

THE UNIVERSITY OF CALGARY

UTILIZATION OF REHABILITATION SERVICES AND ALLIED HEALTH  
SERVICES, WITHIN AN ACUTE CARE HOSPITAL, FOR PATIENTS WITH  
MOVING VEHICLE RELATED INJURIES

by

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A THESIS

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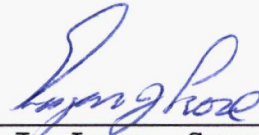
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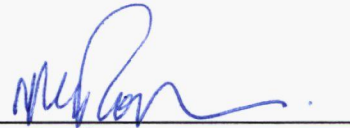
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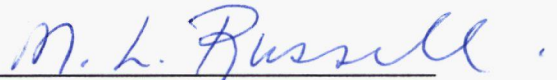
The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled, "The Utilization of Rehabilitation and Allied Health Services, within an Acute Care Hospital, for Patients with Moving Vehicle Related Injuries" submitted by E. Joan McGregor in partial fulfillment of the requirements for the degree of Master of Science.



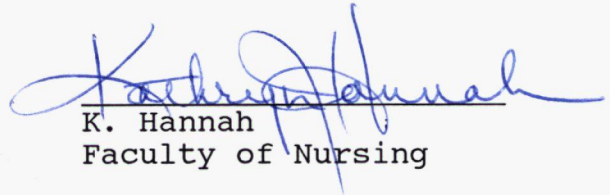
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## ABSTRACT

Injuries sustained from moving vehicle trauma constitute a major public health problem. As a result of technological advances, many individuals with previously fatal injuries are now surviving. Thus, the importance of the rehabilitation component of trauma care is magnified, to ensure that individuals attain their maximal physical, functional and psychosocial recovery.

Although the benefits of rehabilitation are clinically accepted, there is currently a lack of literature delineating the utilization of services for individuals with moving vehicle related injuries. In addition, there is currently an increased emphasis on ethics in rehabilitation, and the need to ensure that individuals receive the services that they require.

This study investigated the utilization of rehabilitation services (physiotherapy, occupational therapy, speech therapy, recreational therapy, orthotics) and other allied health services (social services, psychology, dietary, respiratory therapy) for all patients admitted to the Calgary General Hospital from April 1, 1987 to March 31, 1989 with moving vehicle related injuries. Service utilization was also analyzed to determine its association with the quantitative injury severity measures of the Abbreviated Injury Score (AIS), Injury Severity Score

(ISS), and the Glasgow Coma Scale (GCS).

It was determined that the utilization of rehabilitation and other allied health services is an important aspect of trauma care within the acute hospital, with over 83% of the cases receiving treatment from at least one of the services. The utilization of the services was associated with all of the quantitative injury scores, and the combination of the GCS and the ISS appeared to be the most useful measurement to indicate probable utilization of services.

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## DEDICATION

I would like to dedicate this thesis to my father, and to my mother, who always have encouraged and supported my educational pursuits. I would also like to dedicate this thesis to Smokey, for his companionship throughout this undertaking.

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## Chapter 1

### INTRODUCTION

Trauma has been described as a seriously neglected public health problem in which death and disability are a frequent consequence (Baker, 1987; Trunkey, 1983). Injuries primarily occur near the beginning of an individual's most productive work years and trauma is the most prevalent cause of death between the ages of 1 and 38. Thus, costs to society and personal losses attributable to trauma are high.

Moving vehicle injury is the leading cause of fatal injuries, and the fourth leading cause of nonfatal injuries in the United States. In Canada, moving vehicle injuries account for 30-40% of the total trauma deaths annually and the total years of life lost is greater than for all cardiac and respiratory deaths (Burns, 1985). In addition, injuries sustained from moving vehicles result in a large number of hospitalizations. Trauma from moving vehicles is the second leading cause of hospitalization in Canada, with heart disease being the leading cause. In Alberta, during 1986-1987 there were 252.2 hospital separations and 3.4 fatalities per 100,000 people related to moving vehicle injuries (Injury Awareness and Prevention Centre, 1989). The average length of stay was 8.69 days. It has been

estimated that between 1981 and 1991 there will be 64,000 lives lost and 3,000,000 injuries suffered in Canada which are attributable to moving vehicles (Burns, 1985). It is, thus, evident that moving vehicle injuries have an enormous impact on society and the Canadian Health Care System.

In recent years, much attention has been directed toward reducing the number of trauma fatalities. Numerous studies have reported a decrease in the percentage of trauma incidents that have resulted in death, and conclude that individuals are now surviving what previously would have been fatal injuries (Baxt and Moody, 1987; Cales, 1984; Ornato, Craren, Nelson and Kimball, 1985; Shackford, Mackersie, Hoyt, Baxt, Eastman, Hammill, Knotts and Virgilo, 1987; Walt, 1983). MacKenzie, Seigel, Shapiro, Moody and Smith (1988) report that between 1975 and 1985 the age standardized death rates for all injury-related deaths was reduced by 21%. This improvement in survival has been attributed to advanced prehospital care, to improvements in transportation, to technical developments, to improved trauma organizational systems, to regionalization of trauma care and to aggressive and improved surgical techniques.

Although the reduction of the number of trauma fatalities is inherently very positive, other ramifications of this situation must be considered. Improving the survival rate results in a growing number of individuals

with impairments and disabilities which may interfere with their ability to return to their pretrauma functional status (MacKenzie, Shapiro, Smith, Siegel, Moody and Pitt, 1987; MacKenzie et al, 1988). As defined by the World Health Organization, an impairment is "any loss or abnormality of psychological, physiological or anatomical structure or function" and a disability is "a restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being" (World Health Organization, 1980). Unfortunately, many individuals suffer from severe and lifelong disabilities as a result of moving vehicle crashes. Catastrophic consequences are particularly evidenced in brain and spinal cord injuries, and the long term care of these individuals is increasingly being recognized as a major health care issue (Royce, Dunn and Moody, 1988; Snow, Macartney-Filgate, Schwartz, Klonoff and Ridley, 1988; Viano, 1988).

Some recent studies have sought to determine the long term outcome for individuals sustaining moving vehicle injuries. Rhodes, Aronson, Moerkirk and Petrash (1988) followed 445 trauma patients between 6 months and 30 months post injury. Although they did not clearly define the criteria for the outcome measures, they reported that 83% made a good recovery, 75% returned to their former work status, 5.6% had severe disability and 2% were permanently

institutionalized. The authors concluded that post injury recovery is quite optimistic and that, with time and early rehabilitation, the majority of the patients can expect to return to a productive and independent life.

In contrast, MacKenzie et al (1987) studied 266 trauma patients and conducted a followup at one year post injury. They determined that, of the individuals who had been employed preinjury, only 56% were employed at one year. They emphasize the public health importance of injuries, as related to the disabilities imposed on those who survive. It is important to note that neither of these studies (MacKenzie et al, 1987; Rhodes et al, 1988) indicated the rehabilitation services received by the patients, however MacKenzie et al mentioned parenthetically that 50% of the patients received physiotherapy.

As the survival rate for trauma victims escalates, the importance of the rehabilitation component of trauma care is more clearly identified. Rehabilitation has been described as being the "forgotten stepchild" of trauma care, and it has been stressed that more emphasis must be placed on this aspect of the trauma system (Morris, Limbird, and Johnson, 1988). Trunkey (1983) suggests that a pronounced deficit in trauma care is the lack of an integrated rehabilitation system. In a report of hospital and prehospital resources for optimal care of the injured patient, the Committee of

Trauma of the American College of Surgeons (1986) expressed concern regarding access and utilization of rehabilitation resources. They emphasize that a lack of access to these services leads to increased residual disability and increased costs to society. In a study of nation wide status of trauma systems in the United States, West, Williams, Trunkey and Wolferth (1988) outlined a step-by-step process to correct shortcomings in a number of areas within trauma care. They recommended that plans be developed which deal with the trauma patient in the field to his/her complete rehabilitation. They further state that "comprehensive rehabilitation services must be available for all trauma patients, starting as early in the treatment cycle as possible".

There is currently a lack of literature or research delineating the utilization of rehabilitation services for individuals sustaining injuries from moving vehicle crashes. It was the objective of this study to obtain descriptive information regarding the current rehabilitation services utilization practices, within an acute care hospital, for those individuals admitted with moving vehicle related injuries. Through the exploration of current utilization practices and trends, information would be obtained that would suggest further avenues for research, and help to ensure that individuals receive the rehabilitation services

they require to attain maximal functional recovery from their injuries.

## Chapter 2

### SELECTED LITERATURE REVIEW

#### Rehabilitation

The definition of rehabilitation is broadly based and can have different meanings dependent on the target groups and on the interventions utilized. Rehabilitation can be defined as the "process by which biologic, psychologic and social functions are restored to permit an individual to achieve maximal personal autonomy" (Morris et al, 1988). The specialty of Rehabilitation Medicine strives to enable individuals to achieve the highest functional independence possible, regardless of their impairments or disabilities. McDermott (1985) outlined four types of rehabilitation for the trauma patient:

- 1) Prophylactic rehabilitation - prevention of traumatic complications (e.g. decubiti ulcers) and the institution of family support;
- 2) Active rehabilitation - restoration of function;
- 3) Psychosocial rehabilitation - adaptation to residual disability, with maximal functioning in the home, community and the workplace;
- 4) Vocational rehabilitation - preparation for return to independent vocational activity.

These four types of rehabilitation can be overlapping, and the process of rehabilitation follows a continuum.

Comprehensive rehabilitation is provided by a multidisciplinary team, which aside from the physician and nurse, may include an occupational therapist, physiotherapist, speech therapist, recreational therapist, respiratory therapist, social worker, psychologist, prosthetist, orthotist and dietician.

Rehabilitation services can take the form of innumerable kinds of interventions, including pulmonary therapy, cognitive retraining, improving mobility, training in self care activities, speech retraining, splinting to prevent deformities, counselling and the provision of adaptive equipment. These services are provided in the acute care setting, in rehabilitation units within the hospital, in specialized rehabilitation hospitals and in the community.

### **Rehabilitation Disciplines**

As previously discussed, the rehabilitation of an individual can involve health care professionals from a number of disciplines. Ideally, the treatment team works in a collaborative manner in which the professionals use their specialized skills toward the shared goal of maximizing the patient's physical, psychological and social functioning. The techniques, methods and specific goals of each of the

disciplines are extensive as the professions strive to individualize their treatment to mesh with the needs of the patient. The role of a specific rehabilitation professional can vary depending on the setting, and in many instances there is much overlap in the responsibilities and roles of the disciplines. It is, therefore, difficult to provide a definition of each of the disciplines that is accurate for all circumstances. However, an overview of the services provided by the rehabilitation disciplines for trauma victims can be provided. (The services of the physiatrist and the rehabilitation nurse are not within the scope of this paper).

### *Occupational Therapy*

Occupational therapy is defined as "the therapeutic use of self-care, work and play activities to increase independent function, enhance development and prevent disability" (Hopkins, 1988). This discipline is concerned with the entire life role of an individual, and strives to maximize independence in all activities of daily living regardless of the residual impairments or disabilities that an individual may have. Of particular concern to an occupational therapist is an individual's ability to maintain independence in self care activities such as feeding, dressing, grooming and hygiene. Occupational therapists can provide individuals with various aids and

adaptations to maximize independence, and frequently are involved in splinting to prevent deformities and improve function.

### *Physiotherapy*

A physiotherapist is primarily involved with the neuromusculoskeletal, pulmonary and cardiovascular systems of an individual. This discipline focuses on maintenance or restoration of the functions associated with these systems (Anderson, 1984). Therapeutic interventions include exercises for increasing strength, range of motion, endurance, coordination and balance. Physiotherapists are often involved with patients experiencing respiratory impairments, and are also concerned with maximizing independence with mobility, and reducing pain.

### *Speech Therapy/Pathology*

Previously, speech therapists were primarily involved with the treatment of articulation and voice disorders. However, this role has recently been expanded in response to the complicated profile of many trauma victims (Tsugawa, 1987). In addition to the management of speech disorders, this discipline is also involved with treatment of deficits in cognitive abilities associated with speech and language, with swallowing disorders, and with providing access to alternative methods of communication.

### *Recreational Therapy*

Therapeutic recreation is a service that utilizes recreation as an intervention for individuals with physical, social or emotional impairments to promote growth and development (Nachman, 1981). This discipline is concerned with educating individuals regarding appropriate utilization of their leisure time, and enhancing leisure skills. When an individual experiences residual disability associated with trauma, a recreational therapist can provide him/her with the opportunity to learn new leisure activities and skills, and provide them with information regarding community resources.

### *Respiratory Therapy*

The respiratory therapist's role is important for several categories of traumatized patients, including thoracic trauma, postsurgical and neurological trauma patients (Allaway, 1987). Basically, a respiratory therapist is involved with patients who require respiratory assistance, mechanical ventilation, monitoring and therapy to maintain adequate pulmonary expansion and oxygenation, or airway management. This discipline is also involved with the administration of various assessments and tests to ensure that the pulmonary system of an individual is functioning adequately.

### *Social Services*

A social worker counsels individuals and families in regard to the social and emotional implications of their injuries and any residual disabilities (Anderson, 1984). The role of this discipline is often one of providing support and teaching individuals the necessary skills for coping and adaptation. The social worker is also involved with financial counselling and providing access to community resources and agencies.

### *Psychologist*

The role of the psychologist with the trauma patient can broadly be divided into two areas. Firstly a psychologist, or neuropsychologist is able to administer and interpret a number of formalized assessment tools to assist in an accurate diagnosis of residual impairment (Strubreither, 1987). Secondly, the psychologist can provide psychotherapy to the patient or the family to enhance coping skills and maximize emotional functioning. The psychologist may also provide guidance to other members of the treatment team regarding the most appropriate behavioral management of the patient.

### *Orthotist/Prosthetist*

An orthosis is defined as "any device attached or applied of the external surface of the body to improve

function, restrict or enforce motion, or support a body segment" (Redford, 1984). An orthotist is involved with the development, fabrication and application of these orthoses. Some examples of orthoses frequently required by trauma patients include Philadelphia collars, thoracolumbosacral orthosis, braces and shoe raises. A prosthetist is involved with the development and fabrication of artificial limbs.

### *Dietician*

The role of the dietician is to assist in the evaluation of the patient's nutritional status, to develop modified diets or feeding patterns and in providing education to the patient and the family regarding appropriate eating patterns to maximize health (Anderson, 1984). A patient who has experienced severe trauma will require close assessment of nutritional needs to avoid malnutrition (Gibson, 1987).

### **Benefits of Rehabilitation**

Rehabilitation is a relatively new field in health care, with the growth of many of the professions occurring after World War II. There has been a great expansion in many of the fields of rehabilitation in the past decade, and an increase in demand for services (Melvin, 1988). Research continues to be required in many of the areas to verify the benefits of various therapies. However, often ethical

considerations preclude true experimental research within rehabilitation. In general, however, the value of rehabilitation efforts are clinically accepted and various forms of research support the value of early and comprehensive rehabilitation.

Benefits of rehabilitation are exemplified by the sequela attributed to prolonged inactivity with illness and injury, when rehabilitation interventions are not practiced. It has been shown, clinically, that inactivity leads to contracture formation, skeletal decalcification, pressure sores, excessive muscle weakness, cardiopulmonary deconditioning, cognitive dulling and demoralization of the patient and family (Perry, 1983). A study of 102 head injury patients who had an average 20 month time lag between injury and the institution of rehabilitation services uncovered a total of 40 severe decubiti ulcers, 30 frozen shoulders and 200 major joint deformities (Rusk, Block, Lowman, 1969). In a more recent study undertaken by Yarkony and Sahgal (1987) the incidence of contractures in 75 patients with craniocerebral trauma was investigated. They defined a contracture as a loss of range of motion in a joint to the degree that it impairs activities of daily living, and identified that contractures occurred in 84% of the study population. The authors stress the importance of maintenance of range of motion and limb positioning, and the need for early interventions from occupational and physical

therapists. Similar findings were reported by Sposito, Casalis and Ferraretto (1984) from a study of paraplegic patients in Brazil who did not have early access to rehabilitation. The importance of preventative rehabilitation is clearly demonstrated.

Another form of support for the value of rehabilitation is from extrapolation from animal studies. Yu (1976) reviewed the results attained from experiments on brain damaged animals. His findings suggested that training can have an active and specific role in the functional improvement following brain damage in man.

Support for rehabilitation has also been obtained through research on individuals who have suffered cerebral vascular accidents. It is generally concluded that active and early rehabilitation is important in maximizing a stroke victim's independence. Lehman, Dehateur, Fowler, Warren, Arnhold and Schertzer (1975) studied the effect of rehabilitation of 114 stroke patients. They showed that the patients obtained significant functional gains through rehabilitation, which were maintained at followup. Although there was no control group in this study, they assumed that the gains were not due to spontaneous recovery, as the patients were admitted to the center 6 to 12 months post CVA.

In a controlled study undertaken by Smith, Garraway, Smith and Akhtar (1982), 302 stroke patients were randomly

assigned to a rehabilitation stroke unit and to a medical unit. They showed that more patients were independent in self care in the rehabilitation unit as opposed to the medical unit. The authors attribute this improvement in functional ability to the receipt of additional and earlier rehabilitation services.

Novak, Satterfield, Kolski, Hackmeyer and Connor (1984) also investigated the factor of increasing the time between stroke onset and rehabilitation in a study of 687 patients. They concluded that the time lag adversely affected recovery of physical activities, such as ambulation and mobility, transfers to toilet, bed, tub, and in relearning self care activities.

The importance of early rehabilitation is also stressed by Gogstad and Kjellman (1976). They studied 72 patients with a diagnosis of a head injury or stroke and concluded that one of the most decisive factors determining the level of functional recovery obtained was the period of inactivity before rehabilitation.

Similar results were also reported by Cope and Hall (1982) from a study undertaken on 36 severely head injured patients. The subjects were retrospectively divided into early and late rehabilitation groups (before and after 35 days post injury). The groups were matched for age, length of coma, level of disability and neurosurgical procedures required. Their findings indicated that the early

admissions required half of the amount of acute rehabilitation as the late admission patients. They concluded that early rehabilitation is valuable in improving neurologic outcome and preventing secondary complications.

Aranow (1987) evaluated the benefits derived from inpatient rehabilitation for severe head injuries. In a quasi-experimental retrospective design, subjects were divided into groups who received rehabilitation, and those who did not. She found that although it was the more severe head injured that had received rehabilitation, the rehabilitation group was associated with significantly better long term outcome.

The benefits of rehabilitation for spinal cord injured patients has also been investigated. Yarkony, Roth, Heinemann, Wu, Katz and Lovell (1987) studied the functional outcomes of 711 patients with traumatic spinal cord injuries whom were admitted to a rehabilitation hospital. They found that there were statistically significant improvements for the patients, from admission to discharge, in the areas of self care and mobility. The same authors were involved in a followup study of 236 of the patients 3 years post discharge (Yarkony et al, 1988). They were able to identify that the functional gains the spinal cord injured patients made while in the rehabilitation hospital were maintained at three years followup.

Carey, Seibert and Posavac (1988) investigated the

progress of individuals within inpatient rehabilitation. They studied 6,194 patients with different conditions and disabilities and examined functional gains made within the rehabilitation hospital. They reported that patients with head injury, multiple impairments, orthopedic injury and spinal cord injury made the most gains.

The above studies indicate that active and timely rehabilitation is important for a number of different conditions and illnesses. It is also clear that there is an inconsistency regarding referral of patients to rehabilitation services, and the time frame within which it occurs. In addition, the interventions utilized and the disciplines involved during rehabilitation are not identified.

### **Rehabilitation and the Trauma Patient**

When an individual is involved in a moving vehicle crash, their physical, emotional and social functioning can be instantaneously and severely altered for life. Unlike other chronic conditions such as arthritis and COPD, the individual, his family and the medical personnel involved have not been able to prepare for the patient's possible disability and lifestyle alteration. As many victims of moving vehicle injury incidences are relatively young, they may be facing over 60 years of disability.

Trauma care must not only involve maximizing an

individual's physical status, but also must recognize issues surrounding a person's quality of life and their long term costs to society and the health care system. It is in these areas of trauma care that the rehabilitation component of trauma care is of utmost importance.

Although there may be a large number of medical personnel involved with the rehabilitation of a trauma patient, their ultimate goal is to maximize the individual's functional independency. Therefore, in the long term, rehabilitation can be viewed as a cost containment device for the health care system and society (McMurtry, Nelson, de la Roche, 1989 b; Newman, 1979).

As previously discussed, the rehabilitation component of trauma care is increasingly being recognized as being essential (Morris et al, 1988; Trunkey, 1983; West et al, 1988). However, areas of neglect remain in ensuring that trauma victims receive the rehabilitation services they require to maximize functioning. To quote Gloag (1985), "However brilliant the surgical solution, the end result cannot be satisfactory unless the patient is rehabilitated to function at his maximum."

### **Ethics and Rehabilitation**

Ethics are becoming an increasingly important issue in the area of rehabilitation. Many authors suggest that the number of people who actually receive medical rehabilitation

is far below the number that might benefit from access to care (Caplan, Callahan and Haas, 1987; Haas, 1988; Symington, 1984). Rehabilitation differs from acute medical care, in that there is a greater potential for subjectivity in selection of those individuals who may benefit from the interventions (Haas, 1988). A great number of factors, other than a person's medical status, will influence whether they are referred to rehabilitation services. These factors include, but are not limited to, the availability of rehabilitation personnel, access to rehabilitation facilities, and the knowledge of the physician of the potential benefits of rehabilitation interventions.

One study that exemplifies that referral to rehabilitation services may be influenced by other factors was undertaken by Dore (1987). By investigating the referral patterns to physical therapy from 1981 to 1985, he concluded that utilization of physical therapy increased dramatically with the introduction of the Diagnostic Related Groups (DRG) system. With this system, medicare only allowed certain monetary reimbursements for illnesses or diseases within a particular group. As the Medicare prospective payment system placed economic and time constraints on patient treatment, physical therapy was utilized to maximize treatment within these constraints.

Another study that demonstrates that referral to rehabilitation services can be altered was a quality

assurance study on the utilization of occupational therapy (Ostrow and Kuntavanish, 1983). Initially, through a chart audit, it was determined that 71% of the patients requiring an occupational therapy referral for activities of daily living deficiency did not receive one. They attributed the lack of referrals to a limited awareness of physicians and of nurses of available occupational therapy interventions. To counteract this lack of knowledge, the occupational therapists initiated a campaign to educate other professionals regarding the services they could offer. A subsequent chart audit was undertaken six months later, and they found that the number of missed referrals had decreased to 27%. It is, thus, apparent that many other factors may lead to referral to rehabilitation services.

A study undertaken by Davidoff, Stolp-Smith, Waring and Cole (1988) investigated 107 inpatients who were referred to physiotherapy or physiatry. They reported that many people who were referred to physiotherapy could have benefitted from other rehabilitation services and that there were many inconsistencies in terms of referral practices. They emphasize that physicians have major problems in identifying patients who might benefit from rehabilitation services.

With specific reference to trauma care, Morris et al (1988) expound that a critical component of the rehabilitation process is the identification of those in need of service.

Symington (1984) states that the rehabilitation services in Canada are fragmented, haphazard and that there is a lack of consistency in the delivery of services. He stresses the need for consistent application of comprehensive rehabilitation services to enable people to achieve their maximal level of functional independence.

Although recent attention is being given to the ethical considerations of rehabilitation medicine, there is a lack of literature to suggest methods of ensuring a consistent approach or the quantitative factors that would indicate the utilization of rehabilitation services. Haas (1988) suggests that guidelines delineating standards for rehabilitation referral would assist in decreasing inequities in patient selection. Currently, criteria outlining appropriate usage of rehabilitation services for trauma victims are not available.

The discussion will now focus on the quantitative measurement of severity of injury of trauma victims, and the possible use of these scales to indicate need for rehabilitation services.

### **Injury Severity Scores**

Various scales have been developed to determine the severity of injuries an individual sustains through trauma. These scales provide quantitative measures of selected

patient characteristics to help predict mortality and morbidity (Greenspan, McLellan and Greig, 1985). These scales have proven valuable, throughout trauma care, as a method to describe the extent of injuries and the hazard they cause to life, to suggest the proper allocation of therapeutic resources, and to assist in the assessment of trauma systems (Bull, 1978; Champion, Sacco, and Hunt, 1983; Civil and Schwab, 1988). Although many scales exist, discussion will be limited to the Abbreviated Injury Score (AIS), Injury Severity Score (ISS), and the Glasgow Coma Scale (GCS), as these scales are the most universally utilized in trauma research.

The AIS was first published in 1971 as a single, comprehensive method for rating tissue damage sustained from moving vehicle injury (Greenspan et al, 1985). It has subsequently been revised several times. In the most recent revision (1985) published by the Association for the Advancement of Automotive Medicine, the body is divided into six different body regions (head/neck, face, chest, abdomen, limbs, and external). Each injury is given a six digit score, with the first two digits describing the body region, the next two describing the specific organ or area of injury, and the final two digits referring to the severity level of the injury. The AIS uses a severity scale of 1-6; 1 is defined as a minor injury, 2 is a moderate injury, 3 is a serious injury, 4 is a severe injury, 5 is a critical

injury, where survival is uncertain, and 6 designates an injury which is virtually unsurvivable. It is important to note that the AIS is not a linear progression (Petrucelli, States and Hames, 1981). This scale has been found to be useful for certain purposes, however it was found to be inadequate for persons with multiple injuries.

The ISS was developed by Baker, O'Neill, Haddon and Long in 1974. It provides a valid numerical description of overall severity of injuries for people with more than one injured area of their body. It is the most widely used severity score. The ISS correlates well with mortality and length of stay in hospital; as the score increases, the risk of mortality increases and the length of stay within hospital increases (Cales, 1986). The ISS is obtained by summing the squares of the highest AIS severity code in each of the three most severely injured body regions; the range for the ISS is between 1 and 75. If any injury has a severity score of six, the ISS is automatically 75.

The Glasgow Coma Scale (GCS) is a measurement specific to brain injury. It was developed by Teasdale and Jennett (1974), as a measure of the depth and duration of impaired consciousness and coma. It has been clinically shown to predict the progress and outcome of a head injured patient (Champion et al, 1983). The GCS ranges between 3 and 15, with the lower scores signifying greater brain damage. A score of 8 or less is indicative of severe head injuries.

Many authors stress the need for further investigations and research surrounding the appropriate and expanded use of the previously discussed scales (Baranik and Chatterjee, 1981; Petrucelli et al, 1981). Although the scales were initially developed to predict mortality, there is increasing interest in utilizing standardized scales to predict functional and financial consequences of trauma.

### **Use of Scales to Predict Disability**

Some recent studies have focussed on the ability of the ISS, AIS or GCS to predict long term disability or impairment. Bull (1985) analyzed 2502 subjects with moving vehicle injuries, and compared the ISS with their disability rating. He found a fairly wide scatter of disability ratings for a given ISS and also a wide scatter of ISS within the disability groups. However, he concluded that there were useful threshold values which distinguish groups with high and low disability. This was also true for the AIS. When age is included as a variable, Bull found a strong tendency for injuries with the same ISS to cause a higher proportion of disabilities at increasing years.

MacKenzie, Shapiro, Moody, Siegel and Smith (1986) studied 473 post trauma subjects, excluding those with head injuries, at discharge and six months later to determine their functional disability. They determined that the relationship between disability and ISS is not monotonically

increasing, as it is with length of stay and mortality. Their results indicated that the proportion of people with severe injuries who report limitations is lower than those with moderately severe injuries, as defined by the ISS. They did find, however, that the AIS for particular body regions correlated well with disability measures. The AIS of the most severe extremity and spinal cord injury were the best predictors of post-trauma functional disability, excluding head injuries.

Further investigations on disabilities were performed by these authors, in which they included those patients with severe brain injury (MacKenzie et al, 1988). Four hundred and seventy-nine patients were followed for one year post injury. Of the 479 subjects, 57% had no activity limitations, 16% exhibited a limitation of either major or minor physical activity, and 27% were limited in mobility or one of the five basic self care activities. Disabilities were particularly prevalent for persons with a high AIS for the head, spine and extremities.

Some investigations have also focussed on using both the GCS and the ISS to predict outcome in patients with head injuries (Goris, 1983; Pal, Brown and Fleiszer, 1989). It is believed that a head injury is a strong predictor of future functional disability, and that the trauma scoring system fails to give this adequate weighting in predicting future outcome. Pal et al (1989) analyzed 170 patients with

multiple trauma. They found that ISS levels alone were not able to predict a good or poor functional recovery, but when combined with the GCS the prediction of recovery improved remarkably. They conclude that combining the ISS and GCS may be the best measure to predict functional outcome.

There has been one recent study that explored the economic impact of traumatic injuries, and investigated the utilization of some rehabilitation services as related to the AIS of the principal injury (MacKenzie, Shapiro and Siegel, 1988). Although the scope of rehabilitation was limited in this study, some important results were obtained. The authors studied 487 trauma patients aged 16 to 45, and followed them from admission to the trauma center, to 12 months post discharge. Within hospital, it was determined that the injuries that required the highest overall inpatient rehabilitation were the AIS of 4-5 of the spine, followed by the AIS of 5 for the head. As the severity of the injuries in these two regions increased, there was an increase in overall charges for inpatient rehabilitation. The 12 month followup only included exploration of the rehabilitation service of physiotherapy. They determined that 35% of the population received physiotherapy as an outpatient, with the average number of visits being 25. The association between severity of injury and referral to outpatient physiotherapy was not as strong as inpatient care, which was attributed to high-severity injury groups

with many inpatient days, being less likely to use outpatient services.

These previous investigations indicate that the quantitative scores of ISS, AIS and GCS have some capacities to indicate potential long term disability, functional outcome, and utilization of rehabilitation services. There is a lack of research that correlates these standardized scores with the different rehabilitation services received or required. However, it would appear that this correlation would be feasible and valuable.

MacKenzie et al (1986) suggest that a severity measure, such as the AIS , when applied to a population base, could provide planners with estimates of the rehabilitation resources required. A need for a classification system within emergency medical situations which is reflective of the future functional limitations of an individual has been identified (Cayten, Evans 1979; Pal et al, 1989). This would assist appropriate allocation of rehabilitation resources and help to ensure that all patients receive the rehabilitation services which will maximize their recovery.

### **Summary/Justification for Proposed Study**

With the multitude of advancements in trauma care, individuals with previously fatal injuries are now surviving. Associated with the improvement in survival rates is the need to provide the individuals with resulting

disabilities and impairments with appropriate rehabilitation services to maximize their functional, social, psychological and vocational status. Ethical considerations are becoming increasingly important in rehabilitation medicine, as there is a lack of standardized criteria to suggest or indicate appropriate utilization of rehabilitation services.

Within trauma care, the quantitative measurements of the ISS, AIS, and GCS have recently been utilized to predict long term outcome and functional recovery. It would appear that these scores would also be valuable to indicate or suggest the need for rehabilitation services. If this usage appears feasible and appropriate, the ISS, AIS and GCS could prove valuable in the allocation of rehabilitation resources, and in ensuring that individuals receive the rehabilitation services necessary for their optimal recovery.

### Chapter 3.

#### METHODOLOGY

The contents of this chapter includes the research questions, case definition, source of data, data collection procedures, the method of analyzing the data and the ethical considerations.

#### Research Questions

From the preceding literature, the following research questions arise:

- 1) To what extent are rehabilitative/allied health professional services being utilized in the acute hospital treatment of patients with moving vehicle related injuries?
- 2) When, during the course of hospital treatment, are rehabilitation/allied health services being utilized ?
- 3) How frequently are patients being referred for outpatient treatment?
- 4) Is there an association between the rehabilitation services utilized and any of the quantitative measures of injury severity - the Abbreviated Injury Score, Injury Severity Score, the Glasgow Coma Score or a combination of these measures?
- 5) Are there threshold values of any of the quantitative severity scores that would indicate utilization of any of the rehabilitation/allied health services?
- 6) Can any of the quantitative scores be utilized to

indicate amount of treatment time for the rehabilitation services of physiotherapy and occupational therapy?

7) For the rehabilitation services of physiotherapy and occupational therapy, what are the purposes and goals of the interventions provided?

### Method

The Calgary General Hospital is one of four major acute care hospitals within the city of Calgary. At the time of this study it was 900 bed facility, and included a thirty-seven bed rehabilitation unit. There is not a rehabilitation hospital within the city, the nearest one being 300 kilometers away.

A two year prospective audit of all patients admitted to the Calgary General Hospital for trauma was undertaken from April 1, 1987 to March 31, 1989. These patients were followed until death or discharge from the hospital. Comprehensive data about these individuals was collected, including demographic data, presence of alcohol on breath, seatbelt utilization and measurements of the ISS, AIS and the GCS. Data for this audit was collected by a study nurse from the Emergency Department and hospital records and supplemented, when necessary, by interviewing attending medical and nursing staff.

Scores for the ISS, AIS, and GCS were calculated by the study nurse from the documentation on the subject's chart.

Scores for the ISS and the AIS were calculated from the 1985 revision of the AIS, as provided by the Association of the Advancement of Automotive Medicine.

### **Case Definition**

Cases for this current study were restricted to a subset of this Calgary General Hospital Trauma Audit. All subjects who were admitted to the Calgary General Hospital from April 1, 1987 to March 31, 1989, and had sustained injury related to moving vehicles (pedestrians, bicycles, motorcycles and motor vehicles) were investigated. If a subject died within 48 hours of admission, or was transferred to another acute hospital within 48 hours of admission, they were excluded from this study. In addition, a subject had to have an ISS of at least one. This yielded a sample size of 399.

### **Source of Data**

Data for this study were obtained from two sources, which were the original trauma audit and a retrospective chart review. The variables abstracted from the original trauma audit included: age, sex, cause, presence of alcohol, seatbelt utilization, and the quantitative measurements of the AIS, ISS and the GCS. The identity code used for each case was also obtained. (Appendix 1)

Using the identity code number, the charts of the 399

subjects were retrieved from medical records. A retrospective chart audit was undertaken on these subjects to validate data from the original trauma audit, and to obtain information specific to the utilization of the rehabilitation/allied health services.

### **Data Collection Procedures**

Charts were reviewed to abstract information regarding interventions from physiotherapy, occupational therapy, speech therapy, recreational therapy, orthotics, social services, dietary, psychology and respiratory therapy. The complete charts were reviewed to obtain the necessary information, with the majority of the data being obtained from the charting of the rehabilitation/allied health care disciplines. Physician orders were also reviewed, as were nursing notes when necessary.

Data collected for all of the subjects in the study included the date and time of admission, unit upon admission, in-hospital transfers, date and time of discharge, and their disposition upon discharge. The data collected for each of the services included whether it was received, date of referral, date treatment started, the date treatment ended and whether the case was referred to the service upon discharge. For the rehabilitation services of occupational therapy and physiotherapy, assessments and progress notes were reviewed to determine the purpose of the

interventions. Some data was also collected on the purposes of the interventions with speech therapy, orthotics and recreational therapy. Appendix II outlines the data collected from the hospital charts.

### **Analysis**

Once data was collected, it was entered into the SPSS/PC data entry system. Using the identity code number of the case, variables from the original trauma audit were meshed with the data collected from this study.

The definition of a rehabilitation discipline is inconsistent. For purposes of this study the services of physiotherapy, occupational therapy, speech therapy, recreational therapy and orthotics were classified as rehabilitation services. The services of social services, psychology, dietary and respiratory therapy were included in the "other services" category.

Data were analyzed using the SPSS statistical package, and the Minitab statistical package. Data were collapsed and initially analyzed to determine the characteristics of the study population. The data were then analyzed to find the frequencies of the utilization of all of the services, and the referral patterns upon discharge. Service utilization was then cross-tabulated with each of the quantitative injury severity measures (ISS, AIS, GCS) to determine trends, and threshold values that may indicate

probable utilization of a particular rehabilitation or allied health service.

Although this is a descriptive study, Chi-square and Fisher's Exact Tests were calculated, and statistical significance was determined. These are presented for interest, and to indicate the strength of the associations.

The number of days a case was treated by a service was calculated by subtracting the final day of treatment from the initial day of treatment. Although this is a somewhat crude measurement, it provides data regarding the length of time a subject was on the caseload of a particular service. For each of the nine services, the date of initiation of treatment, date of termination of treatment and the mean number of treatment days were determined.

For the disciplines of physiotherapy and occupational therapy more detailed information was obtained. The number of days spent in treatment was analyzed with the quantitative scores of the ISS and GCS. In addition, descriptive data regarding the purposes of the interventions for these two services was determined.

### **Ethical Considerations**

Before proceeding with this study, approval was obtained from the Conjoint Medical Ethics Committee of the University of Calgary and the Research Committee of the Calgary General Hospital. Throughout the study, cases were identified by a

code number to maintain confidentiality.

## Chapter 4

### RESULTS

There were 422 individuals admitted to the Calgary General Hospital from April 1, 1987 to March 31, 1989 because of a moving vehicle related injury. Eighteen of the patients died within 48 hours of admission, and 4 were transferred to another acute hospital within 48 hours of admission. One patient was admitted for observation despite having an ISS of 0, because she was pregnant. Thus, eligible cases for this study total 399.

First a demographic description of the cases will be presented. This will be followed by an analysis of the relationships of the ISS, AIS, and GCS with the utilization of the rehabilitation/ allied health services. The last section of this chapter will provide a description of the nine services, including the number of days and when, during the hospital stay, services were provided. For the rehabilitation services of physiotherapy and occupational therapy a more detailed analysis will be provided, which correlates the number of days of treatment and the severity of injury.

## Description of Cases

### Age

The age range of the cases was from 1-85, with a mean of  $34.1 \pm 19.1$  years (Table 1). The ages with the highest representation, or the modal ages, were 18, 19, 20, and 21, with 16.8% of the cases being within this range.

**Table 1. Age Distribution of Cases Admitted to the Calgary General Hospital with Moving Vehicle Related Injury\***

| Age Group | n   | Percent | Cum. Percent |
|-----------|-----|---------|--------------|
| 0-15      | 40  | 10.0    | 10.0         |
| 16-25     | 131 | 32.8    | 42.9         |
| 26-35     | 87  | 21.8    | 64.7         |
| 36-45     | 46  | 11.5    | 76.2         |
| 46-60     | 32  | 8.0     | 84.2         |
| 60+       | 63  | 15.8    | 100.0        |
| Total     | 399 | 100.0   | 100.0        |

### Sex

Of the 399 cases, 119 or 29.8% were female and 280 or 70.2% were male. The ages of the female cases were higher than the male, with the mean age of the males being 32.1 and the mean age of the females being 38.7. However, when the cases are regrouped into the aforementioned age categories, the age differences between the two groups is not significant.

\* For further tables, the phrase "of Cases Admitted to the Calgary General Hospital with Moving Vehicle Related Injury" will be excluded, and is to be understood.

### Cause

As displayed in Table 2, the most frequent cause of injury was a motor vehicle crash (MVA), in which 270, or 67.7% of the study population were injured. Fifty-two subjects were injured in a motorcycle crash (MBA), 19 were related to bicycle incidents and 58 were pedestrians.

**Table 2. Cause of Moving Vehicle Related Injury**

| <u>Cause</u> | <u>n</u> | <u>Percent</u> |
|--------------|----------|----------------|
| MVA          | 270      | 67.67%         |
| MBA          | 52       | 13.0%          |
| Bicycle      | 19       | 4.8%           |
| Pedestrian   | 58       | 14.5%          |

The cause of the injury event differed with the sex of the subject (Table 3). For the female cases, 75.6% were caused by motor vehicle crashes, in contrast with 64.2% for the males. The greatest differences between cause for the sexes was for motorcycle crashes, in which 17.1% of the males were injured, and only 3.4% of the females. The bicycle and pedestrian related injuries were more evenly divided between the sexes. For males, 5.4% of injuries were related to bicycles, and 13.2% related to pedestrian incidents. For females, 3.4% were bicycle related and 17.6% were pedestrian events.

Table 3. Cause of Moving Vehicle Related Injury by Sex

| Cause      | Sex   |       |        |       | Total |
|------------|-------|-------|--------|-------|-------|
|            | Male  |       | Female |       |       |
|            | n     | %     | n      | %     |       |
| MVA        | 180   | 64.3  | 90     | 75.6  | 270   |
| MBA        | 48    | 17.1  | 4      | 3.4   | 52    |
| Bicycle    | 15    | 5.4   | 4      | 3.4   | 19    |
| Pedestrian | 37    | 13.2  | 21     | 17.6  | 58    |
| Total      | 280   | 100.0 | 119    | 100.0 | 399   |
|            | 70.2% |       | 29.6%  |       |       |

As shown in Table 4, the cause of the injury event was also related to age. As would be expected, pedestrian injury events occurred more frequently in the lowest and highest age categories - 27.6% of these subjects were aged 0-15, and 25.9% were over 60. Motorcycles were involved more frequently in the age categories of 16-25 and 26-35, with 78.9% of those injured by motorcycles being within these two age groups. Injuries related to bicycles were predominantly found in the cases under 26 years of age - 14 of the 19 cases (73.7%).

Table 4. Cause of Moving Vehicle Related Injury by Age

| Age   | Cause |       |     |       |         |       |      |       | Total<br>n |
|-------|-------|-------|-----|-------|---------|-------|------|-------|------------|
|       | MVA   |       | MBA |       | Bicycle |       | Ped. |       |            |
|       | n     | %     | n   | %     | n       | %     | n    | %     |            |
| 0-15  | 14    | 5.2   | 3   | 5.8   | 7       | 36.8  | 16   | 27.6  | 40         |
| 16-25 | 94    | 34.8  | 23  | 44.2  | 7       | 36.8  | 7    | 12.1  | 131        |
| 26-35 | 60    | 22.2  | 18  | 34.6  | 2       | 10.5  | 7    | 12.1  | 87         |
| 36-45 | 30    | 11.1  | 4   | 7.6   | 1       | 5.2   | 9    | 15.5  | 44         |
| 46-60 | 26    | 9.6   | 3   | 5.8   | 1       | 5.2   | 4    | 6.9   | 34         |
| 60+   | 46    | 17.0  | 1   | 1.9   | 1       | 15.2  | 15   | 25.9  | 63         |
| Total | 270   | 100.0 | 52  | 100.0 | 19      | 100.0 | 58   | 100.0 | 399        |

### Alcohol

Alcohol was known to be a factor in 32.3% or 129 of the cases. Of the 129 known cases, 88% were male, and 80.6% were in the age categories of 16-25 and 26-35. As displayed in Table 5, for the age groups of 16-25 and 26-35, alcohol was known to be a factor in almost 50% of the cases.

**Table 5. Alcohol Use by Age**

| Age   | No or Unknown |       | Alcohol<br>Yes |       | Total |
|-------|---------------|-------|----------------|-------|-------|
|       | n             | row % | n              | row % |       |
| 0-15  | 40            | 100.0 | 0              | 0     | 40    |
| 16-25 | 69            | 52.7  | 62             | 47.3  | 131   |
| 26-35 | 45            | 51.7  | 42             | 48.3  | 87    |
| 36-45 | 33            | 71.7  | 13             | 28.3  | 46    |
| 46-60 | 26            | 81.2  | 6              | 18.8  | 32    |
| 60+   | 57            | 90.5  | 6              | 9.5   | 63    |
| Total | 270           |       | 129            |       | 399   |
|       |               | 67.7% |                | 32.3% |       |

### Seatbelts

For the 270 cases involved in motor vehicle crashes, it was unknown whether seatbelts were worn by 70 (25.9%). For the remaining 200 cases, seatbelts being worn and not worn were almost equally divided, with 48.5% of the remaining cases wearing seatbelts, and 51.5% not wearing them. However, as displayed in Tables 6 and 7, there appears to be a difference based on sex and age. More

females (56.0%) wore seatbelts than did males (44.0%) (Table 6).

**Table 6. Seatbelt Use by Sex**

| Sex    | Unknown<br>n | Seatbelt             |  | Worn          |  | Total |
|--------|--------------|----------------------|--|---------------|--|-------|
|        |              | Not Worn<br>n      % |  | n      %      |  |       |
| Male   | 55           | 70      56.0         |  | 55      44.0  |  | 180   |
| Female | 15           | 33      44.0         |  | 42      56.0  |  | 90    |
| Total  | 70           | 103      51.5%       |  | 97      48.5% |  | 270   |

The age categories of 16-25 and 26-35 were the only age categories where the subjects had a higher frequency of not wearing seatbelts, with 61.9% and 59.5% respectively not wearing them (Table 7).

**Table 7. Seatbelt use by Age**

| Age   | Unknown<br>n | Seatbelt                 |  | Worn          |  | Total |
|-------|--------------|--------------------------|--|---------------|--|-------|
|       |              | Not Worn<br>n      row % |  | n      row %  |  |       |
| 0-15  | 2            | 6      50.0              |  | 6      50.0   |  | 14    |
| 16-25 | 31           | 39      61.9             |  | 24      38.1  |  | 94    |
| 26-35 | 18           | 25      59.5             |  | 17      40.5  |  | 60    |
| 36-45 | 6            | 10      41.7             |  | 14      58.3  |  | 30    |
| 46-60 | 6            | 8      40.0              |  | 12      60.0  |  | 26    |
| 60+   | 7            | 15      38.5             |  | 24      61.5  |  | 24    |
| Total | 70           | 103      51.5%           |  | 97      48.5% |  | 270   |

### Length of Stay

The length of stay within hospital ranged from one day to 738 days; with a mean of  $30.9 \pm 68.3$ , and a median of 11 days. As displayed in Table 8, the values with the highest frequency were 3, 4, 5 and 6 days, which comprised 24.4% of

the cases.

**Table 8. Hospital Length of Stay**

| <u>Days</u>         | <u>n</u> | <u>Percent</u> | <u>Cum. Percent</u> |
|---------------------|----------|----------------|---------------------|
| 1 day               | 2        | .5             | .5                  |
| 2 days              | 13       | 3.3            | 3.8                 |
| 3 days              | 28       | 7.0            | 10.8                |
| 4 days              | 23       | 5.8            | 16.5                |
| 5 days              | 25       | 6.3            | 22.8                |
| 6 days              | 21       | 5.3            | 28.1                |
| 7 days              | 18       | 4.5            | 32.6                |
| 8-14 days           | 97       | 24.3           | 56.9                |
| 15-21 days          | 56       | 14.0           | 70.9                |
| 22-28 days          | 26       | 6.5            | 77.4                |
| 29-60 days          | 51       | 12.8           | 90.2                |
| 61-90 days          | 13       | 3.3            | 93.5                |
| 91-182 days         | 11       | 2.8            | 96.2                |
| 183+ days(6 months) | 15       | 3.8            | 100.0               |
| Total               | 399      | 100.0          |                     |

#### Course of Stay Within Hospital

On initial admission to hospital, almost 30% of the cases were admitted to the Intensive Care Unit. The next most frequent unit was orthopedics (26.8%), followed by other surgical, neurosurgical, pediatrics and medical.

**Table 9. Unit Admissions**

| <u>Unit Admitted</u> | <u>n</u> | <u>Percent</u> |
|----------------------|----------|----------------|
| Intensive Care       | 119      | 29.8           |
| Neurosurgical        | 48       | 12.0           |
| Orthopedic           | 107      | 26.8           |
| Other Surgical       | 66       | 16.5           |
| Medical              | 28       | 7.0            |
| Pediatrics           | 31       | 7.8            |
|                      | 399      | 100.0          |

One hundred and thirty two cases had one within hospital transfer, 34 had two within hospital transfers, 3 cases had 3 within hospital transfers and 2 cases were transferred 4 times during their hospital stay. The majority of the cases were eventually placed on the orthopedic ward or the neurosurgical wards. Twenty three of the cases were eventually on the rehabilitation unit.

#### Disposition

Of the 399 individuals admitted to hospital, 339 (85.0%) were discharged to their homes (Table 10). Thirty-six of the cases (9.0%) were transferred to another hospital, with the majority of the hospitals being within Alberta. Cases were also transferred to hospitals within British Columbia, Saskatchewan, Ontario and the United States.

Three of the cases were transferred to rehabilitation facilities, two for physical rehabilitation and one case for alcohol rehabilitation. Nursing home, or extended care centers accounted for the disposition of 6 of the cases, and four cases required transfer to a disabled housing facility, or a group home for the physically disabled.

Eleven of the cases died during their hospital stay.

Table 10. Disposition

| <u>Disposition</u>          | <u>n</u> | <u>Percent</u> |
|-----------------------------|----------|----------------|
| Home                        | 339      | 85.0%          |
| Acute Hospital              | 36       | 9.0            |
| Rehabilitation Facility     | 3        | .8             |
| Extended Care Facility      | 6        | 1.5            |
| Group Home/Disabled Housing | 4        | 1.0            |
| Death                       | 11       | 2.8            |
| Total                       | 399      | 100.0          |

Of the 11 cases who died after 48 hours, death occurred in the Intensive Care Unit for 10 of the cases and on the ward for one case. As shown in Table 11, death predominantly occurred in the older age category, with 8 of the 11 deaths occurring in subjects with an age of 60 years or older. The mean age of those subjects who died was 62.3, and the median was 69.0. Seven of the cases were males, and four were females. Ten of the 11 cases had an ISS of greater than 16, with one case having a score in the 8-15 category. Six of the cases that died had a neck score of 4 or greater, and four had a GCS of 8 or less. Motor vehicle crashes were the cause of death for 7 cases, with the remaining four being pedestrians.

For the 11 cases that died, the following describes the utilization of rehabilitative/allied healthcare services. All 11 received respiratory therapy, 5 received physiotherapy, 5 received dietary services, 2 received social services and one received occupational therapy. The other services were not involved with these cases.

Table 11. Characteristics of Subjects who Died after 48 Hours from Admission

| Case | Age | Sex | ISS | GCS  | Cause | Day of<br>Death | Services                                                                                            |
|------|-----|-----|-----|------|-------|-----------------|-----------------------------------------------------------------------------------------------------|
| 1    | 38  | M   | >15 | <8   | Ped   | 6               | Respiratory<br>Therapy                                                                              |
| 2    | 60  | M   | >15 | >8   | MVA   | 4               | Respiratory<br>Therapy, Dietary                                                                     |
| 3    | 70  | M   | <15 | N.A. | MVA   | 3               | Respiratory<br>Therapy                                                                              |
| 4    | 80  | F   | >15 | N.A. | Ped   | 18              | Respiratory<br>Therapy, Social<br>Services,<br>Physiotherapy                                        |
| 5    | 53  | M   | >15 | <8   | MVA   | 4               | Respiratory<br>Therapy                                                                              |
| 6    | 23  | M   | >15 | <8   | MVA   | 8               | Respiratory<br>Therapy, Social<br>Services,<br>Dietary<br>Physiotherapy,<br>Occupational<br>Therapy |
| 7    | 69  | F   | >15 | N.A. | MVA   | 9               | Respiratory<br>Therapy, Dietary                                                                     |
| 8    | 73  | F   | >15 | <8   | MVA   | 16              | Respiratory<br>Therapy, Dietary<br>Physiotherapy                                                    |
| 9    | 74  | M   | >15 | N.A. | Ped   | 20              | Respiratory<br>Therapy, Dietary<br>Physiotherapy                                                    |
| 10   | 64  | F   | >15 | N.A. | MVA   | 4               | Respiratory<br>Therapy                                                                              |
| 11   | 81  | M   | >15 | >8   | Ped   | 20              | Respiratory<br>Therapy,<br>Physiotherapy                                                            |

Further analysis will exclude these 11 cases that died while in hospital, resulting in 388 eligible cases.

## Description of Injuries

### Abbreviated Injury Score

The region of the body most frequently reported as having an injury was the external region, with 264 cases (68.0%) having an external AIS of 1 or greater. The second most frequent area of injury was the limbs, with 232 cases (59.8%) being injured in this area. Half of the cases (194) had an injury to the head or neck, and 136 cases (35.0%) had an injury to the chest. The areas less frequently injured were the abdomen with 63 (16.2%) of the cases, and the face, with 59 (15.2%) of the cases injured in this area.

As displayed in Table 12, the majority of the cases were injured in more than one area. Only 79 (20.3%) of the cases had single injuries, with 311 (79.7%) of the cases having injuries in at least two of the areas. Of the cases hospitalized with a single injury, the area most frequently injured was the limbs (33 cases) followed by an injury to the head or neck (24 cases).

**Table 12. Distribution of Abbreviated Injury Scores**

| Body Region | Multiple Injury |      | Single Injury |      | Total |      |
|-------------|-----------------|------|---------------|------|-------|------|
|             | n               | %    | n             | %    | n     | %    |
| external    | 257             | 66.2 | 7             | 1.8  | 264   | 68.0 |
| limb        | 199             | 51.2 | 33            | 8.5  | 232   | 59.7 |
| head/neck   | 170             | 43.8 | 24            | 6.2  | 194   | 50.0 |
| chest       | 124             | 32.0 | 12            | 3.0  | 136   | 35.0 |
| abdomen     | 62              | 16.0 | 1             | .2   | 63    | 16.2 |
| face        | 57              | 14.7 | 2             | .5   | 59    | 15.2 |
|             |                 | 79.7 |               | 20.3 |       |      |

### Injury Severity Score

The Injury Severity Score of the cases ranged from 1 to 75. As displayed in Table 13, there were fewer cases with an ISS of 1-8 , with 27.3% of the cases having an ISS in this range. The remaining cases were equally divided between having ISS of 9-15 and 16-75.

**Table 13. Distribution of Injury Severity Scores**

| ISS   | n   | Percent |
|-------|-----|---------|
| 1-8   | 106 | 27.3    |
| 9-15  | 140 | 36.0    |
| 16-75 | 142 | 36.6    |
| Total | 388 | 100.0   |

Although an ISS of 75 usually is equated with death, there were 3 cases in this study that had a score of 75 and survived. These three cases had each sustained a fracture of the upper cervical spine, and required a multitude of life support measures. These cases had a hospital length of stay of 184 days, 170 days and 275 days, and all three cases received extensive rehabilitation.

In this study, there is an association between the age categories and the ISS (Table 14). The youngest age cases were associated with a lower ISS, with 55% of those admitted in the 0-15 years age category having an ISS of 1-8. This ISS grouping represented between 20% to 32% of the other age categories. Excluding the youngest age category, there is not a significant difference between the age categories and the ISS groupings.

Table 14. Injury Severity Scores by Age.

| Age   | Injury Severity Score |       |      |       |       |       | Total |
|-------|-----------------------|-------|------|-------|-------|-------|-------|
|       | 1-8                   |       | 9-15 |       | 16-75 |       |       |
|       | n                     | %     | n    | %     | n     | %     |       |
| 0-15  | 22                    | 55.0  | 12   | 30.0  | 6     | 15.0  | 40    |
| 16-25 | 28                    | 21.5  | 48   | 37.0  | 54    | 41.5  | 130   |
| 26-35 | 20                    | 23.0  | 34   | 39.0  | 33    | 38.0  | 87    |
| 36-45 | 9                     | 20.0  | 18   | 40.0  | 18    | 40.0  | 45    |
| 46-60 | 9                     | 29.0  | 11   | 35.5  | 11    | 35.5  | 31    |
| 60+   | 18                    | 32.7  | 17   | 30.9  | 20    | 36.4  | 55    |
| Total | 106                   | 100.0 | 140  | 100.0 | 142   | 100.0 | 388   |

There was no association between the Injury Severity Score and the sex of the subject, or the cause of the injury.

#### Glasgow Coma Score

Of the 388 cases, the GCS was not applicable for 244, as there was no injury to the head. Of the remaining 144, there were 48 cases that had a GCS score of 8 or less on admission, which would signify a severe head injury (Table 15). The remaining 96 cases had a GCS of 9 or greater.

| Table 15. Glasgow Coma Score |     |         |
|------------------------------|-----|---------|
| Status                       | n   | Percent |
| Over 8                       | 96  | 66.7    |
| 8 or less                    | 48  | 33.3    |
| Total                        | 144 | 100.0   |

As displayed in Table 16, the GCS was also associated with age, with the lowest age category being less likely to have a GCS signifying a severe head injury.

Table 16. Glasgow Coma Scores by Age.

| Glasgow Coma Score |           |       |           |       |       |
|--------------------|-----------|-------|-----------|-------|-------|
| Age                | 8 or less |       | 9 or more |       | Total |
|                    | n         | row % | n         | row % |       |
| 0-15               | 2         | 7.7   | 24        | 92.3  | 26    |
| 16-25              | 22        | 45.8  | 26        | 54.2  | 48    |
| 26-35              | 15        | 40.5  | 22        | 59.5  | 37    |
| 36-45              | 5         | 27.8  | 13        | 72.2  | 18    |
| 46-60              | 3         | 42.9  | 4         | 57.1  | 7     |
| 60+                | 1         | 12.5  | 7         | 87.5  | 8     |
| Total              | 48        |       | 96        |       | 144   |

There was no association between the Glasgow Coma Scale and the sex of the subject, or the cause of the injury.

#### Description of Rehabilitation/Allied Health Services

Results of this study indicate that individuals sustaining injury from moving vehicles have a high utilization of rehabilitation and other health care services. Of the rehabilitation services, the service that the cases were most frequently referred to was physiotherapy (67.8%) (Table 17). Almost 30% of the cases were referred to occupational therapy, and 15.2% were referred to the orthotic/prosthetic service. Less frequently utilized were speech therapy (8.0%) and recreational therapy (7.5%). Two hundred and eighty-two cases (72.7%) were referred to at least one of the five rehabilitation services.

For some of the rehabilitative services there was a discrepancy between those who were referred for services and

those who actually received them. This was evident to the greatest extent for occupational therapy (20 or 17.7% of the referred cases did not receive treatment). This also occurred with speech therapy (three, or 9.7% of referred cases did not receive treatment), recreational therapy (three, or 10.3% of referred cases did not receive treatment), and orthotics (two, or 3.3% of referred cases did not receive treatment).

For the other allied health services, the service most frequently referred was respiratory therapy (47.7%). Social services and dietary were both referred for 102 cases (26.3%). Less frequently utilized was psychology services, as only 6.2% of the cases were referred to this service. For the service of social services there was also a discrepancy between those cases referred for treatment, and those that actually received treatment (three, or 2.9% of referred cases did not receive treatment).

The majority of the cases were referred to at least one of the rehabilitation or other allied health services. Of the 388 cases, 322 or 83.0% were referred to one or more services.

Table 17. Utilization of Rehabilitation/Allied Health

| Services                            |          |       |          |       |
|-------------------------------------|----------|-------|----------|-------|
| A) Rehabilitation Service           | Referred |       | Received |       |
|                                     | n        | %     | n        | %     |
| Physiotherapy                       | 263      | 67.8  | 263      | 67.8  |
| Occupational Therapy                | 113      | 29.1  | 93       | 24.0  |
| Speech Therapy                      | 31       | 8.0   | 28       | 7.2   |
| Recreational Therapy                | 29       | 7.5   | 26       | 6.7   |
| Orthotics/Prosthetics               | 59       | 15.2  | 57       | 6.2   |
| Any Rehabilitation Service          | 282      | 72.7  | 282      | 72.7  |
|                                     |          |       |          |       |
| B) Other Service                    | Referred |       | Received |       |
|                                     | n        | %     | n        | %     |
| Social Services                     | 102      | 26.3  | 99       | 25.5  |
| Psychology                          | 24       | 6.2   | 24       | 6.2   |
| Dietary                             | 102      | 26.3  | 102      | 26.3  |
| Respiratory Therapy                 | 185      | 47.7  | 185      | 47.7  |
| Any Other Service                   | 234      | 60.3  | 234      | 60.3  |
|                                     |          |       |          |       |
| Any Rehabilitation or other service | 322      | 83.0% | 322      | 83.0% |

Referral upon discharge was most frequently provided for physiotherapy (11.9%), as detailed in Table 18. This was followed by occupational therapy, for which 20 cases (5.2%) were referred. It is important to note that the cases referred for outpatient occupational therapy were not those who were referred but did not receive treatment within the hospital. Speech therapy outpatient referrals occurred for 2.6% of the cases, and for this service the cases who were referred, but did not receive treatment within hospital were referred upon discharge. Discharge referrals were also given, to a lesser extent, for recreational therapy, orthotics, social services and psychology. There were no outpatient referrals for respiratory therapy or dietary services.

**Table 18. Referrals to Rehabilitation/Allied Health Services upon Discharge**

| <u>Service</u>       | <u>n</u> | <u>Percent</u> |
|----------------------|----------|----------------|
| Physiotherapy        | 46       | 11.9%          |
| Occupational Therapy | 20       | 5.2%           |
| Speech Therapy       | 10       | 2.6%           |
| Recreational Therapy | 3        | .8%            |
| Orthotics            | 1        | .3%            |
| Social Services      | 5        | 1.3%           |
| Psychology           | 1        | .3%            |

## Relationship Between Standardized Scores and the Utilization of Rehabilitation/ Allied Health Services

### Abbreviated Injury Score

The utilization of rehabilitation/allied health services will be analyzed by the separate Abbreviated Injury Score (AIS) given to the six areas - neck and head, abdomen, chest, face, limbs and external. It must be cautioned, however, that the injuries to the different regions do not occur in isolation, and the majority of the subjects (79.7%) were injured in more than one area.

#### 1. Neck/Head Score

There were 194 (50.0%) cases with a head/neck AIS score of 1 or greater. When a case had an injury of the head/neck, there was a greater utilization of all of the services, except for physiotherapy, as compared to the overall utilization (Table 19).

**Table 19. Utilization of Rehabilitation/Allied Health Services by Injury of the Head or Neck.**

| Service              | AIS = 0<br>(n = 194) |      | AIS $\geq$ 1<br>(n = 194) |      |
|----------------------|----------------------|------|---------------------------|------|
|                      | n                    | %    | n                         | %    |
| Physiotherapy        | 148                  | 73.6 | 115                       | 59.3 |
| Occupational Therapy | 45                   | 23.2 | 68                        | 35.1 |
| Speech Therapy       | 2                    | 1.0  | 29                        | 14.9 |
| Recreational Therapy | 6                    | 3.1  | 23                        | 11.8 |
| Orthotics            | 25                   | 12.8 | 34                        | 17.5 |
| Social Services      | 31                   | 15.9 | 71                        | 36.6 |
| Psychology           | 3                    | 1.5  | 21                        | 10.8 |
| Dietary              | 43                   | 22.2 | 59                        | 30.4 |
| Respiratory          | 84                   | 43.3 | 101                       | 52.0 |

For all of the cases in the study that received speech therapy, recreational therapy and psychology, the majority had an neck AIS of one or greater. For those subjects who were referred to recreational therapy, 79.3% had a head/neck injury. For those subjects referred to psychology services, 87.5% were injured in this area. Of the subjects referred to speech therapy, 93.5% had an AIS of the head/neck of one or greater. Therefore, it appears that an injury to the head/neck is related to greater utilization of both rehabilitation and allied health care services.

In addition, as the AIS of the head/neck increased, it was strongly associated with the increased utilization of the rehabilitation services of physiotherapy, occupational therapy, speech therapy, recreational therapy, social services, psychology, dietary and respiratory therapy

( $p < 0.001$ ). As displayed in Table 20, this association was most evident in occupational therapy and social services

utilization. The relationship will further be described for each service. It would appear useful to further separate those cases with a neck score of four and over.

For physiotherapy, the increased neck score was associated with an increased utilization of service. For the 52 cases that had a neck score of 4 or greater, 96.15% received physiotherapy. Thus, a high neck score was highly related to utilization of physiotherapy.

For occupational therapy, utilization of service was directly associated with an increased head/neck score. With each increase in head/neck score, the utilization of service increased from 0% to 17.4% to 22.4% to 58.8% to 90.6% to 100%. For the cases with a neck score of 4 or greater, 80.8% received treatment. Thus, this score is also highly related to utilization of occupational therapy.

None of the cases with a neck score of one or two received speech therapy, and utilization increased with each successive increase in head/neck score. For the cases with a neck score of 4 or greater, 48.1% received speech therapy.

Utilization of recreational therapy also increased with an increase in head/neck score. The three cases with a head/neck score of 6 all received recreational therapy, and 32.7% of those with a neck score of 4 or greater received this service.

Utilization of orthotic services was not associated with an increase in head/neck score.

The utilization of social services increased directly with an increase in the head/neck score. For the 52 cases with a head/neck score of 4 or greater, 78.8% received treatment from social services.

For psychology, an increase in head/neck score was associated with increased utilization for all of the head/neck scores except six. For the three cases with a head/neck score of six, service was not received. For the cases with a head/neck score of 4 or greater, 28.9% received services.

Dietary service utilization increased with the increase in head/neck score. For the cases with a head/neck score of 4 or greater, 67.3% received dietary service.

As the head/neck score increased, the utilization of respiratory therapy increased dramatically. For those cases with a head/neck score of 4 or greater 90.38% received respiratory therapy. It appears that the high head/neck scores are related to utilization of respiratory therapy.

Table 20. Utilization of Rehabilitation/Allied Health  
Services by AIS of the Neck/Head.

|                           |   | Neck Score                           |       |      |      |       |       | Total |
|---------------------------|---|--------------------------------------|-------|------|------|-------|-------|-------|
| A) Rehabilitation Service |   | 1                                    | 2     | 3    | 4    | 5     | 6     |       |
| Physiotherapy             |   |                                      |       |      |      |       |       |       |
| no                        | n | 5                                    | 50    | 22   | 2    | 0     | 0     | 79    |
|                           | % | 71.4                                 | 58.1  | 44.9 | 11.8 | 0.0   | 0.0   |       |
| yes                       | n | 2                                    | 36    | 27   | 15   | 32    | 3     | 115   |
|                           | % | 28.6                                 | 41.9  | 55.1 | 88.2 | 100.0 | 100.0 |       |
| Total                     |   | 7                                    | 86    | 49   | 17   | 32    | 3     | 194   |
|                           |   | * Chi-square = 42.7 d.f.= 2 p <0.001 |       |      |      |       |       |       |
| Occupational Therapy      |   |                                      |       |      |      |       |       |       |
| no                        | n | 7                                    | 71    | 38   | 7    | 3     | 0     | 126   |
|                           | % | 100.0                                | 82.6  | 77.6 | 41.2 | 9.4   | 0.0   |       |
| yes                       | n | 0                                    | 15    | 11   | 10   | 29    | 3     | 68    |
|                           | % | 0.0                                  | 17.4  | 22.4 | 58.8 | 90.6  | 100.0 |       |
| Total                     |   | 7                                    | 86    | 49   | 17   | 32    | 3     | 194   |
|                           |   | * Chi-square = 65.7 d.f.= 2 p <0.001 |       |      |      |       |       |       |
| Speech Therapy            |   |                                      |       |      |      |       |       |       |
| no                        | n | 7                                    | 86    | 45   | 10   | 15    | 2     | 165   |
|                           | % | 100.0                                | 100.0 | 91.8 | 58.8 | 46.8  | 66.7  |       |
| yes                       | n | 0                                    | 0     | 4    | 7    | 17    | 1     | 29    |
|                           | % | 0.0                                  | 0.0   | 8.2  | 41.2 | 53.2  | 33.3  |       |
| Total                     |   | 7                                    | 86    | 49   | 17   | 32    | 3     | 194   |
|                           |   | * Chi-square = 63.0 d.f.= 2 p <0.001 |       |      |      |       |       |       |
| Recreational Therapy      |   |                                      |       |      |      |       |       |       |
| no                        | n | 7                                    | 83    | 46   | 15   | 20    | 0     | 171   |
|                           | % | 100.0                                | 96.5  | 93.9 | 88.2 | 62.5  | 0.0   |       |
| yes                       | n | 0                                    | 3     | 3    | 2    | 12    | 3     | 23    |
|                           | % | 0.0                                  | 3.5   | 6.1  | 11.8 | 27.5  | 100.0 |       |
| Total                     |   | 7                                    | 86    | 49   | 17   | 32    | 3     | 194   |
|                           |   | *Chi-square = 29.7 d.f.= 2 p <0.001  |       |      |      |       |       |       |

\* for purposes of Chi-square calculations, neck scores of 1 and 2 are combined, and neck scores of 4 or greater are combined.

Table 20. Utilization of Rehabilitation/Allied Health Services by AIS of the Neck/Head. (continued)

| Neck score          |   |                     |      |          |      |           |       |       |
|---------------------|---|---------------------|------|----------|------|-----------|-------|-------|
| B) Other Service    |   | 1                   | 2    | 3        | 4    | 5         | 6     | Total |
| Social Services     |   |                     |      |          |      |           |       |       |
| no                  | n | 7                   | 73   | 32       | 6    | 5         | 0     | 123   |
|                     | % | 100.0               | 84.9 | 65.3     | 35.3 | 15.6      | 0.0   |       |
| yes                 | n | 0                   | 13   | 17       | 11   | 27        | 3     | 71    |
|                     | % | 0.0                 | 15.1 | 34.7     | 64.7 | 84.4      | 100.0 |       |
| Total               |   | 7                   | 86   | 49       | 17   | 32        | 3     | 194   |
|                     |   | * Chi-square = 60.6 |      | d.f. = 2 |      | p < 0.001 |       |       |
| Psychology          |   |                     |      |          |      |           |       |       |
| no                  | n | 7                   | 83   | 46       | 15   | 19        | 3     | 173   |
|                     | % | 100.0               | 96.5 | 93.9     | 88.2 | 59.4      | 100.0 |       |
| yes                 | n | 0                   | 3    | 3        | 2    | 13        | 0     | 21    |
|                     | % | 0.0                 | 3.5  | 6.1      | 11.8 | 40.6      | 0.0   |       |
| Total               |   | 7                   | 86   | 49       | 17   | 32        | 3     | 194   |
|                     |   | * Chi-square = 24.2 |      | d.f. = 2 |      | p < 0.001 |       |       |
| Dietary             |   |                     |      |          |      |           |       |       |
| no                  | n | 5                   | 79   | 34       | 9    | 7         | 1     | 135   |
|                     | % | 71.4                | 91.9 | 69.4     | 52.9 | 21.9      | 33.3  |       |
| yes                 | n | 2                   | 7    | 15       | 8    | 25        | 2     | 59    |
|                     | % | 28.6                | 9.1  | 30.6     | 47.1 | 78.1      | 66.7  |       |
| Total               |   | 7                   | 86   | 49       | 17   | 32        | 3     | 194   |
|                     |   | * Chi-square = 52.3 |      | d.f. = 2 |      | p < 0.001 |       |       |
| Respiratory Therapy |   |                     |      |          |      |           |       |       |
| no                  | n | 5                   | 58   | 25       | 4    | 1         | 0     | 93    |
|                     | % | 71.4                | 67.4 | 51.0     | 23.5 | 3.1       | 0.0   |       |
| yes                 | n | 2                   | 28   | 24       | 13   | 31        | 3     | 101   |
|                     | % | 28.6                | 32.6 | 49.0     | 76.5 | 96.9      | 100.0 |       |
| Total               |   | 7                   | 86   | 49       | 17   | 32        | 3     | 194   |
|                     |   | * Chi-square = 45.4 |      | d.f. = 2 |      | p < 0.001 |       |       |

\* for purposes of Chi-square calculations, neck scores of 1 and 2 are combined, and neck scores of 4 or greater are combined.

It appears that an injury to the head or neck is related to increased utilization of rehabilitation and allied health services. If the injury to the head/neck is severe (an AIS of 4), then the utilization of all services (with the exception of orthotics) is increased, and the utilization of physiotherapy, occupational therapy, social services and respiratory therapy is probable.

Many of the cases (88.5%) with a head/neck score of 4 or greater were injured in other body regions. This will influence the pattern of utilization based on the other body regions, as the utilization of the service may only be a result of the head/neck score. To enable greater accuracy regarding the relationship between the area injured and the utilization of services, the 52 cases with a head/neck score of 4 or greater will be excluded from the analysis of the remaining AIS regions. Thus, there will be 336 cases that will be used in the analysis of the injuries to the other regions.

## 2. Abdomen Score

There were 54 (16.07) of the cases with an abdomen AIS of one or greater. When a case had an abdomen injury, it was associated with a significantly higher utilization of physiotherapy, dietary services and respiratory therapy,

when compared to the utilization of services by the total study sample. Utilization of physiotherapy occurred for 51 (80.9%) of the AIS abdomen cases, as compared to 67.8% of the total population. Dietary services were utilized by 29 of the cases (46.0%), as compared to 26.3% of the total population and respiratory therapy by 50 cases (79.4%), as compared to 47.7% of the total population.

The association between the abdomen score and physiotherapy utilization is not significant at the .01 level, however as is shown in Table 21, as the abdomen score increases above two, the utilization of physiotherapy significantly increases. Of the 33 cases that had an abdomen score of 3 or greater, 87.8% received physiotherapy. Therefore an abdomen score of 3 or greater is highly related to utilization of physiotherapy.

Although an abdomen injury is associated with increased utilization of dietary services, the increasing abdomen score is not associated with increased utilization of these services. As displayed in Table 21, the abdomen score of 3 was associated with the greatest utilization.

Respiratory therapy utilization followed a similar pattern as physiotherapy. For the cases with an abdomen score of 3 or greater, 84.8% utilized this service. A high abdomen score is related to utilization of respiratory services.

Table 21. Utilization of Rehabilitation/Allied Health  
Services by AIS of the Abdomen.

|                |   | Abdomen Score |      |      |      |       |       |
|----------------|---|---------------|------|------|------|-------|-------|
| Service        |   | 1             | 2    | 3    | 4    | 5     | Total |
| Physiotherapy  |   |               |      |      |      |       |       |
| no             | n | 1             | 7    | 3    | 1    | 0     | 12    |
|                | % | 50.0          | 36.8 | 21.4 | 7.6  | 0.0   |       |
| yes            | n | 1             | 12   | 11   | 12   | 6     | 42    |
|                | % | 50.0          | 63.1 | 78.6 | 92.4 | 100.0 |       |
| Total          |   | 2             | 19   | 14   | 13   | 6     | 54    |
| p = .042*      |   |               |      |      |      |       |       |
| Dietary        |   |               |      |      |      |       |       |
| no             | n | 1             | 14   | 7    | 6    | 4     | 32    |
|                | % | 50.0          | 73.7 | 50.0 | 46.1 | 66.7  |       |
| yes            | n | 1             | 5    | 7    | 7    | 2     | 22    |
|                | % | 50.0          | 26.3 | 50.0 | 53.9 | 33.3  |       |
| Total          |   | 2             | 19   | 14   | 13   | 6     | 54    |
| p = .168 (ns)* |   |               |      |      |      |       |       |
| Respiratory    |   |               |      |      |      |       |       |
| Therapy        |   |               |      |      |      |       |       |
| no             | n | 1             | 7    | 3    | 1    | 1     | 13    |
|                | % | 50.0          | 36.8 | 21.4 | 7.7  | 16.7  |       |
| yes            | n | 1             | 12   | 11   | 12   | 5     | 41    |
|                | % | 50.0          | 63.2 | 78.6 | 92.3 | 83.3  |       |
| Total          |   | 3             | 19   | 14   | 13   | 6     | 54    |
| p = .100 (ns)* |   |               |      |      |      |       |       |

\* For purposes of calculating Fisher's exact test, abdomen scores of 1 and 2 were combined, and abdomen scores of 3 and over were combined.

Therefore, if a subject has an abdomen injury, independent of a head or neck injury, increased utilization of dietary services, respiratory services and physiotherapy services is indicated. For abdomen scores of 3 or greater, utilization of physiotherapy and respiratory therapy is likely.

### 3. Limbs Score

There were 209 (62.2%) cases that had an AIS of the limb of one or greater. An injury to this area was associated with an increased utilization of the services of physiotherapy, and orthotics. This greater utilization was most evident with physiotherapy, as 174 (83.2%) of those cases with a limb injury used this services, compared to 67.8% of the entire population. Orthotics had only slightly increased utilization, with 17.2% of the subjects with a limb injury utilizing this service, compared with 15.2% of the total population. An increase in the limb score was associated with increased utilization of these services, at the  $p = .01$  level of significance (Table 22).

For physiotherapy, the threshold indicator for utilization appears to be a limb score of three. There were 104 cases with a limb score of 3 or greater, and 91.3% of these cases received this service.

Although an increased limb score was associated with increased utilization of orthotics, there was not an AIS

value that would indicate usage. Of the cases with a limb score of 3 or greater, 26.9% received services ; four of the six cases that had a limb score of 4 received services.

The utilization of occupational therapy by the subjects with a limb injury (29.7%) was almost exactly the same as the overall utilization (29.1 %). However, as displayed in Table 22, as the limb score increased, there was increased utilization of occupational therapy. Of those cases with a limb score of three or greater, 43.3% received occupational therapy. All six cases that had a score of 4 received this service.

Table 22. Utilization of Physiotherapy, Occupational Therapy and Orthotics by AIS of the Limbs

|                      |   | Limb Score |      |      |       |       |
|----------------------|---|------------|------|------|-------|-------|
| Service              |   | 1          | 2    | 3    | 4     | Total |
| <hr/>                |   |            |      |      |       |       |
| Physiotherapy        |   |            |      |      |       |       |
| no                   | n | 2          | 24   | 9    | 0     | 35    |
|                      | % | 33.3       | 24.2 | 9.2  | 0.0   |       |
| yes                  | n | 4          | 75   | 89   | 6     | 174   |
|                      | % | 66.7       | 75.8 | 90.8 | 100.0 |       |
| <hr/>                |   |            |      |      |       |       |
| Total                |   | 6          | 99   | 98   | 6     | 209   |
| p = 0.003*           |   |            |      |      |       |       |
| <br>                 |   |            |      |      |       |       |
| Occupational Therapy |   |            |      |      |       |       |
| no                   | n | 6          | 82   | 59   | 0     | 147   |
|                      | % | 100.0      | 82.8 | 60.2 | 0.0   |       |
| yes                  | n | 0          | 17   | 39   | 6     | 62    |
|                      | % | 0.0        | 17.2 | 39.8 | 100.0 |       |
| <hr/>                |   |            |      |      |       |       |
| Total                |   | 6          | 99   | 98   | 6     | 209   |
| p < 0.001*           |   |            |      |      |       |       |
| <br>                 |   |            |      |      |       |       |
| Orthotics            |   |            |      |      |       |       |
| no                   | n | 5          | 92   | 74   | 2     | 173   |
|                      | % | 83.3       | 92.9 | 75.5 | 33.3  |       |
| yes                  | n | 1          | 7    | 24   | 4     | 36    |
|                      | % | 16.7       | 7.1  | 24.5 | 66.7  |       |
| <hr/>                |   |            |      |      |       |       |
| Total                |   | 6          | 99   | 98   | 6     | 209   |
| p = 0.001*           |   |            |      |      |       |       |

\* for purposes of Fisher's exact test calculations, limb scores of 1 and 2 were combined, and limb scores of 3 and 4 were combined.

Thus, it appears that an injury to the limbs, regardless of a head or neck injury is related to increased utilization of physiotherapy and orthotics. A limb score of 3 or greater is associated with probable physiotherapy utilization, and greater utilization of occupational therapy and orthotics.

#### 4. Chest Score

There were 110 (32.7%) of the 336 cases with a chest score of one or greater. A chest score was associated with increased utilization of physiotherapy and respiratory therapy. For the cases with a chest score of one or greater, 75.5% utilized physiotherapy, compared with 67.8% of the total population. With regard to respiratory therapy, utilization of services occurred for 77.3% of the cases with a chest injury, compared to 47.7% of the total population. As the chest score increased, there was increased utilization of respiratory therapy, at the  $p = .01$  level of significance (Table 23).

Although this association is not statistically significant for physiotherapy, there are indications that a chest score of 5 is related to physiotherapy utilization. A chest score of 5 resulted in 91.5% utilization of physiotherapy. A lower chest score appears to be related to respiratory utilization, with 85.7% of those cases with a

chest score of 3 or greater receiving this service. All cases with a chest score of 5 received respiratory therapy.

Table 23. Utilization of Physiotherapy and Respiratory Therapy by AIS of the Chest.

| Service        | Chest Score |      |      |      |      | Total |
|----------------|-------------|------|------|------|------|-------|
|                | 1           | 2    | 3    | 4    | 5    |       |
| Physiotherapy  |             |      |      |      |      |       |
| no n           | 4           | 5    | 9    | 8    | 1    | 27    |
| %              | 57.1        | 26.3 | 20.4 | 27.6 | 9.1  |       |
| yes n          | 3           | 14   | 35   | 21   | 10   | 83    |
| %              | 42.9        | 73.7 | 79.6 | 72.4 | 91.9 |       |
| Total          | 7           | 19   | 44   | 29   | 11   | 110   |
| p = .114 (ns)* |             |      |      |      |      |       |

|             |      |      |      |      |       |     |
|-------------|------|------|------|------|-------|-----|
| Respiratory |      |      |      |      |       |     |
| Therapy     |      |      |      |      |       |     |
| no n        | 3    | 10   | 7    | 5    | 0     | 27  |
| %           | 42.9 | 52.6 | 15.9 | 17.2 | 0.0   |     |
| yes n       | 4    | 9    | 37   | 24   | 11    | 83  |
| %           | 57.1 | 47.4 | 84.1 | 82.8 | 100.0 |     |
| Total       | 7    | 19   | 44   | 29   | 11    | 110 |
| p = .004*   |      |      |      |      |       |     |

\*for purposes of Fisher's exact test calculations, chest scores of 1 and 2 were combined, and chest scores of 3 or greater were combined.

Therefore, this results indicate that a chest injury, independent of the presence of a head or neck injury, is related to increased utilization of physiotherapy and respiratory therapy.

#### 5. External Score

There were 225 (66.7%) cases that had an external score of 1 or greater. Having an external AIS was not associated with any greater utilization of any of the services, as compared to the overall utilization. In addition, as the external AIS increased there were no relationships with increased referrals to the various services.

#### 6. Face Score

There were 53 (15.7%) cases with a face score of one or greater. The only service that was associated with a higher utilization was dietary, as 29 (54.7%) of the cases utilized this service, compared with 26.3% of the total population. A higher face score was not associated with greater utilization of dietary services.

The previous results indicate that the Abbreviated Injury Scores are related to the utilization of rehabilitation and allied health services. An injury to the

head/neck is associated with an increased utilization of almost all of the services, and an increase in the score is associated with increased utilization of these services. Injuries to the abdomen are related to greater utilization of physiotherapy, dietary and respiratory therapy. Injuries to the chest are related to increased utilization of physiotherapy and respiratory therapy. Injuries to the limbs are related to utilization of orthotics and physiotherapy. Injuries to the face are associated with greater utilization of dietary services.

Despite the relationship between the AIS and the utilization of services, there are some difficulties with usage of this measurement score as an indicator of service utilization. As the injuries do not occur in isolation, it is difficult to determine which injuries are related to utilization. The process of separating the scores for the various regions to determine utilization is cumbersome, and likely inappropriate for many of the cases. However, when an injury occurs to only one area, the AIS may be a useful measure to suggest utilization of service. Also, an injury to the head and neck appears to be a valuable indicator for utilization of services. Results will now be described for the Injury Severity Score, which is an overall summary measurement of the Abbreviated Injury Score.

### Injury Severity Score (ISS)

As shown in Table 24, the ISS is significantly related to the utilization of eight of the nine rehabilitation and allied health services. These relationships will be described in greater detail for each of the services.

For physiotherapy, 44.3% of subjects with an ISS of 1-8 received treatment. However, as the ISS increased, the case was more likely to receive physiotherapy. For the cases with an ISS of 9-15, 67.14% received treatment. For the cases that had an ISS of over 15, 85.9% received physiotherapy. Thus having an ISS of over 15 is related to probable utilization of physiotherapy.

Of the cases that had an ISS of 1-8, only 11.3% received occupational therapy. This utilization doubled for those cases with a ISS of 9-15 (25.0%), and almost doubled again for those cases with an ISS of over 15 (46.5%).

Very few cases that had an ISS of 15 or under received speech therapy. However, this utilization increased dramatically for the cases with an ISS of over 15, as 19.7% of these cases received speech therapy.

A similar utilization pattern was displayed for recreational therapy. For the cases with an ISS of 1-8, only 1.9% received recreational therapy, and for the cases with an ISS of 9-15 only 2.1% received recreational therapy. Of the cases with an ISS of over 15, however, 16.9% received treatment.

The utilization of orthotics portrays a different pattern. Although only 5.6% of the cases with an ISS of under 15 receive this service, the utilization for the ISS scores of 9-15 and over 15 is almost equal, and is slightly higher for the ISS scores in the middle range.

Social service utilization is similar to the pattern of occupational therapy. Only 11.3% of the cases with an ISS of 1-8 receive social services. This increases to 17.1% for an ISS of 9-15, and 46.5% with an ISS of over 15.

None of the cases with an ISS of under 9 received psychology services. This increased to 4.5% of the cases with an ISS between 9 and 15, and 12.8% of those with an ISS of over 15.

The utilization of dietary services was almost equal for those cases with an ISS of 1-8 and 9-15 - approximately 13%. However, for the cases with an ISS of over 15, 49.3% received treatment.

The utilization of respiratory therapy increased dramatically as the ISS increased. For those cases with an ISS of 1-8, only 13.2% received treatment. An ISS of 9-15 yielded 37.1% utilization, whereas 85.0% of those cases with an ISS of over 15 received respiratory therapy. An ISS of over 15 may be a useful indicator for respiratory therapy.



Table 24. Utilization of Rehabilitation/Allied Health

Services Injury Severity Score  
(continued)

|                     |     | ISS Score |      |      |       |      |       |
|---------------------|-----|-----------|------|------|-------|------|-------|
| B) Other<br>Service | 1-8 |           | 9-15 |      | 16-75 |      | Total |
|                     | n   | %         | n    | %    | n     | %    |       |
| Social Services     |     |           |      |      |       |      |       |
| no                  | 94  | 88.7      | 116  | 82.9 | 76    | 53.5 | 286   |
| yes                 | 12  | 11.3      | 24   | 17.1 | 66    | 46.5 | 102   |

Chi-square = 48.2    d.f.=2    p < 0.001

|            |  |     |       |     |      |     |      |     |
|------------|--|-----|-------|-----|------|-----|------|-----|
| Psychology |  |     |       |     |      |     |      |     |
| no         |  | 106 | 100.0 | 134 | 95.5 | 124 | 87.3 | 364 |
| yes        |  | 0   | 0.0   | 6   | 4.5  | 18  | 12.7 | 24  |

Chi-square = 18.2    d.f.= 2    p < 0.001

|         |  |    |      |     |      |    |      |     |
|---------|--|----|------|-----|------|----|------|-----|
| Dietary |  |    |      |     |      |    |      |     |
| no      |  | 93 | 87.7 | 121 | 86.4 | 72 | 50.7 | 286 |
| yes     |  | 13 | 12.3 | 19  | 13.6 | 70 | 49.3 | 102 |

Chi-square = 61.2    d.f.=2    p < 0.001

|                        |  |    |      |    |      |     |      |     |
|------------------------|--|----|------|----|------|-----|------|-----|
| Respiratory<br>Therapy |  |    |      |    |      |     |      |     |
| no                     |  | 92 | 86.8 | 88 | 62.9 | 23  | 16.2 | 203 |
| yes                    |  | 14 | 13.2 | 52 | 37.1 | 119 | 83.8 | 185 |

Chi-square = 131.0    d.f.=2    p < 0.001

It appears that an ISS of over 15 can be used as an indicator of increased services for all rehabilitation and allied health disciplines. An ISS score of 15 may also be a useful threshold value to indicate that physiotherapy and respiratory therapy will most likely be utilized. Therefore, the injury severity score appears to be a valuable instrument to indicate utilization of rehabilitation/allied health services.

In addition, the utilization of the Injury Severity Score to indicate usage of rehabilitation services is much simpler than using the separate Abbreviated Injury Scores. However, the ISS does not indicate an injury to the head, which has been shown to be a strongly related to utilization of services.

#### Glasgow Coma Scale

As previously discussed, there were 144 cases in which it was applicable to determine the Glasgow Coma Score. One third of these cases (48) had a GCS of 8 or less, signifying a major head injury. The cases with a GCS of 8 or less had significantly increased utilization of all rehabilitation services, with the exception of orthotics, when compared to the total study population (Table 25).

The service that had the highest utilization was physiotherapy, where 95.8% of those cases with a GCS of 8 or

less received this service. A low GCS appears to be a useful indicator for utilization of this service.

Occupational therapy services were also used frequently with these cases, as 70.8% of this group received services.

Speech therapy utilization occurred for 43.7% of these cases, as compared to 8.0% of the entire study population. Of all the cases in the study that received speech therapy, 67.8% had a GCS of 8 or less. Recreation therapy was utilized by 25.0% of these cases.

The utilization of the other disciplines was also high for the cases with a low GCS. Respiratory therapy was utilized by 93.7% of these cases. Therefore a low GCS may be a useful indicator for this service. Social service utilization was also high for this population, with 75.0% receiving service. Dietary services were received by 64.6% of the low GCS cases, and 27.1% received psychology services.

**Table 25. Utilization of Rehabilitation/Allied Health Services by Cases with a Glasgow Coma Score of 8 or Less.**

| <u>Service</u>             | <u>n</u> | <u>Percent</u> |
|----------------------------|----------|----------------|
| Physiotherapy              | 46       | 95.8%          |
| Occupational Therapy       | 34       | 70.8           |
| Speech Therapy             | 21       | 43.7           |
| Recreational Therapy       | 12       | 25.0           |
| Orthotics                  | 8        | 16.7           |
| Any Rehabilitation Service | 46       | 95.8           |
| Social Services            | 36       | 75.0           |
| Psychology                 | 13       | 27.1           |
| Dietary                    | 31       | 64.6           |
| Respiratory Therapy        | 45       | 93.7           |

It appears that a low GCS is a useful indicator to suggest increased utilization of rehabilitation and allied health disciplines, and would indicate a probable utilization for physiotherapy and respiratory therapy. Utilization of services will now be analyzed by combining the ISS and the GCS.

#### Injury Severity Score Combined with Glasgow Coma Score

As both the ISS and the GCS are useful indicators of the utilization of rehabilitation and allied health services, it would appear appropriate to analyze the data through combining these two measurements.

There were 243 (62.6%) cases with an ISS of less than 16 and a GCS of 9 or more, which would signify a less severe

injury. Only 3 (.77%) cases had an ISS of less than 16 and a GCS of 8 or less, signifying a severe head injury. There were 100 (25.7%) cases with an ISS of 16 or greater and a GCS of 9 or more. Forty-five (11.5%) cases had both an ISS of over 16 and a GCS of 8 or less, which would signify a severe head injury. For purposes of calculations, the three subjects with a lower ISS, but a GCS of 8 or less, were included with the subjects who had a ISS of over 16, but no head injury.

As displayed in Table 26, combining the ISS and the GCS appears to be a useful measure to indicate utilization of all services, except for orthotics. The subjects with an ISS of less than 16 and no head injury were the least likely to utilize rehabilitation and allied health services, and the subjects with both an ISS of 16 or more and a head injury (GCS of 8 or less) were the highest utilizers of services.



**Table 26. Utilization of Rehabilitation/Allied Health Services by Injury Severity Score Combined with Glasgow Coma Score (ISS with GCS) (continued)**

|                     |          | ISS Score/GCS |          |           |          |      |       |     |
|---------------------|----------|---------------|----------|-----------|----------|------|-------|-----|
| A) Other Service    | ISS < 16 |               | ISS ≥ 16 |           | ISS ≥ 16 |      | Total |     |
|                     | GCS > 9  |               | GCS > 9  |           | GCS ≤ 8  |      |       |     |
|                     | n        | %             | n        | %         | n        | %    |       |     |
| <hr/>               |          |               |          |           |          |      |       |     |
| Social Services     |          |               |          |           |          |      |       |     |
| no                  | 208      | 85.6          | 68       | 68.0      | 10       | 22.2 |       | 286 |
| yes                 | 35       | 14.4          | 32       | 32.0      | 35       | 77.8 |       | 102 |
| Total               | 243      |               | 100      |           | 45       |      |       |     |
| Chi-square = 80.7   |          | d.f. = 2      |          | p < 0.001 |          |      |       |     |
| <hr/>               |          |               |          |           |          |      |       |     |
| Psychology          |          |               |          |           |          |      |       |     |
| no                  | 237      | 97.5          | 95       | 95.0      | 32       | 71.1 |       | 364 |
| yes                 | 6        | 2.5           | 5        | 5.0       | 13       | 28.9 |       | 24  |
| Chi-square = 45.9   |          | d.f. = 2      |          | p < 0.001 |          |      |       |     |
| <hr/>               |          |               |          |           |          |      |       |     |
| Dietary             |          |               |          |           |          |      |       |     |
| no                  | 211      | 86.8          | 61       | 61.0      | 14       | 31.1 |       | 286 |
| yes                 | 32       | 13.2          | 39       | 39.0      | 31       | 68.9 |       | 102 |
| Chi-square = 72.1   |          | d.f. = 2      |          | p < 0.001 |          |      |       |     |
| <hr/>               |          |               |          |           |          |      |       |     |
| Respiratory Therapy |          |               |          |           |          |      |       |     |
| no                  | 178      | 73.2          | 24       | 24.0      | 1        | 2.2  |       | 203 |
| yes                 | 65       | 26.8          | 76       | 76.0      | 44       | 97.8 |       | 185 |
| Chi-square = 120.1  |          | d.f. = 2      |          | p < 0.001 |          |      |       |     |

Therefore it appears that the combination of the Injury Severity Score and the Glasgow Coma score provides a useful measurement to indicate the utilization of both rehabilitation and allied health services. By utilizing this combination of standardized measurements, it is apparent that the subjects with the greatest utilization of services are those with both a severe injury and a head injury. These subjects have a probable utilization of physiotherapy (97.8%) and respiratory therapy (97.8%). This combination of measures is easier utilized than the separate AIS, and appears to be a more accurate reflection of the higher utilization of those subjects with a head injury than the use of the ISS alone.

#### Utilization of Services by Age and Sex

For some of the services there appears to be an association between the age of the subjects and their utilization. This association is particularly evident with respiratory therapy, physiotherapy and occupational therapy (Table 27).

However, the association is a result of the lower utilization in the lowest age category. For the cases in the 0-15 age category, only 40.0% received physiotherapy, 10.0% received respiratory therapy and 5.0% received occupational therapy. When this age category is excluded, there is not a significant association between age and

utilization of service.

**Table 27. Utilization of Respiratory Therapy, Physiotherapy and Occupational Therapy by Age**

| Age   | Respiratory therapy<br>no |       | yes |       | Total |
|-------|---------------------------|-------|-----|-------|-------|
|       | n                         | row % | n   | row % |       |
| 0-15  | 36                        | 90.0  | 4   | 10.0  | 40    |
| 16-25 | 67                        | 51.5  | 63  | 48.5  | 130   |
| 26-35 | 47                        | 54.0  | 40  | 46.0  | 87    |
| 36-45 | 21                        | 46.7  | 24  | 53.3  | 45    |
| 46-60 | 13                        | 41.9  | 18  | 58.1  | 31    |
| 60+   | 19                        | 34.5  | 36  | 65.5  | 55    |
| Total | 203                       |       | 185 |       | 388   |

Chi-square = 31.7 d.f. = 5 p < 0.001  
 (Excluding 0-15 category, Chi-square = 6.39, d.f. = 4,  
 p = 0.17)

| Age   | Physiotherapy<br>no |       | yes |       | Total |
|-------|---------------------|-------|-----|-------|-------|
|       | n                   | row % | n   | row % |       |
| 0-15  | 24                  | 60.0  | 16  | 40.0  | 40    |
| 16-25 | 40                  | 30.8  | 90  | 69.2  | 130   |
| 26-35 | 29                  | 33.3  | 58  | 66.7  | 87    |
| 36-45 | 10                  | 22.2  | 35  | 77.8  | 45    |
| 46-60 | 9                   | 29.0  | 22  | 71.0  | 31    |
| 60+   | 13                  | 23.6  | 42  | 76.4  | 55    |
| Total | 203                 |       | 185 |       |       |

Chi-square = 18.4 d.f. = 5 p = 0.002  
 (Excluding 0-15 category, Chi-square = 2.76, d.f. = 4,  
 p = 0.59)

| Age   | Occupational Therapy<br>no |       | yes |       | Total |
|-------|----------------------------|-------|-----|-------|-------|
|       | n                          | row % | n   | row % |       |
| 0-15  | 38                         | 95.0  | 2   | 5.0   | 40    |
| 16-25 | 88                         | 67.7  | 42  | 32.3  | 130   |
| 26-35 | 63                         | 72.4  | 24  | 27.6  | 87    |
| 36-45 | 28                         | 62.2  | 17  | 37.8  | 45    |
| 46-60 | 20                         | 64.5  | 11  | 35.5  | 31    |
| 60+   | 38                         | 69.1  | 17  | 30.9  | 55    |
| Total | 203                        |       | 185 |       |       |

Chi-square = 14.3 d.f. = 5 p = 0.01  
 (Excluding 0-15 category, Chi-square = 1.68, d.f. = 4,  
 p = 0.79)

For subjects that are less than 16 years old, the utilization of rehabilitation and allied health services is less likely. However, the lowest age category is also associated with lower injury severity scores and higher Glasgow Coma Scores. Of the 40 subjects in the 0-15 age category, only 1 had an ISS of over 16 with a GCS of under 9, and only 6 others had an ISS of 16, with a GCS of 9 or more.

Due to the small number of subjects in the 0-15 category, a chi-square calculation is not appropriate to determine the utilization of services by the measurement of the ISS with the GCS. However, it appears that the lower utilization of services by this age category can be attributed to their lower severity scores. There is no association between the sex of the subject and the utilization of services.

### **Utilization by Discipline**

#### **Physiotherapy**

Physiotherapy services were utilized by 67.8% of the cases. The total number of days from initiation of physiotherapy to its termination ranged from 1 to 506 with a mean of  $31.0 \pm 62.9$  and a median of 10 (table 27). Twenty-eight percent of those that received physiotherapy had a frequency of 1, 2 or three days of treatment. However, as displayed in Table 28, there were 22 cases that received

physiotherapy for over three months. Physiotherapy was generally initiated soon after admission, with 30% receiving it by their third day of admission. Physiotherapy was generally terminated at the end of hospital stay, with 74.3% of the cases terminating treatment on the day of discharge, or the day prior to discharge.

**Table 28. Days of Physiotherapy Treatment Provided**

| <u>Days</u> | <u>n</u> | <u>Percent</u> | <u>Cum. Percent</u> |
|-------------|----------|----------------|---------------------|
| 1           | 32       | 12.2           | 12.2                |
| 2-7         | 79       | 30.0           | 42.2                |
| 8-14        | 51       | 19.4           | 61.6                |
| 15-21       | 22       | 8.4            | 70.0                |
| 22-28       | 15       | 5.7            | 75.7                |
| 29-60       | 31       | 8.0            | 87.5                |
| 61-90       | 11       | 4.2            | 91.6                |
| 91+         | 22       | 5.7            | 100.0               |

The number of days of treatment provided by physiotherapy correlated with the combination of the measures of the ISS and the GCS (Table 29). If a subject had a severe injury (ISS greater than 15) and a head injury (GCS 8 or less) they were significantly more likely to have a greater number of days of physiotherapy services.

**Table 29. Days of Physiotherapy Treatment Provided by Injury Severity Score combined with Glasgow Coma Score (ISS with GCS)**

| ISS Score/GCS                               |          |       |          |       |          |       |       |
|---------------------------------------------|----------|-------|----------|-------|----------|-------|-------|
| Days of<br>Treatment                        | ISS < 16 |       | ISS ≥ 16 |       | ISS ≥ 16 |       | Total |
|                                             | GCS > 9  |       | GCS > 9  |       | GCS ≤ 8  |       |       |
|                                             | n        | %     | n        | %     | n        | %     |       |
| 1                                           | 29       | 20.8  | 3        | 3.7   | 0        | 0.0   | 32    |
| 2-7                                         | 57       | 41.0  | 17       | 21.2  | 5        | 11.3  | 79    |
| 8-14                                        | 25       | 17.9  | 22       | 27.5  | 4        | 9.1   | 51    |
| 15-28                                       | 12       | 8.6   | 11       | 13.7  | 14       | 31.8  | 37    |
| 29-60                                       | 10       | 7.1   | 12       | 15.0  | 9        | 20.4  | 31    |
| 61+                                         | 6        | 4.3   | 15       | 18.7  | 12       | 27.3  | 33    |
| Total                                       | 139      | 100.0 | 80       | 100.0 | 44       | 100.0 | 263   |
| Chi-square = 72.9    d.f. = 10    p < 0.001 |          |       |          |       |          |       |       |

For the 263 cases that utilized physiotherapy, the interventions that had the highest frequency were mobilization/ambulation, and interventions for respiratory functioning (Table 30). The least frequent intervention was for activities of daily living functioning. Under the category of "other", the interventions included (in descending frequency) debridement (whirlpool), education, serial casting, Jobst pump and stimulation. Many of the cases that received physiotherapy had more than one intervention provided.

Table 30. Physiotherapy Interventions Provided

| <u>Intervention</u>              | <u>n</u> | <u>Percent</u> |
|----------------------------------|----------|----------------|
| Mobilization                     | 189      | 48.7           |
| Respiratory Function             | 163      | 42.0           |
| Lower Extremity<br>Strengthening | 91       | 23.5           |
| Upper Extremity<br>Strengthening | 83       | 21.4           |
| Provision of Aids                | 14       | 3.6            |
| Pain Reduction                   | 12       | 3.1            |
| ADL Functioning                  | 6        | 1.5            |
| Other                            | 19       | 4.9            |

Occupational Therapy

Occupational Therapy services were provided to 93 of the cases, although 113 cases were referred. The length of time a case received occupational therapy ranged from 1 day to 455. The mean was 47.5, and the median 9.5, however the mode was 1. As displayed in Table 31, over 25% of the cases that received occupational therapy did so for only one day.

Table 31. Days of Occupational Therapy Treatment Provided

| <u>Days</u> | <u>n</u> | <u>Percent</u> | <u>Cum. %</u> |
|-------------|----------|----------------|---------------|
| 1           | 24       | 25.8           | 25.8          |
| 2-7         | 15       | 16.1           | 41.9          |
| 8-14        | 9        | 9.7            | 51.6          |
| 15-21       | 6        | 6.5            | 58.1          |
| 22-28       | 8        | 8.6            | 66.7          |
| 29-60       | 9        | 6.5            | 76.3          |
| 61-90       | 5        | 5.4            | 81.7          |
| 91+         | 17       | 18.3           | 100.0         |
| Total       | 93       | 100.0          |               |

The day that occupational therapy was initiated varied from the second day in hospital to the 145th, with a lack



The interventions most frequently utilized by occupational therapy were for activity of daily living (ADL) functioning, and splinting (Table 33). In reference to ADL functioning, the self care activity most frequently cited as requiring intervention was dressing, followed by household skills. The most frequent splints fabricated were footdrop splints (13) and resting hand splints (12). The least frequent intervention was for home evaluation. Interventions included in the other category were perceptual skill training, relaxation techniques, education, and specialized computer training.

**Table 33. Occupational Therapy Interventions Provided**

| <u>Intervention</u>              | <u>n</u> | <u>Percent</u> |
|----------------------------------|----------|----------------|
| ADL                              | 56       | 59.6           |
| Splinting                        | 35       | 37.2           |
| Provision of aids                | 33       | 35.1           |
| Cognitive Training               | 32       | 34.0           |
| Upper Extremity<br>Strengthening | 26       | 27.7           |
| Mobilization<br>(Transfers)      | 24       | 25.5           |
| Environmental<br>Controls        | 6        | 6.3            |
| Home Evaluation                  | 4        | 4.2            |
| Other                            | 15       | 15.9           |

### 3. Speech Therapy

The percentage of the cases that were referred to speech therapy was 8%. The total number of days a case received speech therapy ranged from 1 to 193, with a mean of 37.3 and a median of 11 days. Speech therapy was generally initiated

later during the course of hospital stay, with a mean of 40.1 days and a median of 31 days from admission. No one that was in hospital less than 14 days received speech therapy. Although termination of treatment varied, 32.1% of the cases had speech therapy terminated on the day prior to, or the day of discharge. As the length of stay increased, a case was more likely to receive speech therapy.

As discussed earlier, speech therapy utilization was associated with injuries to the head/neck, with almost 50% of those cases with a neck score of 4 or greater receiving this service. The service most frequently provided by speech therapy was for cognitive assessment and treatment (60.7%). Speech therapy was also provided to assess swallowing, to improve quality of speech and to provide alternate forms of communication.

#### 4. Recreational Therapy

Recreation services were utilized by 6.7% of the cases. The number of days of utilization of the service of recreation therapy ranged from 1-393, with a mean of 62.8 and a median of 36. Over 15% of the cases that received recreation did so for only one day.

Recreation therapy initiation occurred generally later during the hospital stay, with a mean of 86.6 and a median of 71.5 days. Termination of recreational therapy treatment usually occurred towards the end of hospital stay, with

65.4% having treatment terminated on the day prior to or the day of discharge.

The length of stay was related to receiving the service of recreational therapy. No case that was in hospital less than 28 days received this service.

Increased utilization of recreational therapy was associated with an injury to the head/neck. Recreational therapy was predominantly utilized to facilitate learning new leisure skills.

#### 5. Orthotics/Prosthetics

There were 57 cases that received treatment from orthotic/prosthetic services. The majority of the cases were seen for only one day - 56.1%. There were no clear patterns of orthotic service initiation or termination.

As would be predicted an injury to the limbs was associated with utilization of orthotic services. Of the 57 cases that received orthotic services, 14 (24.6%) were referred for more than one orthoses. One case was referred for 6 different orthoses. The most frequent orthosis provided was a Philadelphia Collar, followed by a thoracolumbar orthosis. Other devices included shoe raises, foot drop splints, lumbo-sacral corsets, Gilford braces, and a variety of others.

#### 6. Social Services

Social services were provided to 99 of the cases in

this study. Social Service involvement ranged from 1 day to 504 days, with a mean of 57 and median of 17. Over 20% of the cases were seen by social service for only one day.

Initiation of social service involvement ranged from the first day of hospitalization to the 88th day. Twenty-eight percent were seen during their first week of hospitalization. Social services was usually involved with the cases until the end of their hospital stay, with over 80% of the cases having social services terminated on the day prior to, or the day of discharge (for 4 cases involvement continued post discharge). An injury to the head/neck was associated with increased utilization of this service.

## 7. Psychology

Psychology services were provided to 24 cases. The length of time psychology services were utilized ranged from 1 day to 192, with a mean of  $16.4 \pm 45.0$  and a median of 1.00. Over 70% of those seen by psychology were only seen for one day.

Psychology was generally initiated later on during a persons stay within hospital, with a mean of  $87.3 \pm 9$  and a median of 54.5. There was not a clear pattern of termination of this service. Psychology utilization was most frequently associated with an injury to the head/neck.

Utilization of psychology services was most frequently

for neuropsychological assessment. Some cases were also seen as a liaison from psychiatric services to provide assessment and support.

#### 8. Dietary

Dietary services were received by 102 of the study cases. Dietary involvement with the cases ranged from one day to 464 days, with a mean of  $29.4 \pm 64.1$  and a median of 6.0. Over 36% of the cases were seen by dietary for one day.

Dietary services were generally utilized soon after admission, with 50% of the cases being seen within the first week. However, one case was seen by dietary on the 303 day post admission. Termination of dietary services varied considerably. Utilization of dietary services was associated with an injury to the head/neck, face or abdomen.

#### 9. Respiratory Therapy

Respiratory therapy was provided to 47.7% of the cases. The length of time respiratory therapy services were received ranged from 1-471 days, with a mean of  $18.7 \pm 49.7$  and a median of 8.0. Twenty-four percent of the cases had respiratory therapy for 1, 2 or three days.

For 86% of the cases that received respiratory therapy, it was initiated on the first or second day of hospitalization. For over 50% of the cases termination of

respiratory therapy occurred on the day of discharge. Respiratory therapy utilization was associated to injuries of the head/neck, chest and abdomen.

From the previous results it is apparent that the utilization of rehabilitation services and other allied health disciplines is an important aspect of trauma care. The utilization of services is related to the quantitative scores of the ISS, AIS and the GCS. Although there are many other factors that will affect the need for these services, certain trends can be identified that can assist in appropriate allocation of services.

## Chapter 5.

### DISCUSSION

The contents of this chapter includes a summary of the results, implication of the findings, limitations of the study and suggestions for future research.

#### **Summary and Implications of the Findings**

##### *Characteristics of the Study Population*

Demographic data obtained from this study, regarding the individuals that are hospitalized with moving vehicle related injuries, corresponds well with the literature. It is reported in many epidemiological studies that the mean age of subjects involved in moving vehicle incidents is relatively young (Baker, 1987; Trunkey, 1983). In this study, the mean age of the subjects was 34.1, with the modal ages being 18, 19, 20 and 21. As the mean age of the subjects is young, the residual impairments or disabilities that may be caused from moving vehicle injuries have long range implications.

An underlying premise surrounding trauma from moving vehicles is that many, if not all, of the injuries could be prevented. Clearly, prevention of the injury events would be the best solution. Many studies have investigated the effects of alcohol use on driving, and the use of seatbelts to reduce the severity of injuries (Waller, 1986; Avery,

1984). It is generally accepted that drinking alcohol impairs an individual's ability to drive, and results in increased moving vehicle crashes. It is also generally accepted that wearing seatbelts will prevent, or reduce, the severity of an injury should a moving vehicle crash occur.

Results of this study indicate that alcohol is a factor in many of the moving vehicle related injuries. In addition, seatbelts are frequently not being worn. Alcohol use especially appears to be a factor with males in the 16 to 35 age category. It is also this demographic group that had the lowest frequency of seatbelt use. It appears that health promotion strategies to encourage seatbelt use and the avoidance of drinking and driving should particularly be targeted at this group.

#### *Utilization of Rehabilitation/Allied Health Services*

The results of this study indicate that individuals hospitalized with moving vehicle trauma have a major impact on the hospital system. Over six percent of the subjects in this study were in hospital for over three months, and 3.8% of the cases were in hospital for over six months. It appears that the acute management of these cases was only one component of trauma care, and that the individuals often remained hospitalized for purposes of rehabilitation.

Utilization of rehabilitation services and other allied health services occurred frequently for the subjects in

this study. Over 72% of the cases received at least one of the five rehabilitation services, and 22 cases received treatment by personnel from the rehabilitation team for over three months. Eighty-three percent of the cases received at least one of the nine rehabilitation/allied health care services.

Some cases were referred for interventions from rehabilitation/allied health services, but were discharged before they received them. This occurred most frequently with occupational therapy, and was attributed to a lack of available therapists. In addition, there were delays to initiation of treatment, and subjects occasionally were put on waiting lists before interventions were initiated.

It is, thus, apparent that the hospitalization of trauma patients has an impact on the rehabilitation services. When a hospital accepts admissions of trauma patients, the implications to the rehabilitation and other allied health services must be considered.

Although the majority of the patients received treatment from at least one of the services, this can be attributed to the high utilization of physiotherapy and respiratory therapy. Questions arise regarding the relatively low utilization of many of the other services, despite the severity of injury of the cases. However, there currently are no standards to indicate appropriate utilization of services. Salsameda and McBride (1986)

outlined the benefits of utilizing a rehabilitation coordinator within a trauma center to ensure a continuum of care and facilitate the appropriate usage of rehabilitation and allied health services. It appears that the use of a rehabilitation coordinator may also be beneficial within an acute care hospital that assumes the care of the trauma patient. If a rehabilitation coordinator was involved with the patient from admission, referral to the appropriate rehabilitation and allied health care services could be ensured. In addition, the coordinator could facilitate appropriate referral to services post discharge to maximize physical, functional and psychosocial functioning.

#### *Relationship Between Quantitative Scores and Utilization of Services*

Results of this study indicate that the quantitative injury scores provided by the Injury Severity Score, Abbreviated Injury Score, the Glasgow Coma Scale and a combination of measures may be useful in the planning and allocation of rehabilitation/allied health services for individuals sustaining trauma related to moving vehicles.

The Abbreviated Injury Score is related to the utilization of rehabilitation/allied health services. This is particularly true for individuals sustaining injuries to the head or neck. As the AIS of the head/ neck increased, it was strongly associated with increased utilization of

physiotherapy, occupational therapy, speech therapy, recreational therapy, social services, psychology services, dietary and respiratory therapy. An AIS of 5 or 6 for the head/ neck indicates probable utilization of physiotherapy, occupational therapy and respiratory therapy.

Abdomen injuries were associated with increased utilization of physiotherapy, dietary services and respiratory therapy. An AIS of 4 or 5 of the abdomen indicates probable utilization of physiotherapy and respiratory therapy.

An injury to the face was associated with increased utilization of dietary services. There was not, however, increased utilization of this service when the face score increased.

Limb injuries were associated with utilization of physiotherapy, occupational therapy and orthotics. A limb score of 3 or 4 appears to indicate the probable utilization of physiotherapy.

Chest injuries were associated with utilization of physiotherapy and respiratory therapy. Chest scores of 5 most likely utilize physiotherapy and a chest score of 3 indicates probable utilization of respiratory therapy.

The Injury Severity Score, which is a summary measurement of the Abbreviated Injury Scores, is a simpler measurement to indicate probable utilization of services. As the Injury Severity Score increases, there is increased

utilization of rehabilitation and allied health services. Injury scores greater than 15 suggest increased utilization of services, and indicate a probable utilization of physiotherapy and respiratory therapy.

The Glasgow Coma Scale also appears valuable in indicating the utilization of rehabilitation/allied health services. Increased utilization of all services, with the exception of orthotics, was found when a case had a Glasgow Coma Score of 8 or less. Over 95% of those cases with a Glasgow Coma Score of eight or less received at least one rehabilitation service.

The measurement that was the simplest, and appears the most useful to suggest utilization of services was the combination of the ISS with the GCS. Subjects with an ISS of over 16 and a GCS of 8 or less, were most likely to utilize rehabilitation and allied health services. This combination of the ISS and GCS has previously been described to be a useful predictor of long term functional recovery (Pal et al, 1989).

Therefore, it appears that these quantitative measurements have a relationship with the utilization of services. This can have implications to hospital resource planning and in the allocation of services.

It must be cautioned, however, that many of those individuals with relatively minor injuries also required

interventions from rehabilitation and allied health services. Other factors aside from the severity of injuries will influence an individual's need for rehabilitation or other interventions. These other factors include, but are not limited to, premorbid physical health and functioning, psychosocial functioning and family and social supports. The quantitative scores can be useful to suggest utilization of services on a population basis, but each individual patient must be assessed for their specific needs.

It is, thus, understandable that many patients with relatively minor injuries required interventions from a variety of disciplines. Questions arise, however, about the individuals with high injury severity scores that did not receive services. With the increased emphasis on ethics and rehabilitation, the use of the quantitative measurement scales may be beneficial to assist in ensuring that individuals are referred to the services that they require.

#### *Initiation and Termination of Rehabilitation/Allied Health Interventions*

There is general agreement that the timing of when rehabilitation services are initiated will impact the physical, psychological and social functioning and recovery of an individual. The length of time elapsed from the injury to initiation of treatment varied from service to

service, but general patterns were determined. Information was not obtained from this study regarding the reasons, or the effects, of delays in treatment. However, one important finding from this study was that for the services of occupational therapy, speech therapy and recreational therapy there was frequently a lengthy delay from when the patient was referred to treatment to its initiation. It was apparent that, during the time of this study, resources were not available to meet the rehabilitation needs of the trauma patient .

Almost all of the services were terminated on, or close to the discharge day of the patient, and relatively few patients were referred to services on an outpatient basis. The service referred most frequently upon discharge was physiotherapy (11.9%), followed by occupational therapy (5.2%). Although it was not captured by this study, this finding raises questions surrounding outpatient rehabilitation. It would be important to determine if the patients did require further service post discharge, or whether they could have been discharged earlier if more resources were available for outpatient rehabilitation.

#### *Utilization of Physiotherapy and Occupational Therapy*

Research in the fields of physiotherapy and occupational therapy have been described to be in the infancy stage (Polatajko, Miller, MacKinnon and Harburn,

1989). Recent papers have encouraged therapists to undertake research activity to determine characteristics of clients, and why they seek interventions (Law, 1988). In addition, therapists have also been encouraged to become involved in research surrounding issues of treatment of individuals injured through trauma, as it appears this area will be of prime importance in the twenty-first century (Madill, Cardwell, Robinson and Brintnell, 1986).

The rehabilitation services of physiotherapy and occupational therapy were utilized frequently for the subjects in this study. The quantitative injury severity scores not only indicated the utilization of these services, but also provided indications regarding the number of days a patient would remain on the caseload of a therapist. The major purposes and goals of the interventions were also determined. Physiotherapy was most frequently utilized to improve mobilization and respiratory functioning, followed by upper and lower extremity strengthening. Occupational therapy was most frequently utilized for maximizing activities of daily living functioning and for fabrication of splints. Interventions related to provision of adapted equipment and aids and cognitive training were also frequently provided by occupational therapy.

Therapists in these two disciplines stress the importance of considering the uniqueness of an individual, and providing interventions that are adapted to correspond

with the specific needs of the patient. The results of this study indicate, however, that by investigating a large population of trauma patients trends can be determined which can assist in program planning.

### **Limitations of the Study**

The research method of using a chart audit has inherent limitations. The accuracy of the data collected is dependent on the accuracy and completeness of what is included in the charts. The data for this study were collected from the documentation of a number of disciplines, and what was charted may not always accurately reflect what occurred in the hospital. In addition, as this study was retrospective, it is limited, as information can only be obtained regarding the actual rehabilitation/allied health care service received. Information regarding other individuals who may have benefitted from services, but did not received them was not obtained. Also, the utilization of services after discharge from the General Hospital was not included in this study. Many of the patients transferred to other acute facilities most likely received rehabilitation/allied health services, which was not captured by this study. In addition, the number of days a case was seen as an outpatient is not available.

Another limitation of this study was that information regarding the benefits of the interventions received was not

accessible. It can be assumed that the cases benefitted from the services provided, however, this was not measured in this study.

This study was limited to the nine rehabilitation or allied health care services of physiotherapy, occupational therapy, speech therapy, recreational therapy, orthotics, respiratory therapy, dietary, social services and psychology. It is recognized that the rehabilitation of individuals will also utilize services of other health care professionals, including, but no limited to, nursing staff and a number of medical specialists. However, this was not investigated in this study.

This study was undertaken within one acute care hospital, and the results obtained may not be generalizable to other facilities. The pattern of utilization of services may vary from hospital to hospital as a result of staffing, policies and different referral practices. However, the data obtained from this study can provide a basis for comparison to other facilities.

#### **Suggestions for Future Research**

Many of the limitations of this study can be attributed to its retrospective design. It is evident that a future prospective study, that follows a patient from admission to hospital to his/her long term functional recovery, would be valuable. The patients should initially be assessed for their need for rehabilitation/allied health services, which

could again be correlated with the quantitative injury severity scores. The amount of treatment time provided by a service should be more clearly delineated, by collection of the number of sessions, and the amount of treatment time provided.

Studies that would substantiate the benefits of the various therapeutic interventions would also prove valuable. With the increasing economic constraints in health care, the importance of justifying the necessity of the services provided by rehabilitation and allied health professionals is magnified. In addition, knowledge of the benefits of services will assist in ethical decisions regarding their allocation.

It is evident that the rehabilitation of individuals sustaining injury from moving vehicles is an important health care issue. This population frequently utilizes rehabilitation and other allied health services, and it appears that utilization of services is strongly associated with severity of injuries. Many questions remain regarding the most appropriate utilization of rehabilitation and allied health care services for these individuals. This study, however, provides preliminary information that may help to ensure that individuals receive the rehabilitation and allied health services they require to achieve maximal physical, social and psychological recovery.

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## Appendix 1

## Data Abstracted from Trauma Audit

1. Age
2. Sex
3. Cause of Injury
4. Presence of Alcohol
5. Seatbelt Utilization
6. Abbreviated Injury Scores - Head/neck  
Abdomen  
Limbs  
Chest  
Face  
External
7. Injury Severity Score
8. Glasgow Coma Scale

## Appendix II

## Data Abstracted from Hospital Charts

1. Date and time of admission.
2. Unit to which subject was initially admitted.
3. Date and unit of in-hospital transfers.
4. Date and time of discharge.
5. Disposition at time of discharge: home  
acute hospital  
rehabilitation  
facility extended care  
center  
other  
death.
6. For the services of physiotherapy, occupational therapy, speech therapy, recreational therapy, orthotics, social services, psychology, dietary and respiratory therapy:
  - a) whether service was received.
  - b) date of referral.
  - c) date treatment from service was initiated.
  - d) date treatment from service was terminated.
  - e) whether service was referred upon discharge.
7. For the service of physiotherapy, whether interventions were provided for the purpose of:
  - a) mobility/ambulation
  - b) upper extremity strengthening
  - c) lower extremity strengthening
  - d) respiratory functioning
  - e) pain control
  - f) activities of daily living training
  - g) provision of equipment
  - h) other.

8. For the service of occupational therapy, whether interventions were provided for the purpose of:

- a) cognitive retraining
- b) upper extremity strengthening
- c) splinting
- d) activities of daily living training
- e) provision of adapted aids and equipment
- f) home evaluation
- g) other.