



## Multidisciplinary trauma team care in Kandahar, Afghanistan: Current injury patterns and care practices

Andrew Beckett<sup>a,b</sup>, Pierre Pelletier<sup>b,c</sup>, Christiaan Mamczak<sup>b,c</sup>, Rodd Benfield<sup>b,c</sup>, Eric Elster<sup>b,c,d,e,\*</sup>

<sup>a</sup> Canadian Field Hospital, CFB Petawawa, Petawawa, Canada

<sup>b</sup> NATO Role III Multinational Medical Unit, Kandahar Airfield, Afghanistan

<sup>c</sup> United States Navy, Medical Corps, Kandahar, Afghanistan

<sup>d</sup> Regenerative Medicine, Naval Medical Research Center, Silver Spring, MD, United States

<sup>e</sup> Department of Surgery, Uniformed Services University of the Health Sciences, Bethesda, MD, United States

### ARTICLE INFO

#### Article history:

Accepted 6 January 2012

#### Keywords:

Multidisciplinary trauma  
Multinational medical staff  
Kandahar, Afghanistan

### ABSTRACT

Multidisciplinary trauma care systems have been shown to improve patient outcomes. Medical care in support of the global war on terror has provided opportunities to refine these systems. We report on the multidisciplinary trauma care system at the Role III Hospital at Kandahar Airfield, Afghanistan.

We reviewed the Joint Trauma System Registry, Kandahar database from 1 October 2009 to 31 December 2010 and extracted data regarding patient demographics, clinical variables and outcomes. We also queried the operating room records from 1 January 2009 to 31 December 2010.

In the study period of 1 October 2009 to 31 December 2010, 2599 patients presented to the trauma bay, with the most common source of injury being from Improvised Explosive Device (IED) blasts (915), followed by gunshot wounds (GSW) (327). Importantly, 19 patients with triple amputations as a result of injuries from IEDs were seen. 127 patients were massively transfused. The in-hospital mortality was 4.45%.

From 1 January 2010 to 31 December 2010, 4106.24 operating room hours were logged to complete 1914 patient cases. The mean number of procedures per case in 2009 was 1.27, compared to 3.11 in 2010.

Multinational, multidisciplinary care is required for the large number of severely injured patients seen at Kandahar Airfield. Multidisciplinary trauma care in Kandahar is effective and can be readily employed in combat hospitals in Afghanistan and serve as a model for civilian centres.

Published by Elsevier Ltd.

### Introduction

Medical care in support of the global war on terror (GWOT) during Operation Enduring Freedom has required innovations in surgical, medical and critical care to provide appropriate trauma care for the victims of the conflict. In 2009 and 2010, there was an increase in military operations in southern Afghanistan that resulted in a potential increase in the number of casualties requiring advanced level trauma care.

Important lessons may be learned from the triage and patient flow management in military trauma facilities in Afghanistan and Iraq during this conflict. These lessons may be extrapolated to civilian institutions for situations of mass casualties and other

instances where a large number of patients with high acuity present for care.<sup>1</sup>

The emergence of multidisciplinary trauma teams is the most notable innovation driving trauma care in the modern combat military hospital. All members of these teams play a role in the triage, care and disposition of trauma patients. The current model utilises a team comprised of an emergency or primary care physician, acting as the trauma team leader, supported by a staff of nurses, medical, radiology and laboratory technicians, general surgeons, specialty surgeons and a radiologist. With the collaboration of NATO partners supporting the medical care of GWOT casualties, a multinational integration of healthcare providers has been applied in trauma teams. This framework of multidisciplinary trauma care provides many lessons for the provision of trauma care in civilian institutions. As shown in previous work, the introduction of a formal multidisciplinary trauma team system improves patient outcomes.<sup>2</sup>

Prior to July 2009, the Role III Hospital (or Combat Hospital) in Kandahar, Afghanistan was a Canadian Forces-led multinational hospital that operated out of a structure built primarily of

\* Corresponding author at: Naval Medical Research Center, 503 Robert Grant Avenue, 2W123, Silver Spring, MD 20910, United States. Tel.: +1 301 319 8632; fax: +1 301 295 1403.

E-mail addresses: [andrew.beckett@utoronto.ca](mailto:andrew.beckett@utoronto.ca) (A. Beckett), [papelletier@mac.com](mailto:papelletier@mac.com) (P. Pelletier), [Rodd.benfield@gmail.com](mailto:Rodd.benfield@gmail.com) (R. Benfield), [Eric.elster1@med.navy.mil](mailto:Eric.elster1@med.navy.mil), [frederick.gage@med.navy.mil](mailto:frederick.gage@med.navy.mil) (E. Elster).

plywood and other temporary building materials.<sup>3</sup> The Role III combat hospital is similar to a Level II trauma centre according to American College of Surgery-Committee on Trauma guidelines.

The US Navy (USN) assumed command of this facility on 15 October 2009. However, this temporary structure had many fire safety concerns and the structure was highly permeable to dust, which interfered with equipment and patient care.

Therefore, a more permanent, robust and safer facility was needed to provide care for a greater number of coalition combat casualties. A new, state of the art, brick and mortar facility opened in May 2010 to coincide with the start of summer military operations in July and August 2010. Although the Role III Hospital is USN lead, a full staff of healthcare providers from Canada (Can), the Netherlands (NLD), Denmark (Den), Australia (Aus) and the United Kingdom (UK) are also key trauma care providers in the hospital.

The hospital at Kandahar Airfield (KAF) is considered a Role III facility in the current military medical system. Within the military medical system, there are five echelons of care.<sup>4</sup> These 5 echelons encompass treatment from the battlefield to final disposition after repatriation of the patient. Role I care is delivered at the point of wounding and includes “buddy aid” care and combat medic care. Role II facilities provide emergent resuscitative care and damage control surgery but have limited patient holding capabilities. Role III care provides the most advanced in-theatre subspecialty patient care, equivalent to most civilian American College of Surgeons-Committee on Trauma (ACS-COT) Level-II trauma centres. The Role IV facility, currently located in Landstuhl, Germany, provides tertiary level care to wounded forces en-route to their home countries. Role V care is where definitive management is provided in the patient’s home country, usually at a tertiary care facility.

The KAF Role III Hospital provides in-theatre trauma care for coalition forces, Afghan security forces and Afghan Local Nationals. This facility is the sole Role III Hospital for Kandahar Province in southern Afghanistan. Current standard combat medical support includes General Surgery, Orthopaedics, Adult Critical Care, Paediatric Intensive Care and Anaesthesia Services. In addition, the Role III facility serves as a referral centre for neurosurgery, ophthalmology, and oromaxillofacial surgery for all of southern and western Afghanistan.

In this review, we provide a detailed description using data base review, of how multinational and multidisciplinary trauma care is provided at the military Role III Hospital in Kandahar, Afghanistan. We assess the critical implications of this model in both military and civilian settings using descriptive methodology.

#### *Physical resources of the Role III facility in Kandahar*

The current Role III facility in Kandahar is a newly built (completed in 2010) brick and mortar structure, provides a degree of safety from the elements and potential enemy attacks. The building was designed for the efficient management of trauma care and was modelled after European trauma centres for ease of flow of patients from the trauma bay to the in-house computed tomography suite, to the operating room and finally to the intensive care unit. This facility provides three operating rooms, a procedural surgical suite, post-operative ward and critical care unit beds. Additionally, essential support services such as haematology and biochemistry lab services, a blood bank and diagnostic imaging services are also located within the building. A fully functional plasmapheresis lab ensures a fresh, safe supply of platelets to match surgical and resuscitative needs.

#### *Composition of Role III medical providers in Kandahar*

Physician staff providers include: Emergency Trained Trauma Team Leaders, Anaesthesia, Orthopaedics, General Surgery, Critical Care, Internal or Family Medicine, Dental and General Radiology. Subspecialties represented at the Kandahar Role III include Ophthalmology, Neurosurgery, Interventional Radiology, and Oral Maxillofacial Surgery.

Important secondary roles in quality assurance include the Director of Surgical Services (DSS) and Director of Trauma Services (DTS), positions that are currently both filled by US Navy General Surgeons. These two positions ensure that the care provided is of a high standard and follows the established Joint Theatre Trauma Service (JTTS) clinical practice guidelines (CPGs) published by the JTTS and the US Army Institute for Surgical Research. These CPGs are publically available at [www.usaisr.amedd.army.mil/cpgs.html](http://www.usaisr.amedd.army.mil/cpgs.html).

Professionals in nursing, physiotherapy, psychiatry, psychology and social work make up the other essential supporting staffs at the Role III facility and are comprised from members of multiple nations (US, Can, NLD, DAN and UK). English is the working language of the Role III facility, and the clinical practices are guided by the American College of Surgeons, Advanced Trauma Life Support protocols and JTTS CPGs.

#### *Involvement of Role III members in trauma team activations*

Upon activation of an Alpha casualty (Priority 1), members of the trauma team assemble in the trauma bay. These members include the trauma team leader (TTL), who coordinates the resuscitation of individual patients with supporting nurses and techs, as well as representatives from Anaesthesiology, Radiology, Orthopaedics, General Surgery and Critical Care.

In situations where large numbers of patients arrive simultaneously, the DSS and the DTS triage patients requiring operative interventions, radiological investigations and final disposition. After consultation with all members of the trauma team, patients are prioritised for necessary surgical and resuscitative care with the appropriate consultants.

Staff radiologists offer a highly effective addition to the trauma team, providing real time feedback by reading plain film radiographic images, performing bedside ultrasonography FAST scans, and organising advanced imaging studies, such as computed tomography and angiography. Subspecialists are available on call to the trauma bay at all times. Additionally, translators are included as part of trauma activations in which care is provided to Afghan patients.

#### *Radiology as part of the trauma team*

The addition of the radiologist to the trauma team is a departure from the typical role this specialty has played in trauma evaluation. It has proven to be an effective innovation for the evaluation of combat trauma patients. This model incorporates an “up front” and “hands on” approach to imaging consultation, with the radiologist being an integral facet of the initial trauma assessment. This significant deviation from the traditional role of the radiologist provides immediate guidance on imaging triage (for example, determining which of the two CT scanners should be employed during imaging) and the imaging modality to be performed. With the radiologist performing the Focused Assessment for Trauma (FAST) exam, an opportunity is provided to survey the patient’s injuries, thereby enhancing study interpretation. This unique practice increases the efficiency of patient imaging whilst providing immediate interpretation of results.

Imaging capabilities at the Role III facility include two Philip Brilliance CT scanners: one 64 detector scanner with Extended Brilliance Workspace software providing 3D vascular and 3D bone reconstructions, and one 16 detector CT scanner. Additionally, the Radiology Department has extensive ultrasound capability, with two Sonosite M-Turbo devices and a Philips iU-22 ultrasound machine.

#### Daily rounds by Role III members

All physician providers and clinical team leaders meet at morning rounds to discuss patient management and disposition, the latter being highly pertinent as many coalition military patients are moved quickly out of theatre to higher echelon facilities. The care and disposition of Afghan local nationals (LN) is also discussed. The KAF Role III provides the highest level of care in southern Afghanistan, and transfer to local Afghan hospitals must be carefully coordinated.

US Navy hospitalists provide post-operative ward coverage, thereby allowing specialist consultants to concentrate on the active surgical management of incoming trauma patients. The critical care unit is staffed with board certified adult and paediatric critical care specialists. The Role III unit is a “closed” unit managed by critical care specialists with input from consultant staff members.

The Role III at KAF works closely with local Afghan partner institutions (Kandahar Regional Military Hospital and Kandahar City’s Mirwais Hospital) in caring for Afghan military and civilian patients; we frequently collaborate with our Afghan colleagues to improve patient outcomes within Kandahar province. A mentorship and combined rounds programme has been established with the Kandahar Military Regional Hospital to improve the Afghan medical system whilst respecting the local religious and cultural values.

#### Involvement of Role III members in quality assurance

Local morbidity and mortality conferences are held weekly to review the previous week’s cases. All members of the Role III trauma team are required to attend. Weekly case conferences are held with the Joint Theatre Trauma System (JTTS), encompassing Role III to Role V facilities and enabling feedback to in-theatre caregivers on final patient outcome and disposition. The facility also maintains an active quality assurance committee that monitors the quality of care indicators and administers ongoing process improvement initiatives.

#### Concurrent multidisciplinary care

An example of the multidisciplinary care provided at the KAF Role III facility is the emergent surgical and resuscitative care required for triple amputee patients with pelvic and perineal injuries, an injury pattern commonly seen after dismantled Improvised Explosive Device blasts. This type of injury requires multiple surgical teams operating in concert with the anaesthesia staff to salvage the patient. These patients are at significant risk for hypovolemic shock and sepsis, and thus close communication with critical care staff and air evacuation teams is paramount.

## Methods

To describe the organisation and composition of the Kandahar Role III Hospital and to implement process improvement, we reviewed the Standard Operational Procedures and Guidelines of this institution. We employed a retrospective database analysis to describe the trauma volumes, blood product usage and surgical cases from 1 October 2009 to 31 December 2010 at this location.

We queried the local Joint Theatre Trauma Registry (JTTR) for data on the number of cases, the monthly usage of operating room hours, the average Injury Severity Score (ISS) (available for 2010) and the monthly amounts of blood products utilised. Operating room records were also queried from 1 January 2009 to 31 December 2010.

The JTTR is a managed multinational database of all trauma casualties treated by coalition forces in Iraq (Operation Iraqi Freedom) and Afghanistan (Operation Enduring Freedom). The Joint Combat Care Casualty Research Team (JC2RT) of the United States Department of the Army approved the analysis of their database for this study. The operating room data is maintained under the direction of the DSS.

#### Inclusion criteria

The inclusion of patients in JTTR encompasses those patients treated at a military Medical Treatment Facility (MTF) meeting at least one of the following criteria:

1. Patient incurs an injury with the following: ICD-9 injury code between 800 and 959.9 or near drowning/drowning if related to an injury (ICD-9 994.1) or Inhalation Injury (ICD-9 987.9) and admitted as an in-patient AND the injury is less than 72 h old at the time of the first admission.
2. The patient dies as a result of injury (trauma), including the following: killed in action (KIA) or dead on arrival (DOA) or died of wounds (DOW), regardless of admission status to the facility.
3. The patient is admitted as an inpatient to the MTF as a result of a traumatic brain injury, regardless of when the original injury occurred.
4. Other patients who sustained injury may be entered into the JTTR if the local facility deems it necessary.

Of note, paediatric patients are defined as being less than 15 years of age at the time of the injury.

## Results

A total of 2599 trauma patients were seen in the study period 1 October 2009 to 31 December 2010 (Table 1). During this period the Kandahar Role III saw an average of 173.2 patients per month in the trauma bay. Our radiology department performed 1400 computed tomography studies in this 15-month period, 53.8% of all trauma patients seen in the trauma bay. The majority of patients admitted to the Kandahar Role III trauma bay from 1 October 2009 to 31 December 2010 were coalition troops (1407), followed by Afghan LNs (581) (Table 1).

Most patients seen at the Role III in the period of 1 October 2009 to 31 December 2010 were in the 0–15 quintile of the ISS scale.

**Table 1**

Trauma bay patient characteristics 1 October 2009 to 31 December 2010 at MMU Role III Hospital, Kandahar Airfield.

Patient admissions to trauma bay	2599
NATO soldier admissions	1407
Local National admissions	581
Afghan Security Force admissions	312
Civilian contractor admissions	102
Paediatric admissions	197
In house mortality	4.45%
PRBCs transfused	4042
Units FFP transfused	3805
Units platelets transfused	585
Whole Blood transfusions	162
Massive transfusions	127
Trauma computed tomography studies	1400
Triple amputation patients	19

**Table 2**

Injury Severity Scores (ISSs) recorded in 1971 trauma patients seen from 1 October 2009 to 31 December 2010 at MMU Role III Kandahar Airfield.

ISS	Number of patients
0–15	1397
16–30	450
31–45	102
46–60	8
61–75	14
Total	1971

**Table 3**

Operating room usage in 2009 and 2010 at MMU Role III Kandahar Airfield (1 January 2009 to 31 December 2010).

	2009	2010
Total cases	1390	1914
Mean # of procedures/case	1.27	3.11
Orthopaedics cases (N)	761	2815
General Surgery (N)	602	1796
Ophthalmology (N)	0	390
OMFS (N)	262	616
Neurosurgery (N)	144	349

OMFS – Oral Maxillofacial Surgery.

However, 14 patients were treated in the 61–75 range of ISS (Table 2). In keeping with higher ISS values from penetrating combat trauma, 127 patients were massively transfused, using the criteria for massive transfusion of either greater than 10 units of pack red cells transfused or patient's entire blood volume replaced within 24 h (Table 1).

The KAF operating room database contains data from 1 January 2009. Operating room usage in 2009 and 2010 was measured by hours and specialty. From 1 January 2010 to 31 December 2010, 4106.24 operating room hours were logged to complete 1914 patient cases. The mean number of procedures per patient in 2010 was 3.11, compared to 1.27 procedures per patient in 2009, an increase of 145% (Table 3).

A seasonal peak is seen corresponding with the “fighting season” in July 2010 (577.2 h and 235 cases). An increase in the volume of surgical patients treated by all surgical specialties and subspecialties was seen from 2009 to 2010 (Table 3). The volume of orthopaedic cases increased three-fold and general surgery cases increased at least two-fold, coinciding with an increasing tempo of operations in southern Afghanistan.

Peak PRBC usage occurred in July 2010, with 445 units transfused; this coincided with a mean ISS of 11.2 for the month

**Table 4**

Monthly averages of patient Injury Severity Score (ISS), Packed Red Blood Cells (PRBCs) used at Role III Kandahar Airfield from 1 January 2010 to 31 December 2010.

	Monthly mean ISS	Blood products used by month (PRBCs)	Monthly use PRBCs used per operative patient
January	12.8	156	1.57
February	14.4	236	2.12
March	11.6	168	1.61
April	10.3	188	1.58
May	9.8	182	1.26
June	11.2	300	1.39
July	11.2	445	1.89
August	11.8	426	2.49
September	11.5	430	2.35
October	13.3	465	2.47
November	14.2	274	1.59
December	14.3	172	0.99
Mean	12.0	286.83	1.78

**Table 5**

Operative cases by month in 2009 and 2010.

Month	2009	2010
January	130	99
February	86	111
March	104	104
April	116	119
May	95	144
June	100	215
July	155	235
August	201	171
September	117	183
October	117	188
November	86	172
December	83	173
Total	1390	1914

(Table 4). However, in this month the number of operative patients also peaked at 235 (Table 5). Average units of PRBCs transfused per operative patient were 1.78 (Table 4).

The most common mechanism for injury seen was IED blast from no found source (915), followed by GSW (327) and then motor vehicle collision (202) (Table 6). Admissions for both IED blast (114) and GSW (42) peaked in July 2010 (Table 7). Importantly, from 1 October 2009 to 31 December 2010, 19 patients with triple amputations due to IED blasts were seen (Table 1).

## Discussion

The multidisciplinary system at the Role III facility effectively handled an increase in the overall number of patients requiring surgical care. The most notable increase was in patients requiring musculoskeletal orthopaedic care. The involvement of all physicians in daily patient rounds had a positive impact on the optimisation of patient care decisions on treatment algorithms and on the efficiency of in-patient flow. The timely disposition of patients was expedited by having all members of the patient care team present at rounds, enabling a peer-reviewed consensus on

**Table 6**

Mechanism of injury Role III MMU Kandahar Airfield 01 October 2009 to 31 December 2010.

Mechanism	Number of patients
Improvised Explosive Device – no found source	915
Bullet/GSW/firearm	327
Motor vehicle collision	202
Mortar/rocket/artillery wounds	101
Fall	81
Other	75
helicopter crash	68
Rocket propelled grenade	52
Improvised Explosive Device – vehicle borne	38
Machinery/equipment	34
Landmine	31
Burns	26
Improvised Explosive Device – person borne	24
Hand grenade	23
Explosion – not otherwise specified	16
Knife/other sharp object injury	14
Blunt Injury – not otherwise specified	7
Unexploded ordnance detonation	5
Penetrating injury – not otherwise specified	4
Aerial bomb	3
Asphyxia/suffocation	2
Chemical injury	2
Plane crash	1
Submersion/drowning	1
Non trauma/not recorded/unknown	547
Total	2599

**Table 7**

Improvised Explosive Device and GSW admissions Role II MMU 1 October 2009 to 31 December 2010.

	IED	GSW
October 09	69	16
November 09	45	13
December 09	36	15
January 10	40	6
February 10	36	12
March 10	42	21
April 10	40	21
May 10	65	21
June 10	86	40
July 10	114	42
August 10	91	40
September 10	110	24
October 10	110	24
November 10	50	26
December 10	57	13

individual patient cases. The weekly morbidity and mortality rounds attended by all members of the trauma team provided a multidisciplinary case review and learning opportunity, in contrast to traditional hospital unidisciplinary-based morbidity and mortality rounds.

The use of CPGs ensured that a uniformly high standard of care was provided to all patients. This is an effective way of providing standardised care when providers have been trained in several different countries.

The previous Canadian trauma experience was reviewed by Tien et al., who reviewed patient care variables for the period of February to July 2006.<sup>3</sup> Consistent with our data, Tien et al. found that the majority of trauma was related to blast or penetrating injuries (45% and 29% respectively). In a six-month period in 2006, 248 patients were treated in Kandahar and 322 operations were performed; 16 of these patients died, for an overall mortality rate of 6%. However, the patients treated during this period had a higher mean ISS (18). It must also be noted that the resources and facilities are now much improved. For example, the Role III facility now has neurosurgery and ophthalmology capabilities. Additionally, there are now expedited transfer agreements established between KAF and the ICRC Mirwais Hospital and the Kandahar Military Regional Hospital, meaning that moribund Afghan patients may die in those facilities rather than at the KAF Role III. We have no follow up data on these patients, so these factors were not examined in this study.

Similar intra-theatre multidisciplinary trauma team models have been successful in other combat hospitals in Afghanistan. At a comparable joint UK and US administered Role III facility in Helmand province at Camp Bastion, 226 level alpha patients were received between mid October 2008 and mid January 2009 requiring trauma team activations. The healthcare providers at Camp Bastion documented a 100% attendance of emergency medicine and anaesthesia consultants at trauma team activations, although there was no mention of the specific attendance patterns of surgeons, sub-specialty surgeons and radiologists in this report. They additionally documented that 98.1% of the surgical procedures were performed by a consultant.<sup>5</sup> Registrar (senior resident) level trainees employed by UK forces medical services completed the remainder of cases. In comparison, at the Role III facility in Kandahar, 100% of alpha level trauma team activations were attended by the TTL and Anaesthesiology, General Surgery, Orthopaedics, Critical Care and Radiology specialists. In addition, 100% of the operations performed in the Role III facility in Kandahar are completed by attending (consultant) surgeons. CT imaging is performed in 53.8% of our trauma patients upon arrival. The Role III facility at Camp Bastion documented 35.6% of their patients undergoing computed tomography as part of their initial assessment in 2007 and 2008.<sup>5</sup>

Historically, the ISS system was designed to evaluate motor vehicle collisions. Although not directly interchangeable, the ISS system is applicable to combat injuries, although it frequently underestimates the extent of wounds sustained in modern combat. For example, a bilateral above-knee amputation from an IED blast yields an ISS of 9, grossly underestimating the extent of injury and blood loss. ISS scores in the 0–15 range predominated our study population. Trends in the ISS were also observed during the increase in patient admissions. At the KAF Role III facility, the mean ISS was 9.63 from October to December 2009 but rose to 13.9 during the same period in 2010. This trend is theoretically due to the increased size and destructive power of IEDs, which was the predominate mechanism of injury for the 915 admissions during the 15 month study period. In the same time period, there was a corresponding increase in the number of units of PRBCs transfused and operative cases, both reflective of higher ISS and an increase in patient volume.

In another study from the Role III facility at Camp Bastion from 1 May 2006 to 1 May 2008, 2210 surgical procedures were documented in 1668 patients. Paediatric cases made up 14.7% of the total cases. The majority of procedures in this study were orthopaedic (66%), followed by general surgery (21%), head and neck (6%), burn surgery (5%), and neurosurgery (1.8%).<sup>6</sup> Additionally, the Camp Bastion Role III facility observed a significant increase (200%) in the number of patient encounters during the last year of their study period.

At the Role III facility in Kandahar, we identified 1390 surgical cases performed from 1 January through 31 December 2009 and 1914 cases from 1 January through 31 December 2010, a 38% increase. The 3304 cases for the two years of data at the Kandahar Role III facility represents 50% more cases than identified at the Role III facility in Camp Bastion. Similar to the experiences at Camp Bastion from 2006 to 2008, cases with the greatest surgical volume were orthopaedic cases, followed by general surgery cases. Of note, surgical subspecialties such as neurosurgery, which is available at KAF but not Camp Bastion, included 144 cases in 2009 and 349 cases in 2010.

The increased number of procedures performed per patient from 2009 to 2010 correlates with the increase in the ISS of trauma patients observed during that time period and highlights the need for multidisciplinary care because multiple surgeons are required to operate on the patients concurrently due to the multitude of injuries sustained in combat operations.

The relatively low in-house mortality rate seen in 2009 and 2010 may be due to the proficient multidisciplinary care provided at the Kandahar Role III facility. However, this must be viewed with caution, as the Role III facility has a limited holding policy, and the theatre policy dictates that patient care must be expedited to higher level care facilities, whenever possible. In cases of wounded NATO soldiers, repatriation typically occurs within 24–48 h. In the case of local national Afghans or members of Afghan security forces, patients can be retained longer at the Role III facility for definitive surgery and acute care. These patients are then transferred to KMRH or ICRC Mirwais for continued care and rehabilitation. There is limited follow up data on these patients, raising the possibility that the low mortality rate reported here does not reflect true long-term mortality. Nevertheless, the multidisciplinary trauma teams prove to be effective in initial resuscitation and surgical efforts in a patient population carrying significant ISS scores and operative needs.

The model of multidisciplinary trauma teams utilised at the KAF Role III facility should be considered for civilian tertiary care hospitals in situations when large numbers of trauma patients require care. It offers a valuable, organised system to handle the large patient volumes and mass casualty situations that may occur during natural disasters or global traumatic events. Creating DSS

and DTS positions in civilian institutions would be an important starting point when replicating trauma teams prepared for handling large volumes of trauma patients. Additionally, poly-trauma scenarios involving the use of multiple surgical teams operating concurrently should be considered and rehearsed.

It must be recognised that the combat situation in Kandahar, where all members at the Role III facility live, eat and work in close proximity to the facility, differs from normal civilian life. Moreover, there are few external distractions such as family or other non-military responsibilities. The quick response to mobilise multiple trauma teams in a civilian setting may be hampered by the introduction of these variables. However, in a civilian disaster these conditions could be replicated by bringing civilian hospital staff in to reside “in house” for the duration of the incident.

Limitations of this study include the retrospective nature of this study and missing variables from the JTTR database.

## Conclusion

The Role 3 Hospital in Kandahar, Afghanistan was able to sustain the ability to provide multidisciplinary trauma care despite increasing combat patient volumes. The innovation of the multidisciplinary care of trauma patients has advanced to include the involvement of all medical departments in the resuscitation and care of patients in a combat hospital setting. This model facilitates increased communication, efficient high quality care and expedited disposition of casualties. Implementation of this model into civilian institutions offers the opportunity to enhance the triage and services rendered to busy emergency departments and mass casualty situations.

## Conflict of interest

All authors have neither financial interests nor conflicts to report.

## Acknowledgements

The authors wish to thank Captain M. McCarten USN MC, Commander MMU Role III, Kandahar Airfield for his support and leadership. The authors would also like to thank all members of the Joint Theatre Trauma Registry, Kandahar for data collection and analysis.

## References

1. Elster EA, Pearl JP, Denobile JW, Perdue PW, Stojadinovic A, Liston WA, *et al.* Transforming an academic military treatment facility into a trauma center: lessons learned from Operation Iraqi Freedom. *Eplasty* 2009;9:e31.
2. Demetriades D, Martin M, Salim A, Rhee P, Brown C, Chan L. The effect of trauma center designation and trauma volume on outcome in specific severe injuries. *Annals of Surgery* 2005;242:512–7. Discussion 7–9.
3. Tien HC, Farrell R, Macdonald J. Preparing Canadian military surgeons for Afghanistan. *CMAJ Canadian Medical Association Journal* 2006;175:1365.
4. Borden Institute (U.S.). *Emergency war surgery*. 3rd U.S. revision ed. Washington, DC: Office of the Surgeon General, U.S. Army, Borden Institute, Walter Reed Army Medical Center; 2004.
5. Henning DC, Smith JE, Patch D, Lambert AW. A comparison of civilian (National Confidential Enquiry into Patient Outcome and Death) trauma standards with current practice in a deployed field hospital in Afghanistan. *Emergency Medicine Journal EMJ* 2011;28:310–2.
6. Ramasay AHD, Edwards D, Stewart M, Midwinter M, Parker P. Skill sets and competencies for the modern military surgeon: lessons from UK military operations in southern Afghanistan. *Injury* 2010;41:453–9.