

# Evaluation of Head and Spinal Cord Injury Care in Ecuador using the IATSIC/WHO Essential Guidelines for Trauma Care

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## ABSTRACT

**Background:** Neurological trauma represents a major cause of global death and disability, with low and middle income countries representing the greatest burden of disease. The goal of this study was to assess the capability of Ecuadorian hospitals to manage head and spinal cord injury utilizing the International Association for Trauma Surgery and Intensive Care (IATSIC) / World Health Organization (WHO) Guidelines for Essential Trauma Care (EsTC).

**Materials and methods:** Site visits were performed at 24 hospitals in 7 provinces of southeastern Ecuador. The 23 human and physical resources required for management of head injury (HI) and spinal injury (SI) were evaluated using EsTC criteria. Resource capabilities were graded as 3 (adequate, >90%), 2 (partially adequate, >50%), 1 (inadequate, <50%), or 0 (absent).

**Results:** Five tertiary (TH) and 12 general (GH) public hospitals were included in the final assessment. Initial assessment of neurological injuries was at least partially adequate for HI (100% TH/GH) and partially adequate for SI (100%TH, 83.3% GH). Maintenance of normotension and oxygenation to prevent secondary neurological injury was partially adequate in TH (100% HI/SI) and inadequate in GH (only 58.3% were partially adequate for HI and 67.7% for SI). Surgical capabilities for treatment of neurological injuries were partially adequate with wide variability in TH. Familiarity or compliance with AANS guidelines and international classification systems for HI and SI were absent at all facilities. CT and MRI capabilities were universally inadequate.

**Conclusion:** Based on WHO/IATSIC EsTC guidelines, significant improvement in physical and human resources is needed for proper management of neurologically injured patients in Southeastern Ecuador.

**Keywords:** Essential trauma care, Traumatic brain injury, WHO guidelines.

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## RESUMEN

**Antecedentes:** El trauma neurológico representa una causa mayor de muerte y discapacidad global, en donde representa la mayor carga de enfermedad en pasises de ingresos bajos y medianos. La meta de este estudio fue la de evaluar la capacidad de manejo de lesiones de cabeza y medula espinal en los hospitales Ecuatorianos utilizando las guías de la

International Association for Trauma Surgery and Intensive Care (IATSIC)/Organización Mundial de la Salud (OMS) del cuidado esencial en trauma (EsTC).

**Métodos:** Se realizó la visita de 24 hospitales en 7 provincias de la zona sureste de Ecuador. Se evaluaron 23 recursos humanos y físicos requeridos para el manejo de lesiones de cabeza (LC) y lesiones de medula espinal (LM) utilizando los criterios de los EsTC. Las capacidades de los recursos fueron evaluados como 3 (adecuado, >90%), 2 (parcialmente adecuado, >50%), 1 (inadecuado, <50%), o 0 (ausente).

**Resultados:** 5 hospitales públicos terciarios (HT) y 12 hospitales generales (HG) fueron incluidos en la evaluación final. La evaluación inicial de lesiones neurológicas fue por lo menos parcialmente adecuada para LC (100% HT/HG) y parcialmente adecuados para LM (100%HT, 83.3% HG). El mantenimiento de una normó tensión y oxigenación para prevenir lesiones neurológica secundaria fue parcialmente adecuada en HT (100% LC/LM) e inadecuada en HG (solo 58.3% fueron parcialmente adecuadas para LC y 67.7% para LM). Las capacidades quirúrgicas para tratamiento fueron parcialmente adecuadas con variaciones extensas en HT. La familiaridad o cumplimiento con las guías de la AANS y clasificaciones internacionales para LC y LM estuvieron ausentas en todas las instalaciones. La TAC y RM fueron universalmente inadecuados.

**Conclusiones:** Basado en guías de la IATSIC/OMS del EsTC, se necesitan mejoras significativas en recursos físicos y humanos para el manejo apropiado de pacientes con heridas neurológicas en el sureste de Ecuador.

**Palabras clave:** Guías esenciales de la atención en el trauma de la OMS, Trauma craneoencefálico (TEC).

## INTRODUCTION

Injury and violence account for an ever-increasing proportion of morbidity and mortality worldwide. Five million people died from injury worldwide in 1990.<sup>1,2</sup> By 2004, 15,000 fatalities a day could be attributed to injury and violence, resulting in 5.8 million deaths per year.<sup>2</sup> The World Health Organization (WHO) predicts that deaths due to injury will increase by 28% before 2030, a trend that continues to be concentrated in low- and middle-income nations (LMICs).<sup>3,4</sup> An associated and more insidious result of this trend is the long-term disability induced by nonfatal injury and violence.

Traumatic head and spinal cord injury represents a subset of diagnoses which are most likely to result in mortality and long-term disability. Traumatic brain injury (TBI) has specifically been implicated as the primary cause in over

half of traumatic deaths.<sup>5</sup> TBI related outcomes result from a variety of causes. Road traffic injuries have been implicated as posing the largest risk, with intentional injuries, falls, other unintentional injuries, and war following behind.<sup>6-8</sup> Historically TBI resulting from road traffic crashes has been most likely to occur in the region of Latin America and the Caribbean.<sup>6</sup> The incidence of TBI is thus likely to rise with the projected increase in road traffic injuries associated with increasingly motorized transport throughout the developing world.<sup>3</sup>

Global public health experts have repeatedly emphasized the preventable nature of injury, but it is wealthier nations that have made the greatest strides to this end.<sup>2</sup> In 2004 the World Health Organization department of injuries and violence prevention teamed up with other partners including the international association for the surgery of trauma and surgical intensive care (IATSI) to create the guidelines for essential trauma care (EsTC).<sup>9</sup> The EsTC guidelines detail the minimum requirements for 260 essential human and physical resources needed to provide care to the injured patient, and represent a form of secondary and tertiary prevention to morbidity and mortality from injury. The EsTC Guidelines provide a structure for evaluating and developing trauma care services within the context of resource poor settings worldwide. Twenty three of the resources identified as essential apply specifically to the care of head and spinal cord injury. The American Association of Neurological Surgeons (AANS) and brain trauma foundation guidelines published in 1996 formed the initial basis for selection and inclusion of these specific resources, with further refinement in subsequent editions.<sup>10-12</sup>

The EsTC guidelines have been validated in diverse international settings as a useful tool for assessing and identifying opportunities for improvement in injury care within LMICs.<sup>13-16</sup> However, few studies have provided a comprehensive assessment of resources available for treating head and spinal cord injury using the EsTC guidelines.

In Ecuador, as with many other LMICs, neurotrauma represents a significant cause of morbidity and mortality.<sup>17</sup> In 2008, 14,395 admissions to hospitals in the 7 southeastern provinces of Ecuador were a result of trauma. Of those, 22.5% were a result of head and spinal cord injury, leading to an annual incidence rate of 163 per 100,000 people.<sup>17</sup> A previous publication highlighted the overall impact of our larger study in this region.<sup>16</sup> In this study, we aimed to assess the regional capability of southeastern Ecuador to assess and manage head and spinal cord injury using the WHO/IATSI EsTC guidelines.

## MATERIALS AND METHODS

Our previous publication describes the methodology by which we conducted our study in more detail.<sup>16</sup>

Southeastern Ecuador was identified as an ideal location in which to assess the preparedness of the health infrastructure to treat head and spinal cord injury. This region contains health facilities ranging from rural health outposts to urban tertiary centers. It is an area undergoing a steady increase in development and urbanization. Previous studies have already emphasized the differences in incidence and presentation of TBI between rural and urban areas, both of which are represented within the 7 provinces that constitute this region.<sup>6,18,19</sup>

Twenty-seven public and private facilities were originally selected to be part of the study, all which receive a fair volume of trauma. These facilities included: Five tertiary hospitals located in the provinces of Azuay, Cañar, El Oro, and Loja; 15 general hospitals in Azuay, Morona-Santiago, Pastaza and Zamora and 7 basic rural clinics in Azuay and Morona-Santiago.

None of the hospitals had a formal institutional review board. Approval for this study was obtained from the Ecuadorian Ministry of Health at the provincial level, the regional president of the Ecuadorian trauma society and all respective hospital directors involved in the study. This study was sponsored and conducted by the Panamerican Trauma Society—Committee on trauma systems. All facilities were given prior notice of the date and time during which the research team would be visiting to conduct the inspection. Additional visits were performed at some facilities during the evening to more adequately assess the resources available during nonworking hours. On-site inspections were completed in 2007 by two members of the research team (MA, FM) and representatives from the Ecuadorian trauma society. Facilities were excluded if staff were unavailable for interviews or to demonstrate functionality of equipment and services.

Assessments were conducted using two modified WHO EsTC Guidelines forms. One form recorded each hospital's size, services, admission statistics, administrative policies and procedures, and its standard protocols for responding to trauma. Results from this survey were presented in a previously published paper.<sup>16</sup> An additional checklist evaluated the 260 human, administrative, and physical resources outlined in the WHO/IATSI EsTC guidelines. For this study, a subset analysis was carried out for the 11 (Table 1) and the 12 (Table 2) EsTC resources dealing with head and spinal cord injuries respectively.

**Table 1: Resources for head injury** <sup>a,b</sup>

Resources	Facility level					
	Tertiary hospitals (n = 5)			General hospitals (n = 12)		
	Resource designation	Absent (0) or inadequate (1)	Partially adequate (2) or adequate (3)	Resource designation	Absent (0) or inadequate (1)	Partially adequate (2) or adequate (3)
Recognize altered consciousness; lateralizing signs, pupils	E	0%	100%	E	0%	100%
Full compliance with AANS guidelines <sup>†</sup> for head injury	D	100%	0%	D	100%	0%
Maintain normotension and oxygenation to prevent secondary brain injury	E	0%	100%	E	41.7%	58.3%
Avoid overhydration in the presence of raised intracranial pressure (with normal BP)	E	40%	60%	E	62.5%	37.5%
Monitoring and treatment of raised ICP	D	80%	20%	D	100%	0%
CT scans	D	80%	20%	D	100%	0%
Burr holes (skill plus drill or other suitable equipment)	E	40%	60%	D	100%	0%
More advanced neurosurgical procedures	D	60%	40%	PR	100%	0%
Surgical treatment of open depressed skull fractures	E	40%	60%	D	100%	0%
Surgical treatment of closed depressed skull fractures	D	40%	60%	PR	100%	0%
Maintenance of requirements for protein and calories	E	20%	80%	E	88.9%	11.1%

<sup>a</sup> Per the WHO/IATSIC guidelines, resources are designation as E (essential), D (desirable), PR (possibly required), or I (irrelevant) as appropriate for a given level of facility

<sup>b</sup> Resources were graded as 3 (adequate, >90%), 2 (partially adequate, >50%), 1 (inadequate, <50%), or 0 (absent)

<sup>†</sup> American Association of Neurological Surgeons

**Table 2: Resources for spinal cord injury** <sup>a,b</sup>

Resources	Facility level					
	Tertiary hospitals (n = 5)			General hospitals (n=12)		
	Resource designation	Absent (0) or inadequate (1)	Partially adequate (2) or adequate (3)	Resource designation	Absent (0) or inadequate (1)	Partially adequate (2) or adequate (3)
Assessment—recognition of presence or risk of spinal injury	E	0%	100%	E	16.7%	83.3%
Immobilization: C-collar, backboard	D	20%	80%	D	33.3%	66.7%
Monitoring of neurological function	E	0%	100%	E	16.7%	83.3%
Assessment by international classification system	E	80%	20%	E	N/A	N/A
Maintain normotension and oxygenation to prevent secondary neurological injury	D	0%	100%	D	33.3%	66.7%
Holistic approach to prevention of complications—especially pressure sores and urinary retention/infection	D	20%	80%	D	33.3%	66.7%
CT scan	E	80%	20%	D	100%	0%
MRI	D	N/A	N/A	PR	N/A	N/A
Full compliance with AANS guidelines <sup>†</sup>	E	100%	0%	D	N/A	N/A
Nonsurgical management of spinal injury (as indicated)	D	20%	80%	PR	75%	25%
Surgical treatment of spinal injury	E	40%	60%	E	N/A	N/A
Surgical treatment of neurological deterioration in the presence of spinal cord compression	E	40%	60%	PR	N/A	N/A

<sup>a</sup> Per the WHO/IATSIC guidelines, resources are designation as E (essential), D (desirable), PR (possibly required), or I (irrelevant) as appropriate for a given level of facility

<sup>b</sup> Resources were graded as 3 (adequate, >90%), 2 (partially adequate, >50%), 1 (inadequate, <50%), or 0 (absent)

<sup>†</sup> American Association of Neurological Surgeons; NA: Not available

Resource capabilities were determined by the research team through interviews with staff at all levels from nursing to surgical specialists, including neurosurgeons if available, as well as through visual and physical inspections. Human resources involving knowledge and skill level were evaluated according to whether or not staff had both received adequate training and felt competent to take care of neurotrauma patients. Physical resources were measured according to their presence, functionality, and whether or not they were able to be provided immediately to those who required them without regard for financial considerations.<sup>9</sup> Resource capabilities were graded according to the principles outlined in the EsTC guidelines. Scores given were 3 (adequate, present >90% of the time), 2 (partially adequate, present >50% of the time), 1 (inadequate, present <50% of the time), or 0 (absent).

## RESULTS

The seven rural clinics assessed in this analysis were excluded due to unavailability of sufficient data on neurotrauma resources. The data from private hospitals were also excluded from the data analysis due to concerns that their additional resource capabilities would provide a biased assessment of overall resource capabilities in this region. The final data analysis thus includes five tertiary hospitals and 12 general public hospitals. All five tertiary hospitals reported having a neurosurgeon on staff, though they were present during the inspection at only 2 of the facilities.

Results of the hospital assessments for 23 resources deemed essential or desirable for recognizing and responding to head and spinal injury are shown in Tables 1 and 2. Percentages reflect the number of hospitals at each level (tertiary or general) in which an individual resource was at least partially adequate or not. Percentages are presented rather than averages to reflect the ordinal nature of the data.

Basic initial assessment of neurological injuries was adequate for head injury and partially adequate for spinal cord injury in both tertiary and general hospitals. However, a more formal utilization of the International Classification System for assessment of head and spinal cord injury, which was deemed as essential at the tertiary hospitals level, was typically absent. In terms of physical resources, use of CT imaging technology to assist in the identification, assessment and management of injury was almost uniformly absent. CT scanners, if present, were frequently broken or nonfunctional due to lack of adequately trained operators. In one large tertiary hospital, the CT scan was operated only between 9 and 11 am. MRI technology was not available for the public sector in this region of Ecuador.

Maintenance of normotension and oxygenation to prevent secondary neurological damage is a critical aspect of head injury and spinal cord management, and was at least partially adequate in most hospitals, particularly at the tertiary level.<sup>20</sup> Proper immobilization of spinal cord also tended to be at least partially adequate, more so at the tertiary level.

However, management beyond the assessment stages revealed greater weaknesses. Monitoring and treatment of raised intracranial pressure (ICP) for head injury appeared to be relatively poor in both tertiary and general hospitals compared to monitoring of neurological function for spinal cord injury, which was generally adequate at both levels. Most was attributed to lack of resources and adequate training in its use. Another potentially preventable complication in the management of head injury is overhydration within the setting of raised ICP, an outcome that only 60% of tertiary hospitals were deemed capable at avoiding while only 37.5% of general hospitals were at least partially adequate at doing so.

A greater discrepancy was noted between tertiary and general hospitals when evaluating surgical capabilities for treatment of neurological injuries. 60% of tertiary proved to be at least partially adequate at performing burr holes and providing surgical treatment in the setting of open and closed skull fractures, spinal injury and neurological deterioration in the context of cord compression, while general hospitals were universally inadequate in this regard. A similar distinction was noted between tertiary and general hospitals in the area of nonsurgical management for spinal cord compression, with 80% of tertiary hospitals measuring at least partially adequate compared to 25% of general hospitals.

## DISCUSSION

Neurotrauma is responsible for a significant amount of morbidity and mortality worldwide, particularly in LMICs.<sup>6,7,21,22</sup> Yet adequate research to evaluate both the incidence of neurotrauma and the readiness of health care facilities to manage it are lacking in these areas.<sup>23</sup> Our study utilized the WHO/IATSI's Guidelines for Essential Trauma Care as a standardized system for evaluating the capabilities of hospitals in Southeastern Ecuador to respond to head and spinal cord injury.

Our results highlight the accomplishments of these facilities in the areas of recognition and initial assessment of head and spinal cord injury as well as prevention of secondary neurological complications. At the tertiary level, these hospitals also demonstrate at least partially adequate availability of surgical treatment including burr holes and



management of skull fractures. The results also highlight areas of weakness, including the employment of international assessment systems for neurotrauma, utilization of medical imaging technology, and prevention of complications. Significant discrepancies were noted between hospitals at the general and tertiary level even for resources (such as nonsurgical management of spinal cord compression) that were identified as essential for both.

It is important to note that though full compliance with the AANS guidelines (an item deemed essential) was absent at all of the hospitals, the inclusion of this resource represents a controversial area of the WHO/IATSIC EsTC guidelines. The AANS guidelines were initially created in 1994 through the sponsorship of the American Association of Neurological Surgeons and Congress of Neurological Surgeons joint section on neurotrauma and critical care.<sup>10,24</sup> Though their effectiveness in reducing morbidity and mortality from neurotrauma has been demonstrated in several community hospitals throughout the United States, they were not designed for and have not been proven to be useful in resource-poor areas of developing nations.<sup>25,26</sup>

However, some 'desirable' elements of the EsTC Guidelines that have been emphasized in AANS communications, such as adequate monitoring and treatment of raised intracranial pressure, can be effectively provided for a manageable cost even in resource limited areas. Raised intracranial pressure is a significant factor in the evolution of secondary brain injury, and can be accurately measured using a ventricular catheter attached to an external gauge for just over \$200.<sup>12,27</sup>

It is important to note the limitations that exist in our study. Results from rural hospitals are not available due to inadequacy of staff to conduct the assessments. Results were not available for all of the resources studied at even the general level hospitals for similar reasons. This occurred despite our provision of advance notice to all facilities of our visit. As many of these hospitals may represent a first line for neurotrauma in the Amazon regions of southeastern Ecuador, it will be important to assess in future studies their resource capabilities in the areas of head and spinal cord injury.

What is missing in our assessment is a comparative data on the burden of disease attributable to neurotrauma generally, in the region and particularly at each facility. The estimates of traumatic brain and spinal cord injury incidence and their long-term impacts are hindered by poor data collection systems internationally, the inability of even good registries to capture the impact of prehospital mortality from neurotrauma, and lack of agreement on terminology and classification of these injuries.<sup>7,9-11</sup> Even the WHO has only recently begun to acknowledge the need to track specific data on TBI. It is likely that the impact of

neurotrauma is far greater than what current data describe.<sup>6</sup> The EsTC guidelines do not address specifically the type and quality of data that is being collected. The survey however, does address the presence or absence of a trauma registry. This was noted in our previous study to be uniformly absent.

## CONCLUSION

Neurotrauma is an important cause of morbidity and mortality worldwide, particularly in LMICs. Low-cost interventions to improve identification and management of head and spinal cord injury exist in the form of the WHO/IATSIC guidelines for essential trauma care. Based on these guidelines, significant improvement in physical and human resources are needed for proper care of neurologically injured patients in the southeastern regions of Ecuador.

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