1995

The Continuum of Care for the Traumatic Brain Injured

Maile M.K. Collado  
*University of North Dakota*

Follow this and additional works at: [https://commons.und.edu/pt-grad](https://commons.und.edu/pt-grad)  
Part of the [Physical Therapy Commons](https://commons.und.edu/pt-grad)

Recommended Citation  
[https://commons.und.edu/pt-grad/102](https://commons.und.edu/pt-grad/102)

This Scholarly Project is brought to you for free and open access by the Department of Physical Therapy at UND Scholarly Commons. It has been accepted for inclusion in Physical Therapy Scholarly Projects by an authorized administrator of UND Scholarly Commons. For more information, please contact zeinebyousif@library.und.edu.
THE CONTINUUM OF CARE FOR THE TRAUMATIC BRAIN INJURED

By

Maile M. K. Collado
Bachelor of Science in Physical Therapy
University of North Dakota, 1994

An Independent Study
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Master of Physical Therapy

Grand Forks, North Dakota
May
1995.
This Independent Study, submitted by Maile M. K. Collado in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

(Faculty Preceptor)

(Graduate Advisor)

(Chairperson, Physical Therapy)
PERMISSION

Title The Continuum of care for the Traumatic Brain Injured

Department Physical Therapy

Degree Master of Physical Therapy

In presenting this Independent Study Report in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the Department of Physical Therapy shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my work or, in her absence, by the Chairperson of the department. It is understood that any copying or publication or other use of this independent study or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and the University of North Dakota in any scholarly use which may be made of any material in my Independent Study Report.

Signature

Date
# TABLE OF CONTENTS

ACKNOWLEDGMENTS ................................................................. v

ABSTRACT ........................................................................... vi

CHAPTER

I  INTRODUCTION ................................................................. 1

II  DEFINITION, EPIDEMIOLOGY, ETIOLOGY, AND
    COMPLICATIONS OF TRAUMATIC BRAIN INJURY .............. 4

   Epidemiology ..................................................................... 5
   Etiology .......................................................................... 8
   Complications .................................................................. 10

III THE CONTINUUM OF CARE FOR THE TRAUMATIC BRAIN
   INJURED PATIENT ............................................................ 13

   The Acute Care Phase ...................................................... 16
   The Acute Rehabilitation Phase ........................................ 17
   The Post Acute Rehabilitation Phase ................................. 19
   The Independent Phase .................................................... 24
   Funding .......................................................................... 25

IV BRAIN RECOVERY AND RE-ADMISSION TO
   REHABILITATION ............................................................... 28

V DISCUSSION AND CONCLUSION ............................................. 33

REFERENCES ......................................................................... 35
ACKNOWLEDGMENTS

I would like to send my sincere gratitude to my entire family and my husband, Romeo, for their support and love these past three years. If it were not for their caring ways, my education pursuits would not have been made possible. Much aloha to the faculty of the UND Physical Therapy Program, and especially to Renee Mabey for all her input into this literature review. Also a great big thank you to Alyson White for being the fastest typist I know!
ABSTRACT

Physical therapists play an important role in the rehabilitation and management of the traumatic brain injured (TBI) patient. Physical therapy is accomplished through therapeutic strategies, intervention techniques, and recommendations for placement and discharge. Many times P.T. services are discontinued for various reasons, two of which are loss of reimbursement or the perception that the patient no longer requires P.T. services. Many times, however, services are discontinued due to a lack of awareness of available services.

There is limited research available that follows the TBI patient along the continuum of care towards reintegration into society. Thus, the purpose of this study is to review the literature of the various interventions along the continuum of care of the TBI patient. It also reviews the literature that focuses on the plastic quality of the brain and the benefits of continuing rehabilitation interventions for the chronic TBI patient.

This study benefits physical therapists by increasing their awareness of the programs available for the TBI patient. It also increases their knowledge of the plastic property of the brain and encourages them to continue rehabilitation of the TBI patient throughout the continuum of care.
CHAPTER I

INTRODUCTION

Traumatic brain injury (TBI) is a sudden unexpected injury to the brain that leads to physical, social, and financial difficulties.\textsuperscript{1-4} In the United States alone, an estimated two million persons per year sustain a TBI.\textsuperscript{5} One fourth of these persons will require hospitalization.\textsuperscript{1,6} Of those who survive, between 40,000 to 90,000 will endure life-long disabilities as a result of head trauma.\textsuperscript{4,6,7} These life-long deficits are cognitive or physical or a combination of the two. Normal everyday functioning is altered and continued assisted care is required. In addition, the patient's life expectancy is almost the normal life span due to technological advances in medicine.\textsuperscript{2,8}

The problems that arise from TBI are seldom endured by the patient alone. Families and agencies relative to the care of the TBI patient become involved. Care of the TBI patient involves managing a chronic disability and becomes increasingly frustrating with the severity of the injury and the resulting deficits. The continuum of care for the TBI population is a series of programs geared to meet the changing needs of the individual. It progresses the patient towards optimal function and a life of maximal independence.
Effective rehabilitation incorporates a comprehensive multidisciplinary team of specialists who communicate, educate, and work with the patient and his or her primary care givers. As specialists, physical therapists play an important role along this continuum. They help to restore the patient's functional and physical skills. This is accomplished through therapeutic strategies, intervention techniques, and the therapist's recommendations for placement and discharge. During the stages of disability and handicap in the years after the acute situation, specialists in rehabilitation focus their energy on helping the patient to successfully integrate into society and family. Thus, following the patient through the continuum of care will ultimately help the patient have a more productive and satisfying role in society.

Many studies review the continuum of care for the TBI patient during the early recovery and formal rehabilitation. However, limited research exists in the various kinds of care and alternative living situations available to the TBI patient post rehabilitation. Also, few studies are available on whether these programs affect the restoration of functional independence.

The purpose of this study is to review the literature of the placement options available for the TBI patient along the continuum of care. The contents of this study will first give a summary of TBI and the significance of its occurrence in the United States. Next, it will define the continuum of care of the traumatic brain injured and describe institutions and programs serving this population. Finally, this paper reviews the literature relative to the brain's
plasticity and how re-admission to rehabilitation affects functional outcomes. This review of the literature is directed towards informing physical therapists of the various TBI program options available post rehabilitation and of the effects of continued rehabilitation services along the continuum of care.
CHAPTER II
DEFINITION, EPIDEMIOLOGY, ETIOLOGY, AND COMPLICATIONS
OF TRAUMATIC BRAIN INJURY

Traumatic brain injury (TBI) is defined as an external mechanical force causing trauma, with evidence of damage to the brain.\textsuperscript{2,6} Brain damage is signified by the loss of consciousness, post traumatic amnesia (PTA), or by the patient's physical or mental status.\textsuperscript{11} A fracture of the skull may or may not be present.\textsuperscript{1,2,4} The Glasgow Coma Scale (GCS) and the Ranchos Los Amigos Level of Cognitive Functioning (RLAL-CF) describe the TBI patient's response to stimuli. These scales classify the patient's condition throughout the continuum of care. They also provide care givers with a base line of the patient's needs at different levels of consciousness and awareness.

The GCS is often used in the emergency room situation and is a good indicator of the patient's prognosis.\textsuperscript{4,10,11} Many studies reveal that the GCS has a high correlation with outcome.\textsuperscript{10} This scale rates the level of consciousness by three categories: eye-opening, best motor response, and best verbal response.\textsuperscript{12,13} A score between three and eight signifies a severe TBI and the outcome is generally poor.\textsuperscript{4,9,11} Moderate TBI is a GCS score of 9 to 11 or 9 to 12 depending on the study.\textsuperscript{4,11} Finally, the mild head injury exhibits a GCS score
greater than 12. This is an injury that has good prognosis. Thus, the GCS is a useful tool because it offers an objective description of the patient's level of consciousness.\textsuperscript{14}

The RLAL-CF evaluates the TBI patient's cognitive abilities by his or her behavior.\textsuperscript{12,13} This assessment is made through observations of the patient's behavior in relationship to awareness of the environment, memory skills, social skills, and appropriateness. The RLAL-CF focuses on how the patient processes and uses the information actively. Descriptive terminology is used to give clinicians a clearer view of the patient's cognitive dysfunctions.

Other types of assessments include the Disability Rating Scale, the Functional Independence Measure (FIM), the Functional Assessment Measure (FAM) which is an expansion of the FIM, the Children's Orientation and Amnesia Test (COAT), and the Abbreviated Injury Scale (AIS). These scales use functional and physiological measures to grade the severity of TBI.\textsuperscript{11}

Although descriptive tools are available, investigators agree there are a variety of definitions used throughout the literature to describe the severity of TBI.\textsuperscript{1,2,4,11} This makes it difficult to draw conclusions and make comparisons and assumptions about this population.

Epidemiology

TBI is often referred to as the "Silent Epidemic."\textsuperscript{2,15} The estimate of TBIs occurring each year lies somewhere between 500,000 to 2 million.\textsuperscript{7,14} This
estimate and the proportion of mild, moderate, and severe injuries varies
between studies.\textsuperscript{1-4,6,20}

There are three primary factors that affect the disparity of TBI incidence
data. The first is that data depend on how the investigator chooses to define
TBI.\textsuperscript{1-4,8,10,11,14} Sometimes the terms “head injury” or “head trauma” are inclusive
of non-brain injuries and may further escalate the perceived TBI incidence.\textsuperscript{3} In
addition, how the investigators classify the severity of TBI affects the outcomes
reported. For example, to date, there is no set definition of a moderate head
injury.\textsuperscript{11} This causes difficulties when comparing the results of moderate head
injury studies.

Second, it is difficult to estimate the frequency of TBIs because
descriptive demographics were rarely done prior to the 1980s; even 1994 data
bases are incomplete.\textsuperscript{2,4} Currently, formal registries exist in 12 states, and of
them only 11 have a legislative mandate to report TBI incidence.\textsuperscript{2} The
organizations gathering TBI data vary and the information collected is not
uniform due to differences in the purpose, contents, and methods for data
collection.\textsuperscript{2} Epidemiological data gathered in places like San Diego are also
influenced by the number of TBIs seeking medical attention who are non-United
States citizens.\textsuperscript{1} Ultimately, there is a lack of a central data base for collecting
national data since individual studies are limited to just a few areas and data
bases are required in just a few states.\textsuperscript{2}
Finally, in the emergency room situation, the severity of the injury based on the GCS may influence how aggressive a physician may be with his or her intervention. If the prognosis is poor, the physician may choose a less intensive intervention for head injury emergency care. The number of TBI survivors may be altered accordingly.\textsuperscript{14} However, the improvement of diagnostic tools and surgical and neurological interventions has increased the attention given towards these patients. In summary, because of definition and collection disparities and treatment concerns, epidemiological data are possibly underestimated in the United States.\textsuperscript{14}

Despite these factors, investigators estimate the total numbers of TBIs in the United States to be between 500,000 to 2 million per year.\textsuperscript{7,14} Although most are mild injuries, 50,000 to 70,000 are considered to be moderate or severe. These individuals will suffer severe deficits and require assistance with activities of daily living.\textsuperscript{6,14} Epidemiologic studies specifically done on children reveal non-fatal TBIs estimated to be 219.4 per 100,000 population annually.\textsuperscript{3} Trends are found in child and adult populations when studying the correlation between TBIs and gender, age, socioeconomic status, and race.

Studies on the correlation of TBI incidence with gender and age reveal that adults and children follow a similar pattern. Males have two to three times as many TBIs as females do.\textsuperscript{3,4,7,9,11,14} Gender differences appear as early as the preschool years which is a reflection of behavior differences between males and females.\textsuperscript{3} There are ages that best exemplify the TBI incidence in young
people and adults. The average age of a young brain injured person is 15 to 24 years old.\textsuperscript{4,7,16} The adult is usually male who is 34 years old.\textsuperscript{1,12}

Socioeconomic status and race also appear to have correlations with TBI. The rates of head injury relate inversely to socioeconomic status. The highest rates of TBI are found in lower economic populations for both children and adults.\textsuperscript{3,4,11,14}

Investigators also report a higher incidence of TBI found in the minority populations for both children and adults.\textsuperscript{1,3} The highest incidence is found in the Native American population, followed by blacks, Hispanics, whites, and then Asians.\textsuperscript{3} Incomes appear to be a common element among TBI patients more so than ethnicity.\textsuperscript{3} It is difficult to draw solid conclusions about ethnic and socioeconomic backgrounds with information as poorly defined as that found in brain injury demographics. However, a comparison of several epidemiologic studies profiles the moderate TBI as a 15- to 24-year-old male who is single, a minority living in the city, with a 42% possibility of a history of alcohol abuse and a 21% incidence of being chronically unemployed.\textsuperscript{4,11,14}

Etiology

The etiology of traumatic brain injury is directly related to the descriptive demographics. The number one cause of TBI is motor vehicle accidents (MVA).\textsuperscript{1,7} This fact correlates with the dramatic increase in TBI rates at the age of 15 years when most adolescents are able to obtain their licenses to drive.\textsuperscript{3} MVAs account for 21% to 25% of childhood and adolescent TBIs.\textsuperscript{1,17} For adults,
50% of head traumas result from car accidents.\textsuperscript{7} Seventy-two percent of these adults had alcohol in their blood and over two-thirds had a blood alcohol level of 0.1% or higher.\textsuperscript{14} These figures do not include the number of TBIs from other traffic related accidents such as incidences involving pedestrians.

The second most frequent cause of TBI is falls.\textsuperscript{1} Preschoolers comprise 42% of the pediatric population who receive TBIs as a result of falls.\textsuperscript{1} This may be attributed to the higher center of gravity located in the head of the youngster.\textsuperscript{3} As the child develops, his or her center of gravity moves more towards the center of the body. Comparatively, only 14% of adolescent head traumas are due to falls.\textsuperscript{1} In adults, 21% of trauma related injuries are due to falls, many of which may be attributed to balance and equilibrium changes in the elderly.\textsuperscript{7}

Third, assaults lead to TBIs of varying degrees. Penetrating head injuries occur at a rate of 12 per 100,000 population of United States citizens each year.\textsuperscript{10} These injuries result from interpersonal and domestic violence using handguns, baseball bats, knives, and scissors.\textsuperscript{10} In children, the number one subcategory of assaults is child abuse.\textsuperscript{3} It is estimated that nine in ten TBIs in children result from abuse.\textsuperscript{3} Subdural hematomas are most often seen in abused children. Retinal hemorrhage is common in children who are victims of the shaken-impact syndrome; retinal hemorrhage rarely shows up in unintentional injury.\textsuperscript{3}
Finally, recreation and sports account for approximately 21% to 40% of brain injuries in children and adolescents, and 10% of adult injuries. The National Head Injury Foundation, Inc., estimates approximately 50,000 TBIs are sustained by children riding bicycles each year. Injuries related to playground equipment, children's vehicles, roller skates, and skateboards decrease with age and the increased use of helmets.

Complications

Serious TBI results in a variety of complications. The functional neuroanatomy of the brain is dynamic and every part of the brain is considered functional. Unlike the stroke which is a focal injury, the TBI is diffuse and the patient suffers extensive damage to the highly organized system of the brain. Thus, the TBI patient experiences a myriad of complications encompassed in the following categories: 1) medical, orthopedic, and neurological problems, 2) cognitive deficits, and 3) subsequent difficulty with discharge and placement after acute rehabilitation.

First, common complications are seen in relationship to medical, orthopedic, and neurophysiologic areas. Medical complications may include coma, respiratory problems, thermal control problems, seizures, increased intracranial pressure, cardiovascular changes, and nutritional problems due to changes in metabolic rates. Orthopedic complications are also seen in TBI as a result of the mechanism of injury. Multiple musculoskeletal trauma occurs in 33% to 67% of TBI victims. Heterotrophic ossification and osteoporosis are
common musculoskeletal disorders that arise after TBI secondary to prolonged bed rest and inactivity.\textsuperscript{12,13} Finally, a long list of neuromotor dysfunctions are often associated with TBI. These dysfunctions include altered sensation, perceptual dysfunction, spasticity, hypotonia, rigidity, altered reflexes, and movement disorders. Common movement disorders include ataxia, apraxia, tremor, and dyskinesia.\textsuperscript{12}

Next, cognitive deficits are often more disabling than the physical complications. The TBI patient will usually regain physical function, but the severe deficits in cognition prevent him or her from operating independently outside a structured environment. Typically, the patient is disoriented, has decreased arousal, and conveys confusion. He or she becomes inflexible with his or her thoughts about the environment, and often demonstrates decreased judgment and safety awareness. Language disorganizations are also commonly seen.\textsuperscript{12,13} The patient may be unable to remember or use words in their proper context. Language disorders compounded with memory problems become barriers to learning new activities. These impairments, both cognitive and physical, inclusively contribute to the generally low rates of post-injury employment and poor retention of jobs. Other psychosocial issues such as behavioral, sexual, and social dysfunctions also become evident.\textsuperscript{12,13}

Last of all, discharge and placement of the TBI patients are difficult depending on the severity of the complications noted earlier. No two TBI patients are alike and post acute rehabilitation placement must be customized.
This ensures the patient's ongoing needs are met and quality of life is preserved. Acute hospital and rehabilitation hospital case managers often consider discharge and placement as being the most frustrating and challenging issue when working with the TBI population.

As stated earlier, there are many residual deficits that affect the amount of care and supervision this patient may require post discharge. Also, the number of specialized facilities that meet the needs of these patients are limited. Finally, along the continuum of care, family support is the key to successful reintegration of the TBI patient into society.\textsuperscript{18,19} However, some families are unprepared to cope with a young chronically disabled person who requires constant supervision and assistance. When family assistance is unavailable, finding an appropriate living situation that meets all the patient's needs is difficult and frustrating.
CHAPTER III

THE CONTINUUM OF CARE FOR THE TRAUMATIC BRAIN INJURED PATIENT

The life-long deficits resulting from TBI are evidence of the need for a well-modeled continuum of care promoting quality care. The client-oriented program integrates services that guide and tract patients over time through a comprehensive array of health and psychosocial services.\textsuperscript{14,16-21} For the TBI patient, the continuum of care spans all levels of cognitive function and health care need. Its goal is to help the TBI patient achieve and maintain functional independence.\textsuperscript{13,20} Unpredictable and variable deficit patterns make the care of each TBI patient unique.\textsuperscript{22} Historically, many have been inappropriately placed in programs for the retarded or mentally ill, or in facilities unequipped to meet their needs.\textsuperscript{12,22} Case managers are, therefore, obligated to locate services that best benefit the patient's progress towards independence.

To provide quality of care for the TBI patient, four key principles of strategic management are applicable. These principles include: 1) having a client-oriented basis, 2) providing services that span more than one dimension, 3) maintaining and maximizing the patient's functional independence, and 4) integrating care services.\textsuperscript{19}
The TBI continuum of care is a dynamic program. Under this model, one does not expect patients to experience a prolonged period of residency at the same facility. Once the goals at one facility are achieved, the patient is progressed to the next appropriate program. A special effort is made to carefully match the treatment needs of the TBI patients with the level of care. For example, it is not appropriate to find a young TBI patient on the same ward as elderly patients who have different cognitive, physical, and/or social needs. In addition, studies reveal that at least 16% of institutionalized elderly are able to function either independently or with minimal assistance at home. A parallel can be drawn between elderly and TBI patients: with the implementation of appropriate rehabilitation therapies, more TBI patients can achieve functional independence. But, the longer patients remain in nursing home facilities, the more likely they will show subsequent confusion and physical failure: they are more likely to die there.

Discharging a TBI patient to an inappropriate facility decreases his or her chance for independent living. Ideally, placement errors for the TBI patient are avoided by integrating information about each individual's background needs. A flexible continuum of care also allows the patient to move smoothly from one phase to another. In reality, meeting the needs of the TBI patient is frustrating due to the limited amount of resources and programs available. Receiving services heavily depends upon the patient's physical and cognitive status;
financial resources; assertiveness and aggressiveness in seeking resources; geographic location; and realistic goals towards functional independence.\textsuperscript{22}

Fortunately, the number of programs that specialize in TBI rehabilitation is increasing. As of 1987, there are 500 categorical United States TBI programs and three federally funded programs.\textsuperscript{22} This increase in programs is due to the participation and activation of head injury advocacy groups, the families of TBI victims, legislative mandates, and the insurance agencies.\textsuperscript{22} The quantity and quality of TBI programs vary from state to state. Diane Hageman, RN and TBI case manager, and Michael Sullivan, Director of the Hawaii Head Injury Foundation, surmised that the number of programs available and the quality of the TBI continuum of care appear to be directly related to activity at the state chapters of the National Head Injury Foundation (via separate conversations in October, 1994).

Despite limited resources, the basic TBI continuum of care plan can be separated into four phases. The first phase is the acute care phase, which is followed by the acute rehabilitation phase and the post acute rehabilitation phase, and finally, the independent living phase. These phases are not discrete as one facility may offer services generally provided in another phase. The phases also share common goals to maximize a person's level of independence and productivity.
The Acute Care Phase

TBIs vary in severity and not every patient will require acute hospital care. The patient who experiences less than 20 minutes of unconsciousness sustains a mild head injury. This patient generally fails to seek medical attention, but still experiences the post-concussive syndrome. The post-concussive syndrome includes symptoms of dizziness, fatigue, depression, irritability, headache, memory deficits, and a normal neurological examination.

On the other hand, the moderated, severe, and catastrophic injured patient requires acute medical attention due to the lengthened loss of consciousness time and the physical, cognitive, and psychosocial disabilities. The continuum of care for the TBI patient begins in the acute hospital setting just after the injury occurs. At the time of injury, medical attention may or may not be required. For those persons who do require medical attention, the facility contains a specialized branch of surgical and medical care for trauma management. The intensive care unit emphasizes managing the multiple primary injuries and preventing secondary complications. The most common complications in the acute care phase include hypoxia, delayed treatment, sepsis, intracranial hypertension, and seizures. Cushing’s triad is another secondary complication caused by direct pressure in the respiratory centers of the medulla. It is signified by increased blood pressure, bradycardia, and irregular respiratory effort. This syndrome precedes irreversible brain damage.
Thus, in the acute care phase, airway, breathing, circulation, and neurological changes are closely monitored.\textsuperscript{13,23}

Therapy in the acute care phase is aimed at preventing secondary complications and directing motor responses as a result of spontaneous recovery.\textsuperscript{13} Acute treatment is focused upon achieving autonomic homeostasis, reflex integration, and development of normal movement to promote functional abilities.\textsuperscript{13} Positioning, skin care, range of motion, and pulmonary hygiene are regular practices in the acute care rehabilitation regime.\textsuperscript{12,13} After the patient regains consciousness, is medically stable, and able to follow simple commands, he or she should be referred to an acute rehabilitation program or the next appropriate phase as soon as possible.\textsuperscript{12,14}

The Acute Rehabilitation Phase

The second phase of the continuum of care is the acute rehabilitation phase. This program may be a part of the acute hospital or it may be housed in a separate rehabilitation center. It often provides ongoing therapy in a structured hospital-like setting.\textsuperscript{13} A structured environment allows the patient to process stimuli cognitively, and decreases agitation and distraction.\textsuperscript{12,13} In this phase, the goal is physical restoration by eliminating physical deficits which interfere with activities of daily living. It pays special attention to the cognitive and psychosocial disabilities that result from head injuries.\textsuperscript{22} Goals in general are attained through the implementation of a multidisciplinary team approach. The team includes a full spectrum of therapies inclusive of physical,
occidental, speech, recreational, and psychiatric therapies. Some facilities provide community re-orientation programs for reintegration into society. A holistic approach is also extended from patient care to family concerns and education.

Early acute rehabilitation intervention after a TBI has a positive effect on the length of stay and outcomes. Patients with severe TBI admitted quickly into rehabilitation programs have shorter rehabilitation stays, fewer complications, and lower medical costs than those who receive delayed admission into rehabilitation intervention. Patients with delayed admission into rehabilitation show a greater degree of cognitive disability at five to ten years post injury. The intensity of and length of stay in a rehabilitation program also correlates positively with TBI outcome.

Acceptance into the acute rehabilitation phase usually occurs two to three weeks post injury or as soon as the patient is medically stable and services are available. Criterion for admission varies between facilities. Many facilities limit admission to patients with a RLAL-CF of level V or higher. The Dakota Hospital Rehabilitation Unit in Fargo, ND, accepts TBI patients with a RLAL-CF of at least stage II or IV (via phone conversation in November, 1994). Geographic location may also play a deciding factor in the admission process. Often families are required to select a program which is located hundreds of miles from home. The states of Hawaii and North Dakota are prime examples. Both states have only a few formal TBI rehabilitation programs that serve their
entire populations. Specifically, Hawaii has only one formal acute rehabilitation program for the TBI patient located on the island of Oahu. Outer island residents must fly to Oahu for rehabilitation services where family support may then be minimal.

The Post Acute Rehabilitation Phase

The post acute rehabilitation phase encompasses a broader variety of continued care services than the two previous phases. The post acute rehabilitation phase may be a part of an acute care hospital or a specialized head injury center that is either an inpatient or outpatient setting. Specialized services are delivered for one to two years. Subcategories include swing beds, specialized TBI transitional living programs, outpatient therapy, day care therapy, alternative housing, the family home, and chronic care institutions such as nursing homes and psychiatric hospitals. These programs are designed to provide services to brain injury survivors who no longer require hospital based or intensive medical or rehabilitation treatment, but who do require continued rehabilitation in order to function independently in the community.

Swing beds. The swing bed transitions the patient awaiting discharge from the hospital to home or an alternative housing placement. Hospitals use their acute beds interchangeably with skilled nursing facility beds and reimbursement depends on the amount of health care and skills provided. The continuum and quality of care is improved because swing beds provide better
access to support services for the patient and his or her family. Specialized personnel and patient and family education are readily available.

**Transitional living programs.** Swing bed admission may not be necessary if other alternative transitional programs are appropriate and available to the TBI patient. Transitional living programs are community based and designed to re-integrate the head injured patient into the community after he or she is discharged from acute rehabilitation. The home-like residential treatment centers help apply skills learned in acute rehabilitation treatment to real-life situations.

One example of the transitional living programs is the community based Rainbow House located in Kaneohe, Hawaii. The setting is structured, yet has more flexibility than acute medical and rehabilitation facilities. It currently has both a five-bed inpatient facility and an outpatient program. Both programs focus on higher level functioning deficits, advanced self-care, cognitive processing, improved mobility in the community, social interaction, and vocational and educational readiness (as per a letter from the Rainbow House received in November, 1994). A multidisciplinary team approach similar to an acute rehabilitation hospital is used to ensure the development and use of compensatory strategies to improve activities of daily living (ADL). Thus, any brain injured patient who no longer requires nursing care is admitted. The staff is also trained to work with the physically challenged TBI patient. The chance for admission is better when the injury is recent, but admission is also possible
if there is a favorable prognosis. Upon discharge, follow-up care is continued through outpatient care and through active support of the transition into independent living and employment.

**Outpatient and day treatment.** Outpatient and day treatment are active rehabilitation programs that may incorporate vocational evaluation, sheltered employment, homemaker, and independent living skills. They specialize in treating patients at a later stage post TBI. Both use the same criterion for acceptance in that the patient must be able to function in the community independently or with minimal assistance; housing the patient does need intervention for the remaining cognitive and physical deficits.

In outpatient therapy, an individualized program is developed and therapy is usually limited to two to three sessions daily and scheduled only a few days per week. Functional retraining is aimed at returning the patient to the highest possible level of community independence. The family is required to provide most of the reinforcement of therapy to ensure carry over of the treatment.

In contrast, the day center offers a much more intense level of treatment as it requires five to six hours of daily therapy. This allows the family members to continue their daily activity and still care for the patient at home. Home life, reintegration into the community, and developing skills in real-life situations are greatly emphasized. Significant functional gains in TBI patients are noted in outpatient and residential community treatment settings because of this emphasis.
Alternative housing. Alternative housing that provides home-like transitional living includes group homes, halfway houses, and care homes. Group homes and halfway houses are similar in their organization and purpose. There is a home-like environment, emotional support from staff, and the ability to develop skills within the home.\textsuperscript{32} This kind of living situation provides appropriate care specific to the needs of the TBI patient. It also attempts to deinstitutionalize the client. However, a recent study by Mowbray et al\textsuperscript{32} showed that an institutional focus remains prevalent in group homes and there is limited availability of rehabilitation and social activities offered.

In the state of Hawaii, care homes offer housing alternatives for persons who require 24-hour supervision and whose families are unable to provide that care. Care homes are private homes of RNs, LPNs, and nurse aides with at least one year of working experience. Care home operators must be licensed by the state and are subject to rules, regulations, and inspection of the facility. The regulations of running a care home and admission of patients are found in Hawaii's State Department of Health Chapter 100 bylaw. The criteria for acceptance into the care home restricts which patients are eligible for this service. The patient must be independent with ambulation or wheelchair mobility and in self ADL skills. Admission is also heavily dependent on whether the care home operator is willing to accept a particular patient. Not all care home operators are familiar with the therapeutic needs or handling skills necessary to work effectively with the TBI patient.
The family home. Of the transition living alternatives, discharge to home with family members as the primary care givers is the most commonly utilized. The number of families taking TBI patients home is increasing. Families believe they can provide better care for the patient at home; they also express a sincere concern for the well-being of their injured family member; and they are willing to assume responsibility for the patient's needs. They act as effective advocates and case managers for the patient. Families are mainly concerned with two issues: 1) the day-to-day function of the patient and the family as a unit and 2) the financial impact of the diagnosis due to medical bills and lost wages. Most TBI patients fall between the ages of 15 to 24 years old and have not yet established financial stability. Regardless of the stresses that inevitably occur, studies reveal that families with strong ties and who are supportive have a positive effect on the patient's recovery. The hospital-based home care system provides patient treatment at home by a visiting staff member. Respite care for the severe TBI patient helps prevent burn-out of family members.

Institutionalization. In contrast to family care, chronic institutionalization tends to have deleterious effects on the TBI patient and should be considered the last resort when placing the patient. Although many nursing homes provide good quality care, they are often not equipped to handle the problems of the head injured patients. Consequently, the social structure of nursing
homes can significantly affect the symptomatology for which the patient is institutionalized.\textsuperscript{27}

The Independent Phase

Independent living is the ultimate goal of the continuum of care for the TBI patient. This is when a patient is able to lead a productive lifestyle as measured by gainful employment and successful retention of work.\textsuperscript{37} Few TBI patients achieve full-time employment. Only 30\% of patients with mild head injury will return to work and the numbers are even less for moderately and severely injured patients after three months post injury.\textsuperscript{4}

In order to achieve independent living, the patient must possess the following qualities: capacities in cognition, self care and mobility; the potential for employment; adequate financial resources; and a high degree of motivation and cooperation. He or she must have previously exhibited the ability to live independently without supervision or assistance.\textsuperscript{38} Independent living centers are available to assist the disabled in ensuring his or her rights to live independently. Organizations such as the Hawaii Centers of Independent Living (HCIL) and Options in east Grand Forks, MN, aid TBI patients in peer counseling, independent living skills, housing assistance and referral, and attendant referral. They also assist in obtaining benefits at federal, state, and local levels; advocacy; and promoting education to the community about the benefits and cost effectiveness of independent living for persons with disabilities
(via an interview with Options and via a letter from HCIL received in November, 1994).

Funding

The high expense of TBI involves both direct and indirect costs. The direct costs are the medical care costs and the indirect costs involve lost wages and lowered production.\(^4,40\) Nationally, early costs of TBI injury were estimated at $3.9 to $4.2 billion in medical expenses, lost wages, and lowered production.\(^4,40\) In 1990, the expenses skyrocketed to $12.5 billion.\(^6\) In 1993, Jaffe et al\(^41\) published a study on the economic costs of children with mild, moderate, and severe TBIs. The total acute care and rehabilitation costs ranged from $458 to $338,383 in 69 subjects. The mean and median costs were $11,478 and $38,615 per child respectively. Currently, head injury ranks third in the United States as one of the leading neurological causes of disability.\(^40,42\) As previously mentioned, TBI most often occurs in young adults during their vocationally productive years. These two factors alone increase the direct and indirect costs of TBIs.

Medical costs are paid through insurance coverage and the financial resources of the patient. The general fee structure includes private insurance, Medicaid and Medicare, fee for service, Workers' Compensation, and sometimes the Veterans' Administration.\(^39\) Most medical, rehabilitation, and specialized TBI organizations will vary billing and payment depending on the patient or service.\(^39\) Insurance coverage for the post acute stage is often limited
and many patients must rely upon their own diminishing financial resources. Centers of Independent Living are usually non-profit organizations and offer their services to patients at no charge.

Indirect costs such as lost wages and lowered production stem from the inability of the TBI patient to return to stable employment. Supported employment is a recently developed rehabilitation alternative that is designed to assist in the return to work of TBI individuals. This program provides paid work within integrated settings which offer ongoing support services. Comparatively, supported employment yields an increased monthly employment ratio from 13% after injury without support to 67% with supported services. Although supported work programs are successful, they are often costly. Studies have calculated means of 237.8 to 250 hours of staff intervention time needed to train and supervise program participants.

Family members who opt to care for their injured loved one may also suffer from lost time and wages. This is especially true if the patient requires 24-hour supervision. The financial burden can be great in the TBI patient and his or her family, but an efficient, fluid, and client-oriented continuum of care will promote better outcomes for victims of TBI.

Another way to decrease the costs of TBI is through assessment of cost effectiveness of medical and rehabilitation treatments. Adjusting practice patterns of care to decrease disability and dependence on society will help to lower both direct and indirect costs. Future research on the effectiveness of
the various rehabilitation programs and clinical techniques in therapies is needed to cut unnecessary or duplicated treatments. Currently, few studies are available that substantiates the effectiveness of therapeutic techniques that will benefit the TBI population specifically.

In summary, this chapter presented the various programs that are available to the TBI patient. Placement difficulties often arise after discharge from the acute care and acute rehabilitation care settings especially if the family is unable to assume responsibility for the patient’s needs. The lack of funds to support the long-term care of the TBI patient compounds the problem further. Expenses are often high and program alternatives are often few. This is why it is important for therapists and other health care providers relative to TBI to stay abreast with the latest issues of the continuum of care and therapeutic interventions.
CHAPTER IV

BRAIN RECOVERY AND RE-ADMISSION TO REHABILITATION

The time and course of behavioral and functional recovery following TBI varies substantially from a few minutes to many years depending on the severity of injury.\textsuperscript{45} Ultimately some degree of recovery or functional sparing occurs in all TBI injuries.\textsuperscript{27,46,47} Accumulating evidence reveals that the capacity for plasticity and functional reorganization does exist in the healthy human adult brain.\textsuperscript{47} The actual mechanism of brain recovery is unknown, but long-term outcome studies document functional recovery and improvement of TBI patients several years post injury.\textsuperscript{48} This chapter discusses re-admitting TBI patients into rehabilitation programs based on the belief that the brain is a malleable organ.

The central nervous system consists of specialized nerve cells. The neuroblasts or primitive nerve cells are the basis of brain tissue.\textsuperscript{49} They arise only from neuroepithelial cells and, once these cells are formed, they are incapable of osmotic division.\textsuperscript{49} Although the individual brain cells do not regenerate, the cell processes, axons, and dendrites still remain highly responsive to functional demand.\textsuperscript{50}

When TBI occurs, destruction of CNS tissue means the loss of certain functional capacities. On the other hand, the human brain possesses plasticity.
Plasticity is the ability of neural tissue to change according to its activation. The brain becomes involved in a dynamic process in which the lesion and preserved brain tissues undergo continuous change. The result is an attempt to promote healing and adaptation in order to restore the physiological functions. This is evidenced by some degree of recovery or functional sparing seen in TBI patients over time.

Several theories exist to justify the brain injury recovery mechanism. First of all, von Monakows diaschisis theory suggests brain injury causes a temporary disruption of the brain’s neural reorganization. The disappearance of the brain’s dysfunctional state accounts for the recovery of function. Second, the substitution theory infers that a secondary neural system maintains the functional capacity for the injured primal neural system. Third, the vicariation or equipotentiality theory proposes that there are regions of the brain which are not specialized in any one particular function. After injury occurs, they become activated to assume the function of the damaged tissue.

Other theories regarding recovery include the regeneration and collateral sprouting theories which hypothesize that new growth occurs in damaged and undamaged neurons. Next, the denervation sensitivity theory states there is an increase in sensitivity to the transmitter substance by denervated neurons. Increased sensitivity aids in the recovery of brain function. Last of all, the behavioral strategic change theory speculates that internal and external environmental cues help to maintain the patient’s functions.
The capacity of brain plasticity and functional reorganization is notable. Beethe's work on brain plasticity reorganization concludes that the high degree of plasticity in man and higher vertebrates is due to dynamic reorganization and adaptation to new circumstances. Rehabilitation services, such as physical therapy, are believed to affect recovery from brain injury in a positive way by providing meaningful challenges needed to stimulate reorganization.

In medical terms, the definition of rehabilitation is to restore or develop biological, psychological, and social functions. This in turn allows an individual to regain his or her maximum autonomy and achieve an independent, noninstitutional lifestyle. Based on the theories of brain plasticity and the dynamic nature of brain development, continued rehabilitation beyond acute rehabilitation is a reasonable consideration. Unfortunately, formal rehabilitation is received by only 1 in 20 TBI patients per year. It is noted that patients who are seen by a rehabilitation specialist in the acute care setting are more likely to be referred to a rehabilitation facility than those treated by a physician who is not a rehabilitation specialist.

Few patients participate in post acute rehabilitation programs due to lack of referral by physicians, depletion of funds to care for the patient, or lack of available TBI programs within the community. Still, the literature reveals that patients of various TBI severity show improvement many years after onset and acute treatment when the appropriate program is initiated. These improvements are measured in terms of residential status level, productivity,
and hours per day of required attendant care or supervision.\textsuperscript{54} Attaining autonomy in these areas greatly increases patient productivity and his overall well-being.

Although cognitive, behavioral, and vocational problems remain long-term issues, in general, investigators believe that physical improvement plateaus between 6 and 12 months.\textsuperscript{54} Tuel et al\textsuperscript{64} studied the effects of re-admitting TBI patients into a formal inpatient rehabilitation program. The main requirement was that the injury must have occurred at least one year prior to their entry. Seventy percent of the subjects were considered to be victims of "extremely severe" head injuries, 28\% fell into the "very severe" injury group, and 2\% were labeled as "severe" injuries.\textsuperscript{54} This study reported that 79\% of the subjects showed physical improvement. Physical gains were highly correlated with the length of re-admission, but not with the subject's age, age of onset, length of coma, time between injury and re-admission, or duration of previous rehabilitation.\textsuperscript{54} The authors concluded that patients with severe head injuries may show improvement after a prolonged interval between discharge from acute rehabilitation and re-admission. They also predicted that physiological recovery occurs during this interval and improves the patient's response to head injury rehabilitation programs. The results of this study revealed that severely head injured patients can improve in functional physical abilities after the expected plateau.\textsuperscript{54}
Follow-up studies reveal stabilized or improved outcomes for TBI patients years after treatment in post acute rehabilitation programs. A six-week program that emphasized improvement of real life functional abilities benefited TBI subjects who were 50.3 months post injury. Subjects maintained their gains at follow-up sessions 6, 12, and 18 months later. In addition, a case study by DePoy also illustrates the success of re-admitting the TBI into a rehabilitation program. The subject was a 30-year-old male who was able to return to work and independent living after being admitted into a community re-entry program six years after his TBI occurred. He presented with right sided mild ataxia, decreased fine motor skills; he was capable of ambulation without an assistive device. Through the program's holistic approach and return to work emphasis, the subject was able to return to a productive and independent life.

Patients with moderate and severe TBIs require reassessment and revision of home programs over the years. Reassessment is beneficial when it focuses on patient readiness for more rehabilitation. Studies on brain plasticity and re-admission to rehabilitation show that improvements in functional abilities are possible several years post injury. Yet, few re-admission programs and funds are available to consider extended therapies.
CHAPTER V
DISCUSSION AND CONCLUSION

The management of traumatic brain injury entails many issues requiring professional attention. Of these issues, progressing the patient along the continuum of care after acute rehabilitation is often the most difficult to resolve. The individualized nature of TBI and its resulting cognitive, social, and physical deficits may limit placement possibilities. Two areas which may assist to alleviate this problem include: 1) to further research the efficacy of existing TBI programs and 2) to develop TBI continuum of care algorithms. Each will be considered.

First, studies that compare the efficacy and effectiveness of various programs are difficult to find. Currently, it is difficult to say that one treatment program is better than another. Efficacy and comparison studies will target therapies that specifically cater to the needs of TBI patients and improve the quality of care provided by specialists. The implementation of appropriate programs may also help to lower care costs as TBI patients may see a quicker return to productive lives or receive care that is streamlined to meet their needs.
Second, a TBI continuum of care algorithm will help specialists plan for suitable discharge and placement. The algorithm should lay out the general programs for TBI patients and the criteria for acceptance into the program. Health care providers will have a clearer idea of the facilities that will best benefit their patients and they will be able to focus their therapy goals accordingly. Algorithms will probably vary from state to state, depending on the TBI programs available.

The continuum of care for the TBI patient is a complex system with many problems that make it difficult for the patient to receive appropriate care. Rehabilitation programs post acute care for the TBI patient are not always readily available. Patients must meet certain physical and cognitive requirements prior to their admission. Other restrictive factors include budget restraints and the amount of potential for improvement a patient possesses. Therapists must be aware of the existence of TBI living programs and the services they have to offer to make accurate decisions in discharge planning.
REFERENCES


