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# Trauma systems are associated with increased level 3 trauma centers



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## ABSTRACT

**Background:** State-supported trauma systems have a proven association with improved mortality, but to date, there are no data reported on what mechanism leads to this benefit. Our hypothesis is that trauma systems with funding support are associated with increased number of trauma centers (TCs).

**Materials and methods:** A retrospective population study: data for the number of American College of Surgeons–verified adult TCs in 2010 were obtained from the American College of Surgeons and for state-designated TCs from state departments of health. Population and gross domestic product (GDP) were obtained from the US Census. The main outcome measure was the number of TCs per population and per GDP. Statistical analysis was carried out using the Mann–Whitney *U*-test and Poisson regression.

**Results:** There was no association between a trauma system and the numbers of level 1 or 2 centers. In states with funded trauma systems, the numbers of level 3 centers per GDP and per million state population were  $4.76 \pm 2.37/\$100$  billion and  $1.77 \pm 0.51/\text{million people}$  compared with  $0.72 \pm 1.72/\$100$  billion and  $0.28 \pm 0.60/\text{million people}$  for unfunded states ( $P < 0.05$ ). Poisson multivariate regression identified system funding as an independent predictor of number of level 3 centers.

**Conclusions:** Our study shows that the number of level 3 TCs significantly and independently correlated with the presence of a funded trauma system. The number of level 1 and 2 centers showed no such correlation. Further study will determine if increased number of level 3 centers leads to improved clinical outcome.

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## 1. Introduction

Each year traumatic injuries account for 42 million emergency department visits and two million hospital admissions with an

economic burden of 406 billion US dollars [1,2], which includes health care costs and lost patient productivity. Early triage of severely injured trauma victims has an important impact on the mortality and functional recovery. To this end, American

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communities have developed municipal or statewide trauma systems, which are organizations charged with the development of Emergency Medical Services, certification of trauma care centers, and maintaining outcome data [3,4]. Statewide systems and national implementation have developed rapidly for more than the past 20 years. Currently 42 states have statewide trauma systems [5,6]. However, trauma systems are not standardized across the nation. Some trauma systems accredit trauma centers (TCs) and monitor compliance with treatment and resource allocation protocols, others do not; some trauma systems are a branch of the state's Department of Health, others operate as public nonprofit organizations, and some operate without state funds at all; some states maintain a Data Registry for clinical outcomes, others keep no statewide record [7]. There are states, such as New York that maintain Trauma Registries that report outcome data to a State Trauma Committee, without designating or monitoring TCs. As of 2010, eight states still operated without statewide trauma systems [8].

Funding for the implementation of trauma systems has been provided from Federal grants through several different acts such as the Trauma Systems Planning and Development Act of 1990. However, funding has not remained consistent and many states have developed their own means of funding these systems. Only 24 of the states in the US have state funding in place; the remaining 26 provide for the trauma system without public funds or have no system at all [8]. Inhomogeneity in the trauma systems may lead to disparate access to trauma care among the states. To date there has been no investigation of the influence of trauma system funding has on the delivery of trauma care or the composition of the state health care system.

Level 3 TCs (L3TCs) provide initial triage and stabilization for severely injured patients, provide definite care for the noncritically injured, and represent the portal of entry into trauma care and identification of patients as trauma victims. Studies have demonstrated that patients initially evaluated and stabilized at L3TCs have improved outcomes compared with patients managed at or transferred from undesignated hospitals. In addition, it has been shown that data collection is more complete and accurate in patients transferred from L3TCs compared with undesignated hospitals [9,10]. Thus, L3TCs provide measurable clinical benefits in triage, stabilization, management, and referral of trauma patients; thus, the L3TCs provide higher quality of care than lower level and undesignated hospitals and are useful as a marker for the quality of a trauma system. The aim of our study is to examine the association of the presence of a trauma system, with and without funding, on the number of L3TCs in the state on a per capita and per gross domestic product (GDP) dollar basis. We hypothesize that the presence of a funded state trauma system is associated with an increased number of L3TCs, which may reflect a higher quality of those systems.

## 2. Materials and methods

### 2.1. Data sources

This study was a retrospective review of population data obtained from the 2010 US Census [11], including state

population and state GDP. The year 2010 was chosen for the study year, as this is the most recent official US census, and the most complete and accurate population and GDP data are for that year. Trauma systems information (type of funding and scope of function) was obtained from the American College of Surgeons Committee on Trauma (ACS-COT) website [8] and from the 50 state departments of health (or other organizational departments charged with trauma policy in the state). The definition of a trauma system used for this study was from the ACS-COT Trauma System Evaluation and Planning Committee [12], "A lead trauma agency and to plan, develop, maintain, and evaluate the trauma system during all phases of care." The ACS-COT website also provided number of ACS-COT verified TCs. The 50 state departments of health were queried by Web to obtain the number of officially state-designated TCs. All the TC data examined in the study are from the year 2010 to correlate with US Census figures.

The Centers for Disease Control's WISQARS (Web-based Injury Statistics Query and Reporting System), an online public database [13], was used to compile age-adjusted fatal injury statistics per state in 2010.

### 2.2. Population

This analysis included only adult TCs in the 50 states of the USA. Pediatric-only TCs were excluded from analysis, and mixed centers were counted as adult centers for the purpose of analysis.

### 2.3. Variables

Population variables were US Census residents per state and state GDP. Numbers of L1TCs, L2TCs, and L3TCs were the study variables. Level 4 and higher centers were excluded. A TC was defined as any hospital that had received a designation from its home state or from ACS-COT as meeting the state or ACS requirements for the corresponding level of trauma care. The ACS-COT and individual state requirements are variable, but similar.

### 2.4. Statistical analysis

State totals of level 1, 2, and 3 centers (ACS-COT verified, state-designated, or both) were tallied and then grouped into funded and unfunded categories. Those states in the funded category had reported a state budget, contract, or grant within 1 year of 2010; those states in the unfunded category reported no support or did not have a statewide trauma system. These figures were indexed to the state population and to the state GDP. Study variables were compared using the Mann–Whitney *U*-test;  $P < 0.05$  was considered significant. Poisson multiple regression analysis was used to determine independent association. Analysis was conducted using SAS 9.3 (Copyright [c] 2002–2010 by SAS Institute Inc, Cary, NC) and SigmaPlot 12.5 (Copyright [c] 2010 Systat Software, Inc, San Jose, CA). This study was approved by the Harvard Medical School Human Research Committee.

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