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The Efficacy of the Regionalized Trauma Center in Decreasing Mortality in the Trauma Patient

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The Efficacy of the Regionalized Trauma Center in Decreasing Mortality in the Trauma Patient

Abstract
Background: Through the years injury mortality in the trauma patient has come more into focus and not necessarily in a good way. The question has always remained have we, as providers, offered the best care in a timely, appropriate manner, and in the appropriate setting?

Objective: To search and evaluate articles from the past 16 years in regards to pre and post implementation of regionalized trauma centers. To then evaluate if there is, or has been, any significant reduction in mortality associated with that implementation.

Methods: An exhaustive search of available medical literature with a focus on pre and post implementation of a regional trauma system or center. Mortality needed to be a focus, or part of the discussion, to gain entrance into the articles used.

Results: Nine articles were included in the final paper. The results were varied in their significance however, all the articles showed a decrease in mortality after the implementation of a regional trauma center. With the highest significance noted with the articles that focused on regional trauma centers in Canada.

Conclusion: It appears from reading the 9 articles that were included in the paper as well as articles not, that the conclusion was that there was in fact a significant decrease in patient mortality post implementation of a regional trauma center. However, most articles were directed at urban centers where transport time was less, and a higher level of care was available to the patient, delivering a higher level of intervention sooner.

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The Efficacy of the Regionalized Trauma Center in Decreasing Mortality in the Trauma Patient

Jennifer Martin PAC

A Clinical Graduate Project Submitted to the Faculty of the School of Physician Assistant Studies

Pacific University

Hillsboro, OR

For the Masters of Science Degree, December 2009

Faculty Advisor: Professor Sommers MS, PAC
Clinical Graduate Project Coordinators: Annjanette Sommers MS, PAC & Rob Rosenow PharmD, OD
Jennifer Martin is a native of Alaska where she grew up as the child of two over educated parents. Instilled with the desire to learn, it has become a life long passion. After spending 11 years being a paramedic Jennifer finally felt prepared to move forward in her medical career as a Physician Assistant. She was lucky enough to be admitted to the second oldest program in the United States. There, she flourished under the guidance of her professors, after two very interesting and challenging years Jennifer started working in the emergency room as a Physician Assistant. Though for a time she was fulfilled, she realized that she needed and wanted more, and after spending several years as a PAC, she felt the need and the desire to continue on with her studies. In a moment of weakness, not necessarily a bad thing, she decided to dive into a new 2 year residency program offered at Pacific University. Hence the new beginning of her life, and now those two years of her life have come to an end. She knows not where she goes, but she knows where she has been. Though it has been a rocky road it is one that she is glad she traveled.
Abstract

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**Keywords:** Decreased Mortality, Pre/Post Implementation, Trauma Systems, Trauma Centers, Rural Trauma Centers, Urban Trauma Centers.
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To Dr. William Long, with his tireless desire to teach and reach out to those who are in search of themselves and the pot of gold at the end of the rainbow. You are a tireless teacher, wonderful mentor, surrogate father, and kind soul. Your hard work, determination, and fortitude will forever go down in the history of trauma education, long past the day that God takes you home.

To my parents: Thank you for helping me to succeed and for supporting me when I began to question why I was putting myself through this much work. The end is worth it again. I promise to you though this will be the last time, well maybe. I love you more than words can express.
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Table 1: Characteristics of Review Articles

List of Abbreviations

TBI……………………………………………………………………...…Traumatic Brain Injury

ISS................................................................................................................ Injury Severity Score

GCS………………………………………………………………………..Glasgow Coma Scale

AVPU……………………………………………………………… Alert, Voice, Pain, Unresponsive

HDI……………………………………………………………………….. Hospital Discharge Service

TRISS………………………………………………………………Trauma and Injury Severity Score

DOA………………………………………………………………………….Dead on Arrival

ED…………………………………………………………………………….Emergency Department

OR..........................................................................................................Odds Ratio

CI........................................................................................................Confidence Ratio
The Efficacy of the Regionalized Trauma Center in Decreasing Mortality in the Trauma Patient

INTRODUCTION

Prior to 1970, funeral homes were primarily responsible for getting "victims" from the scene of an emergency to the hospital. The personnel had no training and minimal equipment. With the publication of "Death in a Ditch" and "Accidental Death and Disability: the neglected disease of modern society" also known as the White Paper was written in 1966 by the National Academy of Science, it was recognized that inadequate training of ambulance attendants may have caused unnecessary death and disability. ¹

These same publications also brought to the forefront, the reality of high death rates associated with trauma related injuries. Emergency room and trauma surgeons started to talk amongst themselves and started brainstorming on how to decrease the high death rates. With those ongoing discussions taking place, the designated Trauma Center was born. Though trauma always has been a leading cause of death, it has, over the past 3 decades, become a central topic in medical conversations.² More and more research and time has been invested in trying to determine how we, as providers, can decrease the mortality associated with trauma. The Rural Preventable Mortality Study, conducted by the Critical Illness and Trauma Foundation, demonstrated that, absence of a trauma system, was resulting in preventable trauma-related deaths.³ The hope was to build a system that would streamline all critical trauma patients to a center where all the patient’s
needs could be met at one time, thus increasing the save rate and decreasing the mortality outcomes associated with trauma related injuries.²

**BACKGROUND**

Injury related research conducted following the Viet Nam war, demonstrated that the civilian application of principles learned from the military management of trauma, can significantly reduce injury related morbidity and mortality. Concentrating trauma care in specialized facilities where multiple, coordinated services are immediately available is essential to achieving optimal outcomes for these patients. Without an organized, consistent approach to the trauma patient, and personal necessary to assess and treat the injury victim, will be absent or slow to respond, making diagnosis and treatment haphazard, uncoordinated, and at times ineffective.²

After a while this research and the discussions led those involved in the front lines of treating trauma, to consider and ponder if there was a better way to serve the community when it came to trauma, and if so just how one would go about it. Hence the conception and the so called birth of the Trauma System along with the concept of utilizing and establishing designated Trauma Centers that could care for patients as a whole.¹

A systematic approach to trauma care provides the best means to protect the public from premature death and prolonged disability. A trauma care system reduces death and disability by identifying the causes of injury and promoting activities to prevent initial injury from occurring, and assuring that the required emergency medical resources are available, and the necessary infrastructure in place, to deliver the "right" patient to the "right" hospital. These thoughts and discoveries lead to the implementation of different
levels of hospitals depending on their hospitals, ability to provide a certain level of care
to the trauma patient in a timely manner. The results are as follows:

**Level I**
Level I trauma centers have an organized trauma response and are required to provide
total care for every aspect of injury, from prevention through rehabilitation. These
facilities must have adequate depth of resources and personnel with the capability of
providing leadership, education, research, and system planning.

**Level II**
Level II trauma centers have an organized trauma response and are also expected to
provide initial definitive care, regardless of the severity of injury. The specialty
requirements may be fulfilled by on call staff that is promptly available to the patient.
Due to limited resources, Level II centers may have to transfer more complex injuries to a
Level I center. Level II centers should also take on responsibility for education and
system leadership within their region.

**Level III**
Level III trauma centers, through an organized trauma response, can provide prompt
assessment, resuscitation, stabilization, emergency operations and also arrange for the
transfer of the patient to a facility that can provide definitive trauma care. Level III
centers should also take on responsibility for education and system leadership within their
region.
Patients are entered into and transported to designated trauma centers depending on the severity of their injuries upon initial assessment by either highly trained pre-hospital providers, or an emergency doctor upon arrival at a lower level trauma hospital.  

METHODS

A detailed search of the published literature was done using the online systems Pub Med, Medline. No search time schedule was used however, the articles that are included in this paper span nearly 14 years were published in English between 1994 and 2009. The search string used to identify the appropriate literature involved using keywords such as: Decreased Mortality, Pre/Post Implementation, Trauma Systems, Trauma Centers, Rural Trauma Centers, and Urban Trauma Centers were used. Each of the articles needed to contain information that pertained to the question of whether there was a decrease in mortality associated with the implementation of a regional or direct trauma system. Most articles included data from a pre and post perspective. The articles included in this review are a mixture of retrospective cohort studies, cohort, and prospective studies. A total 9 articles and one online site were used for the review material. (see Table 1)

RESULTS

Article One

Mann et al ⁴ is a retrospective cohort study assessing injury mortality through 30 days after hospital discharge. A total of 940 patients were included in the study group.
Pre-trauma centers 3 years (1985-1987) and 3 years following each hospital’s trauma system designation (post-trauma system years [1990-1994]) were included in the study. Included in the study were data from 9 years, 3 years pre the development of the trauma center to 3 years post development, with 3 years additional treatment years between covering a total period of 1985-1994. High mortality injuries with significant potential for morbidity and mortality were chosen. The statewide hospital discharge database was used to gather data and those patients ICD-9 codes that fit the index injuries were used. Injury Severity Score (ISS), Glasgow Coma Score (GCS) as well as Alert, Verbal, Pain, Unresponsive (AVPU) were used to demonstrate the level of acuity into which the patients fit.4

The study concluded that Oregon has demonstrated an approximate 20% reduction in mortality risk among the severely injured with implementation of a statewide trauma system. It was found that, although these low population density regions represent a small proportion of the total population of the state vital statistics data confirms that injury related deaths are excessive in the remote rural counties.4

Vital statistics data allow them to extend the window of investigation up to 9 years after the hospital designation within the Oregon Trauma system. Figure 1 indicates that the injury death rates did decrease significantly (p=0.001), during the 9 year time frame, supporting the claim that the investigation may have been premature and that more data could have revealed a survival benefit was realized among remote rural trauma canters in later years.4

Article Two
Bowman et al$^5$ was a retrospective study using discharge administrative data from 1998-2003. Patients selected had traumatic injuries that were hospitalized and brought to a rural hospital with traumatic injuries. The focus was on small, rural hospitals, excluded hospitals were excluded if they had more than 1,500 discharges a year. According to the study rural residents are 50% more likely to die from trauma than urban resident. They identified a total of 9,950 hospitalizations with injuries among small, rural hospitals. There were 333 in-hospital deaths representing 3.5% of injury hospitalizations. In the lowest-volume hospitals (fewer that 500 total discharges per year), patients were more likely to die in non-designated hospitals than in trauma designated hospitals (OR 2.35%, (5%CI 1.25-4.41, P=0.008).$^5$

**Article Three**

Tiesman et al$^6$ is a retrospective analysis of an injured cohort, to assess Traumatic Brain Injury (TBI) survival before and after the implementation of a trauma system. The main objective of this study was to examine how the implementation of the trauma system affected the triage and in-hospital mortality of TBI, patients. Timely arrival at definitive care is critical for patients with TBI since secondary damage can occur in the hours following an injury event.$^6$

The major outcomes considered were mortality in the Emergency Department (ED), mortality within the first 72 hours, mortality within the first 30 days, and the mortality during hospitalization. The effects of the trauma system on mortality and discharge outcomes were compared between pre- and post-system years. They found the decrease in mortality to be almost immediate. Outcomes of the study showed that the
most severe TBI patients GCS 3-5 experienced a significant decrease in mortality within 72 hours after the trauma system was implemented (decrease of mortality in transfers from 42% to 29%, p=0.007; decrease of mortality in non-transfers 65%-42%, p<0.0001). These decreases were statistically significant. It was concluded that the Iowa Trauma System was successful in getting the more severely injured patients to level 1 and 2 hospitals, where optimal care is immediately available.6

Article Four

In a retrospective study by Mullins et al7 it was found that in hospitals that are not designated trauma centers 20-40% of fatalities could have been prevented with optimal care. Four urban counties in the state of Oregon that constitute metropolitan Portland and its suburbs were used in the study groups. Most data for analyses were obtained from the Oregon Hospital Discharge Index (HDI).7

The goals of the analyses were (1) to examine where a severely injured patient dies after institution of the trauma system (decedent analysis) and (2) to examine whether survival of the injured patients changed over time with institution of the trauma system (outcome analysis). They compared three periods of 2 years’ duration, each before the trauma system, (Jan 1984 through Dec 1985); the transition period (Jan 1986 through Dec 1987); when patients entered into the trauma system were transported to one of the 5 trauma centers; and after establishment of the current trauma system (Jan 1990 though De 1991), when trauma system patients were transported to, one of two, level 1 trauma centers. However, for all hospitalized injured patients in the region with an ISS of 16 or greater, the adjusted risk of death was lower in the 1990 and 1991 compared with the two
earlier periods. Also for hospitalized injured children in the region, the adjusted risk of
death was lower in 1990 and 1991 compared to the two earlier periods. \(^7\)

**Article Five**

In this study by Ursic et al\(^8\) all data were collected prospectively and analyzed
retrospectively using SGPH computerized trauma patient registry, maintained since 1991
by the hospitals trauma registry data manager. This study compares demographic and
patient outcomes variables of two 18 month time periods, before, and after formation of a
dedicated trauma service at the St. George Hospital on 1 November 2003.\(^8\)

The overall mortality rate for patients admitted during the pre group was 3.5%
while that of the post Group was 2.5%. This difference was not statistically significant.
However, there was a statistically significant reduction in death rate of 8% for patients
with more severe injuries, as defined by as ISS rate >15, in the post groups as compared
to the pre group (12.2% and 20.2% respectively, p=0.007). The results of the study
showed a decrease in mortality of the severely injured patient.\(^8\)

**Article Six**

Looking again at the Oregon trauma system, Mullins et al\(^8\) analyzed the data was
to determine whether its implementation influenced the outcomes of hospitalized injured
patients throughout the state. One of the things looked at was to whether risk of death for
patients with index injuries declined. To accomplish this task, they selected data on
hospitalized injured patients obtained from the Oregon Hospital Discharge Index (HDI)
for analysis.\(^9\)
To calculate whether risk-adjusted death rates for injured patients differed after the statewide trauma system was established compared to patients treated before implementation it was noted that the statewide trauma system implementation was also associated with a decline in the risk of death for injured patients. The reduction in the risk of death was seen statewide. It was determined that after the trauma system was implemented, better care of injured patients with survivable injuries accounted for a reduction in preventable deaths.⁹

During the 8 years from 1985-1993, the population of the state increased. In the four-county Portland metropolitan area the population grew from 111,114,100 to 1,306,800. In the other Oregon counties, the population increased from 1,561,700 to 1,700,700. Both Portland metro area patients and patients from counties in the remainder of the state showed no significant difference in the “not-in-hospital” deaths during the time period 1985-1993. During the same period, “in-hospital” and “emergency department” deaths showed significant reductions (p<0.05) both in the Portland area and in the remainder of the state.⁹

**Article Seven**

Data was collected prospectively before and during the introduction of the program by Simons et al¹⁰. Data are presented in annualized form (for 1996 and 1997) or by quarter. Comparisons between post-program introduction data to pre-program performance were made by using analysis of variance within significance set at a p value of less that 0.05 and denoted by asterisk. Vancouver General Hospital (VGH) had no coordinated trauma services prior to July 1996. In July of 1996, they established a clinical
trauma service. Data was concurrently collected by the hospital administration, the trauma program manager, and the trauma registry staff during this transition period and forms the basis of this study.\textsuperscript{10}

Overall trauma patient mortality, and mortality of patients with an ISS >16 remained unchanged over the two time periods, 4.5\% and 16.0\%, respectively, for 1996, and 4.6\% and 16.2\% for 1997. However, the Trauma Injury Severity Score (TRISS) analysis demonstrated improved survival, with the 1997 z score, achieving a statistical significance compared with Major Trauma Outcomes Study outcomes. The comparison between the results is shown in figure 5.\textsuperscript{10}

**Article Eight**

This study is based on two cohorts of major trauma patients. The first cohort was those included in the 1987 study and treated at the three Montreal area hospitals which, at that time, were classified as having trauma care compatible with a level 1 trauma center. The second cohort consisted of the patients who were treated at two of the Montreal area, level 1 trauma center during the first 5 months of their designation in 1993.\textsuperscript{11}

All patients were identified prospectively. In 1987, a study evaluating trauma care in Montreal, Quebec was conducted. The results of this study, which were based on a sample of 360 patients with major trauma, showed an 85\% mortality, with a significant Flora’s z statistic of 6.7 (P<0.001). Because the purpose of this study was to evaluate the impact of trauma designations as part of the changing trauma care system in Quebec it is appropriate to compare patients treated at hospitals that have high levels of trauma care but which differ with respect to designation. In this study, the results showed that the
relative risk of mortality was higher, by a factor of two, in the 1987 cohort when compared to the 1993 cohort. The risk of mortality was three times higher in 1987 when compared to 1993. These results indicate a decrease in the risk of dying between 53% and 30% in 1993. This analysis produced a statistically significant adjusted odds ratio (OR) for mortality associated with being in the 1987 cohort of 3.25 with 95% confidence intervals (CI) between 1.62 and 6.52 (p=0.009).11

**Article Nine**

In the final included study, a prospective cohort study by Sampalis et al12 discussed the evolution of trauma care regionalization in Quebec from 1992, or before its inception in 1993, to 1998, measuring its impact on mortality among patients with major trauma was examined. In addition, the prospective nature of the study and the uninterrupted follow-up during the first 5 years of regionalization and the integration of the trauma care system allowed the assessment of the process-outcome association. This assessment allowed the evaluation of causal relationships between the components of a regionalized trauma care system and trauma-related mortality. The results of the study show, that since the implementation of the regionalized system, the mortality in major trauma patients was significantly reduced. The results of the stratified analysis showed, that implementation of the regionalization produced significant reductions in the mortality rates among patients with moderate and major injuries, although the impact on patients with fatal injuries was modest.12

The primary outcome measured of the study was survival to discharge. The data in Table 7 show that the proportions of patients discharged alive, increased from 48% in
1992-1993 to 82.3 in 1997-1998. This represents a significant threefold decrease in the mortality rate, from 52% in 1992-1993 to approximately 18% between 1996 and 1998 (p<0.001). These, results which are summarized in Table 8, show that the mortality rate decreased from 52% before regionalization, to 32% during the initial phase, to 19% during the intermediate phase, and to 18% during the advanced phase. These changes are considered to be both clinically and statistically highly significant (p<0.001). The data in Tables 17 and 18 describe the mortality rates by trauma center designation during the study period. These data show that the mortality rate was consistently significantly lower in the tertiary centers than in the secondary and primary center (p<0.001). 12

DISCUSSION

The Oregon trauma system was established by an enabling state statute in 1985 and was implemented and enforced with considerable effort and cost. It is timely and valuable to determine if this major endeavor has been successful.10 Most of the available studies deal with trauma centers in major metropolitan area which are already close to larger, more well; equipped hospitals. Trauma system development has been shown to dramatically reduce the incidence of preventable death. An integrated model of trauma care permits better continuity of care, minimizes communication errors, and clearly establishes the overall responsibility for care, placing it in the hands of physicians with a special interest in trauma.10 The designation of trauma centers is the initial step toward trauma care regionalization; however, on its own it is not sufficient to improve the outcomes for trauma victims. The implementation of patient triage protocols for the prompt transport of patients with severe injuries, to these trauma centers is an equally important component of an efficient trauma care system. 11 It was discussed that trauma
centers reduce mortality in patients with severe injuries primarily because of prompt resuscitation, correct initial diagnosis, and the availability of advanced technology and experienced personnel. Studies have shown that patients treated at trauma centers have reduced mortality when compared to similar patients treated at non-specialized facilities. First, the staff in trauma centers may have improved proficiency and have developed better protocols for treating injured patients as the number of seriously injured patients admitted to the trauma centers increased from 580 in 1984 and 1985 to 1530 in 1990 and 1991. One wonders if this because of an increase in the surrounding population, or is because of better triage protocols.

The Iowa Trauma System was successful in getting the more severely injured patients to level 1 and 2 hospitals, where optimal care is immediately available, and implementation of the trauma system was associated with a significant decreased risk of death overall, and within 72 hours, regardless of the transfer status of the TBI. U.S trauma systems were designed to transport the injured to medical facilities where appropriate care is available; therefore, trauma systems are most successful in large metropolitan locations where there are significant numbers of high quality, well equipped, trauma centers.

Ongoing research and study point to the larger issues relating to the ongoing trauma epidemic in the United States and the surrounding continents. One wonders what we are really doing. Are we making a true difference in the outcomes? The recent earthquake in Haiti is a prime example of our failure to grasp trauma as a larger entity. In a perfect world everyone would get first rate treatment in a timely manner and only succumb to catastrophic injuries, but it is not a perfect world. There are many places that
have neither the access nor the education to provide a high standard of care. People by the thousands will probably perish in Haiti due to injuries that in other places would not cause loss of life. Unfortunately even in the United States there are still communities that do no benefit from the conclusions reached in the studies and are still denied this superior treatment.

The obvious conclusion is that regionalization of trauma systems and centers decrease the overall mortality associated with trauma related injuries. However, these are also in the urban areas where trauma centers are close and the ability to receive a higher level of care in a timely manner is available. The bigger question is what about those people who do not live in an urban setting. What are we doing for those communities, patients, providers? What are we doing to help and support them so that they can access a high quality of care in a timely manner? What are we doing to increase their chances of an improved outcome and a decrease in their trauma related deaths?

Limitations of these studies are the lack of information and examination of the rural areas. These would be the areas that need to be studied and data should be broken down to see if we are making as significant reductions in mortality in the rural areas as we are in the urban areas. Mann’s study suggests that implementation of the Oregon Statewide Trauma System did not enhance survival among remote rural residents hospitalized with severe injuries during the time interval of the study. However the post implementation time interval did not provide for a lengthy “transitional period” that would allow systemic changes in the decision-making among rural trauma hospitals time to stabilize and mature.4
Rural area present challenges to the development and success of trauma systems. To be effective, trauma systems must improve both the process and outcomes of care. The most important aspect of the outcome of care is whether such patients are more likely to survive after the implementation of the system. After implementation of the trauma system, severely injured patients in the region were more likely to be hospitalized in level 1 trauma centers and survive their injuries. The effect was significant; and the adjusted rate of mortality at the designated trauma centers was reduced by one third as compared with the pre-trauma system rate. Introduction of the trauma system has shifted care of the seriously injured patients at risk of imminent death to trauma systems.7

Although evidence exists that in major metropolitan communities with abundant resources, trauma systems reduce mortality from serious injury, there is little information regarding the potential effectiveness of trauma systems in remote rural communities, where mortality rates remain excessive. Factors cited as responsible for this excessive mortality in rural areas include restricted diagnostic capacity and delayed or incomplete surgical capabilities which could be ameliorated by the institution of trauma systems.4

Despite a 2 fold greater rate of trauma mortality in rural communities than in urban areas, the role played by trauma systems in the rural setting has received relatively little attention and has been limited to studies focusing on 1 or 2 level III hospitals in a single state or regional trauma system. The limitation of this study was that it did not deal with actual mortality it spent more time on the discussion of rural hospitals making a timely decision to transfer the patient.5 The increased in-hospital care fatalities in small, rural, non-designated hospitals deserve attention. While previous studies have
been limited to large, urban hospitals, this study was the first to illustrate the potential benefit of trauma designation to small, rural hospitals.⁵

**CONCLUSION**

After some research in this area, one thing becomes very clear and that is, that at the end of the day the implementation of a trauma center, or the regionalization of a trauma system, decreases the mortality in trauma patients. Not only does it affect trauma patients with substantial injuries, but it affects even the patients whose injuries are minor. To be lucky enough to live in a metropolitan or urban area that has taken the time to institute trauma resuscitation protocols for their emergency providers, has made available institutions that can not only provide the advanced technology associated with running a trauma center, but is interested in doing it right is still not an option available to all state residents equally.

On the other side of the coin are those that do not have that luxury of living within the confines of a larger city. These people choose to live on the outskirts of town, on a farm, in the mountains, by lakes, and streams, wherever they may be, but it is not close to any trauma system, or regionalized trauma center. There may not even be a hospital in the town if there even is a town. The United States is made up of 3,537,441 square miles, consider this in South Carolina there are 46 counties totaling 1,425 square miles are considered urban, and 28,685 square miles are considered rural. Now consider all those people that reside in those 28,625 square miles where is their regionalized trauma center? How far do they have to go for advanced evaluation and treatment? The services that many take for granted in the urban areas are often inaccessible in rural areas. In 2002 urban land was found to barely make up 3% of the land used in the United States. In 2002
the United State Department of Agriculture did an economic research survey, and it found that in Oregon alone there are 11 urban counties and 25 rural counties. Although these low population density regions represent a small proportion of the total population of the state, vital statistics data confirm that injury related death rates are excessive in the remote rural counties. ¹

So although the conclusions of these articles point out the overwhelming success in decreasing mortality in the trauma patient after implementation of a designated trauma system, or the institution of a regionalized trauma center. It is also clear that trauma in the rural setting needs to be the next new focus, should be bring in line the huge proportion of rural counties with these considered “urban” under the survey and seeing to it that all citizens receive the same opportunities what it comes to trauma care.
REFERENCES


**Table 1: Characteristics of Review Articles**

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<td>Tiesman et al</td>
<td>2007</td>
<td>TBI</td>
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<td>p&lt;0.008</td>
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<td>1994</td>
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<td>Ursic et al</td>
<td>2009</td>
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<td>1996</td>
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