

## Emergency department care for trauma patients in settings of active conflict versus urban violence: all of the same calibre?

Pola Valles<sup>a,\*</sup>, Rafael Van den Bergh<sup>b</sup>, Wilma van den Boogaard<sup>b</sup>, Katherine Tayler-Smith<sup>b</sup>, Olivia Gayraud<sup>c</sup>, Bashir Ahmad Mammozai<sup>d</sup>, Masood Nasim<sup>d</sup>, Sophia Chéréal<sup>c</sup>, Alberta Majuste<sup>c</sup>, James Philippe Charles<sup>c</sup> and Miguel Trelles<sup>a</sup>

<sup>a</sup>Médecins Sans Frontières - Operational Centre Brussels, Medical Department, Brussels, Belgium; <sup>b</sup>Médecins Sans Frontières - Operational Centre Brussels, Operational Research Unit (LuxOR), Luxembourg, Luxembourg; <sup>c</sup>Médecins Sans Frontières - Operational Centre Brussels, Port-au-Prince, Haiti; <sup>d</sup>Médecins Sans Frontières - Operational Centre Brussels, Kunduz, Afghanistan

\*Corresponding author: Tel: +32 473 247 880; E-mail: pvalles@hotmail.com

Received 23 December 2015; revised 16 March 2016; accepted 5 April 2016

**Background:** Trauma is a leading cause of death and represents a major problem in developing countries where access to good quality emergency care is limited. Médecins Sans Frontières delivered a standard package of care in two trauma emergency departments (EDs) in different violence settings: Kunduz, Afghanistan, and Tabarre, Haiti. This study aims to assess whether this standard package resulted in similar performance in these very different contexts.

**Methods:** A cross-sectional study using routine programme data, comparing patient characteristics and outcomes in two EDs over the course of 2014.

**Results:** 31 158 patients presented to the EDs: 22 076 in Kunduz and 9082 in Tabarre. Patient characteristics, such as delay in presentation (29.6% over 24 h in Kunduz, compared to 8.4% in Tabarre), triage score, and morbidity pattern differed significantly between settings. Nevertheless, both EDs showed an excellent performance, demonstrating low proportions of mortality (0.1% for both settings) and left without being seen (1.3% for both settings), and acceptable triage performance. Physicians' maximum working capacity was exceeded in both centres, and mainly during rush hours.

**Conclusions:** This study supports for the first time the plausibility of using the same ED package in different settings. Mapping of patient attendance is essential for planning of human resources needs.

**Keywords:** Afghanistan, Emergency department, Haiti, Low income countries, Operational research, Trauma

### Introduction

Traumatic injury is a leading cause of death globally among persons under the age of 45 years. Over 5 million deaths occur each year as a result of injuries, representing 9% of the world's mortality (1.7 times the total number of deaths due to malaria, tuberculosis and HIV/AIDS combined). Of these injury-related deaths, 90% occur in low and middle income countries (LMICs).<sup>1</sup> Non-fatal injuries are among the leading global cause of emergency department (ED) visits, hospitalisations and long-term morbidity, accounting for a large part of health systems workload.<sup>1–3</sup> Although road injuries, falls and self-harm are the top three causes of injury burden globally, their relative importance may

differ according to the region. While these three causes contribute more or less equally to the injury burden in high income countries (HICs), road injuries clearly dominate in LMICs.<sup>1</sup> In conflict areas, however, violent trauma is a major cause of injury.<sup>4,5</sup>

Provision of timely, effective and quality emergency care is vital to minimise the disability, morbidities and fatalities of injured individuals.<sup>1</sup> There is extensive evidence showing that this is possible when concerted efforts are made to improve the organisation of, planning of and access to trauma care systems.<sup>1,6,7</sup> Although most of this evidence comes from HICs, hospital-based improvements at the level of human resources (training and staffing), physical resources (equipment and supplies) and organisation have been shown to be feasible for LMICs.<sup>5,8–10</sup>

Such improvements may depend on an understanding of the local typology of trauma, i.e. different patterns of trauma may require different ED resources and management strategies.<sup>11</sup> This raises the yet unanswered question: to what extent can ED care be provided as a standardised package versus a context-adapted model of care?

Médecins Sans Frontières (MSF) has been providing a standardised model of ED trauma care in a setting of active conflict (Kunduz, Afghanistan) and of urban violence (Tabarre, Haiti). It is unknown whether the needs of trauma patients and their management are similar in such differing contexts. Information on whether these programmes perform comparably in terms of meeting international standards of ED care could guide the decision to focus on standardised versus context-adapted models of care.

This study therefore aimed to assess whether provision of the same package of ED care performed equally in these two different contexts. Specific objectives were to compare in both EDs, over the course of 2014: the sociodemographic and clinical characteristics of presenting patients, trends in ED attendance and the overall ED performance indicators,<sup>12</sup> including final ED patient outcomes.

## Methods

### Design

This was a cross-sectional comparative study using routine ED data from two MSF trauma centres.

### Settings and study sites

The study sites were two MSF trauma centres: Kunduz Trauma Centre (Kunduz, Afghanistan) and Tabarre Trauma Centre (Port-au-Prince, Haiti).

#### *Afghanistan*

Afghanistan is located within South-central Asia bordering with China, Iran, Pakistan, Tajikistan, Turkmenistan and Uzbekistan. It is a multi ethnic society; one of the roots of the current conflict can be found in Afghanistan's complex ethnic and linguistic fault lines, which divide the country between competing political and armed factions. This is even further aggravated by ongoing migration within the country, and by the US-led invasion of the country in 2001. The estimated total population is around 35 million. Despite the economic progress made over the past few years, it is still an extremely poor country, highly dependent on foreign aid, with violence still affecting daily life and access to care.<sup>13</sup> Advanced medical care is only available in the capital, Kabul, and in a number of high-tech military hospitals around the country. Afghanistan has among the highest incidences of people with disabilities, with approximately one million people affected; most of these secondary to violent trauma incidents.

#### *Kunduz Trauma Centre*

Kunduz province is located in the north of Afghanistan. It has around one million inhabitants and has seen a great deal of active conflict, in particular following the 2010 USA troop surge. The MSF

Kunduz Trauma Centre started its activities in August 2011 as a standalone facility, serving the whole province. It aimed to fill the gap in trauma care, which was only provided by the regional hospital prior to 2011, and to improve quality of care by reducing the time between the incident and trauma care. In 2014 the hospital had 70 beds, and offered ED care, intensive care, surgery (mainly orthopaedic), surgical hospitalisation and physiotherapy. On 3 October 2015 the United States Air Force attacked the Kunduz Trauma Centre, leaving the hospital unusable.

#### *Haiti*

Haiti is the second most populous Caribbean nation, with an estimated 10.7 million people, of which approximately one million live in the capital city of Port-au-Prince. Recurring political violence has destabilised the country for decades. Additionally, the already deficient sanitation system, poor nutrition and inadequate health services were completely disrupted by the earthquake in 2010, followed by the largest cholera epidemic ever. Recovery has been slow, with the initial sizeable foreign aid almost completely drying up by 2013.

#### *Tabarre Trauma Centre*

The burden of trauma emergencies has increased since the earthquake, in particular in Port-au-Prince, with higher numbers of road accidents (linked to overcrowding and over-saturated traffic)<sup>14</sup> and growing urban violence (linked to gang fighting). The MSF Tabarre Trauma Centre, a pre-fabricated modular hospital, started providing specialised care for trauma and acute surgical conditions in February 2012 in Port-au-Prince; in order to cover the post-earthquake gap in trauma care. In 2014 the hospital had 119 beds, offering a similar package of care as described for Kunduz Trauma Centre.

#### *Emergency department standard package of care*

The ED of both projects offered care in line with the WHO trauma quality recommendations.<sup>15</sup> The EDs were staffed by general doctors, who were not specialised in emergency medicine due to lack of national programmes, but had been trained by international specialists, using the Advanced Trauma Life Support (ATLS; American College of Surgeons, 2008) methodology as a main reference. Timely response to patient care was ensured by having a medical doctor 24/7 in the department, as well as support from various specialists inside the hospital compound (anaesthetists, general surgeons and orthopaedists). All patients were triaged at arrival using the South African Triage Score (SATS) system,<sup>16</sup> and were attended according to their severity. All major or severe trauma patients were immediately seen in the resuscitation area and time spent from admission to the operating room or ICU was minimised as much as possible. Medical resources (equipment and supplies) corresponded to the needs for immediate management of airways, shock resuscitation, and initial trauma care. More detail on available resources can be found in Box 1. The quality of care provided in both EDs was routinely monitored using a set of standardised performance indicators (Box 2).

**Box 1.** Available resources in both Emergency departments of Kunduz and Tabarre Trauma Centres

	Kunduz Trauma Centre	Tabarre Trauma Centre
Human resources <sup>a</sup>		
Nurse in ED	5	4
General doctor in ED	2	1
Nurse supervisor in ED	1	1
Medical supervisor in ED	1	0
Beds per component		
Resuscitation room	3	1
Consultation/treatment room	2	3
Observation room	6	5
Equipment		
Airway		
Oral airway devices	✓	✓
Suction device	✓	✓
Laryngoscope and endotracheal tubes	✓	✓
Breathing		
Stethoscope	✓	✓
Oxygen supply	✓	✓
Chest tubes	✓	✓
Pulse oximetry	✓	✓
Arterial blood gas determinations	✓	✓
Bag-valve-mask	✓	✓
Mechanical ventilator	✓ <sup>b</sup>	✓ <sup>b</sup>
Circulation		
Blood pressure cuff	✓	✓
Crystalloid	✓	✓
Blood transfusion capability	✓	✓
Urinary catheter	✓	✓
Electronic cardiac monitoring	✓	✓
Defibrillator	✓	✓
Haemoglobin determination	✓	✓
Electrolyte determinations	✓	✓
Lactic acid determination	✓	✓
Fluid warmer	✓	✓
Diagnosis / others		
Plain radiological films	✓	✓
Portable films	✓	✓
Ultrasound	✓	✓
CT	x <sup>c</sup>	x <sup>c</sup>

ED: emergency department; CT: computed tomography

<sup>a</sup> Number of human resources present during the day shift<sup>b</sup> Available in the Intensive care unit<sup>c</sup> Possibility to be done in an external facility

## Study population

All trauma patients presenting to the ED of Kunduz and Tabarre trauma centres and recorded in the electronic ED register from January to December 2014 were included in this study.

## Data variables, data collection and sources of data

The variables collected included the sociodemographic and clinical characteristics of presenting patients, the attendance trends and ED performance indicators, as well as the ED outcomes of these patients (admitted (i.e. hospitalised), discharged, referred (transferred to another facility for care), left without being seen (LWBS) and died).

The source of data was both projects MSF electronic ED database for 2014. These are standardised databases (identical variables) used across all MSF trauma centres.

## Analysis and statistics

All data from patients arriving in the ED was routinely collected in the department's paper register by the attending doctors and afterwards encoded in the electronic registers by each hospital's data encoder. Paper and electronic registers were the same in both settings. Data pertaining to this study was then extracted from these electronic registers and entered into a specifically designed database using EpiData Entry software (version 3.1, EpiData Association, Odense, Denmark). Analysis was performed using EpiData Analysis software (version 2.2.2.182, EpiData Association). Data extraction and analysis were carried out by the principle investigator.

Baseline characteristics were described using medians and interquartile ranges (IQRs) for continuous variables and counts and percentages for categorical data. Differences between groups of variables were compared using the  $\chi^2$  test for categorical variables. The level of significance was set at  $P < 0.05$ .

## Ethics

Approval was obtained from the national ethics bodies of both Afghanistan and Haiti. This study met the MSF Ethics review board (Geneva, Switzerland) for analysis of routinely collected programme data, and was also approved by the ethics advisory group of the International Union Against Tuberculosis and Lung Disease, Paris, France.

As this was a record review study with anonymised data, the issue of informed patient consent did not apply.

## Results

### Patient Characteristics

In total, 31 158 patients presented alive to the EDs during 2014: 22 076 in Kunduz and 9082 in Tabarre. Male gender predominated in both projects (76.7% (16928/22075) in Kunduz and 68.6% (6233/9082) in Tabarre) and the median age of patients was 19 years (IQR 12–30) for Kunduz and 26 years (IQR 15–37) for Tabarre. Patient characteristics are indicated in Table 1.

**Box 2.** Relevant emergency department indicators and reference values used in Médecins Sans Frontières projects

ED indicators	Numerator	Denominator	Reference value
Use of service			
ED presentations	Total patients presenting to the ED	None	
ED high acuity proportion	Total red and orange cases	Total patients presenting to the ED	≥25%
Quality			
Clinician patients/hour	Total patients seen per shift	Clinicians working per shift multiplied by the hours in the shift	<3 patients/hour
ED mortality rate	Deaths in the ED among alive patients on arrival	Total alive patients presenting in the ED	<1% (0% for yellow and green cases)
Over triage	Discharged red and orange patients	Total red and orange patients	<50%
Under triage	Green patients admitted, died or referred	Total green patients	<10%
Surveillance list			
Trauma – category	Patients with specific traumatic presentation	All trauma patients	As per surgical surveillance list
Proportional morbidity	N° of patients with condition “X”	Total patients presenting to the ED	As per specific morbidity list
Delay to presentation	Time from onset of illness/ injury to arrival	none	

ED: emergency department; N°: number

The most marked differences between the two centres included the delay in presentation; 14.0% (3087/22073) between 1–6 h and 29.6% (6530/22076) >24 h in Kunduz, compared to 47.1% (4275/9082) between 1–6 h and 8.4% (763/9082) >24 h in Tabarre; and the proportions of non-emergency cases (green, yellow and orange SATS).

### Trends in emergency department attendance

Figure 1 shows the ED attendance per week. Kunduz saw a seasonal increase during the summer period, while in Tabarre, an increase in the number of cases during the last 5 months of the year correlated with the closure of a major surgical and trauma facility in Port-au-Prince. The proportion of violent trauma in both centres stayed stable despite these fluctuations (data not shown).

In terms of timing of daily arrivals, both centres showed main peak hours between 08:00 and 11:00 in the morning (Figure 2). These cases were mainly less severe (green and yellow) cases (data not shown).

### Emergency department performance indicators

Overall and cause-specific ED performance indicators are shown in Table 2: both trauma centres performed well within the indicator thresholds (Box 2); with the exception of the over triage rate in Kunduz (55.6% [3557/6389]).

Detailed analysis of the workload for consultants in the ED showed that in Kunduz the human resource capacity of maximum three patients / consultant / hour was exceeded mainly between

08:00–12:00 h and to a lesser extent between 20:00–23:00 h. In Tabarre, this occurred less, mainly between 17:00–18:00 h.

### Emergency department outcomes

In terms of ED outcomes, both centres showed a low proportion of mortality (0.1%; 13/22076 in Kunduz and 13/9082 in Tabarre)<sup>17</sup> and LWBS (1.3%; 277/22076 in Kunduz and 115/9082 in Tabarre).<sup>18</sup> All deaths were red cases, except for one orange case in Tabarre. Tabarre admitted more patients from the ED (30.8% [2797/9082]; compared to 11.5% [2533/22076] in Kunduz). Conversely, Kunduz discharged more patients (79.8% [17622/22076]; versus 65.4% [5936/9082] in Tabarre).

### Discussion

This is the first study comparing a standardised package of ED care across two different settings. It demonstrates excellent performance in both studied trauma centres, the main difference being the more frequent overstretching of human resource capacity in the Kunduz setting of active violence.

A strength of this study was the large sample size in both hospitals. Furthermore, all data was collected through the same standardised paper and electronic databases. Follow up and technical support of both EDs was ensured by the same technical advisors, guaranteeing the similarity of the package of care offered.

The limitations of the study included the use of a surveillance list for the classification of the cause of trauma, which was insufficiently specific as many patients were categorised as ‘other’; precluding a full understanding of the different morbidities. Time of patients’ first medical contact was not recorded correctly in

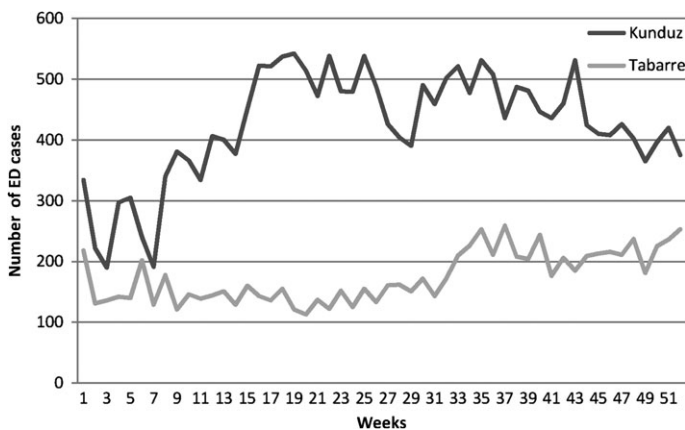
**Table 1.** Sociodemographic and clinical characteristics of patients who presented alive at the Emergency departments of Kunduz and Tabarre Trauma Centres during 2014

Variable	Kunduz n (%)	Tabarre n (%)	P value <sup>a</sup>
Total presenting alive	22076 (95.5)	9082 (99.9)	
Dead on arrival <sup>b</sup>	118 (0.5)	2 (<0.1)	NA
Sex			
Female	5147 (23.3)	2849 (31.4)	
Male	16928 (76.7)	6233 (68.6)	<0.001
Not recorded	1 (<0.1)	0 (0.0)	NA
Age (years)			
0–4	1858 (8.4)	686 (7.6)	0.012
5–14	6284 (28.5)	1480 (16.3)	<0.001
15–19	3001 (13.6)	801 (8.8)	<0.001
20–49	8686 (39.3)	5101 (56.1)	<0.001
>50	2245 (10.2)	1014 (11.2)	0.009
Not recorded	2 (<0.1)	0 (0.0)	NA
Age, years, median (IQR)	19 (12–30)	26 (15–37)	<0.001
Delay in presentation (hours)			
< 1	6445 (29.2)	2350 (25.9)	<0.001
1–6	3087 (14.0)	4275 (47.1)	<0.001
7–24	6011 (27.2)	1694 (18.7)	<0.001
>24	6530 (29.6)	763 (8.4)	<0.001
Not recorded	3 (<0.1)	0 (0.0)	NA
SATS classification			
Green	5283 (23.9)	1709 (18.8)	<0.001
Yellow	10404 (47.1)	4999 (55.0)	<0.001
Orange	5524 (25.0)	2058 (22.7)	<0.001
Red	865 (3.9)	316 (3.5)	0.07
Cause of Trauma			
Violent			
Mines	18 (<0.1)	0 (0.0)	0.007
Gunshot	940 (4.3)	707 (7.8)	<0.001
Bomb	572 (2.6)	0 (0.0)	<0.001
Knife	241 (1.1)	584 (6.4)	<0.001
Assault	783 (3.5)	108 (1.2)	<0.001
Torture	3 (<0.1)	87 (1.0)	<0.001
Accidental			
Traffic	4386 (19.9)	3390 (37.3)	<0.001
Burn	217 (1.0)	6 (0.1)	<0.001
Others	14916 (67.6)	4200 (46.2)	<0.001
Total violent trauma	2552 (11.6)	1486 (16.4)	<0.001
Main diagnosis			
Fracture	8087 (36.6)	4125 (45.4)	<0.001
Dislocation	150 (0.7)	272 (3.0)	<0.001
Sprains and strains	110 (0.5)	242 (2.7)	<0.001
Internal organ injury	1040 (4.7)	245 (2.7)	<0.001
Open wound	8252 (37.4)	2694 (29.7)	<0.001
Contusion or superficial	3095 (14.0)	1315 (14.5)	0.3
Burns	274 (1.2)	13 (0.1)	<0.001
Others	855 (3.9)	154 (1.7)	<0.001
Not recorded	213 (1.0)	22 (0.2)	NA

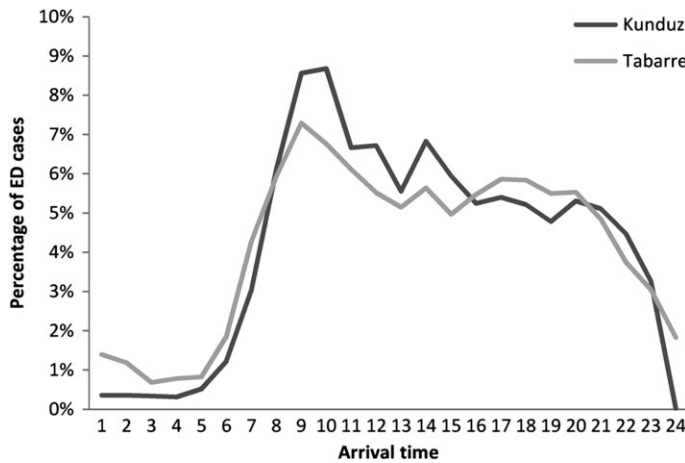
IQR: interquartile range; NA: not applicable; NS: non-significant (level of significance was set at  $p < 0.05$ ); SATS: South African Triage Scale.

<sup>a</sup>  $\chi^2$  test for categorical variables and Wilcoxon rank sum test for continuous variables.

<sup>b</sup> Excluded from further analysis.



**Figure 1.** Emergency department attendance at Kunduz and Tabarre trauma centres, Afghanistan-Haiti 2014. ED: emergency department.



**Figure 2.** Trends in the timing of daily arrivals at the Emergency departments of Kunduz and Tabarre trauma centres, Afghanistan-Haiti 2014. ED: emergency department.

Kunduz, making the comparison of the ‘time to initiation of care’ impossible. There was no mechanism in place to double-check the data entry at project level; nonetheless, involved staff had been previously trained and constant supervision during the process was ensured. The mortality rate was assessed only at ED level; no follow up of patients was made after admission to allow a more in-depth quality analysis of activities.

Sociodemographic characteristics of patients in both settings correlate with those of a population at higher risk of trauma-related incidents, i.e. young adults and especially males, who are more exposed to violence and work-related accidents.<sup>1</sup> In Kunduz, the proportion of male patients was higher than in Tabarre, suggesting that sociocultural behaviours also have an impact on patient characteristics; women in Afghanistan are less exposed as they tend to stay at home and girls are not necessarily attending school.<sup>19</sup>

The observed delays in presentation differed in both settings: almost one-third of cases seen in Kunduz arrived at the hospital more than 24 h after the incident; compared to only 8% in Tabarre. This could be explained by higher insecurity and transport

constraints in Kunduz. Secondly, Kunduz had a wider catchment area, covering the whole province, compared to Tabarre, where patients mainly came from the neighbouring districts in Port-au-Prince.

Despite the violent environment of both settings, accidental trauma was in general more prevalent than violent trauma. Remarkably, the proportion of violent trauma was higher in the urban context of Tabarre compared to the active conflict setting of Kunduz. This may be the consequence of higher on-scene mortality rates linked to active violence (as suggested by the higher proportions of dead on arrival patients in Kunduz) and barriers to accessing care specifically for victims of active conflict in Kunduz. As only facility-based data was used, such patients were missed from the analysis.

Differences in the annual attendance between the two sites can be explained by the more pronounced climate changes in Kunduz; the hot months of April to October seeing a considerably increased caseload. While this observation has commonly been linked to the ‘spring offensive’ of the Taliban fighters, there was no increase in the proportion of violent trauma cases observed in this period. Tabarre, having only minimal variations throughout the year, showed a profound increase in the last 5 months of the year, correlating with the closure of trauma-related activities in Drouillard hospital in Port-au-Prince in July 2014.

The trend of daily attendance in both settings was similar. Both centres’ main peak hours of attendance were between 08:00 and 11:00 h (Figure 3). A study from India showed the same trend and mainly attributed this to the lack of public transport during the night hours.<sup>20</sup> This is likely similar in our settings, although the insecurity factor also plays an important role. Stratifying arrival trends by case severity showed a higher proportion of severe cases during night hours, contrasting with the high proportion of less severe cases during the peak hours of the morning. An explanation could be that less severe cases are more prone to wait at home until the morning. Additionally, traffic accidents are more frequent during the rush hours (06:00 to 09:00 h and 15:00 to 17:00 h).<sup>21</sup>

Target performance indicators values were reached in both settings, with the exception of the over triage rate in Kunduz, which was just above the threshold.<sup>12</sup> This was considered as a minor project failure, as high over triage values indicate being precautionous for the patient; although this may impair the quality of care provided to more severe cases.

The mortality rate in both EDs was extremely low compared to a recent WHO systematic review of EDs in LMICs, which demonstrated a median mortality of 1.8% (IQR 0.2–5.1).<sup>17</sup> Human resource capacity was often exceeded in Kunduz, especially during the peak attendance hours (correlating with both daily rush hours), this being less so in Tabarre. However, physicians’ shifts-planning was not adapted to this which has the potential to lead to patient overcrowding, a common problem in EDs in LMICs and HICs, and reduced quality of care.<sup>20,22</sup> EDs are by their nature often understaffed at certain times and over-staffed at other times. A study conducted in three different EDs in Dhaka, Bangladesh, has shown that staff simulation models can be used to keep this standard error to a minimum.<sup>22</sup>

Some policy implications can be highlighted from this study. As performances and outcomes in the two studied EDs were very similar despite their different settings, we can infer that

**Table 2.** Emergency department (ED) performance indicators and ED outcomes for patients attending the EDs of Kunduz and Tabarre Trauma Centres during 2014

Variable	Kunduz n (%)	Tabarre n (%)	P value <sup>a</sup>
Total	22076	9082	NA
High acuity cases <sup>b</sup>	6389 (28.9)	2374 (26.1)	<0.001
Cases under triaged	131 (2.5)	132 (7.7)	<0.001
Cases over triaged	3557 (55.7)	742 (31.3)	<0.001
Consultant capacity exceeded (hours, out of total annual working hours)	962 (11.0)	291(3.3)	<0.001
Initiation of care within target time			
Red (< 1 min)	ND	247 (81.0)	NA
Orange (< 10 min)	ND	1146 (56.9)	NA
Yellow (< 60 min)	ND	3916 (79.9)	NA
Green (< 240 min)	ND	1646 (98.0)	NA
Not recorded	22076	2127	NA
Length of stay (hours)			
<24	20026 (90.7)	7966 (87.7)	
≥24	281 (1.3)	548 (6.0)	<0.001
Not recorded	1769 (8.0)	568 (6.3)	
ED outcome			
Admitted	2533 (11.5)	2797 (30.8)	< 0.001
Discharged	17622 (79.8)	5936 (65.4)	<0.001
Referred	1631 (7.4)	221 (2.4)	<0.001
LWBS <sup>c</sup>	277 (1.3)	115 (1.3)	NS
Died	13 (0.1) <sup>d</sup>	13 (0.1) <sup>d</sup>	0.019

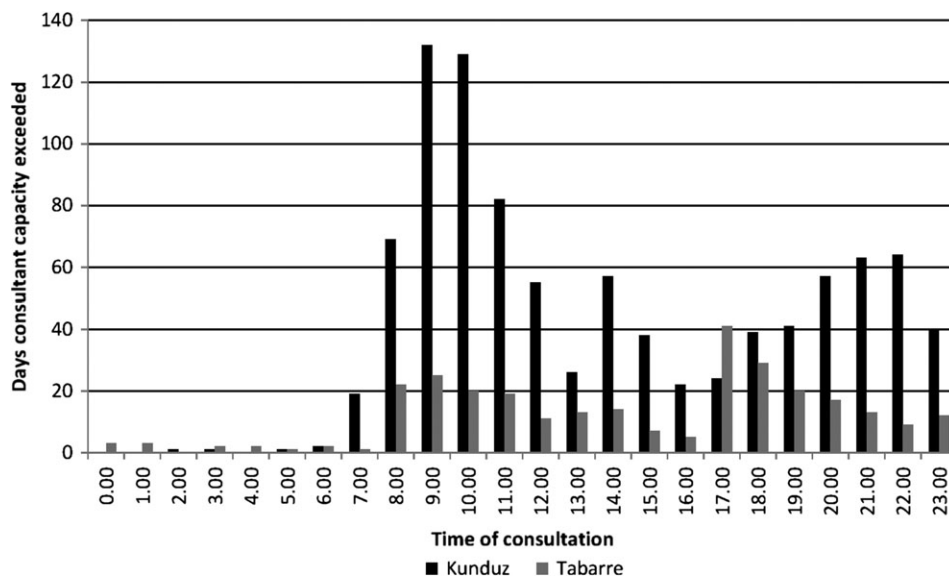
ED: emergency department; ND: no data; NS: non-significant (level of significance was set at  $p < 0.05$ ); NA: not applicable.

<sup>a</sup>  $\chi^2$  test for categorical variables and Wilcoxon rank sum test for continuous variables.

<sup>b</sup> All ED cases triaged as Red or Orange.

<sup>c</sup> Left without being seen.

<sup>d</sup> No deaths were reported for either Yellow or Green cases.



**Figure 3.** Number of days the consultant capacity was exceeded by hour in Kunduz and Tabarre trauma centres, Afghanistan-Haiti, 2014.

future dedicated trauma EDs can follow the same package of care, regardless of their setting. Secondly, flexibility in additional human resources should be foreseen during daily rush hours, to accommodate for the higher patient load. Additionally we recommend that after setting up a new ED, a full analysis be conducted of the first year of data and/or by using staffing simulation models, to ensure appropriate human resource planning adapted to the local context. Lastly, it is recommended to put in place a more sensitive trauma classification to allow a better refined analysis of the context-specific morbidities.

## Conclusion

This is the first study of its kind investigating the use of a standardised package of ED care in different settings. Despite the differences in context, the package of care yielded excellent results in both settings. Initial mapping of the patients' attendance trends, by daily and annual observation of arrivals, is of great importance for future planning of human resource needs.

**Authors' contributions:** PV and MT conceived the study; PV, RVdB, WvdB and KTS designed the study protocol; PV, MT, OG, MN and SC were instrumental in designing and implementing the data tools required for the department and this study and for training staff in their use. BAM, AM and JPC did the data collection, whereas PV and RVdB cleaned the database and conducted analysis. PV, RVdB, WvdB and KTS provided interpretation of this data. PV, RVdB and WvdB drafted the manuscript. PV, RVdB, WvdB, KTS, OG, BAM, MN, SC, AM, JPC and MT all critically revised the manuscript for intellectual content. All authors read and approved the final manuscript. PV is the guarantor of the paper.

**Acknowledgements:** We would like to thank the wonderful staff that worked in both EDs as well as everyone else working for MSF in both countries.

**Funding:** This work was conducted within the routine operations of MSF-OCB, and did not receive additional funding.

**Competing interests:** None declared.

**Ethical approval:** Approval was obtained from the national ethics bodies of both Afghanistan and Haiti. This study met the MSF ethics review board (Geneva, Switzerland) for analysis of routinely collected programme data, and was also approved by the ethics advisory group of the International Union Against Tuberculosis and Lung Disease, Paris, France.

## References

- 1 WHO. Injuries and Violence - The Facts 2014. Geneva: World Health Organization; 2014. [http://www.who.int/violence\\_injury\\_prevention/media/news/2015/Injury\\_violence\\_facts\\_2014/en/](http://www.who.int/violence_injury_prevention/media/news/2015/Injury_violence_facts_2014/en/) [accessed 11 March 2015].
- 2 Murray CJL, Vos T, Lozano R et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:2197–223.
- 3 Higashi H, Barendregt JJ, Kassebaum NJ et al. Burden of injuries avertable by a basic surgical package in low and middle-income regions: a systematic analysis from the Global Burden of Disease 2010 Study. *World J Surg* 2015;39:1–9.
- 4 WHO. Global Status Report on Violence Prevention 2014. Geneva: World Health Organization; 2014. [http://www.who.int/violence\\_injury\\_prevention/violence/status\\_report/2014/en/](http://www.who.int/violence_injury_prevention/violence/status_report/2014/en/) [accessed 30 November 2015].
- 5 Hofman K, Primack A, Keusch G, Hrynkow S. Addressing the growing burden of trauma and injury in low- and middle-income countries. *Am J Public Health* 2005;95:13–7.
- 6 Mock C, Quansah R, Krishnan R et al. Strengthening the prevention and care of injuries worldwide. *Lancet* 2004;363:2172–9.
- 7 Hashmi Z, Haider A, Zafar S et al. Hospital-based trauma quality improvement initiatives: first step toward improving trauma outcomes in the developing world. *J Trauma Acute Care Surg* 2013;75:60–8.
- 8 Thomassen O, Mann C, Mbwana J et al. Emergency medicine in Zanzibar: the effect of system changes in the emergency department. *Int J Emerg Med* 2015;8:22.
- 9 Noordin S, Allana S, Ahmada T et al. Evolution of trauma management at a tertiary care hospital: a cohort study. *Int J Surg* 2011;9:75–8.
- 10 Sunyoto T, Van den Bergh R, Valles P et al. Providing emergency care and assessing a patient triage system in a referral hospital in Somaliland: a cross-sectional study. *BMC Health Serv Res* 2014;14:531–7.
- 11 Luria S, Rivkin G, Avitzour M et al. Comparative outcome of bomb explosion injuries versus high-powered gunshot injuries of the upper extremity in a civilian setting. *Isr Med Assoc J.* 2013;15:148–52.
- 12 American College of Surgeons. Committee on Trauma American College of Surgeons (ACS-COT): Resources for Optimal Care of the Injured Patient. Chicago; American College of Surgeons; 2014.
- 13 Carthaigh N, De Gryse B, Esmati A et al. Patients struggle to access effective health care due to ongoing violence, distance, costs and health service performance in Afghanistan. *Int Health* 2015;7:169–75.
- 14 McLaughlin N, Rogers H. Helping Haiti's transportation issues: increasing Haiti's medical liabilities. *J Glob Health* 2013;3:1–4.
- 15 WHO. Guidelines for trauma quality improvement programmes. Geneva: World Health Organization; 2009.
- 16 Gottschalk SB, Wood D, DeVries S et al. The Cape Triage Score: a new triage system South Africa. Proposal from the Cape Triage Group. *Emerg Med J* 2006;23:149–53.
- 17 Ziad Obermeyer Z, Abujaber S, Makar M et al. Emergency care in 59 low- and middle-income countries: a systematic review. *Bull World Health Organ* 2015;93:577–86.
- 18 Hsia RY, Asch SM, Weiss RE et al. Hospital determinants of emergency department left without being seen rates. *Ann Emerg Med* 2011;58:24–32.
- 19 Samar S, Agil A, Vogel J et al. Towards gender equality in health in Afghanistan. *Glob Public Health* 2014;9(Suppl1):S76–92.
- 20 Tiwari Y, Goel S, Singh A. Arrival time pattern and waiting time distribution of patients in the emergency outpatient department of a tertiary level health care institution of North India. *J Emerg Trauma Shock* 2014;7:160–5.
- 21 De Smet A. Transportation accident analysis and prevention. Nova Science Publishers, Inc. 2008 p253.
- 22 Al-Najjar SM, Ali SH. Staffing and scheduling emergency rooms in two public hospitals: a case study. *Int J Business Admin* 2011;2:137–48.