NOTE TO USERS

Evaluation of Geriatric Trauma Care in Quebec

By: Nadia Longo

Department of Surgical Research
Experimental Surgery
McGill University, Montreal

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ABSTRACT

The purpose of this prospective cohort study was to describe the profile and outcomes of geriatric trauma care patients treated in level I trauma centers in Quebec. The study also evaluated the quality of care provided to geriatric trauma patients and identified predictors of outcomes which focused on mortality.

A total of 4934 trauma patients over the age of 65 were admitted for the treatment of injuries in three level I trauma centers in Quebec. The majority of the patients were injured in falls and had a low injury severity score. Male gender, older age, thoracic and abdominal injuries, burns, and delayed emergency room stays were identified as significant predictors of mortality. Inferior quality of care was observed with increased age and fall-related injuries.

The observed association between longer emergency room stay and falls with increased risk of mortality along with inferior care for patients injured in falls would suggest that level I trauma centers are inefficient and potentially harmful in treating elderly trauma patients. Further studies would be helpful in confirming these conclusions.

RÉSUMÉ

L'objectif de cette étude prospective était de décrire le profil et les résultats d'une cohorte de patients gériatriques-traumatisés soignés dans un centre de traumatisme tertiaire du Québec. Également, l'étude a évalué la qualité des soins prodigués aux patients gériatriques-traumatisés et a permis d'identifier les facteurs indicateurs de risque de mortalité.

Un total de 4934 patients traumatisés, âgés de plus de 65 ans, fut admis pour le traitement de blessures dans trois centres de traumatisme tertiaire du Québec. La majorité des patients souffraient de blessures causées par des chutes tout en présentant un faible ISS. Les facteurs suivants furent identifiés comme étant des indicateurs significatif de risque de mortalité : genre masculin, blessures thoraciques et abdominales, brûlures et attente prolongée dans les salles d'attente. Une qualité de soin inférieur fut observée chez les plus âgés et chez les victimes de chutes.

Les corrélations observées entre les temps d'attente prolongés en salle d'urgence et les chutes avec un risque de mortalité élevé ainsi que la qualité inférieure des soins prodigués aux patients victimes de chute pourraient suggérer que les centres de traumatologie de niveau 1 sont inefficaces et potentiellement dangereux dans le traitement de patients gériatriques-traumatisés. Des études subséquentes sont recommandées pour confirmer ses conclusions.

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1.0 INTRODUCTION

The Impact of Trauma

Trauma remains the fourth leading cause of death in North America and is the number one cause of death for individuals under the age of 45 years.[1] In 1997, the annual trauma-related mortality rate for the United States was 57 per 100,000 population and it was 43 per 100,000 population for Canada.[2-3] There were approximately 220,000 injury admissions to acute care hospitals and 8,626 deaths were reported nationally, resulting in trauma being the fifth leading cause of mortality in Canada. Trauma is the number one cause of severe disabilities in Canada and according to the 1996-97 Canadian National Population Health Survey, an estimated 1.3 million people 12 years and older have long-term disabilities caused by injuries.[4]

In 1966, the National Academy of Sciences Committee of Trauma revealed the degree to which trauma was affecting our society after they published a report depicting accidental death and disability as the "neglected disease of modern society".[5] The authors identified the immense magnitude of the problem of trauma by detailing its consequences such as: the tragedy of early death among the young, the burden of disability, and the health care costs amounting to billions of dollars. The scope of the problem was all the more alarming when contrasted with the public's apathetic attitude towards trauma care.

The report made the following recommendations for improving the care of seriously injured patients. Optimal treatment had to start in the prehospital phase, and the authors recommended the creation of established standards for ambulance services, including vehicle construction and credentialing of fully trained ambulance attendants.

They identified radio-communication technology as essential for timely dispatch to a call for help. Delayed and inadequate physician response to trauma care could be resolved by the emergence of a new discipline; that of medicine-physicians with "special care in immediate care". This prediction helped inspire a new medical specialty: Emergency Medicine. The document also called for outside agencies with regulatory authority to categorize hospital capabilities and the need to establish regionalized trauma care systems.

In the late 1970s, West et al. published a study indicating that injured patients in Orange County without regionalized trauma care system received inferior care compared to that delivered in the city of San Francisco that had a regionalized trauma care system. West et al. also found that in Orange County, two thirds of the deaths were preventable due to delayed or inadequate care.[6] These observations were later confirmed in a second, more rigorous study.[7] As a consequence of these reports, public opinion favored implementation of a trauma system in Orange County, with designation of one Level I and four Level II trauma centers. Follow-up studies of the impact of implementation of the system indicated that frequency of preventable deaths declined substantially after implementation of a regionalized trauma care system.[8,9]

Incidence of Trauma

According to Health Canada Statistics, nearly 220,000 Canadians are admitted into acute care hospitals for the treatment of unintentional injuries every year.[10] An unintentional injury is defined as an unforeseen incident, where the intent to cause harm, injury or death was absent, but which resulted in damage to the body resulting from acute exposure to thermal, mechanical, electrical, or chemical energy or from the absence of

such essentials as oxygen. This definition does not include suicides. Injury admissions on average involved 15 days' stay in the hospital, and most (77%) were discharged home, while 3% (6, 382) died in the hospital, the remaining patients (20%) where transferred to a rehabilitation center or nursing home.[10] These deaths did not include those who died at the scene of the event or en-route to the hospital.

Every year 22,000 Canadians have major life threatening injuries of which 6,500 will die in the hospital and another 6,500 will die before they arrive at the hospital. The rate of hospitalization for injury in Canada as a whole is 915 per 100,000 population.[11] There are some striking inter-provincial variations in rates of hospitalization for injuries. Overall Saskatchewan and British Columbia have the highest rates of hospitalization 1,332 and 1,167 per 100,000 population, respectively. Ontario and Quebec have the lowest rates 810 and 768 per 100,000 population, respectively.[11]

Motor vehicle accidents are the leading cause of hospital admission for Canadians aged between the years of 15 to 34.[11] However, unintentional falls accounted for the majority (52%) of the hospital admissions for all ages combined, and the rate for injury admission among seniors is more than double the rate for the population as a whole.[11] The second most common cause of injury admission for the elderly was motor vehicle accidents (16%), followed by being struck by objects, persons, or falling objects (5%).[11]

Age as Risk Factor

The majority of both fatal and non-fatal injuries occur among the young. Persons under the age of 45 years account for 61% of all injury fatalities, 62% of hospitalizations, and 80% of emergency visits due to injury.[10-11] However, different patterns emerge when the injury-related mortality rates by age are examined. What is most striking is that the

elderly aged 65 years and older are actually at highest risk for both fatal injuries and injuries requiring hospitalizations. The injury-related mortality rate for a person aged 65 years and older is 103 per 100,000 population and for persons aged 75 and older, it is 117 per 100,000 population. This is more than 2.5 times the injury-related mortality rate for all ages combined at 42.6 per 100,000 population.[3]

Consequences of Trauma

1.1.1 Mortality

Despite advances in injury prevention and medical care, death from trauma remains a major source of mortality in North America. For the first four decades of life, unintentional injuries are the leading cause of death. Motor vehicle accidents are the primary cause of death for Canadians aged 15-34 years and falls becomes the principle cause of death for individuals aged 75 years and older[3]

Perdue et al., studied the differences in mortality rates between the elderly (aged ≥ 65 yrs) and younger (18 – 64 yrs) trauma patients.[12] The study reported that mortality rates in elderly patients were twice that in younger patients despite equivalent injury severity (P=0.001). The higher mortality rate was attributed to the greater prevalence of preexisting conditions in the elderly compared to the younger population.

Sacco et al., reviewing the Multiple Trauma Outcome Study (MTOS) data, demonstrated that preexisting conditions such as hepatic, cardiovascular, respiratory and renal conditions were significantly associated with increased rates of mortality.[13] Milzaman et al., using trauma registry data, documented that preexisting disease increased in prevalence with age and that preexisting diseases were an independent

predictor of mortality in trauma patients (R^2 =0.1918; P < 0.0001) using multivariate regression.[14]

The incidence of complications among the elderly is another significant contributor to the higher mortality rate among the elderly. Perdue et al., demonstrated that the incidence of cardiac (21.4 vs. 2.0), respiratory (12.7 vs. 5.7), renal (1.6 vs. 0.4), and infectious complications (5.4 vs. 3.3) were significantly higher (P=0.001) in the elderly compared to the younger trauma patient population.[12] Similarly, Schiller et al., showed that the rates of respiratory complications, infections, and thrombophlebitis were all approximately doubled (P < 0.001) in the elderly, and cardiac dysrhythmias were almost five times higher in the elderly when compared to that in the younger trauma patient group (P < 0.001).[15]

1.1.2 Morbidity

The prevalence of preexisting conditions in the total trauma population is estimated between 8.8% and 19.3%. McMahon et al. found that preexisting conditions to be common in the elderly (> 65 years) and documented a gradual but steady increase in these conditions from age 25 to 75 years.[16] The study also demonstrated that during the fourth decade of life the prevalence of preexisting conditions was 17%; by the sixth decade this figure had risen to 40%; and by the eighth decade or age 75 years a 69% prevalence of one or more preexisting conditions was noted. Physiologic changes including decreased bone mass as seen in osteoporosis, diminished fat stores, loss of subcutaneous tissues, and muscle atrophy leave an elderly body prone to more severe injury given equal amounts of kinetic energy. These physiologic changes along with a reduction in resilience strength, and a higher prevalence of preexisting conditions

increases the incidence of complications after injury, which pre-dispose the elderly to poor outcomes after the injury.[17]

1.1.3 Economic

The cost of health care has been a subject of increasing concern for physicians, patients, industry, and legislators. Canada's total health cost was $75.3 billion in 1997, representing 9.2% of gross domestic product.[18] Preventable injuries cost Canadians $8.7 billion or $300 for every citizen. Falls accounted for $3.6 billion or more than 40% of the total amount. Motor vehicle accidents cost almost 1.7 billion or 20 % of the total costs. The remaining 40% of the total costs can be attributed to a combination of drowning, poisoning, fires and a range of other injuries. On average, each injury generates $4,000 in direct and indirect costs.

Over 2 million injuries in 1997 accounted for more than $4.2 billion in direct and indirect health care costs in Canada. The most costly injuries were falls, totaling almost $2.4 billion or 57 per cent of total direct costs, and motor vehicle accidents at $375 million or 9 per cent of the direct costs.[19] These two types of injury accounted for almost three quarters of the direct health costs. Caring for the injured elderly cost over $980 million or 41 per cent of the $2.4 billion of direct costs spent on falls, with females representing more cases than men. Treating children and youth for falls accounted for $575 million, with males representing slightly more cases than females. Although only 6 per cent of patients injured ended up in the hospital, the cost hospitalization generated 23 per cent or nearly $935 million of the of the total direct health costs. Therefore, hospitalization is a strong indicator of the severity of the injury.

Interventions against Injuries

1.1.4 Injury Prevention

Early attempts at injury prevention were largely based on the premise that injured individuals had been careless or were "accident-prone". Although this may be true in some circumstances, the resulting injury prevention strategies based on the above assumption, were not established on the scientific approach and were greatly limited in their scope and success.[20,21] Several pioneers laid the current foundation for the scientific approach to understanding the causation of injury and to developing rational prevention programs.[20-25]

Prevention can be classified into three strategies.[20] The first is an education and behavior change strategy, which is accomplished by continuously educating the public on how to initially avoid trauma. The second strategy is an enforcement and legislation strategy, which also addresses behavior, but the change is primarily generated by requirements and penalties imposed by laws or administrative rules (i.e. fines, jail sentences for drunk driving). Finally the third strategy deals with engineering and technology which automatically protects the potential host by adjusting the agents, vehicles, and the environment through laws, rules or persuasion addressed to manufacturers (i.e., requiring high-mounted brake lights on automobiles).

1.1.4.1 Historical Development of Injury Prevention

One of the earliest developments of the science of injury prevention was the work of Hugh DeHaven in the 1930s and 1940s. DeHaven demonstrated that, during an injury-producing event such as a crash or a fall, the body could withstand varying amounts of

kinetic energy depending on how that energy was dissipated. He pointed out the possibility of disconnecting the linkage of "accident" and the resultant "injury".[22,23] He provided a biomedical foundation for subsequent injury prevention work and introduced the concept of injury thresholds.

In the late 1940s, John E. Gordon introduced the use of epidemiology to the evaluation of injury. He pointed out how injuries occurred with recognizable patterns across time and populations, similar to any other diseases.[24] He also indicated that injuries, like all other diseases, were the result of the interaction of the host, the agent of injury production, and the environment within which they interacted.

The most notable of the early pioneers of injury prevention was William Haddon, the first director of the National Highway Traffic Safety Administration (NHTSA). Haddon advanced these earlier works and developed a systematic approach to the evaluation and prevention of injuries. He based his approach on the recognition that virtually all injuries resulted from rapid and uncontrolled transfer of energy to the human body. Furthermore, such energy transfers were understandable and predictable and, hence, preventable. Haddon expanded Gordon's ideas on the interaction of the three factors of host, agent, and environment into what would ultimately become known as Haddon's matrix.[25]

In this model, each of the three factors influences the likelihood of injury during each of three phases: pre-event, event, and post-event. In the pre-event phase, each of the three factors influences the likelihood of an injury-producing event, such as a crash, to occur. During the event phase, they influence the probability that such an event will result in an injury and determine the severity of the injury. During the post-event phase,

these same components determine what ultimate consequences the injury will have. Figure 1 gives such an example of such interactions.

Figure 1. Examples of the interactions of phases and factors within Haddon's Matrix of Injury Etiology

Factor	Phase		
	Pre-Event	Event	Post-Event
Human/Host	Driver Intoxication	Use of safety belts	Age
	Experience		Physical Conditioning
Vector/Vehicle	Condition of brakes or tires	Airbags	Integrity of fuel system / fireproof gasoline tanks
	Accessibility of moving parts in machinery in factories	Collapsible steering column	
	Windows bars at high elevations	Side impact protection	
Environment (Social & Physical)	Speed Limits	Highway design (guardrails, breakaway poles)	Trauma care systems
	Societal attitudes and laws on intoxicated driving		
	Traffic regulations	Societal attitudes and laws regarding seatbelts use	
	Highway design (road curvature, intersections, and road conditions		

Haddon provided a firm basis for the modern approach to injury control. The principals summarized in his matrix have also served as guidelines for the development of prevention efforts. He went on to develop 10 strategies to dissociate potentially injury-producing "energy" from the host.[25]

1.1.4.2 Injury Prevention Strategies

In general, interventions can be thought of as either being active or passive on the part of the person being protected. *Active* interventions involve behavior change and require people to perform an act such as putting on a helmet, fastening a seatbelt, or using

a trigger lock for a handgun. Whereas *passive* interventions require no action on the part of those being protected and are built into the design of the agent or the environment, such as airbags, or separation of vehicle routes and pedestrian walkways. In general, passive interactions are considered more reliable than are active ones.[26-27] However, even passive interventions require an action on the part of some segment of society, such as passage of legislation to require certain safety features in automobiles.

The accomplishments of injury prevention strategies in society can be undertaken through three primary modalities: (a) enforcement and legislation, (b) education and behavior change, and (c) engineering and technology. These are often referred to as the three "E's".

1.1.4.3 Enforcement and Legislation

Enforcement and legislation can work at different governmental levels. The primary objective of this strategy is to reduce the risk of injuries by implementing legislation, which will modify behavior.[28,29] For example, federal or provincial legislation define what constitutes as drunk-driving and establish the strictness with which the laws are enforced.

The anti drunk-driving effort has been a cornerstone of road safety efforts in the United States and most other developed countries.[30,31] These have employed both educational and legislative approaches.[32] In terms of legislation, almost all the states have adopted per se laws, in which any driver with a blood alcohol concentration (BAC) above the present legal limit of 100 mg/dL is considered impaired. However, several studies[33,34,35] which have been published in the last 5 years, have demonstrated that a decrease in alcohol-related crashes was observed when the BAC limit was lowered to 80

mg/dL. Nevertheless, legislation must be linked to enforcement, because any law is as good as its enforcement. In the case of drunk-driving enforcement, random sobriety checkpoints and administrative license suspensions are two examples of methods to increase enforcement.

1.1.4.4 Education and Behavior

The primary objective of this strategy is to educate potential victims of injury in order to alter their behavior in a way that will reduce their risk of getting injured.[27,28] This strategy is accomplished through educations programs such as driver's education, seminars for teenagers for drug and alcohol consumption and media messages as "Don't Drink and Drive". The major barrier to this strategy is the fact that it requires behavior change from a person in order for the strategy to be effective. Few people would deny that drinking and driving is dangerous, nonetheless in 2000, 864 people died in an alcohol-related motor vehicle accident.[36]

However, educational programs can be very successful if they are delivered in a well thought out manner and coupled with other methods of injury prevention, such as public campaigns, like informing the public of the harsher punishments under the new and more stringent anti drunk-driving laws.

1.1.4.5 Engineering and Technology

Engineering and technology address a variety of issues, such as, development of safer roadways, more effective safety features for automobiles, and automatic protection for manufacturing equipment.[27-28] One of the greatest advances in automotive safety was

the realization that a significant component of the injuries sustained in crashes were due to ejections and to secondary collisions of the occupants with the vehicle interior after the vehicle collided with another object.[37,38] This understanding led to the development of seatbelts to allow occupants to be restrained during a crash and thus sustaining lesser degree injuries. However, seatbelts require fastening to be effective and thus it became a major injury prevention challenge to convince people to use their seatbelts. Efforts to increase belt usage were coupled with education and legislation.[39]

1.1.5 Treatment

Except when death occurs immediately, the outcome of injury depends not only on its severity, but also on the speed and appropriateness of treatment. Communication systems are needed to facilitate decision-making, injury management at the site, and the rapid delivery of the patient to a hospital that can provide the definitive care.

Prehospital care of the injured has greatly improved during the last two decades. Once a severely injured person arrives at a hospital, treatment requires the effort of a team that includes specialists in various medical and surgical fields. Designated trauma centers with experienced medical personnel available and necessary facilities are essential.

1.1.5.1 Trauma Care Systems

The 1966 publication of Accidental Death and Disability: The Neglected Disease of Modern Society by the National Academy of Sciences/National Research Council, called attention to the enormity of the problem of dealing with the injured as well as the

lack of proper facilities (trauma centers) and set forth recommendations for trauma system development. This publication clearly demonstrated that trauma care in the United States was deficient and that major changes were needed.[5]

Congress responded to the Accidental Death and Disability report by enacting legislation. The National Highway Safety Act of 1966 profoundly influenced several aspects of the injury problem in America.[40] The Department of Transportation was given authority, funding, and instructions to implement the law. Injury to occupants of motor vehicles was to be reduced, and research resulted in development of effective car safety devices. In addition, the bill identified systematic changes that could improve the care of injured patients.

In 1973 the "Emergency Medical Services (EMS) Act" was implemented.[41] The purpose of this legislative measure was to establish regionalized trauma care systems across the United States. As a result of the enactment of this law, approximately 300 regionalized emergency medical systems with intergraded trauma care centers were created in the United States.[42]

In 1976, the American College of Surgeons (ACS) Committee on Trauma first published the guidelines "Optimal Hospital Resources for care of the seriously injured".[43] These guidelines described the hospital commitment, organization, and performance levels required to provide effective trauma care. Expansion and amplification of the guidelines occurred in 1979, 1983, 1986, and 1989.[44-28]

The latest publication of the ACS Committee on Trauma in 1989 "Recourses for Optimal Care of the Injured Patient" addressed several essential issues that had arisen since the last revision of the guidelines in 1986. The Committee focused on further

developing and improving trauma care systems by; creating and implementing treatment protocols for prehospital management of the trauma patient, establishing field categorization for the trauma patient, creating guidelines for management of critically injured patient in the intensive care unit, establishing guidelines for an eye trauma care center, and they also began planning a pediatric trauma care center. The committee also addressed other health care issues including; optimal care in rural settings, critical care air ambulance service, hospital designation criteria, neuro-trauma care, inter-hospital transfer of patients and quality assurance in trauma hospitals.

Since its original publication in 1976, the guidelines have been implemented in state and regional trauma care systems across North America.[45] Several studies have shown that regional trauma care systems significantly reduce trauma-related mortality, primarily due to the fact that patients are treated at facilities which are capable of providing high level care (level I trauma centers).[40-45]

The main requirements[43-45] for a regional trauma center, are the following:

1. Designation and establishment of level I trauma centers.
2. Classification of acute care hospitals according to the level of trauma care available.
3. Centralized control and communication centers.
4. Sounding of the alert through a central system such as "911" telephone number and dispatching of personnel coordinated at the controlling center.
5. Training of paramedics and EMS ambulance personnel to evaluate and provide on-site care.

6. Implementation of protocols for the transfer of severely injured patients to the level I trauma centers.
7. Establishment of communication of the EMS ambulance personnel with the receiving hospital.
8. Evaluation, research and education.

1.1.5.2 Prehospital Care

Emergency medical personnel using either Basic Life Support (BLS) or Advanced Life Support (ALS) techniques provide prehospital care for trauma patients. BLS consists of noninvasive interventions such as wound dressing, immobilization, fracture splinting, oxygen administration, and noninvasive cardiopulmonary resuscitation. ALS encompasses all of these BLS techniques as well as to invasive procedures, including intubation, initiation of intra venous access with fluid replacement, and administration of medications. The rationale for the use of on-site ALS in trauma is that these interventions will reduce the rate of physiological and hemodynamic deterioration, thus stabilizing the patient before arrival at the hospital. It is expected that this will result in increased chances of survival. The paradox is that on-site ALS increases the amount of time that is spent on the scene and hence increases the delay to definitive in-hospital care. To date, the controversy between the "scoop and run" versus "stay and stabilize" approach to prehospital trauma care remains unresolved and has been the subject of a several studies. Studies supporting ALS have failed to show an association between on-site ALS and increased survival among patients with major trauma.[46,47,48] By contrast, studies supporting BLS have shown higher survival rates for patients treated with the

"Scoop and run" approach compared to those treated with on-site ALS approach.[49,50,51] Currently, the weight of evidence supports the "scoop and run" approach for the pre-hospital course of trauma patients in urban settings.

1.1.5.3 In-Hospital Care

The ACS Committee on Trauma identified and established three levels of trauma center designation. Variations of available medical and surgical specialists and equipment primary differentiate the levels of trauma centers. In a level III trauma center, a trauma surgeon is immediately available. In a level II trauma center, the trauma surgeon is in the emergency department when the patient arrives, and in a level I the trauma surgeon is in-house 24 hours a day. Furthermore, in a level III trauma center a neurosurgeon and in-house operating crew are not required, whereas in a level II and I centers the neurosurgeon and in-house operating crew are promptly available. Level I trauma centers have the additional obligation to support and improve trauma care through education and research.

Initial evaluation, stabilization, and definitive care should be essentially the same at level I and level II trauma centers. However, without the required in-house surgeon and intensive care unit coverage, level II trauma centers may not be able to provide the same support to all critical trauma patients. A level III trauma center is usually in a rural area and should be capable of accepting the critical trauma patient and begin stabilization. Depending on the resources of the facility and magnitude of the injuries, definitive care may be provided or transfer to a level II or I may be indicated.

Trauma Care in Quebec

1.1.6 Quebec Trauma Care before 1993

Before 1993, trauma care in Quebec was not organized at any level. In urban areas, patients were transported by public or private ambulances to the hospital that was nearest to the site of the event. Although some hospitals had the expertise and technology to treat patients with major trauma, there was no formal designation of trauma centers.

In 1987, a cohort study was undertaken to evaluate the pre-hospital care in Montreal.[52,53] At the time, severely injured patients received on-site care by Emergency Medical Technicians (EMT) and physicians and were transported to the nearest acute care hospital with an available emergency room. There were no triage protocols for the transfer of severely injured patients to hospitals with high level of care available and there were no designated trauma centers. The study, which was based on all major trauma patients treated by Urgences-Santé between March 1987 and April 1988, showed that there was an 81% excess mortality in the cohort. The conclusion from this study were that: a) in Montreal there was a deficiency in the existing system to provide adequate care to severely injured patients; b) long pre-hospital times were associated with increased risk for mortality; c) treatment at hospitals with inadequate level of trauma care was associated with significantly increased mortality risk; and d) physicians provided on-site Advance Life Support (ALS) was associated with significant increase in total pre-hospital time and did not provide any benefits to severely injured patients.[51-54]

1.1.7 Evolution of the Quebec Trauma Care System

The study described in the previous section prompted the Quebec government in 1993, to initiate the process of trauma care regionalization. The first step of this process

was the designation of four tertiary (Level I) trauma centers. Three of these trauma centers are in the Montreal area; The Montreal General Hospital, Sacré-Coeur Hospital, and Charles LeMoyne. The Enfant-Jesus Hospital is the only one located in Quebec City. Between 1993 and 1996 there were 33 secondary (Level II) and 30 primary (Level III) trauma centers designated within Quebec. In 1995, transport protocols were introduced according to which patients with major injures are either transported directly from the scene or are transferred from other hospitals to one of the tertiary trauma centers.[68]

With respect to prehospital care, there is significant variation within Quebec. In Montreal, a limited number of physicians are employed by the emergency medical system (Urgences-santé) and are dispatched to the scene for cases of major trauma. Physicians provide on-site care to patients that could range from Basic to Advanced Life Support, according to their judgment and without any standardized protocols. Emergency Medical Technicians (EMTs) are also employed by Urgences-santé and are dispatched to the site for cases of minor injuries and cases of major trauma when a physician is not available. However, EMTs are limited by law to only provide Basic Life Support to patients on-site. Therefore in Montreal, there exists a random variation with respect to the on-site trauma care provided to patients.[52-54]

Geriatric Trauma Care

1.1.8 Epidemiology

Seniors (≥ 65 years) are one of the fastest growing population groups in Canada. In 2000, there were an estimated 3.8 million Canadians aged 65 and over, an increase of 62% from 2.4 million in 1981.[55] In fact, the senior population has grown about twice as fast as the overall population since the early 1980's.

As a result, more than one out of every 8 Canadians is now over the age of 65 years. During the year 2000, seniors made up 13% of the population, an increase from 10% in 1981 and 8% in 1971.[56] The rapid growth in the size of the senior population is also expected to continue well into the future, particularly when those born during the "baby boom" years from 1946 to 1966 begin turning 65 in the next decade. Statistics Canada has projected, for example, that by 2021 there will be almost 7 million seniors, who will represent 19% of the total population, and that by 2041 there will be over 9 million seniors making up an estimated 25% of the total population of Canada.[55-57]

Seniors as a group may vary in age by as much as 25 to 35 years. This produces a need to create subcategories within the aging population: young-old aged 65-74, the middle-old from 75 to 84 years, and the old-old aged 85 and over.[58] The elderly population however is not a homogenous group. From a statistical standpoint, people aged 65-74 (young-old) more closely resemble those in age groups under 65 than they do to those aged 85 while people aged 75-84 (middle-old) appear to be in a period of transition.[58] Seniors aged 85 and over (old-old), on the other hand, are the most likely to be characterized by many of the conditions, such as ill health, associated with old age.

It is estimated that the old-old age group will make up 45% of all elderly by 2031. This is particularly significant because the population aged 85 and older is the fastest growing segment of the overall senior population.[57] In 2000, there were over 400,000 Canadians aged 85 and over. Statistics Canada has projected that there will be almost 2 million Canadians aged 85 and over in 2051, almost five times the current figure. The growth in this particular category is of importance because people in this age category generally have the greater needs with respect to social support and health care. For

example, in 1996, Canadians over the age of 85 made up almost half (46%) of all seniors in health-related institutions, whereas they represented only about 10% of the total senior population.[59]

Accordingly the geriatric trauma patient presents a significant clinical challenge from all perspectives including pre-hospital, acute-care, post-care and rehabilitation. However, since injuries have a more significant impact on the younger population, all the emphasis to date has been focused on younger individuals, and little attention has been paid to the elderly injured patient.

1.1.9 Age as an Indicator for Special Care

Trauma in the elderly is a different disease than in the young. Not only do the elderly suffer different types of injuries but also their response to injury and ultimate outcome are very different. According to the 1995-96 statistical report on the health of Canadians, unintentional falls were the leading cause of hospital admissions for all age groups except the 15-34 year old age group.[60] The leading cause of injury for 15-34 years old was motor vehicle accident, which accounted for 29% of hospital admissions in this age group.

In those 65 years of age and older, the leading cause of injury and mortality were unintentional falls, accounting for 84% of hospital admissions and one third of traumatic elderly fatalities. Motor vehicle accidents account for 25% of elderly deaths, and one third of these involve elderly pedestrians. Burns, suffocation, poisoning, and firearms cause the remaining elderly mortalities in decreasing order of frequency.[60]

Unintentional falls represent an enormous health problem for the elderly, resulting in 7 million injuries and 10,000 deaths per year. Unintentional falls most commonly are

the result of the accumulated effects of age and environmental hazards. Most falls in the elderly are caused by several age-related factors that affect their stability. Impairment of sensations and proprioception, visual disturbances, vertigo, vestibular-basilar insufficiency and predisposition to syncope from cardiac dysrhythmias or orthostatic hypotension are a few factors that cause the elderly to fall.[61] Impairments in vision, hearing and memory make any environment unfamiliar and very dangerous for the elderly, even their own home. Prescription medications are also a frequent contributing factor in falls. Especially the following medications; sedatives, antihypertensive, diuretics, and hypoglycemic agents, as some of their side effects are vertigo, cardiac dysrhythmias, anemia, electrolyte imbalance and transient ischemic attacks which more often than not cause the elderly to lose their balance and fall.[62]

Another important factor that justifies why the elderly need special care is that the elderly respond to injury much differently compared to the younger population.[12, 63] Normal physiologic changes seen in the elderly creates many complications for treatment of injury in an elderly trauma patient. The elderly have a limited ability to respond to the stress of the injury because of their narrow physiological tolerance and reverse.

In general, there is a decrease in cardiac output and stroke volume along with slowed electrophysiological conduction, increased myocardial stiffness, loss of myocardial cell mass and diminished blood supply to the cardiac tissue, which predisposes the elderly to dysrhythmias. Sudden major stress can suddenly case cardiac dysrhythmias, heart failure and sudden death.[64] Thus, the aged heart is ill equipped to deal with the tremendously increased demands of major trauma and is often the reason why an elderly patient succumbs to their injury.

As the body ages the chest wall stiffens, and the lung loses much of its elasticity, as a result of changes in elastin and collagen.[65] These changes consequently result in reduction of pulmonary function and compliance. The elderly are also prone to hypoxia resulting from changes in pulmonary function, which include a decrease in fixed expiratory volume (FEV), peak expiratory flow rate, and diffusion capacity. Additionally, functional vital capacity is decreased and this causes a loss in effective coughing. These changes in the mechanics of breathing, coupled with the loss of an effective immunologic defense against bacteria contribute to the frequency of pneumonia. Pneumonia continues to be a frequent problem in the elderly in general and more specifically to the elderly trauma patient.

Renal dysfunction is another preexisting disease that increases the chance of complications in the elderly trauma patient. Although the kidney continues to grow in size until early adulthood, it loses mass rabidly after the age of 50. This loss of mass involves entire nephron units that result in a 30% to 40% loss of glomerular function. Furthermore, morphologic changes in the kidney's vascular supply results in a lesser percentage of the already diminished cardiac output perfusing this organ. The above physiologic changes cause the kidney to lose its ability to buffer acid or base loads and to eliminate creatinine.[66]

2.0 RATIONALE

Trauma care regionalization is an ongoing process that involves two fundamental components with long-term benefits. First, the establishment, designation and maintenance of tertiary trauma centers and second the implementation of patient triage protocols by which patients with severe trauma are transported and treated at these tertiary centers within minimal delays. The introduction of such regionalized trauma care systems has been shown to reduce trauma-related mortality.

In Quebec the process of trauma care Regionalization was initiated in April of 1993 with the designation of four tertiary trauma centers. In July of 1995 a protocol was implemented according to which patients with severe trauma are transported to the four regional tertiary trauma centers. Results from a study conducted by Sampalis et al. has shown that mortality in patients with major injuries has been reduced after trauma care regionalization from 50% to 18%, and that patients transported directly to a tertiary center have reduced risk of mortality when compared to those transferred from a less specialized hospitals.[67]

A process of rigorous and ongoing evaluation that has ensured that the specific needs of trauma actions in Quebec are addressed has guided the implementation and subsequent evolution of the Quebec Trauma Care System. We now have a system of trauma care that has significantly reduced the morbidity and mortality in patients with major trauma with quality of care that is equal, if not superior, to trauma care systems in other North American regions. As part of the ongoing evaluations of the Quebec Trauma Care System, the level of inquiry has advanced from the general population of trauma victims to specific segments that may warrant special attention.

These inquiries have identified the elderly injured patients as an important segment. The data collected have shown that the geriatric trauma population represents a significant proportion of the overall trauma population. To this date, a study specifically addressing the issue of geriatric trauma patients has not been reported in Quebec. The current study addressed this question by describing the profile and outcomes of older trauma patients treated at level I trauma centers in Quebec.

3.0 STUDY OBJECTIVES

The objectives of the study were the following:

1. To describe the profile of injuries of patients over the age of 65 years that are treated in level I trauma centers in Quebec.

2. To describe the outcome of trauma patients over the age of 65 that are treated in level I trauma centers in Quebec.

3. To describe the association between predictor variables and outcomes in the study sample of elderly trauma patients.

4. To assess the quality of care of older trauma patients treated at Quebec level I trauma centers.

4.0 METHODS

Study Design

This was a single prospective cohort study composed of elderly patients treated for injuries in tertiary level I trauma centers in Quebec. The cohort was comprised of geriatric trauma patients who were injured from April 1, 1998 to March 31, 2002. The point of entry into the cohort for subjects was the time of their injury.

Data Sources

4.1.1 Quebec Trauma Registry (QTR)

The Quebec Trauma Registry (QTR) was established in April 1993 and is an epidemiological tool aimed at collecting data on all patients that are treated for major injuries in all acute care hospitals in the province of Quebec. Data abstractors employed by the hospitals identify potential trauma cases from hospital charts. Once a case of trauma is identified, the patient's medical record is reviewed for information that is entered first onto a case abstraction form, and then into a computer database by the data entry personnel. The QTR database is extensive and contains data on patient demographics, pre-hospital, emergency room, and in-hospital care. It also includes diagnostic assessments, medical treatments, surgeries, and other health care services provided to the patients. In addition, outcomes measures such as mortality, complications and status at discharge from the acute care hospital are included. Since its inception, the QTR has data on over 60,000 trauma patients from over fifty hospitals in the province.

4.1.2 Identification of Cases of Geriatric Trauma Patients

The study subjects were identified from the Quebec Trauma Registry and the following inclusion criteria were applied for subject selection:

1. Admission for injury identified by ICD9-E codes, at an acute tertiary trauma care hospital (Level I);
2. Subjects were $\geq$ 65 years at the time of injury.
3. Admission and treatment of significant injuries indicated by one of the following;
    - ~ Death due to injury, or
    - ~ Admission with hospital stay of greater than 3 days, or
    - ~ Treatment in an intensive care unit (ICU).

4.1.3 Participating Centers

Three of the four tertiary trauma centers in Quebec contributed patients to the study. The Montreal General Hospital is a 533-bed facility centrally located in downtown Montreal. It is a large teaching hospital associated with the McGill University Faculty of Medicine. L'Hôpital du Sacré-Cœur de Montréal is a 685-bed facility located in the north end of the City of Montreal, and is a teaching hospital associated with l'Université de Montreal Faculty of Medicine. L'Hôpital Enfant-Jésus, a 1020-bed hospital, is the only major trauma facility in the Quebec City area. It is also a teaching hospital associated with l'Université de Laval Faculty of Medicine.

Statistical Methods

4.1.4 Objective 1

The following statistics were produced to describe the profile of elderly trauma patients included in the study.

Parent Demographics:

Age

- Mean, median, standard deviation, 95%CI of the mean, and proportion of patients in each of the following age categories:
  - 65-69
  - 70-74
  - 75-79
  - 80-84
  - 85-89
  - 90-94
  - 95-99

Gender

- Proportion of male and female patients

Mechanism of Injury (MOI)

- Proportion of patients injured in the following:
  - Motor Vehicle Accidents (MVA)
  - Falls
  - Firearm
  - Stabbing
  - Blunt object
  - Laceration
  - Other

Body Regions Injured

- Proportion of the patients with at least one injury in the following body regions:
  - ~ Head and Neck Injury
  - ~ Face Injury
  - ~ Thoracic Injury
  - ~ Abdominal Injury
  - ~ Extremity Injury
  - ~ Burn Injury

Injury Severity Score (ISS)

The Injury Severity Score (ISS) has a range from 1 to 75. The ISS is the sum of the squares of the highest AIS code in each of the three most severely injured ISS body regions. The body regions are as follows: 1) head or neck, 2) face, 3) chest, 4) abdominal or pelvic contents, 5) extremities or pelvic girdle, 6) external burns. Any AIS code of 6 is automatically assigned an ISS of 75. ISS codes cannot be calculated for a patient with an AIS code of 9. The injuries in each region are scored a one for minor injuries, two for moderate injuries, three for severe but not life-threatening, four for life threatening, and five as uncertain survival.

- Distribution of the ISS score, mean, median, standard deviation, 95% CI of the mean, and the proportion of patients with an ISS score in one of the following categories:
  - ~ 1-11
  - ~ 12-24
  - ~ 25-49
  - ~ >50

Hospital Course

- Transfer
  - ~ Proportion of patients in each of the following:
    - *Direct transport*: Transported directly to the tertiary trauma center
    - *Transferred:* Transferred to the tertiary trauma center after initial transport to a secondary or tertiary trauma center
- ICU Admission
  - ~ Proportion of patients admitted in the ICU
- Surgery
  - ~ Proportion of patients undergoing a surgery

Emergency Room Stay

This was defined as the time elapsed between the arrival of the patient at hospital and discharged from the emergency room for admission to definitive care. For patients expiring in the ER this variable was calculated as the time from arrival at the hospital to time of death.

- Mean, median, standard deviation, 95% CI of mean of duration of stay in the emergency room and proportion of patients with a duration of stay (hrs) in the following categories:
  - ~ ≤ 3
  - ~ $4-6$
  - ~ $7-12$
  - ~ ≥ 13

4.1.5 Objective 2

The following variables were used to describe the outcome of the subjects in the study.

Hospital Stay

- Mean, median, standard deviation, 95% CI of mean of duration of stay in the hospital, and the proportion of patients with a duration of stay (days) in the following categories:
  - 0.1 – 3.0
  - 3.1 – 7.0
  - 7.1 – 14.0
  - 14.1 – 30.0
  - ≥ 30.1

Intensive Care Unit Stay

- Mean, median, standard deviation, 95% CI of mean of duration of stay in the ICU, and the proportion of patients treated within the ICU with a duration of stay (days) in the following categories:
  - 0.01 – 2.0
  - 2.1 – 3.0
  - 3.1 – 7.0
  - 7.1 – 10.0
  - 10.1 – 14.0
  - 14.1 – 30.0
  - ≥ 30.1

Incidence of Complication

Complications are recorded in the Quebec Trauma Registry. In this analysis any complication noted in the record was considered regardless of severity, course and nature.

- Mean, median, standard deviation, and 95% CI of mean number of complications and proportion of patients with at least one complication.

Discharge Status

- Proportion of patients with the following discharge status

- ~ Home without help
- ~ Home with help
- ~ Admitted to same hospital
- ~ Left against advice
- ~ Transfer to acute care hospital
- ~ Transfer to chronic care hospital
- ~ Transfer to nursing home
- ~ Transfer to rehabilitation center
- ~ Deceased

4.1.6 Objective 3

The associations between the study outcomes and the following potential predictors were assessed using unadjusted bivariate analysis. For these associations, the Chi-Square test was used to assess statistical significance.

- Age Categories
- Gender
- Mechanism of Injury
- Body Region Injured
- ISS category
- Hospital Course
- ER Stay

Multivariate Logistic Regression analysis was to assess the adjusted independent association between mortality and the above predictors of outcome.

4.1.7 Objective 4

In order to address this objective, standardized mortality ratio (SMR) was used to measure the quality of care. This will be based on standardization of the mortality rate in the study cohort to the Major Trauma Outcome Study (MTOS)[68] cohort using TRISS

methodology. The TRISS methodology uses a logistic model that incorporates the patient's age, ISS, Revised Trauma Score (RTS) and presence of penetrating trauma to estimate the probability of death for each patient under the assumption that they were treated at the trauma centers contributing data to the MTOS.

The standardized mortality ratio (SMR) is the ratio of observed to expected deaths. A SMR below 1.0 indicates a decreased risk of mortality in the samples, whereas a SMR greater than 1.0 indicates increased risk. Expected mortality rates were calculated by indirect standardization to the MTOS cohort. The MTOS cohort is comprised of over 100,000 trauma patients treated at 100 level I trauma centers in North America. Therefore the MTOS represents the best possible care available to trauma patients in North America. The SMR is an estimate of the relative risk associated with being in the study population compared with being in the external standardized population and thus is a measure of excess mortality experience in the study sample.[69]

5.0 RESULTS

Objective 1

5.1.1 Patient Demographics

A total of 4934 patients were identified from the Quebec trauma registry and were included in the study. The mean (SD) age of the sample was 79.39 (8.07) years with 33% of these patients being males. Of the patients in the sample 30% of the patients were between the ages of 65 and 74 years, almost half of the patients (42%) were between the ages of 75 and 84 years and the remaining 29% were greater than 85 years old (Table 1).

5.1.2 Mechanism of Injury

The most frequent mechanism of injury was falls accounting for 83.3% of the injuries followed by motor vehicle accidents accounting for 12.3% (Table 2).

5.1.3 Body Regions Injured

The majority of the patients 4087 (82.8%) sustained injuries to the lower extremities including the pelvis followed by a head or neck injury (24.1%), face injury (14.1%), and thoracic (12.9%). External burns accounted for only 0.6% (Table 3).

5.1.4 Injury Severity Score

The mean (SD) Injury Severity Score (ISS) was 10.83 (7.51) with a median of 9.00. The majority of patients (79.4%) had an ISS score between 1 and 11 indicating mild injury severity levels (Table 4).

5.1.5 Hospital Course

More than three quarters (75.8%) of the patients were directly transported to a level 1 trauma center. In addition the majority of patients (71.1%) required a surgical procedure, while less than a quarter (15.4%) of the patients required treatment in the ICU (Table 5).

5.1.6 Duration of Emergency Room Stay

The mean (SD) length of stay in the emergency room was 10.4 (10.6) hours, with a median of 6.0 hours. There was a homogeneous distribution of patients in each category of emergency room stay (Table 6)

Objective 2

5.1.7 Duration of Hospital Stay

The mean duration of hospital stay was 15.0 (14.5) days, with a median of 11.0 days. More than one third (35.7%) of the patients had a length of stay between 7 and 14 days (Table 7).

5.1.8 Duration of Intensive Care Unit (ICU) Stay

The mean (SD) length of stay in the intensive care unit was 8.1 (14.0) days, with a median of 3.5 days. The highest proportion of patients stayed in the ICU for less than two days (Table 8).

5.1.9 Incidence of Complications

The overall incidence of complications was 36.6% and the mean (SD) number of complications was 2.4 (2.1) with a median of 2.0 (Table 9).

5.1.10 Discharge Status

A total of 436 (8.8%) of the study sample died. More than a third (37.8%) of the patients that were discharged from the hospital where transferred to a rehabilitation center. The remaining patients were discharged home with help (14.2%) or without help (21.2%) or were transferred to one of the following institutions; acute care hospital (6.1%), nursing home (3.3%) or chronic care hospital (2.5%) (Table 10).

Objective 3

5.1.11 Outcomes by Age

5.1.11.1 Hospital Stay

There was a significant increase in mean duration of hospital stay with increasing age (P=0.024). The younger age group (65-69) had a mean (SD) duration of hospital stay of 13.8 (17.2) days compared to 16.3 (14.5) days for the older age group (85-89). In addition a higher proportion of younger patients stayed in the hospital for less than three days when compared to the older patients (Table 11).

5.1.11.2 ICU Stay

No significant associations were found between age and duration of stay in the Intensive Care Unit (Table 12).

5.1.11.3 Incidence of Complications

The incidence of complications increased linearly from 29.6% in the 65-69 age group to 49.2% in the 95-99 age group (P=0.001) (Table 13).

5.1.11.4 Discharge Status

The mean age was significantly higher for patients that left the hospital against advice, discharged without help and died (P=0.001). Mortality rates increased with age from 6.8% in the 65-69 age group to 13.1% in the 95-99 age group (P=0.001) (Table 14).

5.1.12 Outcomes by Gender

5.1.12.1 Hospital Stay

The mean duration of hospital stay was significantly higher in men when compared to women (16.9 vs. 14.2 days) (P=0.005). A significantly higher proportion of males stayed in the hospital for more than 30 days when compared to females (P=0.001) (Table 15).

5.1.12.2 ICU Stay

There was a significantly higher mean duration of ICU stay for men when compared to women (P=0.005). The highest proportion of patients staying in the hospital for more than 30 days was observed in the male patients (P=0.045) (Table 16).

5.1.12.3 Incidence of Complications

Of the total study sample, men had a higher proportion with complications than women (41.6% vs. 34.2%) (P=0.001). Similarly, the mean number of complications was significantly higher in men than in women (2.7 vs. 2.1) (P=0.001) (Table 17).

5.1.12.4 Discharge Status

Mortality rate was significantly higher in males than in females (P=0.001). In addition, a significantly higher of proportion of females were transferred to a

rehabilitation center, chronic care hospital or nursing homes, and where discharged home without help (P=0.001) (Table 18).

5.1.13 Outcome by Mechanism of Injury

5.1.13.1 Hospital Stay

Patients injured with firearm injuries had the highest mean duration of hospital stay, followed by those injured by blunt object, MVA, and falls (P=0.001). A significantly lower proportion of patients injured in a fall stayed in the hospital for less than three day when compared to other mechanism of injury (P=0.001). The highest proportion of patients staying in the hospital for more than 30 days was observed for those injured with firearms (Table 19).

5.1.13.2 ICU Stay

No associations were found between ICU Stay and Mechanism of Injury (Table 20).

5.1.13.3 Incidence of Complications

The highest incidence of complication (81%) was observed in patients injured in falls (P=0.001) (Table 21).

5.1.13.4 Discharge Status

Firearm related injuries had the highest mortality rate of 27.3% followed by stabbing at 16.7%, MVA at 14.7% and falls at 8.0% (P=0.001) (Table 22).

5.1.1 Outcomes by Body Regions Injured

5.1.1.1 Hospital Stay

The highest mean hospital stay was observed for patients having burns, followed by patients with abdominal injuries and head or neck injuries (P=0.001) (Table 23).

5.1.1.2 ICU Stay

The highest ICU stay was observed in patients with abdominal injuries followed by those with thoracic injuries (P=0.001) (Table 24).

5.1.1.3 Incidence of Complications

The mean number of complications was significantly higher for abdominal injuries followed by thoracic and face injuries (P=0.001). Victims of burns had the highest incidence of complication, followed by those with abdominal injuries and those with head or neck injuries (P=0.001) (Table 25).

5.1.1.4 Discharge Status

Mortality rates were higher for patients with burns, head or neck injuries and thoracic injuries (P=0.001) (Table 26).

5.1.2 Outcomes by Injury Severity Score Categories

5.1.2.1 Hospital Stay

Mean duration of hospital stay increased linearly from 13.9 days in patients with an ISS score of 1-11 to 23.6 days for those with an ISS score of 25-49. The lowest mean duration of stay in the hospital was observed in patients with an ISS greater than 50, however this observation is due to the high mortality rate in this group (Table 27).

5.1.2.2 ICU Stay

There was a significantly increase in the mean duration of ICU stay with increasing injury severity scores (P=0.001) (Table 28).

5.1.2.3 Incidence of Complications

The mean number of complications was significantly highest in the 25-29 ISS category (P=0.001). The proportion of patients with complications increased significantly with increasing ISS (P=0.001) (Table 29).

5.1.2.4 Discharge Status

As expected the highest mortality rate was observed in the ≥ 50 ISS category (P=0.001). Significantly higher proportions of patients with an ISS score between 1 – 11 were transferred to rehabilitation center (P=0.001) (Table 30).

5.1.3 Outcomes by Hospital Course

5.1.3.1 Hospital Stay

There was no association found between duration of hospital stay and the method of transport to the hospital. Patients who were admitted in the ICU had a significantly longer hospital stay when compared to patients who were not admitted in the ICU (P=0.001). Similarly, patients requiring surgery also had a significantly longer hospital stay than patients without surgery (0.042) (Table 31).

5.1.3.2 ICU Stay

Patients who were transferred to the level I trauma center from other hospitals had a significantly longer ICU duration stay than those transported directly to the level I trauma center (P=0.001). The highest proportion of patients staying in the ICU for less

than two days were those that were directly transported to the level I trauma center (P=0.05). A significantly higher mean duration of ICU stay was observed for those patients requiring surgery (P=0.001) (Table 32).

5.1.3.3 Incidence of Complications

Patients that were directly transported to the level I trauma center had lower incidence of complications than those that were transferred (P=0.088). Patients admitted in the ICU had significantly higher mean number of complications as well as a higher incidence of complications (P=0.001) (Table 33).

5.1.3.4 Discharge Status

Mortality rate was significantly higher in patients that were admitted in the ICU and for those not treated with surgery (P=0.001). The highest proportion of patients transported to a rehabilitation center was for those requiring surgery (P=0.001) (Table 34).

5.1.4 Outcomes by ER Stay (Prior to Admission)

5.1.4.1 Hospital Stay

Mean hospital stay increased significantly with ER delay (P=0.001). The highest proportion of patients staying in the hospital for more than 30 days was for those patients staying greater than 13 hours in ER (P=0.001) (Table 35).

5.1.4.2 ICU Stay

No significant associations were found between ER Stay and duration of stay in the ICU (Table 36).

5.1.4.3 Incidence of Complications

The incidence of complications increased directly with duration of ER stay (P=0.001) (Table 37).

5.1.4.4 Discharge Status

The highest mortality rate was observed for patients with an ER Stay greater than 3 hours (P=0.001). This is most likely due to the early deaths in the Emergency Room. However after the initial three-hour period mortality rate increased significantly with duration of ER stay (P=0.001) (Table 38).

5.1.4.5 Logistic Regression Analysis for Mortality

The logistic Regression analysis showed that the following variables were independent significant predictors of mortality: male gender (P=0.001), injured in a fall (P=0.087), head or neck injuries (P=0.012), abdominal injuries (P=0.011), burns (P=0.001), higher ISS (P=0.001), older age (P = 0.001), and longer ER stay (0.001) (Table 39).

5.1.5 Objective 4

5.1.5.1 Standardized Mortality Rate

Quality of care was assessed by standardized mortality rate in the whole sample and stratified by age and mechanism of injury. The MTOS data were used to produce expected number of deaths using external indirect standardization. These results are summarized in Table 40 show that the observed mortality rate was lower than the age and injury adjusted expected rates for patients under the age of 75 years. However, the inverse was true for patients over the age of 75 suggesting an increased deterioration in

the quality of care with increasing age. Stratification of the analysis by mechanism of injury showed that while the observed mortality rate for MVA is less then expected indicating appropriate care. For falls the observed mortality is higher by a factor of 2.2 indicating significantly inappropriate level of care (Table 41).

6.0 DISCUSSION

The aging population continues to grow and will require progressively more health care services. Regional trauma care systems had been designed for young trauma patients that are mostly injured in motor vehicle collisions and have severe penetrating trauma. Triage protocols both at the pre-hospital and in-hospital level are aimed at identifying those patients with severe injuries for whom immediate definitive care at a level I trauma center is essential in order to prevent death. However, these trauma care systems have not anticipated the emerging need to manage the geriatric trauma patient. It is essential that modern trauma systems meet the special needs of these elderly trauma patients. The current study took the first step in determining whether the Quebec trauma care system addresses the needs of the elderly trauma patients.

This was a prospective single cohort study composed of elderly patients treated for injuries in level I trauma centers in Quebec. The study sample was comprised of approximately 5,000 patients over the age of 65 who were treated for injuries in 3 of the 4 level I trauma centers in Quebec.

The purpose of the study was to describe the profile and outcomes, identify predictors of outcomes focusing on mortality and evaluate the quality of care provided to the elderly trauma patients treated in level I trauma centers in Quebec. The results of this study showed that the leading cause of injury in the elderly population were falls, followed by motor vehicle accidents (MVA). These findings are consistent with other studies in the literature and with the known epidemiology of injury.[61,70,71] The annual incidence of falls is approximately 30% in persons over the age of 65 years and this rates rises to 50% in persons over 80 years of age.[72] One reason for this observation is that the

elderly have intrinsic factors such as; decreased muscle tone and strength, uneven gait, and declining visual abilities, which predispose them to having fall-related injuries. There are several studies that show that the above age-related physiological factors contribute to instability and thus cause the elderly to have higher incidence of falls and fall-related injuries.[73-75]

This and other studies have documented that falls in the elderly population result in mild injuries, as indicated by low ISS scores.[71-73] In the current studies the overall injury severity was low. The study also showed that the majority of injuries are mild in severity as shown by the high proportion (79%) of patients with an ISS between 1 and 11. However, despite the milder injuries, a relatively high mortality was observed. This is consistent with other reports and the expected outcome in the elderly trauma patient. One possible explanation is that the injury severity scoring system such as the ISS may be less predictive in the elderly population. Similar conclusions have been rendered by others.[76,77]

Several studies have demonstrated that age is an important determinant of morbidity and mortality after injury in the elderly.[14,78-79] The current study confirmed these findings and that older age was significantly associated with higher incidence of complications, and longer hospital stays. Older subjects were also more likely to be injured in falls and had injuries of a lower severity. These findings were also consistent with those reported in the literature and the epidemiology of injury.[71-73]

Bivariate analysis identified older age, male gender, higher Injury Severity Score (ISS), injuries to the head, neck and thorax and injuries by firearms or stabbing to be associated with increased risk of death. As mentioned earlier older age is a known risk

factor for mortality among trauma patients. Other authors have reported similar results with respect to gender.[79] A possible explanation of this may be the difference in the mechanism of injury and the higher prevalence of preexisting conditions in males in the elderly trauma patient.

Injuries to the head or neek[12] and those affecting the upper body[13] are associated with increased risk of death for trauma victims of all ages. These results therefore are compatible with others in the literature and are expected in consideration of the physiological processes relating to injuries in these anatomical regions.

The association between higher injury severity and risk of dying is also expected. Similarly firearm and stabbing related injuries are associated with increased risk of death in all age groups. Violence is an increasing cause of injury in the elderly population. Although the image of violent assault is that of the younger population, several studies have demonstrated that assault is the source of 4% to 14% of the trauma admissions in the elderly population.[80-82] Penetrating trauma due to gunshots wounds or stabbings have also been associated with a higher risk of dying in the elderly population because of the higher injury severity as well as increase in incidence of complications.[81-83] The current study findings concur with the other studies in the literature.

Even though there were a small number of burn victims in the study population, a significant association was found between burns and higher mortality rate. There are several physiological explanations that justify these study findings. First, aging causes a decline in the immune system competence and a decreased cell-mediated and humoral immune response to foreign antigens, which increases the risk of infection and complications.[83] Second, skin and tissue regeneration as well as wound healing

significantly decrease with age, which again results in increased rates of complications and mortality in the elderly bum victim.[84]

Logistic regression analysis was used to evaluate the independent effect of the outcome predictors on risk for mortality. The results of this analysis showed that older age, male gender, falls, thoracic and abdominal injuries, and longer ER stay. Morris et al.[79], also reported that male gender along with age and severity of injury were factors that were associated with most deaths.

In the current study longer emergency room wait after the first three hours was associated with increased mortality risk. However, the highest mortality rate was observed for patients waiting less than three hours in the emergency room. This observation is compatible with Trunkey's classification[85] of immediate trauma deaths. These arc deaths that occur within the first three hours after the injury and are for the most part non-preventable regardless of the quality of care provided. According to Trunkey's model however, the next phase of trauma deaths are known as early deaths and they occur within the first 24 hours after the injury. These deaths can be prevented if appropriate care is provided. In addition the distribution of early deaths resembles the normal with the highest death rate occurring at approximately 12 hours and then declining.

In the current study the rate of dying increased steadily after three hours and was highest for patients waiting in the emergency room for more than 12 hours. These results would suggest that the existing emergency room triage protocols in the level I trauma centers fail to identify those elderly patients that are at increased risk for dying. The most likely explanation for this observation is that these triage protocols are aimed at

identifying patients with severe injuries. The elderly trauma patient injured in a fall has a low injury severity ranking and is therefore triaged as low priority resulting in long emergency room waits for definitive care. Lack of consideration of preexisting conditions and the specific needs of the older trauma patient results in the misclassification of risk and causes increased risk of dying with longer emergency room waiting times. This is an important observation and signals a serious deficiency in the Quebec Trauma system and level I trauma centers that requires immediate and careful attention. There are no other studies that have evaluated this parameter specifically in the elderly population.

Quality of care evaluation based on indirect standardization to the MTOS showed inferior quality of care with increasing age and for patients injured in falls. However, patients injured in motor vehicle accidents received superior level of care. These results taken in combination with the observed association between risk of death and longer emergency room waiting as well as the high prevalence of falls supports the conclusion that the level I trauma centers are not effective in managing elderly patients with minor trauma that are injured predominantly in falls. These results indicate a flaw in the triage system and the initial assessment of the elderly trauma patient. In addition, these data would indicate inferior understanding of the physiology of the older patient by the trauma team. This has important implications for the triage protocols both at the pre-hospital and in-hospital phase of care but also for the composition of the trauma team that is primarily comprised of surgical staff

In consideration of the above findings there may be a need to change triage protocols to accommodate the geriatric trauma care needs and to include staff

specializing in geriatric trauma care on the trauma team. The high volume of elderly trauma patients may also justify the creation of specialized geriatric trauma centers.

One of the possible limitations of the study was the use of databases that may not have been designed to the specific study questions. More specifically, preexisting conditions and concomitant medications were frequently unreported and therefore not included in the statistical analysis. In addition, the database did not contain any information regarding patient outcome once the patient was discharged from the level I trauma center, therefore no long-term follow-up information was available.

Among the strengths of the study, the prospective direction of the follow-up is important as the patients were followed forward in time from time of injury to time of discharge. Additionally, the Quebec Trauma Registry (QTR) was used, which consists of data on over 170,000 patients that have been treated for major injuries in all acute care trauma centers in the province of Quebec. This database is comprehensive: by which all eligible trauma patients were identified and included in the study. Specifically, all patients fulfilling the study criteria were identified and included in the study. This prevents selection bias from affecting the validity of our results. The low rate of missing data in the QTR, which is under 10% further enhances the validity of the results. Quality assurance measures applied during data collection and data entry ensure reliability of the data.

A major strength of the study is also the fact that this was the first ever evaluation of trauma care in the elderly conducted using data from the entire region where a regional trauma care system is operating. Data from this system were systematically collected for all eligible patients over a period of four consecutive years. This minimized the impact of

random temporal effects on the results, which may have been a concern if the data were collected during a single randomly selected year.

The last strength of the study was the use of logistic regression analysis and Standardized Mortality Rate. These statistical methods were used to adjust for potential confounders in order to ensure that statistical significance was valid and unbiased.

7.0 CONCLUSION

The results of this study have shown that the majority of elderly trauma patients are injured in falls and despite the low ISS, they have an increased mortality rate. The results have also shown that male gender, older age, injuries in the thorax, abdomen, and bums all are independent significant predictors of mortality. The observed association between longer emergency room stay and falls with increased risk of mortality along with inferior quality of care for patients injured in falls would suggest that level I trauma centers are inefficient and potentially harmful in treating these patients. Further studies would be helpful in confirming these conclusions

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APPENDIX 1 - TABLES

Table 1. Patient Demographics

Age (Years)	Mean		79.39
	Median		79.00
	Std Deviation		8.07
	95% CI of the mean	Upper	79.62
		Lower	79.17
Age (Categorical)	65 - 69	N	672
		%	13.6%
	70 - 74	N	790
		%	16.0%
	75 - 79	N	1054
		%	21.4%
	80 - 84	N	991
		%	20.1%
	85 - 89	N	860
		%	17.4%
	90 - 94	N	437
		%	8.9%
	95 - 99	N	130
		%	2.6%
Gender	Male	N	1643
		%	33.3%
	Female	N	3291
		%	66.7%

Table 2. Mechanism of Injury

Mechanism of Injury	MVA	N	606
		%	12.3%
	Fall	N	4111
		%	83.3%
	Firearm	N	11
		%	.2%
	Stabbing	N	12
		%	.2%
	Blunt Object	N	73
		%	1.5%
	Laceration	N	19
		%	.4%
	Other	N	102
		%	2.1%

Table 3. Body Regions Injured

		N	%
Body Regions	Head or Neck	1187	24.1%
	Face	695	14.1%
	Thoracic	636	12.9%
	Abdominal	303	6.1%
	Extremity	4087	82.8%
	Burns	32	.6%

Table 4. Injury Severity Score (ISS)

ISS	Mean		10.83
	Median		9.00
	Std Deviation		7.51
	95% CI of the mean	Upper	11.04
		Lower	10.62
ISS (Categorical)	1 - 11	N	3919
		%	79.4%
	12 - 24	N	556
		%	11.3%
	25 - 49	N	445
		%	9.0%
	>= 50	N	14
		%	.3%

Table 5. Hospital Course

		Count	%
Transfer	Direct Transport	3742	75.8%
	Transferred	1192	24.2%
ICU Admission	Yes	762	15.4%
Surgery	Yes	3508	71.1%

Table 6. Duration of Emergency Room (ER) Stay

ER Stay (Hrs)	Mean		10.36
	Median		6.00
	Std Deviation		10.64
	95% CI of the mean	Upper	10.70
		Lower	10.02
ER Stay (Categorical)	<= 3	N	793
		%	20.2%
	4 - 6	N	1108
		%	28.3%
	7 - 12	N	894
		%	22.8%
	>= 13	N	960
		%	24.5%
	Unknown	N	166
		%	4.2%

Table 7. Duration of Hospital Stay

Hospital Stay (Days)	Mean		15.09
	Median		11.04
	Std Deviation		14.54
	95% CI of the mean	Upper	15.51
		Lower	14.70
Hospital Stay (Categorical)	0.1 - 3.0	N	198
		%	4.4%
	3.1 - 7.0	N	992
		%	22.1%
	7.1 - 14.0	N	1601
		%	35.7%
	14.1 - 30.0	N	1239
		%	27.6%
	> 30.0	N	459
		%	10.2%

Table 8. Duration of Intensive Care Unit (ICU) Stay

ICU Stay (Days)	Mean		8.12
	Median		3.52
	Std Deviation		13.97
	95% CI of the mean	Upper	9.12
		Lower	7.12
ICU Stay (Categorical)	0.01 - 2.0	N	251
		%	34.1%
	2.1 - 3.0	N	87
		%	11.8%
	3.1 - 7.0	N	171
		%	23.2%
	7.1 - 10.0	N	49
		%	6.6%
	10.1 - 14.0	N	57
		%	7.7%
	14.1 - 30.0	N	88
		%	11.9%
	>= 30.1	N	34
		%	4.6%

Table 9. Incidence of Complications

Complications	Yes	N	1808
		%	36.6%
Number of Complications	Mean		2.37
	Median		2.00
	Std Deviation		2.12
	95% CI of the mean	Upper	2.46
		Lower	2.27

Table 10. Discharge Status

Discharged Status	Home without help	N	1047
		%	21.2%
	Home with help	N	699
		%	14.2%
	Left against advice	N	5
		%	.1%
	Transfer to Acute Care Hospital	N	301
		%	6.1%
	Transfer to Chronic Care Hospital	N	122
		%	2.5%
	Transfer to Nursing Home	N	163
		%	3.3%
	Transfer to Rehabilitation Center	N	1863
		%	37.8%
	Deceased	N	436
		%	8.8%
	Other	N	298
		%	6.0%

Table 11. Hospital Stay by Age Category

			Age							Total
			65 - 69	70 - 74	75 - 79	80 - 84	85 - 89	90 - 94	95 - 99	
Hospital Stay (Days)	Mean		13.80	14.54	14.77	15.37	16.31	15.57	16.23	15.10
	Std Deviation		17.27	14.72	13.78	14.20	14.52	11.92	14.09	14.54
	P-Value		0024							
Hospital Stay (Categorical)	0.1 - 3.0	N	54	45	33	30	21	13	2	198
		%	8.8%	6.2%	3.4%	3.3%	2.7%	3.3%	1.7%	4.4%
	3.1 - 7.0	N	183	178	228	172	138	70	23	992
		%	29.7%	24.7%	23.6%	19.0%	18.0%	17.7%	19.5%	22.1%
	7.1 - 14.0	N	190	248	358	330	283	151	41	1601
		%	30.8%	34.3%	37.1%	36.5%	36.9%	38.1%	34.7%	35.7%
	14.1 - 30.0	N	132	179	259	288	227	114	40	1239
		%	21.4%	24.8%	26.8%	31.8%	29.6%	28.8%	33.9%	27.6%
	> 30.0	N	57	72	88	85	97	48	12	459
		%	9.3%	10.0%	9.1%	9.4%	12.7%	12.1%	10.2%	10.2%
	Total	N	616	722	966	905	766	396	118	4489
	P-Value		0.001							

Table 12. ICU Stay by Age Category

			Age							Total
			65 - 69	70 - 74	75 - 79	80 - 84	85 - 89	90 - 94	95 - 99	
ICU Stay (Days)	Mean		9.29	7.64	8.37	8.91	5.91	5.03	2.64	8.12
	Std Deviation		17.57	9.08	12.01	19.85	8.40	5.43	2.22	13.97
	P-Value		0.506							
ICU Stay (Categorical)	0.01 - 2.0	N	64	61	52	41	22	10	1	251
		%	38.8%	31.9%	30.1%	34.5%	36.7%	40.0%	25.0%	34.1%
	2.1 - 3.0	N	19	23	18	14	8	3	2	87
		%	11.5%	12.0%	10.4%	11.8%	13.3%	12.0%	50.0%	11.8%
	3.1 - 7.0	N	32	34	53	27	18	6	1	171
		%	19.4%	17.8%	30.6%	22.7%	30.0%	24.0%	25.0%	23.2%
	7.1 - 10.0	N	8	20	7	9	3	2		49
		%	4.8%	10.5%	4.0%	7.6%	5.0%	8.0%		6.6%
	10.1 - 14.0	N	11	20	11	10	3	2		57
		%	6.7%	10.5%	6.4%	8.4%	5.0%	8.0%		7.7%
	14.1 - 30.0	N	19	27	24	12	4	2		88
		%	11.5%	14.1%	13.9%	10.1%	6.7%	8.0%		11.9%
	>= 30.1	N	12	6	8	6	2			34
		%	7.3%	3.1%	4.6%	5.0%	3.3%			4.6%
	Total	N	165	191	173	119	60	25	4	737
	P-Value		0.438							

Table 13. Incidence of Complications by Age Category

			Age							Total
			65 - 69	70 - 74	75 - 79	80 - 84	85 - 89	90 - 94	95 - 99	
Number of Complications	Mean		2.67	2.29	2.41	2.30	2.35	2.29	2.14	2.37
	Std Deviation		2.39	1.93	2.25	1.98	2.30	1.60	2.05	2.12
	P-Value		0.431							
Complications	No	N	473	531	679	604	507	266	66	3126
		%	70.4%	67.2%	64.4%	60.9%	59.0%	60.9%	50.8%	63.4%
	Yes	N	199	259	375	387	353	171	64	1808
		%	29.6%	32.8%	35.6%	39.1%	41.0%	39.1%	49.2%	36.6%
	Total	N	672	790	1054	991	860	437	130	4934
	P-Value		0.001							

Table 14. Discharge Status by Age Category

			Age							Total
			65 - 69	70 - 74	75 - 79	80 - 84	85 - 89	90 - 94	95 - 99	
Discharged Status	Home without help	N	238	206	218	158	137	64	26	1047
		%	35.4%	26.1%	20.7%	15.9%	15.9%	14.6%	20.0%	21.2%
	Home with help	N	115	122	160	163	98	31	10	699
		%	17.1%	15.4%	15.2%	16.4%	11.4%	7.1%	7.7%	14.2%
	Left against advice	N	1	2	1			1		5
		%	.1%	.3%	.1%			.2%		.1%
	Transfer to Acute Care Hospital	N	44	45	63	61	59	26	3	301
		%	6.5%	5.7%	6.0%	6.2%	6.9%	5.9%	2.3%	6.1%
	Transfer to Chronic Care Hospital	N	5	14	33	19	24	22	5	122
		%	.7%	1.8%	3.1%	1.9%	2.8%	5.0%	3.8%	2.5%
	Transfer to Nursing Home	N	5	11	24	29	47	35	12	163
		%	.7%	1.4%	2.3%	2.9%	5.5%	8.0%	9.2%	3.3%
	Transfer to Rehabilitation Center	N	198	301	412	413	332	165	42	1863
		%	29.5%	38.1%	39.1%	41.7%	38.6%	37.8%	32.3%	37.8%
	Deceased	N	46	61	93	84	90	45	17	436
		%	6.8%	7.7%	8.8%	8.5%	10.5%	10.3%	13.1%	8.8%
	Other	N	20	28	50	64	73	48	15	298
		%	3.0%	3.5%	4.7%	6.5%	8.5%	11.0%	11.5%	6.0%

Table 15. Hospital Stay by Gender

			Gender		Total
			Male	Female	
Hospital Stay (Days)	Mean		16.895	14.207	15.099
	Std Deviation		17.611	12.647	14.537
	P-Value		0.001		
Hospital Stay (Categorical)	0.1 - 3.0	N	87	111	198
		%	5.8%	3.7%	4.4%
	3.1 - 7.0	N	336	656	992
		%	22.5%	21.9%	22.1%
	7.1 - 14.0	N	462	1139	1601
		%	30.9%	38.0%	35.7%
	14.1 - 30.0	N	394	845	1239
		%	26.4%	28.2%	27.6%
	> 30.0	N	216	243	459
		%	14.4%	8.1%	10.2%
	Total	N	1495	2994	4489
	P-Value		0.001		

Table 16. ICU Stay by Gender

			Gender		Total
			Male	Female	
ICU Stay (Days)	Mean		9.291	6.349	8.119
	Std Deviation		16.386	8.925	13.971
	P-Value		0.005		
ICU Stay (Categorical)	0.01 - 2.0	N	142	109	251
		%	31.8%	37.5%	34.1%
	2.1 - 3.0	N	44	43	87
		%	9.9%	14.8%	11.8%
	3.1 - 7.0	N	103	68	171
		%	23.1%	23.4%	23.2%
	7.1 - 10.0	N	33	16	49
		%	7.4%	5.5%	6.6%
	10.1 - 14.0	N	39	18	57
		%	8.7%	6.2%	7.7%
	14.1 - 30.0	N	59	29	88
		%	13.2%	10.0%	11.9%
	>= 30.1	N	26	8	34
		%	5.8%	2.7%	4.6%
	Total	N	446	291	737
	P-Value		0.045		

Table 17. Incidence of Complications by Gender

			Gender		Total
			Male	Female	
Number of Complications	Mean		2.71	2.16	2.37
	Std Deviation		2.49	1.82	2.12
	P-Value		0.001		
Complications	No	N	959	2167	3126
		%	58.4%	65.8%	63.4%
	Yes	N	684	1124	1808
		%	41.6%	34.2%	36.6%
	Total	N	1643	3291	4934
	P-Value		0.001		

Table 18. Discharge Status by Gender

			Gender		Total
			Male	Female	
Discharged Status	Home without help	N	392	655	1047
		%	23.9%	19.9%	21.2%
	Home with help	N	207	492	699
		%	12.6%	14.9%	14.2%
	Left against advice	N	3	2	5
		%	.2%	.1%	.1%
	Transfer to Acute Care Hospital	N	140	161	301
		%	8.5%	4.9%	6.1%
	Transfer to Chronic Care Hospital	N	21	101	122
		%	1.3%	3.1%	2.5%
	Transfer to Nursing Home	N	31	132	163
		%	1.9%	4.0%	3.3%
	Transfer to Rehabilitation Center	N	540	1323	1863
		%	32.9%	40.2%	37.8%
	Deceased	N	214	222	436
		%	13.0%	6.7%	8.8%
	Other	N	95	203	298
		%	5.8%	6.2%	6.0%
	Total	N	1643	3291	4934
	P-Value		0.001		

Table 19. Hospital Stay by Mechanism of Injury

			Mechanism of Injury							Total
			MVA	Fall	Firearm	Stabbing	Blunt Object	Laceration	Other	
Hospital Stay (Days)	Mean		15.923	14.964	30.231	7.042	16.599	6.410	15.527	15.099
	Std Deviation		15.581	13.896	24.282	5.180	18.233	6.149	25.461	14.537
	P-Value		0.001							
Hospital Stay (Categorical)	0.1 - 3.0	N	52	129	2	3	7	2	3	198
		%	9.6%	3.4%	18.2%	25.0%	9.9%	11.8%	3.2%	4.4%
	3.1 - 7.0	N	135	807		3	16	10	21	992
		%	25.0%	21.6%		25.0%	22.5%	58.8%	22.6%	22.1%
	7.1 - 14.0	N	143	1378	3	5	23	4	45	1601
		%	26.4%	36.8%	27.3%	41.7%	32.4%	23.5%	48.4%	35.7%
	14.1 - 30.0	N	141	1067	1	1	14	1	14	1239
		%	26.1%	28.5%	9.1%	8.3%	19.7%	5.9%	15.1%	27.6%
	> 30.0	N	70	363	5		11		10	459
		%	12.9%	9.7%	45.5%		15.5%		10.8%	10.2%
	Total	N	541	3744	11	12	71	17	93	4489
	P-Value		0.001							

Table 20. ICU Stay by Mechanism of Injury

			Mechanism of Injury							Total
			MVA	Fall	Firearm	Stabbing	Blunt Object	Laceration	Other	
ICU Stay (Days)	Mean		8.321	7.836	11.279	1.528	6.827	1.271	12.411	8.119
	Std Deviation		11.055	15.551	11.551	.667	9.665	.854	21.841	13.971
	P-Value		0.652							
ICU Stay (Categorical)	0.01 - 2.0	N	95	136	2	2	10	2	4	251
		%	34.1%	34.4%	20.0%	66.7%	37.0%	100.0%	19.0%	34.1%
	2.1 - 3.0	N	29	47	1	1	4		5	87
		%	10.4%	11.9%	10.0%	33.3%	14.8%		23.8%	11.8%
	3.1 - 7.0	N	58	102	2		7		2	171
		%	20.8%	25.8%	20.0%		25.9%		9.5%	23.2%
	7.1 - 10.0	N	18	27	1				3	49
		%	6.5%	6.8%	10.0%				14.3%	6.6%
	10.1 - 14.0	N	28	23	1		2		3	57
		%	10.0%	5.8%	10.0%		7.4%		14.3%	7.7%
	14.1 - 30.0	N	38	44	2		2		2	88
		%	13.6%	11.1%	20.0%		7.4%		9.5%	11.9%
	>= 30.1	N	13	16	1		2		2	34
		%	4.7%	4.1%	10.0%		7.4%		9.5%	4.6%
	Total	N	279	395	10	3	27	2	21	737
	P-Value		0.752							

Table 21. Incidence of Complications by Mechanism of Injury

			Mechanism of Injury							Total
			MVA	Fall	Firearm	Stabbing	Blunt Object	Laceration	Other	
Number of Complications	Mean		2.93	2.25	3.00	5.00	2.03	1.20	3.07	2.37
	Std Deviation		2.56	1.98	2.33	1.41	1.38	.45	3.60	2.12
	P-Value		0.001							
Complications	No	N	336	2646	3	10	43	14	74	3126
		%	55.4%	64.4%	27.3%	83.3%	58.9%	73.7%	72.5%	63.4%
	Yes	N	270	1465	8	2	30	5	28	1808
		%	44.6%	35.6%	72.7%	16.7%	41.1%	26.3%	27.5%	36.6%
	Total	N	606	4111	11	12	73	19	102	4934
	P-Value		0.001							

Table 22. Discharge Status by Mechanism of Injury

			Mechanism of Injury							Total
			MVA	Fall	Firearm	Stabbing	Blunt Object	Laceration	Other	
Discharged Status	Home without help	N	140	832	3	4	24	14	30	1047
		%	23.1%	20.2%	27.3%	33.3%	32.9%	73.7%	29.4%	21.2%
	Home with help	N	61	608		2	10	2	16	699
		%	10.1%	14.8%		16.7%	13.7%	10.5%	15.7%	14.2%
	Left against advice	N	1	3			1			5
		%	.2%	.1%			1.4%			.1%
	Transfer to Acute Care Hospital	N	44	236	2	2	5	2	10	301
		%	7.3%	5.7%	18.2%	16.7%	6.8%	10.5%	9.8%	6.1%
	Transfer to Chronic Care Hospital	N	3	118					1	122
		%	.5%	2.9%					1.0%	2.5%
	Transfer to Nursing Home	N	7	149	1	1			5	163
		%	1.2%	3.6%	9.1%	8.3%			4.9%	3.3%
	Transfer to Rehabilitation Center	N	244	1568	1	1	21	1	27	1863
		%	40.3%	38.1%	9.1%	8.3%	28.8%	5.3%	26.5%	37.8%
	Deceased	N	89	328	3	2	6		8	436
		%	14.7%	8.0%	27.3%	16.7%	8.2%		7.8%	8.8%
	Other	N	17	269	1		6		5	298
		%	2.8%	6.5%	9.1%		8.2%		4.9%	6.0%
	Total	N	606	4111	11	12	73	19	102	4934
	P-Value		0.001							

Table 23. Hospital Stay by Body Region

			Head or Neck Injury		Face Injury		Thoracic Injury		Abdominal Injury		Extremity Injury		Burns	
			No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Hospital Stay (Days)	Mean		14.085	18.329	14.802	16.916	14.726	17.614	14.766	20.220	16.533	14.802	15.091	16.372
	Std Deviation		12.389	19.547	13.911	17.804	13.873	18.214	13.978	20.745	18.354	13.596	14.457	24.124
	P-Value		0.001										0.619	
Hospital Stay (Categorical)	0.1 - 3.0	N	104	94	144	54	153	45	178	20	49	149	198	
		%	3.0%	8.8%	3.7%	8.9%	3.9%	8.1%	4.2%	8.0%	6.4%	4.0%	4.4%	
	3.1 - 7.0	N	788	204	842	150	872	120	956	36	181	811	988	4
		%	23.0%	19.1%	21.7%	24.7%	22.2%	21.5%	22.6%	14.4%	23.8%	21.7%	22.2%	13.8%
	7.1 - 14.0	N	1308	293	1457	144	1458	143	1530	71	233	1368	1586	15
		%	38.2%	27.5%	37.5%	23.7%	37.1%	25.6%	36.1%	28.4%	30.7%	36.7%	35.6%	51.7%
	14.1 - 30.0	N	940	299	1071	168	1079	160	1158	81	197	1042	1231	8
		%	27.5%	28.0%	27.6%	27.6%	27.4%	28.7%	27.3%	32.4%	25.9%	27.9%	27.6%	27.6%
	> 30.0	N	283	176	367	92	369	90	417	42	100	359	457	2
		%	8.3%	16.5%	9.5%	15.1%	9.4%	16.1%	9.8%	16.8%	13.2%	9.6%	10.2%	6.9%
	Total	N	3423	1066	3881	608	3931	558	4239	250	760	3729	4460	29
	P-Value		0.001										0.328	

Table 24. ICU Stay by Body Region

			Head or Neck Injury		Face Injury		Thoracic Injury		Abdominal Injury		Extremity Injury		Burns	
			No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
ICU Stay (Days)	Mean		7.234	8.330	7.406	9.299	6.870	10.461	7.391	12.180	7.356	8.733	8.085	10.972
	Std Deviation		12.177	14.364	13.564	14.566	11.716	17.211	12.236	20.796	13.046	14.658	13.978	13.862
	P-Value		0.396		0.071		0.001		0.001		0.178		0.538	
ICU Stay (Categorical)	0.01 - 2.0	N	51	200	160	91	181	70	218	33	119	132	250	1
		%	35.4%	33.7%	34.7%	33.0%	37.9%	26.9%	34.9%	29.5%	36.1%	32.4%	34.3%	11.1%
	2.1 - 3.0	N	25	62	64	23	63	24	78	9	44	43	85	2
		%	17.4%	10.5%	13.9%	8.3%	13.2%	9.2%	12.5%	8.0%	13.3%	10.6%	11.7%	22.2%
	3.1 - 7.0	N	32	139	110	61	112	59	152	19	80	91	169	2
		%	22.2%	23.4%	23.9%	22.1%	23.5%	22.7%	24.3%	17.0%	24.2%	22.4%	23.2%	22.2%
	7.1 - 10.0	N	6	43	32	17	29	20	36	13	25	24	48	1
		%	4.2%	7.3%	6.9%	6.2%	6.1%	7.7%	5.8%	11.6%	7.6%	5.9%	6.6%	11.1%
	10.1 - 14.0	N	13	44	34	23	26	31	46	11	14	43	56	1
		%	9.0%	7.4%	7.4%	8.3%	5.5%	11.9%	7.4%	9.8%	4.2%	10.6%	7.7%	11.1%
	14.1 - 30.0	N	11	77	46	42	48	40	68	20	32	56	87	1
		%	7.6%	13.0%	10.0%	15.2%	10.1%	15.4%	10.9%	17.9%	9.7%	13.8%	12.0%	11.1%
	>= 30.1	N	6	28	15	19	18	16	27	7	16	18	33	1
		%	4.2%	4.7%	3.3%	6.9%	3.8%	6.2%	4.3%	6.3%	4.8%	4.4%	4.5%	11.1%
	Total	N	144	593	461	276	477	260	625	112	330	407	728	9
	P-Value		0.001										0.328	

Table 25. Incidence of Complications by Body Region

			Head or Neck Injury		Face Injury		Thoracic Injury		Abdominal Injury		Extremity Injury		Burns	
			No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of Complications	Mean		2.20	2.72	2.28	2.76	2.25	3.02	2.30	3.11	2.45	2.35	2.37	2.18
	Std Deviation		1.98	2.35	2.04	2.41	1.98	2.64	2.03	2.85	2.28	2.08	2.12	1.74
	P-Value		0.001								0.439		0.711	
Complications	No	N	2506	620	2740	386	2769	357	2966	160	536	2590	3111	15
		%	66.9%	52.2%	64.6%	55.5%	64.4%	56.1%	64.0%	52.8%	63.3%	63.4%	63.5%	46.9%
	Yes	N	1241	567	1499	309	1529	279	1665	143	311	1497	1791	17
		%	33.1%	47.8%	35.4%	44.5%	35.6%	43.9%	36.0%	47.2%	36.7%	36.6%	36.5%	53.1%
	Total		3747	1187	4239	695	4298	636	4631	303	847	4087	4902	32
	P-Value		0.001										0.328	

Table 26. Discharge Status by Body Region

			Head or Neck Injury		Face Injury		Thoracic Injury		Abdominal Injury		Extremity Injury		Burns	
			No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Discharged Status	Home without help	N	789	258	884	163	882	165	979	68	275	772	1041	6
		%	21.1%	21.7%	20.9%	23.5%	20.5%	25.9%	21.1%	22.4%	32.5%	18.9%	21.2%	18.8%
	Home with help	N	579	120	626	73	615	84	647	52	114	585	694	5
		%	15.5%	10.1%	14.8%	10.5%	14.3%	13.2%	14.0%	17.2%	13.5%	14.3%	14.2%	15.6%
	Left against advice	N	2	3	4	1	4	1	5		4	1	5	
		%	.1%	.3%	.1%	.1%	.1%	.2%	.1%		.5%	.0%	.1%	
	Transfer to Acute Care Hospital	N	188	113	247	54	261	40	285	16	89	212	300	1
		%	5.0%	9.5%	5.8%	7.8%	6.1%	6.3%	6.2%	5.3%	10.5%	5.2%	6.1%	3.1%
	Transfer to Chronic Care Hospital	N	109	13	112	10	116	6	120	2	6	116	121	1
		%	2.9%	1.1%	2.6%	1.4%	2.7%	.9%	2.6%	.7%	.7%	2.8%	2.5%	3.1%
	Transfer to Nursing Home	N	137	26	149	14	153	10	160	3	15	148	162	1
		%	3.7%	2.2%	3.5%	2.0%	3.6%	1.6%	3.5%	1.0%	1.8%	3.6%	3.3%	3.1%
	Transfer to Rehabilitation Center	N	1513	350	1638	225	1680	183	1763	100	165	1698	1854	9
		%	40.4%	29.5%	38.6%	32.4%	39.1%	28.8%	38.1%	33.0%	19.5%	41.5%	37.8%	28.1%
	Deceased	N	225	211	330	106	333	103	396	40	107	329	430	6
		%	6.0%	17.8%	7.8%	15.3%	7.7%	16.2%	8.6%	13.2%	12.6%	8.0%	8.8%	18.8%
	Other	N	205	93	249	49	254	44	276	22	72	226	295	3
		%	5.5%	7.8%	5.9%	7.1%	5.9%	6.9%	6.0%	7.3%	8.5%	5.5%	6.0%	9.4%
	Total	N	3747	1187	4239	695	4298	636	4631	303	847	4087	4902	32
	P-Value		0.001										0.328	

Table 27. Hospital Stay by ISS

			ISS				Total
			1 - 11	12 - 24	25 - 49	>= 50	
Hospital Stay (Days)	Mean		13.888	17.187	23.594	5.735	15.099
	Std Deviation		12.162	15.351	25.679	9.995	14.537
	P-Value		0.001				
Hospital Stay (Categorical)	0.1 - 3.0	N	112	16	63	7	198
		%	3.1%	3.2%	15.5%	50.0%	4.4%
	3.1 - 7.0	N	848	102	39	3	992
		%	23.7%	20.6%	9.6%	21.4%	22.1%
	7.1 - 14.0	N	1362	148	88	3	1601
		%	38.1%	29.8%	21.7%	21.4%	35.7%
	14.1 - 30.0	N	963	166	110		1239
		%	27.0%	33.5%	27.1%		27.6%
	> 30.0	N	288	64	106	1	459
		%	8.1%	12.9%	26.1%	7.1%	10.2%
	Total	N	3573	496	406	14	4489
	P-Value		0.001				

Table 28. ICU Stay by ISS

			ISS				Total
			1 - 11	12 - 24	25 - 49	>= 50	
ICU Stay (Days)	Mean		5.025	6.459	10.907	5.485	8.119
	Std Deviation		7.607	9.435	18.202	7.102	13.971
	P-Value		0.001				
ICU Stay (Categorical)	0.01 - 2.0	N	64	94	89	4	251
		%	43.5%	37.0%	27.4%	36.4%	34.1%
	2.1 - 3.0	N	28	31	27	1	87
		%	19.0%	12.2%	8.3%	9.1%	11.8%
	3.1 - 7.0	N	28	64	75	4	171
		%	19.0%	25.2%	23.1%	36.4%	23.2%
	7.1 - 10.0	N	5	21	23		49
		%	3.4%	8.3%	7.1%		6.6%
	10.1 - 14.0	N	12	14	30	1	57
		%	8.2%	5.5%	9.2%	9.1%	7.7%
	14.1 - 30.0	N	8	20	59	1	88
		%	5.4%	7.9%	18.2%	9.1%	11.9%
	>= 30.1	N	2	10	22		34
		%	1.4%	3.9%	6.8%		4.6%
	Total	N	147	254	325	11	737
	P-Value		0.001				

Table 29. Incidence of Complications by ISS

			ISS				Total
			1 - 11	12 - 24	25 - 49	>= 50	
Number of Complications	Mean		2.16	2.56	3.16	2.70	2.37
	Std Deviation		1.89	2.17	2.79	1.25	2.12
	P-Value		0.001				
Complications	No	N	2640	306	176	4	3126
		%	67.4%	55.0%	39.6%	28.6%	63.4%
	Yes	N	1279	250	269	10	1808
		%	32.6%	45.0%	60.4%	71.4%	36.6%
	Total	N	3919	556	445	14	4934
	P-Value		0.001				

Table 30. Discharge Status by ISS

			ISS				Total
			1 - 11	12 - 24	25 - 49	>= 50	
Discharged Status	Home without help	N	865	133	49		1047
		%	22.1%	23.9%	11.0%		21.2%
	Home with help	N	617	58	24		699
		%	15.7%	10.4%	5.4%		14.2%
	Left against advice	N	2	2	1		5
		%	.1%	.4%	.2%		.1%
	Transfer to Acute Care Hospital	N	192	62	47		301
		%	4.9%	11.2%	10.6%		6.1%
	Transfer to Chronic Care Hospital	N	116	4	2		122
		%	3.0%	.7%	.4%		2.5%
	Transfer to Nursing Home	N	147	10	6		163
		%	3.8%	1.8%	1.3%		3.3%
	Transfer to Rehabilitation Center	N	1532	203	127	1	1863
		%	39.1%	36.5%	28.5%	7.1%	37.8%
	Deceased	N	230	50	143	13	436
		%	5.9%	9.0%	32.1%	92.9%	8.8%
	Other	N	218	34	46		298
		%	5.6%	6.1%	10.3%		6.0%
	Total	N	3919	556	445	14	4934
	P-Value		0.001				

Table 31. Hospital Stay by Hospital Course

			Transfer		ICU Admission		Surgery	
			Direct Transport	Transferred	No	Yes	No	Yes
Hospital Stay (Days)	Mean		15.093	15.117	13.902	21.719	14.436	15.368
	Std Deviation		14.404	14.953	11.999	23.079	13.037	15.096
	P-Value		0.962		0.801		0.042	
Hospital Stay (Categorical)	0.1 - 3.0	N	136	62	110	88	87	111
		%	4.0%	5.5%	2.9%	12.9%	6.9%	3.4%
	3.1 - 7.0	N	743	249	896	96	332	660
		%	22.1%	22.2%	23.5%	14.1%	26.5%	20.4%
	7.1 - 14.0	N	1184	417	1443	158	350	1251
		%	35.2%	37.2%	37.9%	23.2%	27.9%	38.7%
	14.1 - 30.0	N	953	286	1056	183	365	874
		%	28.3%	25.5%	27.7%	26.9%	29.1%	27.0%
	> 30.0	N	351	108	303	156	120	339
		%	10.4%	9.6%	8.0%	22.9%	9.6%	10.5%
	Total	N	3367	1122	3808	681	1254	3235
	P-Value		0.088		0.001		0.001	

Table 32. ICU Stay by Hospital Course

			Transfer		Surgery	
			Direct Transport	Transferred	No	Yes
ICU Stay (Days)	Mean		7.356	9.068	4.945	10.700
	Std Deviation		13.527	14.467	11.804	15.038
	P-Value		0.094		0.001	
ICU Stay (Days)	0.01 - 2.0	N	157	94	151	100
		%	38.7%	28.4%	45.3%	24.8%
	2.1 - 3.0	N	50	37	39	48
		%	12.3%	11.2%	11.7%	11.9%
	3.1 - 7.0	N	84	87	81	90
		%	20.7%	26.3%	24.3%	22.3%
	7.1 - 10.0	N	24	25	19	30
		%	5.9%	7.6%	5.7%	7.4%
	10.1 - 14.0	N	31	26	20	37
		%	7.6%	7.9%	6.0%	9.2%
	14.1 - 30.0	N	46	42	20	68
		%	11.3%	12.7%	6.0%	16.8%
	>= 30.1	N	14	20	3	31
		%	3.4%	6.0%	.9%	7.7%
	Total	N	406	331	333	404
	P-Value		0.088		0.001	

Table 33. Incidence of Complications by Hospital Course

			Transfer		ICU Admission		Surgery	
			Direct Transport	Transferred	No	Yes	No	Yes
Number of Complications	Mean		2.33	2.46	2.12	3.04	2.05	2.47
	Std Deviation		2.09	2.19	1.85	2.62	1.73	2.22
	P-Value		0.257		0.001		0.001	
Complications	No	N	2405	721	2842	284	981	2145
		%	64.3%	60.5%	68.1%	37.3%	68.8%	61.1%
	Yes	N	1337	471	1330	478	445	1363
		%	35.7%	39.5%	31.9%	62.7%	31.2%	38.9%
	Total	N	3742	1192	4172	762	1426	3508
	P-Value		0.088		0.001		0.001	

Table 34. Discharge Status by Hospital Course

			Transfer		ICU Admission		Surgery	
			Direct Transport	Transferred	No	Yes	No	Yes
Discharged Status	Home without help	N	805	242	947	100	396	651
		%	21.5%	20.3%	22.7%	13.1%	27.8%	18.6%
	Home with help	N	533	166	647	52	244	455
		%	14.2%	13.9%	15.5%	6.8%	17.1%	13.0%
	Left against advice	N	3	2	3	2	5	
		%	.1%	.2%	.1%	.3%	.4%	
	Transfer to Acute Care Hospital	N	86	215	211	90	69	232
		%	2.3%	18.0%	5.1%	11.8%	4.8%	6.6%
	Transfer to Chronic Care Hospital	N	100	22	117	5	17	105
		%	2.7%	1.8%	2.8%	.7%	1.2%	3.0%
	Transfer to Nursing Home	N	138	25	154	9	36	127
		%	3.7%	2.1%	3.7%	1.2%	2.5%	3.6%
	Transfer to Rehabilitation Center	N	1513	350	1628	235	366	1497
		%	40.4%	29.4%	39.0%	30.8%	25.7%	42.7%
	Deceased	N	315	121	222	214	169	267
		%	8.4%	10.2%	5.3%	28.1%	11.9%	7.6%
	Other	N	249	49	243	55	124	174
		%	6.7%	4.1%	5.8%	7.2%	8.7%	5.0%
	Total	N	3742	1192	4172	762	1426	3508
	P-Value		0.088		0.001		0.001	

Table 35. Hospital Stay by ER Stay

			ER Stay (Hrs)				Total
			<= 3	4 - 6	7 - 12	>= 13	
Hospital Stay (Days)	Mean		14.497	16.162	15.683	16.604	15.612
	Std Deviation		15.805	15.344	15.363	14.869	15.367
	P-Value		0.001				
Hospital Stay (Complications)	0.1 - 3.0	N	54	33	28	25	181
		%	7.0%	3.2%	3.3%	2.6%	4.8%
	3.1 - 7.0	N	171	201	166	197	785
		%	22.1%	19.2%	19.6%	20.6%	20.7%
	7.1 - 14.0	N	298	385	305	323	1350
		%	38.5%	36.8%	35.9%	33.8%	35.6%
	14.1 - 30.0	N	188	309	262	287	1069
		%	24.3%	29.5%	30.9%	30.0%	28.2%
	> 30.0	N	63	119	88	124	405
		%	8.1%	11.4%	10.4%	13.0%	10.7%
	Total	N	774	1047	849	956	3790
	P-Value		0.001				

Table 36. ICU Stay by ER Stay

			ER Stay (hrs)				Total
			<= 3	4 - 6	7 - 12	>= 13	
ICU Stay (Days)	Mean		7.419	9.708	8.195	7.307	8.277
	Std Deviation		10.009	12.961	23.194	10.786	14.427
	P-Value		0.504				
ICU Stay (Categorical)	0.01 - 2.0	N	91	62	47	24	226
		%	37.6%	29.4%	37.0%	35.8%	34.3%
	2.1 - 3.0	N	25	23	16	8	73
		%	10.3%	10.9%	12.6%	11.9%	11.1%
	3.1 - 7.0	N	51	45	38	15	154
		%	21.1%	21.3%	29.9%	22.4%	23.4%
	7.1 - 10.0	N	15	17	6	5	44
		%	6.2%	8.1%	4.7%	7.5%	6.7%
	10.1 - 14.0	N	21	18	5	6	51
		%	8.7%	8.5%	3.9%	9.0%	7.7%
	14.1 - 30.0	N	28	33	12	5	80
		%	11.6%	15.6%	9.4%	7.5%	12.1%
	>= 30.1	N	11	13	3	4	31
		%	4.5%	6.2%	2.4%	6.0%	4.7%
	Total	N	242	211	127	67	659
	P-Value		0.001				

Table 37. Incidence of Complications by ER Stay

			ER Stay (hrs)				Total
			<= 3	4 - 6	7 - 12	>= 13	
Number of Complications	Mean		2.60	2.32	2.34	2.60	2.44
	Std Deviation		2.53	1.94	1.85	2.45	2.18
	P-Value		0.082				
Complications	No	N	509	673	528	546	2386
		%	64.2%	60.7%	59.1%	56.9%	60.9%
	Yes	N	284	435	366	414	1535
		%	35.8%	39.3%	40.9%	43.1%	39.1%
	Total	N	793	1108	894	960	3921
	P-Value		0.001				

Table 38. Discharge Status by ER Stay

			ER Stay (hrs)				Total
			<= 3	4 - 6	7 - 12	>= 13	
Discharged Status	Home without help	N	165	213	169	142	755
		%	20.8%	19.2%	18.9%	14.8%	19.3%
	Home with help	N	124	187	128	153	631
		%	15.6%	16.9%	14.3%	15.9%	16.1%
	Left against advice	N		2	1	2	5
		%		.2%	.1%	.2%	.1%
	Transfer to Acute Care Hospital	N	80	89	31	45	265
		%	10.1%	8.0%	3.5%	4.7%	6.8%
	Transfer to Chronic Care Hospital	N	26	24	31	28	111
		%	3.3%	2.2%	3.5%	2.9%	2.8%
	Transfer to Nursing Home	N	28	39	29	54	150
		%	3.5%	3.5%	3.2%	5.6%	3.8%
	Transfer to Rehabilitation Center	N	230	417	365	380	1418
		%	29.0%	37.6%	40.8%	39.6%	36.2%
	Deceased	N	110	83	88	84	370
		%	13.9%	7.5%	9.8%	8.8%	9.4%
	Other	N	30	54	52	72	216
		%	3.8%	4.9%	5.8%	7.5%	5.5%
	Total	N	793	1108	894	960	3921
	P-Value		0.001				

Table 39. Logistic Regression Analysis for Mortality

Variables	B	S.E	P-Value	Odds Ratio	95% CI for Odds Ratio	
					Lower	Upper
Male Gender	.626	.126	.000	1.870	1.459	2.396
Falls	.282	.165	.087	1.325	.960	1.830
Body Region Injured						
Head or Neck	.475	.190	.012	1.607	1.108	2.331
Face	.198	.156	.204	1.219	.898	1.655
Thorax	.222	.174	.200	1.249	.889	1.755
Abdomen	.525	.206	.011	1.690	1.129	2.531
Extremities	.079	.163	.626	1.083	.787	1.489
Burns	4.557	.389	.000	95.250	44.396	204.359
ISS	.064	.008	.000	1.067	1.050	1.084
Transfer vs. Direct Transport	.223	.137	.103	1.250	.956	1.635
Surgery	-.338	.136	.013	.713	.546	.932
Age (Overall)			.000			
70 – 74 vs. 65-69	.682	.147	.000	1.977	1.481	2.639
75 – 79 vs. 70 – 74	.784	.143	.000	2.189	1.653	2.899
> 80 vs. 75 – 79	1.788	.289	.000	5.979	3.396	10.527
ER Time (hrs) (Overall)			.001			
4 – 6 vs. < 4	.553	.161	.001	1.739	1.268	2.384
7 – 12 vs. 4 - 6	-.360	.164	.028	.698	.506	.963
> 12 vs. 7-12	.313	.145	.031	1.367	1.029	1.817

Table 40. Standardized Mortality Rate by Age

		Age					Total
		65 – 69	70 – 74	75 – 79	80 – 84	>85	
Expected Mortality		65	79	77	55	43	319
Observed Mortality		46	61	93	84	152	436
Standardized Mortality Rate		0.71	0.77	1.20	1.53	3.53	1.37
95% Confidence Intervals	Lower	0.486	0.555	0.905	1.111	2.619	1.19
	Upper	1.045	1.091	1.667	2.221	5.265	1.59
P - Value		0.09	0.151	0.25	0.017	0.001	0.001

Table 41. Standardized Mortality Rate by Mechanism of Injury

		Mechanism of Injury	
		MVA	Falls
Expected Mortality		102	147
Observed Mortality		89	328
Standardized Mortality Rate		0.87	2.23
95% Confidence Intervals	Lower	0.660	1.869
	Upper	1.172	2.769
P - Value		0.38	0.0001

APPENDIX II – ETHICS CERTIFICATION