initially versus proceeding with intramedullary fixation of the femur fractures was a damage control approach. Not clear as to why damage control was chosen. The patient did receive appropriate prophylaxis for VTE. The case would have benefitted from review in committee to discuss the indications for damage control and the guideline being used to evaluate hematuria (stress cystogram vs CT cystogram).

CASE 22: ISS > 25 and survival ISS: 41

This 86-year-old with history of atrial fibrillation and COPD was driving a vehicle which struck a tree. The patient was found complaining of chest pain. There was history of loss of consciousness. The patient was transported to an outlying hospital. CT scans were performed which showed no evidence of intracranial injury. There were multiple right rib fractures 2 through 9. In addition, a sternal fracture was noted. CT of the abdomen was reported as negative. The patient was admitted to the ICU at the other hospital though developed a hypotensive episode. This then necessitated repeat CT of the abdomen which again showed no evidence of intraabdominal bleeding. The patient was intubated and arrangements made for transfer to the trauma center. The patient was apparently delayed approximately 6 hours after being accepted. This was felt to be related to the outlying hospital outsourcing their radiology and x-ray reports were not available. The patient was then transferred to the trauma center where the full trauma team was awaiting the patient's arrival including the orthopedist, abdominal surgeon and thoracic surgeon. Upon evaluation, a chest x-ray was performed which showed a pneumothorax on the right as well as the right rib fractures. Thoracic surgery placed a chest tube. The abdominal surgeon performed a FAST examination which was normal. Initial blood gas revealed a pH of 7.3 with a lactate of 1.2. The patient was hemodynamically labile. The patient was started on norepinephrine. Labile blood pressure was felt to possibly be related to propofol infusion dose. A TE was ordered which showed the ejection fraction to be 45% to 50%. The patient required continued ventilation. The outside CT scans were re-read and a repeat chest x-ray performed. This showed the complete evacuation of the right hemothorax. Epidural catheter was placed. The patient was weaned from the ventilator. Over the next several days, the patient developed increased secretions. CPAP was initiated. The patient was eventually transitioned from the epidural catheter to a Duragesic patch. The patient did require CPAP. Followup chest x-ray showed the right lower lobe to have collapsed. Bronchoscopy and PAL were performed. The patient developed progressive dyspnea. A chest x-ray showed again right lower lobe collapse. The patient was re-intubated and placed back on mechanical ventilation. The patient had bronchoscopy performed. This was relatively unchanged. The patient then developed a hypotensive episode. The patient required dopamine as well as norepinephrine for blood pressure support. Blood cultures were obtained as was a bronchoscopic specimen. Antibiotics were broadened to Zinacef, meropenem and ciprofloxacin. The patient then developed atrial fibrillation. Amiodarone was initiated. The rate was well controlled. Over the ensuing several days, the patient developed progressively worsening renal function. A Lasix drip was initiated. In addition, the patient's liver function tests had elevated and this was felt to represent a shocked liver. The patient was started on digoxin. The patient's creatinine continued to climb and dialysis was initiated. The abdominal surgeons, upon their evaluation, were concerned that the patient may have developed acalculous cholecystitis. An ultrasound was performed which was negative for cholecystitis. The patient was gradually weaned from the vasopressors. Tube feeds were initiated. The patient was gradually weaned from the ventilator. During the sedation holiday, the neurologic

examination noted the patient was slow to wake up. A neurology consult was obtained. They felt that this was related to a metabolic cause. The patient remained febrile and Diflucan was added to the antibiotic regimen. The patient continued to make slow progress. Physical therapy and occupational therapy had evaluated the patient. Arrangements were then made for the patient to be transferred back to a hospital closer to home on post injury day 11.

PI: There were no PI notes indicating that this case was reviewed.
COMMENT: Good documentation in the critical care unit.

CASE 23: Liver and spleen ISS: 41

This 17-year-old had jumped from the 4th floor of a hotel. The patient was found in the street with a large amount of blood coming from the patient's mouth. EMS spinally immobilized the patient. Initial vital signs were systolic blood pressure of 93, pulse of 88, respirations of 16. A peripheral IV was established and a liter bolus of normal saline initiated. Scene time was 18 minutes. The patient was met at the trauma center by the full trauma team. The abdominal surgeon performed FAST exam which was positive. The patient's blood pressure had responded to the initial 1 liter bolus with a BP of 100/60. Heart rate was 110, respirations were 24. Oxygen saturation was 100%. Glasgow Coma Score was 14. The patient also had a chest x-ray and pelvic x-ray, both of which were negative. The patient continued to have a moderate amount of blood from the mouth and the patient underwent a rapid sequence induction with ketamine, propofol, succinylcholine and fentanyl. The patient was orotracheal intubated. The patient was given tranexamic acid. Initial pH was 7.19 with a lactate of 4.0. The abdominal surgeon felt that laparotomy was indicated due to hypotension and the positive FAST exam. In addition, ENT and oromaxillofacial surgery were consulted for a mandibular fracture. The patient was taken to the OR and underwent splenectomy. In addition, the patient was noted to have a pancreatic contusion, a liver laceration which was repaired with hepatorrhaphy. The patient was found to have a tear in the cecum and underwent right hemicolectomy. Estimated blood loss intraoperatively was 1 liter. The patient received 1200 mL of crystalloid. In addition, the patient did require transfusion, approximately 1800 mL of fresh frozen plasma and a platelet pheresis pack. A tag exam was done. The patient's lactate remained elevated intraoperatively at 3.8. ENT evaluated the patient in the OR. The patient was given an additional dose of tranexamic acid in the OR. Postoperatively, the patient was taken for a CT scan where CT of the head did show a left epidural hematoma with frontal contusion as well as the Le Fort 3 fracture and mandible fracture. Neurosurgery placed an ICP monitor. The patient was noted to have developed bilateral pneumothoraces. The thoracic surgeon placed chest tubes. The patient was mechanically ventilated and was kept sedated with fentanyl and propofol. The patient's initial ICP was 17. The patient remained hemodynamically stable. The following day, the patient's ICP had increased to 19-20. In addition, the patient was noted to have myoglobinuria. A Lasix drip was initiated. The patient was treated with hypertonic saline for the mild increase in ICPs. Cerebral perfusion pressures were maintained. Ophthalmology was consulted and the patient was felt to have evidence of a right globe injury with an ovoid nonreactive right pupil. ICP monitoring was continued. VTE prophylaxis was initiated 48 hours later. Repeat CT of the brain was unchanged. The patient required continued mechanical ventilatory support. The patient was taken on the 6th post injury day to the OR for facial nerve repair and tracheostomy. Postoperatively, the patient was returned back to the ICU. ICPs had elevated to 23. This was despite osmolar therapy. Repeat CT scan showed blossoming contusions of both frontal lobes. The patient's ICPs gradually improved over the ensuing several days. The ICP monitor was discontinued. The wakeup assessment did reveal the patient to move all four extremities and eventually began following commands. The patient's fentanyl and propofol were discontinued and the patient started on methadone for pain control. The chest tubes were placed to water seal. The patient was noted to have a climbing white count as well as C-reactive protein. The patient was started on antibiotics. The chest tubes were clamped for 1 day prior to chest tube removal. The patient was successfully weaned from the ventilator. A passy-muir valve was used to allow for the patient to talk. The patient had been receiving nasogastric

feedings with high residuals and erythromycin was started. The trach tube was discontinued. The patient was transferred out of the ICU. Arrangements were made for the patient to be transferred back home to Israel. The patient was transferred on the 17th post injury day.

PI: This case was not reviewed in committee.

COMMENT: There appeared to be several opportunities for better coordination of care, though the outcome was excellent.