

# Challenges to the development of the trauma system in Egypt

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## Abstract

Trauma is a hidden disease in Egypt, and its significance on public health has been underestimated for decades. Road traffic accidents are the leading cause of injuries presented to hospitals in Egypt. Trauma systems in developed countries effectively reduced the morbidity and mortality associated with injuries in crowded cities. Developing a trauma system in Egypt is mandatory with the exploding population growth, increasing incidence of injuries, and the vast expansion of the infrastructures in the road network. However, the implementation of the trauma system in Egypt will not be devoid of challenges, including a lack of mandatory health-care infrastructures such as adequate pre-hospital care, poor quality of data, and a shortage of adequately trained emergency physicians across the country.

## Introduction

Trauma has been one of the leading causes of death and disability worldwide; this has been recognized by the World Health Organization (WHO) and several governmental bodies globally, leading to tremendous efforts to implement guidelines and policies

to improve trauma management.<sup>1</sup> Despite an estimated share of 90% of the whole global trauma cases, injuries in low- and middle-income countries (LMIC) have been underreported.<sup>2</sup> In addition, there has been a significant gap in identifying, assessing, and managing injury in these countries, which may contribute to the little research in the literature that highlights the magnitude of the problem in the LMIC.<sup>3</sup> The WHO has recently changed this through its leading efforts to enhance trauma care across the globe, and specifically in the LMIC, to save more than one million lives yearly.<sup>4</sup>

Egypt is one of the LMIC, as classified by the World Bank Group,<sup>5</sup> that has suffered from the negligence of trauma care over the past few decades. The population in Egypt reached more than 100 million in 2020.<sup>6</sup> Recently, the consecutive ministers of health and population grew full attention to developing a trauma system that may save the lives of more than 10,000 victims of road traffic accidents alone.<sup>7</sup> Trauma is a hidden disease in Egypt, with a reported death rate of more than 12,000 annually.<sup>8</sup> Additionally, the number of victims from road traffic accidents in Egypt is probably under-reported if we consider the weak infrastructures, poorly developed transportation system, and low quality of trauma care provided across the country. As a result of urbanization, approximately 44% of the country's population lives in 2 large cities, Cairo and Alexandria, making it the most densely populated area worldwide.<sup>9</sup> This adds to the burden of the exhausted trauma care system, which raises concerns about increased mortality and disability from road traffic accidents in these urban districts in Egypt.

A trauma system is a highly organized, cooperative, and coordinated effort within a specific geographical region where all patients with various grades of trauma receive a maintained quality of healthcare as a part of an integrated public healthcare system.<sup>10</sup> This includes all stages of care, starting from injury prevention to late stages of rehabilitation following an injury. In addition, trauma care must have a multidisciplinary approach that includes all teams from all healthcare staff, comprising pre-hospital care, hospital transfer, physicians of different specialties, theatre availability, interventional radiology, intensive care units, and post-injury rehabilitation.<sup>11</sup> This study's main aim is to highlight the current trauma care situation in Egypt, reviewing the point.

## Methods

We have performed literature research in PubMed, Medline, and EMBASE databases using the key words "trauma in Egypt", "Emergency medicine in Egypt", "Egypt trauma system", "Trauma" and "Egypt". The preferred reporting items for systematic reviews and meta-analysis (PRISMA) guidelines were followed and all articles discussing the management of trauma and emergency medicine in Egypt. Additional reviews from the grey literature, including regional and national conferences for presented abstracts, were included in addition to figures and statistics from trusted national and international organizations such as the Egyptian Central Agency for Public Mobilization and Statistics,

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WHO, and the World Bank. We identified 18 related articles and databases concerned with statistical configurations and studies of the trauma systems in Egypt as demonstrated in the PRISMA flow chart in Figure 1. The results are furtherly divided into 3 categories: strengths that advocated for the implementation of a trauma system in Egypt, challenges and difficulties to the development of the trauma system, while the last subheading discussed the priorities to develop such an inclusive trauma system. Only 10 published peer-reviewed articles addressed the different aspects of trauma care, including the following: i) training in emergency medicine; ii) rate of admissions with trauma; iii) mortality and morbidity rates after trauma in Egypt; iv) evaluation of pre-hospital care and its effectiveness; v) difficulties in triaging and pre-assessment; vi) completeness of trauma patient records (Tables 1 and 2).<sup>7,8,12-19</sup>

### Strengths developed in the Egyptian trauma system

Since its introduction in 1978 by the American College of Surgeons, the advanced trauma life support (ATLS) program has successfully improved patients' outcomes and decreased mortality rate worldwide.<sup>20-22</sup> Hence, the ministry of health and population (MOHP) in Egypt started to grow special attention in the early 2000s for the education of physicians, nurses, and paramedics to gain access to ATLS for all emergency staff. However, these ambitions were slowed down by the poor infrastructure recommended by the ATLS process, implementation costs, and difficulty in adapting it to limited-resource settings. A collaborative study between the MOHP and Dr. John Hirshon from the University of Maryland, USA under the umbrella of the NIH Fogarty Grant, was started in 2006 to introduce an alternative course of ATLS to the emergency medical society in Egypt.<sup>12</sup> Sequential trauma emergency/education programs (STEPS) included basics of trauma care for emergency physicians, including pre-hospital management, initial resuscitation, anesthesia, and surgical management. The course was accredited by the WHO and the Egyptian Board of Emergency Medicine as a part of the curriculum for all emergency physician trainees, with an estimate of 639 students trained for STEPS in the period between 2006 and 2013. These trainees are now leading the national efforts for educating the new emergency staff team.<sup>13</sup> Successfully, STEPS has transitioned the process of trauma care education for high-income countries to low- and middle-income ones. Alternative resuscitation courses were recognized by the Egyptian resuscitation council (ERC), which was officially registered in 2001 to increase awareness about the need to gain basic resuscitation skills.<sup>23</sup> While the European trauma course (ETC), which was introduced in 2009, is the most recognized by the Egyptian Emergency Society due to its flexible, nation-based accustomed advanced trauma care,<sup>24</sup> the ERC continued to provide other resuscitation courses such as prehospital trauma life support (PHTLS), advanced life support (ALS) and basic life support (BLS) to improve the quality of the service provided by emergency staff.

In 2014, Jayaraman concluded that ALS and BLS certification did not improve the overall outcomes of traumatic patients, especially for the ambulance crew.<sup>25</sup> On the other hand, PHTLS certification has been shown to decrease overall pre-hospital mortality when implemented for pre-hospital care staff.<sup>26,27</sup>

In addition, the literature did not provide any evidence for favorable outcomes after ETC implementation. Therefore, further research is needed to determine if the course can improve trauma care in the early hospital setting. The pre-hospital care has undergone revolutionary changes in Egypt over the past decade. In 2013, the Egyptian MOHP started upgrading the ambulance sector with

more than 1200 fully equipped ambulance vehicles, with an estimated 3200 operating high-quality fully equipped ambulance vehicles across the country.<sup>28</sup> This is in addition to the high rescue speed boats and helicopter air transfer. However, the latter is currently fully operated only by military personnel. These efforts aim to relatively decrease transportation time through the typical congested streets of Egypt, which drives most patients and their relatives to find their way to the emergency department. All paramedics receive a mandatory certification of basic and advanced life support even though they are not allowed by MOHP to provide definitive airway management, which negatively impacts the survival rate of traumatized patients. This adds up to the relatively short period of training that paramedics receive.<sup>29</sup>

The WHO guidelines considered training as one of the major components of essential trauma care.<sup>30</sup> The Egyptian fellowship of emergency medicine, which started in 2002, was one of the very first emergency medicine fellowships in the Middle East. It has provided high-quality training based on the British emergency curriculum for more than 350 emergency medicine physicians until 2017.<sup>31</sup> Young Egyptian physicians have widely accepted emergency medicine fellowship as a highly recognizable certificate along with the usual master's academic pathway. The trainees have clinical rotations in different emergency-related clinical specialties throughout different sites, including designated high-volume hospitals of the ministry of health and teaching university hospitals.<sup>15</sup> Main aspects of strengths of trauma in Egypt are highlighted in Figure 2.

### Deficits of trauma care in Egypt

According to the literature review by Gregory in 2018, the time of transportation and transfer of critically traumatized patients to a designated trauma center was the first and most cited reason for a good outcome.<sup>31</sup> Unfortunately, a cross-sectional hospital-based study in one of the busiest university hospitals in Cairo (Ain Shams university hospital) has shown that trauma patients have a delay of more than 3 hours till they reach the emergency department, which violates the concept of the golden hour for the care of trauma patients.<sup>16</sup> Another study by Mostafa *et al.* found that there is an increased mortality rate of up to 14.3% in patients with delayed presentation of more than 2 hours to the emergency department in Suez Canal university hospital.<sup>17</sup> Khalil *et al.*,<sup>18</sup> at Beni-Suef university in Upper Egypt, found that patients over 60 years old and with rural residency were associated with pre-hospital delays of more than 60 minutes, while patients with decreased consciousness levels seem to suffer fewer hospital delays. This is due to the overcrowded streets of large cities, such as Cairo, patients' awareness of the number of ambulance services, and inadequate training of the paramedic crew.

The trauma system in Egypt is not well established; there are no obvious designated trauma centers by the MOHP, rather than small trauma units in the university hospitals throughout the 29 governorates of Egypt, which run under the supervision of the ministry of higher education.<sup>32</sup> In addition, MOHP provides trauma services through their scattered teaching hospitals that are accessible to most of the population, especially those with low socio-economic status.<sup>33,34</sup> On the other hand, the private sector continues to provide high-quality trauma care for unreasonably high payments. This is totally against the concept of the necessity to establish trauma centers and adjunct inclusive trauma system networks, which have proven to decrease the mortality rate in comparison to the non-trauma centers in high-income countries,<sup>35</sup> as illustrated by Staudenmayer *et al.* in 2016 after a national survey in the United

Table 1. Findings of included studies (part 1).

Author / Year	Study Design	Aim	Results	Challenges & Recommendations
Puvanachandra <i>et al.</i> <sup>7</sup> (2013)	Systematic review	Road traffic injuries and data systems in Egypt: addressing the challenges.	<ul style="list-style-type: none"> <li>Hospital-based injury surveillance system implemented</li> <li>International Classification of Diseases (ICD-10) coding</li> </ul>	<ul style="list-style-type: none"> <li>Lack of use of risk factors such as speeding, alcohol, or seat belt.</li> <li>Limited coverage of the surveillance system.</li> <li>Lack of Inclusion of injury severity scores and disability indicators, and standardization</li> </ul>
Mahran <i>et al.</i> <sup>8</sup> (2013)	Descriptive retrospective	To identify the patterns of injury admissions and deaths in the trauma unit in Upper Egypt	<ul style="list-style-type: none"> <li>Less than 30 years (58.4%).</li> <li>Fall injuries (43.6%), then road accidents (31.1%).</li> <li>56.4% of deaths were due to road traffic accidents.</li> </ul>	<ul style="list-style-type: none"> <li>Special attention for young adults as they are more prone to trauma.</li> <li>Prioritize preventive measures for road traffic injuries, falls, and violence.</li> </ul>
Hirshon <sup>12</sup> (2011)	Prospective project	<ul style="list-style-type: none"> <li>Enhance emergency &amp; trauma training</li> <li>Expand training opportunities and research for injury-related research</li> <li>To train a group of health professionals in intensive summer injury research training courses, followed by in-country mentored research activities.</li> </ul>	639 physicians from multiple specialties have taken the 4-day course through the ministry of health and population or public and governmental universities.	<ul style="list-style-type: none"> <li>Meet all ongoing requirements of World Health Organization (WHO) for finalizing our WHO Collaborating center for research and training on injury prevention and management</li> <li>Use current methodologies in trauma resuscitation training</li> <li>To conduct at least two short-term injury related training courses per year</li> <li>Enrolled five trainees per year in the intensive injury research summer/mentored research project long-term training.</li> </ul>
El-shinawi <i>et al.</i> <sup>13</sup> (2015)	Prospective	Create a high-quality, modular, adaptable, and sustainable trauma care course for trauma care physicians in a lower- or middle-income country.	639 physicians from multiple specialties have taken the 4-day course through the ministry of health and population or public and governmental universities.	<ul style="list-style-type: none"> <li>The course transitioned completely to the leadership of Egyptian academic physicians</li> <li>Multiple Egyptian medical schools and the Egyptian emergency medicine board now require sequential trauma emergency/education programs or its equivalent for physicians in training as guidance of competency</li> </ul>
Abbasi <i>et al.</i> <sup>14</sup> (2017)	Descriptive	Highlighting the development and status of trauma and emergency educational programs in Egypt	<ul style="list-style-type: none"> <li>Five emergency medicine educational programs in Egypt based upon the British model of higher degree</li> <li>The Egyptian fellowship program is the largest and most acceptable</li> <li>350 specialists graduated with around 50 registered consultants.</li> </ul>	<ul style="list-style-type: none"> <li>Despite the fast-growing emergency medicine specialty, Egypt still needs an urgent well-structured system supported by the ministry of health.</li> <li>Need further attention for the Egyptian society of emergency medicine and holding regional and international emergency medicine conferences as AFEM</li> </ul>



Table 2. Continued findings of selected studies (part 2).

Author / Year	Study Design	Aim	Strengths	Challenges & Recommendations
Mohamed <i>et al.</i> <sup>15</sup> (2020)	Review	Outline the development of emergency medicine in Egypt, including infrastructure, education, specialty certification, and future challenges	<p>Outline the following:</p> <ul style="list-style-type: none"> <li>Hospital systems</li> <li>The prehospital system</li> <li>Evolution of the specialty of emergency medicine</li> <li>Training and education</li> <li>Collaborative resuscitation training efforts</li> <li>Emergency departments</li> <li>Societies and organization</li> </ul>	<ul style="list-style-type: none"> <li>Address challenges: "brain drain"; immigration of highly qualified emergency physicians in addition to low salaries offered to specialists.</li> <li>Consistent and balanced education for trainees including standardization of the training experience across institutions, and greater oversight.</li> <li>Increased support for emergency medicine research critical.</li> <li>Lack of reliable data sources for emergency patient such as trauma or cardiac arrest registries.</li> </ul>
Saleh <i>et al.</i> <sup>16</sup> (2017)	Cross-sectional	<ul style="list-style-type: none"> <li>To measure the time interval between injury and presentation to the emergency department of university hospitals</li> <li>To identify possible causes of these delays.</li> </ul>	<ul style="list-style-type: none"> <li>The average reported transport time for patients from injury to hospital arrival was 3.8 hours, while the mean ambulance response time was 45 minutes</li> <li>Referral from other hospitals was revealed to be a significant cause of delay (<math>P=0.004</math>), while ignorance of the local ambulance phone number couldn't be confirmed as a cause (<math>P=0.2</math>)</li> </ul>	<ul style="list-style-type: none"> <li>The additional nationwide analysis is needed to establish the clear causation or association of these causes with the delay intervals.</li> <li>Hospital-to-hospital pathway for hospital-to-hospital transfer and improve ambulance services and compliance</li> </ul>
Mostafa <i>et al.</i> <sup>17</sup> (2016)	Descriptive	Evaluation of the effectiveness of pre-hospital management of adult polytraumatized patients in a university hospital	<ul style="list-style-type: none"> <li>Arrival delay is strongly related to the percent of mortality, as it was 14.3% with time arrival &gt;2 hours.</li> <li>30% higher in emergencies arriving from rural areas</li> </ul>	Prominent relationship between number of mortality and absence, ineffective or delayed pre-hospital care for adult polytrauma patients.
Khalil <i>et al.</i> <sup>18</sup> (2021)	Cross-sectional	To assess the factors affecting the prehospital time delay of the injured patients arriving at the emergency department.	The prehospital time delay (>one hour) of the injured patients was positively associated with age >60 years and rural residence but inversely associated with consciousness level.	The prehospital time delay of the injured patients arriving at the emergency department was associated with old age, rural residence, and consciousness level.
Al-Teheawy <i>et al.</i> <sup>19</sup> (2016)	Observational	Evaluate the timeliness of the emergency room cycle time which is measured from patient registration to patient disposition in a tertiary hospital in Egypt.	<ul style="list-style-type: none"> <li>The time to physician assessment in different categories of patient severity by the Canadian triage and acuity scale (CTAS) was noted to meet the target duration for each category of the CTAS.</li> <li>The longest phase was the initial physician assessment with a median of 16 minutes and an interquartile range of 47 minutes.</li> </ul>	Hospitals should start developing triage systems and should keep their excellent performance in keeping the timeframe for different Canadian triage and acuity scale categories patients in line with the recommended durations

States demonstrating lower mortality rate in trauma centers 7.6% versus 9.5% in non-trauma hospitals.<sup>36</sup> The lack of an appropriate trauma system and verification of trauma centers in Egypt will continue to affect the mortality of traumatized patients. The deficiency of completed trauma medical records was demonstrated by Mohammed *et al.* in a study reviewing 539 medical records for trauma patients at Beni-Suef university.<sup>37</sup> The study clearly showed significant defects in 4 studied criteria, including demographic data, administrative fields, clinical description of injury, and the casualty event, which was concluded to be inadequate for developing trauma registry data.

Communication between the emergency medical services (EMS) and the hospital or between 2 different hospitals has been proven to be crucial in an effective trauma system; this is questionable due to the lack of proper training of the EMS and hospital personnel to have an effective communication before the arrival of the patient to the emergency department or during the transfer of the patients between different hospital via ambulance crew. There is no formal unified triage system in emergency departments across the Egyptian hospitals of the ministry of health and population. Usually, it is a station where a single general physician is responsible for predicting the severity of the cases upon registration. Multiple injury scores have been undertaken in different hospitals.<sup>15</sup> A single study of the triaging system in a single non-trauma hospital in Cairo showed the efficiency of Canadian triage and acuity scale with time to initial physician assessment noted to meet the target ones worldwide.<sup>37</sup>

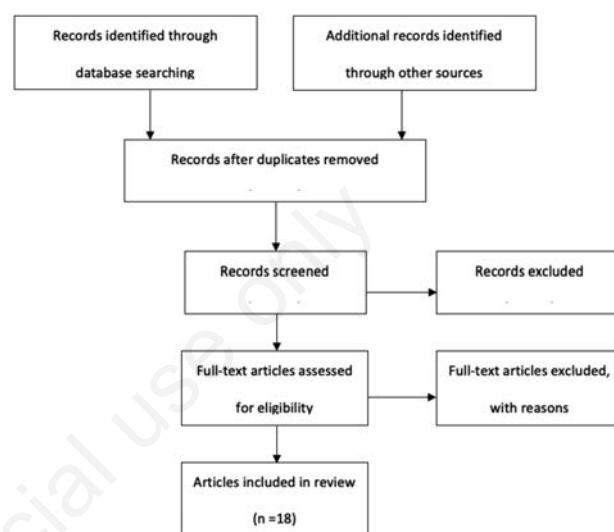
From the training perspective, and despite the efforts made to enhance emergency and trauma training *via* the formal Egyptian fellowship and masters' pathways, the number of graduated emergency and trauma physicians remains very low to meet the needs of the 100 million population.<sup>14</sup> In addition, most of the graduated trainees are allocated at the large university hospitals within the large cities, mostly in Cairo, with an inappropriate distribution of physicians over the Egyptian governorates, where there is a lack of trauma service provided in comparison with the capital. This might also negatively impact any implementation of an effective trauma system. Challenges are outlined in Figure 3.

## Priorities of trauma care development in Egypt

Preventing the majority of incidents that are likely to be preventable is one of the top priorities to enhance trauma services in Egypt. Mahran *et al.* demonstrated that more than half of the deaths of injured patients presented to an emergency department in upper Egypt were due to transportation injuries.<sup>10</sup> Road traffic accidents have a fatality rate of 42 deaths per 100,000 population, considered one of the highest in the Middle East and worldwide.<sup>34</sup> That adds to the burden of the exhausted trauma system and the population's overall health. Recently, there has been an exceptional development of road infrastructures in addition to a newly developed network of highways that have soared the ranking of Egypt's road quality up to 28<sup>th</sup> globally compared to the 118<sup>th</sup> in the previous years.<sup>38</sup> However, these efforts might not benefit the healthcare system as the safety measures across the roads are still relatively low, which mandates the enforcement of traffic laws for drivers across Egyptian roads. Through his review, Wong *et al.* have prioritized 12 essential criteria for developing a functioning trauma center in an LMIC suitable for urgent resuscitation of traumatized patients.<sup>39</sup> These included the availability of laparotomy services, endotracheal intubation, cricothyroidotomy, tracheostomy, chest tube equipment, and accessibility of blood products.

The Egyptian ministry of health should create a plan to imple-

ment a trauma system through which all efforts can be combined. The hub and spoke model of the London major trauma system should be a role model to implement a similar system that can accommodate the trauma burden in the busy capital of Egypt.<sup>40</sup> Trauma units will serve the purpose of dealing with trauma patients who don't have potentially life or limb-threatening injuries. Also, trauma units can accommodate trauma patients who do not necessarily need a multidisciplinary team approach. The designated major trauma centers should provide all the mandatory equipment and facilities to provide special care for severely trau-



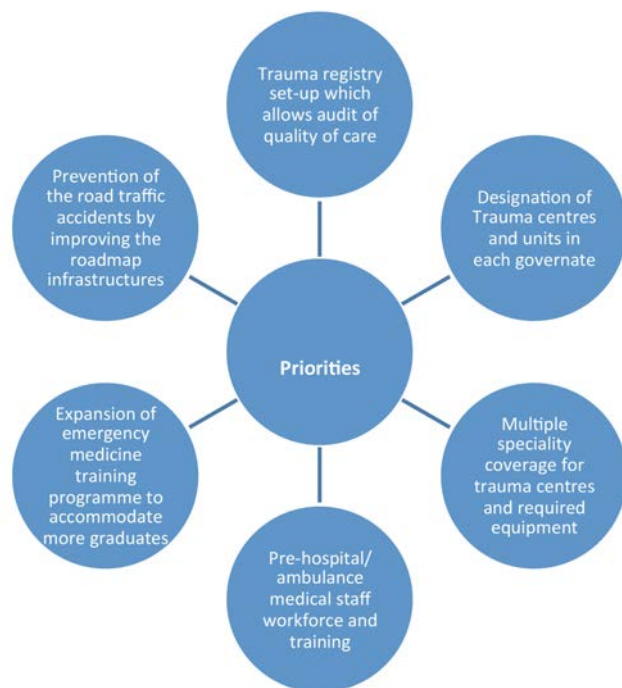
**Figure 1.** Preferred reporting items for systematic reviews and meta-analyses flow diagram for the selection of the studies.



**Figure 2.** Strengths of trauma and emergency medicine in Egypt. MSc, master of sciences; STEPS, sequential trauma emergency/education programs; ATLS, advanced trauma life support.



**Figure 3.** Challenges of the trauma system in Egypt.



**Figure 4. Priorities in developing a trauma system.**

matized patients. In addition, clinical multi-specialty coverage should be available 24 hours a week with adequate staffing to maintain high-quality care and to face the burden of trauma cases expected to flow to the designated major trauma centers. The burden relies on Cairo to develop its trauma network, which should be composed of at least 4 major trauma centers to accommodate the presenting injuries of its massive population. Quality data is required across all Egyptian hospitals to accurately assess the burden of trauma and injuries on the public health system. Developing an electronic trauma registry where all the data of patient's demographics, clinical condition, and reporting casualty input is mandatory for assessing injuries aiming for better clinical care, and implementing primary and secondary prevention plans. The main priorities are listed in Figure 4.

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