A Model of Care for Neurological Rehabilitation

Gordon J. Horn PhD and Frank D. Lewis PhD CBIST



According to the Center for Disease Control (CDC) health statistics (2013) the annual cost of healthcare in the United States has risen steadily since 2000, from \$1.2 trillion to \$2.3 trillion in 2011 (approximately \$7300 per capita), almost doubling in 11 years. For those aged 44-84, the average hospital cost was

\$12,500 per admission; younger persons averaged \$7,000 per event, reflecting increasing costs with aging. Two-thirds of hospitalization costs was spent on persons aged 44 or older.

Some health care costs have decreased. According to the CDC (2012), the death rate for auto related accidents decreased between 2006-2010 by 30-60% across all ages, genders, and races in the United States. According to Caro (2011), automobile accidents may account for up to 60% of traumatic brain injuries. Even with fewer automobile-related injuries, costs for TBI are about \$76 billion dollars per year. The Brain Trauma Foundation, The American Association of Neurological Surgeons, Congress of Neurological Surgeons, and the AAN/CNS Joint Section on Neurotrauma and Critical Care (2007) provided guidelines for the acute care of adults with severe brain injury. They concluded that widespread adoption of these guidelines could cause a 50% reduction in deaths, and savings of \$288 million in medical and rehabilitation costs. Now it is imperative to develop guidelines related to a neurological rehabilitation to evaluate each level of care, coordinate services, and manage costs.

The CDC reports there were approximately 2.5 million traumatic brain injuries sustained in 2013, approximately 20% of traumatic brain injuries in the moderate to severe category and requiring support post-hospital discharge. This group accounts for the greatest costs in posthospital care. The purpose of this paper is to describe efficient levels of rehabilitative care

Gordon J. Horn is Deputy Director of Clinical Outcomes Systems for NeuroRestorative - National and the Director of Clinical Services for NeuroRestorative - Florida. He may be reached at <u>gordon.horn@neurorestorative.com</u>. Frank D. Lewis is the National Director of Outcome Services for NeuroRestorative Brain Injury Rehabilitation Centers and Clinical Director of NeuroRestorative - Augusta GA. He may be contacted at <u>frank.lewis@neurorestorative.com</u> and cost management for moderate to severe traumatic brain injury.

Traumatic Brain Injury

Many persons with moderate to severe traumatic brain injury are unable to live independently after inpatient discharge (Langlosis, Rutland-Brown & Wald, 2006). However, with appropriate post-hospital services, they can improve enough to live more independently at home and engage in productive activity, thereby lowering overall health costs. Clinically meaningful improvements (Hayden, Plenger, & Bison, 2013) can be demonstrated any time, not just within the first post-injury year.

Most rehabilitation occurs **SIX n** in inpatient admissions, with average length of stay about two to three months, and with limited funding for care options after discharge. However, much post-injury recovery occurs after the first 6 months. Thereafter, behavioral experiences and interventions drive further recovery (Hayden et al., 2013; Johnson & Lewis, 1991; Lewis & Horn 2013; and Nudo, 2003). Post-hospital services restore independence gradually, using appropriate medical, behavioral, and social supports to sustain and enhance quality of life. The following describes the various elements of hospital and post-hospital care and efficacy, and when these modalities are appropriate for the patient.

Levels of Care in the Neurologic Rehabilitation Continuum

I. Hospital: Intensive Care and Acute Care Step-down

Much post-injury recovery occurs after the first six months.

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Care Step-down The immediate post-trauma period is characterized by life or death decision-making and emergency care to achieve survival. After this, most individuals will spend one to fourteen days (average six days; McElroy, et al., 2013) in critical care or step-down units. This level of care is the most costly due to medical acuity and intensity of medical services (Haddad & Arabi,

2012), approximately \$9,700 per day (Pfuntner, Wier & Steiner, 2013), not including physicians, medication, or ancillary costs.

Acute care step-down length of stay ranges from one to fifteen days, depending upon severity and complexity of patient needs. The overall average length of stay in the acute hospital setting is 6.8 days for all intracranial

injuries (Russo, Owens & Stocks, 2004).

TBI is one of the five most costly conditions, with the aggregate cost of \$18,000 per day, nearly double the average daily cost for other conditions (Pfuntner, Wier & Steiner, 2013). For moderate to severe intracranial injury, average length of acute hospital stay was 8.1 days with an average daily cost of \$19,300 (Russo & Steiner, 2004).

II. Hospital: Acute Hospital Inpatient Rehabilitation

Inpatient rehabilitation is the second stage of recovery. The individual is mostly medically stable. Length of stay ranges approximately two to three weeks (average = 12.6 days), with an average daily cost of \$2,350 not including physicians, medication, or ancillary services (HCUP, 2006).

The goal is to maximize the individual's potential to return home with family. However, this individual will typically not be ready to use higher level skills and abilities, and in most cases remains dependent on others for supervision and assistance. Hawkins, Lewis, & Medeiros (1996) found that upon discharge from the acute rehabilitation hospital, many TBI patients required physical and/or cognitive assistance in the following areas: 51% with ambulation, 46% with self-care, 55% with communication, and 76% with social cognitive skills. These deficits prevent many TBI survivors from returning to independent, meaningful, and productive activity. As a result, Masel (2009) argued that we should think of TBI as, "a chronic disease rather than a single event or final outcome." In other words, TBI causes disruptions in neurological systems that require rehabilitation for months or years.

There is a broad spectrum of post-hospital rehabilitative care, described in the next sections, to help move individuals towards less disability and reduced supervision at home and in the community. The continuum is flexible to allow the entry at any level of posthospital care. **Table 1** describes general needs-based admission guidelines for appropriate placement for post-hospital rehabilitation care.

III. Post Hospital Community Neurorehabilitation

The first step after inpatient care is often a community neurorehabilitation (PHCN) program. These residential programs first appeared in 1977 and were referred to as *community re-entry* or *transitional living*, and were based on an educational rather than a medical model of care. Costs are determined by treatment intensity and patient needs, but begin at or lower than cost of inpatient rehabilitation programs. As the name implies, they are generally community-based.

This level of care teaches and promotes gencontinued next page

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Admission Guideline	Medical Status	RLA	Volitional Aggression	Inappropriate behaviors	Inappropriate verbalizations	Time since Injury
PHCN <u>Criteria</u> : neuro- logical injury, dis- ease, or illness	Stable medi- cally including being afebrile, negative for infection, trach capped, bolus G-tube feeding, possibly insulin dependent with appropriate protocols in practice	IV - VII	Not volitionally aggressive; may be mild to moderate involi- tionally aggres- sive based on RLA Level	Impulsive, be- havior inappro- priate for the situation, easily frustrated, atten- tional deficits,	Mild - easily redi- rected by staff or loved ones; inap- propriate verbaliza- tions may be due to residual confusion	Range = 1 to 24 months since injury and following acute hospital and acute rehabilitation hospi- tal discharge
NBI <u>Criteria</u> : neuro- logical illness, disease, or injury that results in behavior impair- ment interfering with social func- tioning	Stable medi- cally including being afebrile; negative for infection, insulin protocol with medications but no injectables	IV - VIII	Mild to Severe aggressive; may be volitionally aggressive; or may be involi- tionally aggres- sive based on the RLA Level	Impulsive, be- havior inappro- priate for the situation, easily frustrated, atten- tional deficits, aggressive to others and de- structive of property	Mild-Moderate- Severe levels; inap- propriate verbaliza- tions require structure, cues, and redirection; verbalization tends to be impulsive, and inappropriate in most contexts	> 8 months since time of injury with minimal residual confusion (e.g., if patient is perpetu- ally in Rancho IV-V due to injury sever- ity)
* SL <u>Criteria</u> : longer term need for assistance with basic care, ac- cess, medical management, daily living needs	Stable medi- cally stable but may include comorbid medical com- plications asso- ciated with other diseases and aging ef- fects	VI-VIII	Mild only but redirected; there are sup- ported living brain injury fa- cilities that can also provide service for the mildly behav- ioral intense	Need to be eas- ily redirected by staff or loved ones	Easily redirected by staff or others	> 2 years duration of injury, and after neu- rorehabilitation with residual assistance needed for basic care, daily living activities
Day Trx <u>Criteria</u> : must live in the community inde- pendently or semi- independently	Stable medi- cally stable but may include comorbid medical com- plications or conditions; ag- ing effects	VI - VIII	Mild but redirectable, and minimally socially interfering	Easily redirected by staff, and does not require law enforcement for behavior control	Easily redirected by staff or others	Based on need, could be any time after the hospital where high structure is not required for success
H&C <u>Criteria</u> : must live in the community either independ- ently or with fam- ily but still needs assistance with identified con- cerns	Stable medi- cally but may include comor- bid medical complications or conditions; aging effects.	VII - VIII	Mild but redirectable, and minimally socially interfering	Easily redirected by others	Easily redirected by others	Anytime following acute rehabilitation, post-acute rehabili- tation, or following outpatient services for skills generaliza- tion

Table 1 Post-hospital brain injury rehabilitation options: Admission guidelines

PHCN = Neurorehabilitation; NBI = Neurobehavioral Intense; * SL = Supported Living; Day Trx = Day Treatment; H&C = Home and Community. In all program types, ambulation is not a rule out criteria for admission. Those who may be rated as a Rancho Los Amigos (RLA) Level III or lower would be more appropriate for Long-term Acute Care (LTAC) facilities due to the complexity of residual injury and medical needs. With improvement, the patient could re-enter the rehabilitation continuum noted above.

* SL services should only be an option once it has been determined that further neurorehabilitation is no longer showing gains and the emphasis focuses on stability and prevention of decline.

eral functional skills (e.g., safe ambulation, problem-solving, compensatory memory strategies, effective interpersonal communication, self-care, and money management) to help prepare patients to return home and resume productive pre-vocational or vocational activities. Though patients are medically stable, a medical director, most often a physiatrist, oversees most of these programs. Services commonly include physi-

cal, occupational, and speech therapy, and often psychological counseling (Lewis & Horn, 2013). Treatment focuses on functional return and effective compensatory strategies. Though research indicates that participation in these programs within 3-6 months of injury results in the greatest gains, patients typically enter PHCN six months to one year postinjury, (Hayden et al., 2013; Lewis & Horn, 2013).

Need for PHCN is well-established. In a study of nine PHCN programs, Johnston & Lewis (1991) found that 73% of individuals required day and night supervision and could not be left alone. Similarly Lewis & Horn (2013) found that over 60% of 285 TBI adults at this level of care experienced debilitating problems with basic cognitive skills such as problem-solving, self-awareness, memory, initiation, and attention/concentration.

Effectiveness of PHCN is also wellestablished. Cope and colleagues (1991) found that 77% of their patients required attendant care at admission, and only 23% required attendant care at one year after

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discharge. In a comprehensive review of outcomes, Malec & Brasford (1996) observed return to work rates as high as 50% one year post-discharge from PHCN programs. Hayden et al. (2013) studied the outcomes of 1274 patients admitted to PHCN with 5 days per week, 6 hours per day of multidisciplinary intervention. Sixty-nine percent of their

sample demonstrated significant functional improvement at the conclusion of treatment. Improvement was greatest for those admitted within three months of injury, but even those admitted five years post injury showed statistically significant clinical improvement. Similar results were found by Lewis & Horn (2013) indicating that a multidisciplinary program providing individualized

care results in better outcomes (reduced disability) independent of how soon it begins post-injury.

IV. Neurobehavioral Intense Programs

Persons with significant *behavioral dyscontrol* after TBI require intensive neurobehavioral rehabilitation from a skilled clinical team, because the most severe kinds of behaviors can result in potential danger to self and/or others. Behavioral dyscontrol includes:

- Poor impulse control
- Explosive outbursts
- Poor planning and judgment
- Limited or poor self-awareness
- Verbal and physical aggression

Neurobehavioral Intensive (NBI) programs use applied behavior analysis extensively, to identify triggers that elicit aggression and, to the extent possible, eliminate or substantially reduce their effect. Staff are proficient in crisis prevention intervention and de-escalation techniques. A physician prescribes and oversees mood stabilizing medication, and counselors and behavior analysts teach patients to replace maladaptive behaviors with prosocial ones.

NBI programming teaches patients how to use skills in context, using community outings and productive activities, rather than only traditional therapies; the physical environment plays an important role in treatment. These programs are typically in rural settings or in a campus model. Residence design maximizes safety and allows space for reducing stimulation and social complexity simultaneously. Large open areas create a better line of sight for nonintrusive supervision. The environment also has features to control potential for dangers (e.g., few wall fixtures or decorations that could be missiles).

Some NBI programming is in secured settings due to patients' increased risk of elopement, impulsive behavior, and impaired decisionmaking. The short-term goal is to stabilize patient behavior with repeated learning trials so that patients can move to less restrictive, functionally-based setting. The long-term goal is for patents to achieve socially appropriate behavior and skills so they can return home or live in the community with minimal to no supervision. These patients tend to have been injured longer than the typical neurorehabilitation patients, with time between onset of injury to admission often averaging over five years (Lewis & Horn, 2014).

In one of the earliest studies of NBI program effectiveness, Eames & Wood (1985) observed that 66% of their participants achieved behavioral stabilization good enough to allow discharge to less restrictive treatment settings. In a multicenter study of NBI outcomes,

Worthington and colleagues (2006) reported significant gains in social functioning and reduction in supervision levels that were maintained 18 months post-discharge. Lewis & Horn (2014) studied 70 neurobehavioral patients with moderate to severe symptoms of behavioral dyscontrol. After comprehensive inpatient post-hospital rehabilitation, they achieved statistically significant disability reduction (p<.01) in multiple cognitive, behavioral, and patients showed functional skills. This was significant gains in particularly remarkable since they were chronically impaired, averaging 8.3 years post injury at the time of study entry. This study was consistent in showing that time to rehabilitation was not a significant factor in reducing disability.

social functioning and reduction in supervision levels that were maintained 18 months post-discharge

NBI

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V. Comprehensive Day Treatment

Comprehensive Day Treatment (CDT) programs offer structured educational activities and therapies from 4-6 hours per day, 3-5 days per week. The multidisciplinary team includes psychologists or mental health counselors, and physical, occupational, and speech therapists. A case manager coordinates treatment and interacts with payers to avoid

interruptions in care, allowing seamless transition from more intensive levels of care. Patients typically live at home with family, in supported individual apartments, or in supported living facilities. Patients do not require 24 hour supervision. Treatment builds upon the same functional community reentry activities as in residential rehabilitation. At this

> point, treatment is largely aimed at improving cognitive skills: initiation, attention, concentration, self-awareness, problem solving, and organization. Higher levels of these skills promote greater home and community safety and vocational success.

Malec & Brasford (1996) reviewed 9 separate CDT outcome studies. They found return to work rates, including part-time, one year after completing CDT programs averaged 60% to 80%. Horn & Lewis (2013) evaluated the outcomes of 12 CDT programs across the United States using the Mayo Portland Adaptability Inventory-4 (MPAI-4). Their data showed statistically significant improvement in MPAI-4 T-scores for Abilities (cogni-

tive and physical skills), Adjustment (behavioral and adjustment skills) and Participation (residential and community skills). These improvements were achieved with an average time of onset of injury to program admission of almost 3 years.

VI. Home and Community Programs

These newer additions to the post-hospital continuum provide services that begin in the patient's home but may follow them to work, shopping, or recreational settings. This model is particularly useful for patients who have difficulty transferring the skills they learned in a treatment facility to home, community, and work. These programs teach transition skills using an individualized selection of skilled treatments including PT, OT, SP, cognitive services, behavior analysis, vocational services, and paraprofessional skills for 3-10 hours per week.

Altman et al. (2010) evaluated outcomes of 489 patients averaging 4 months of service within seven post-acute, home and community programs. Using the Mayo Portland Adaptability Inventory-4 (*see page 672, Ed.*) significant improvement was noted from admission to discharge, even for patients injured longer than one year. Further study is needed, but this model provides an innovative approach to transition individuals to their homes gradually. Cost is based on fee for service.

VII. Supported Living Programs

There is a growing trend toward NBI patients entering Supported Living (SL) programs after stabilization in neurobehavioral programs. More SL programs are adding behavioral management services to maintain positive prosocial behaviors and mitigate periodic behavioral outbursts. Supported Living programs do not typically provide active restorative rehabilitation services unless there is a specific need, e.g., PT, OT, SLP, or counseling. Their focus is threefold:

- Provide a safe living environment
- Maintain the patient's health and prevent decline by addressing daily health needs
- Involve patients in multiple recreational, leisure, and prevocational activities to improve quality of life

These programs are usually located in the community in shared housing or apartments. Health focus promotes cognitive and physical exercise and challenge.

There are few published studies of their program outcomes. Horn & Lewis (2013) used the MPAI-4 to study outcomes of 70 patients in multiple post-hospital programs, and found that SL patients with an average length of stay of over five years were able to mainta their health and achieve functional gains from admission to discharge.

Cost of the continuum of care

Costs for the programs described above can range from \$19,300 per day in critical care (Russo and Steiner, 2007) to \$2,350 per day for inpatient rehabilitation (HCUP, 2006). These estimates may vary widely due to unanticipated needs which may arise. Although there have been no systematic studies addressing average post-hospital costs, ranges can be estimated from available data.

Inpatient hospital rehabilitation care averages \$2,350 per day, while long-term acute care (LTAC) hospitals/facilities is approximately \$1,318 per day. It is reasonable to consider that post-hospital care would begin at either the same cost or lower than for inpatient hospital rehabilitation, and then decrease as the patient's need for services decreases. Allocating resources as indicated by clinical needs is important for medical, rehabilitation, and behavioral stability, thus affecting total projected costs. As noted by the Brain Injury Foundation (2007) costs to manage brain injury decrease over time if a proper individualized program continually adjusts with patient status changes. The table below presents a worksheet for clinical cost estimation within post-hospital community rehabilitative care. Relative values (fees) for the services listed can be estimated from sources such as the <u>www.cms.gov</u> for professionals. Other services provided may vary based on each facility. (Table 2)

For example, the cost to care for a neurobehaviorally-intense individual requiring 24-hour 1:1 supervision may be the same or

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Provision of Service	Cost estimation based on hours per day				
Supervision	# hours of direct supervision provided daily x rate				
Medical services	# hours of physician, nursing, examination(s) x rate				
Medications	Cost of each (brand vs. generic); daily administration cost				
Rehabilitation services (service x rate = cost)	Physical therapy, occupational therapy, speech therapy, recreation therapy, psychology/counseling, behavior management				
Ancillary services	Community skills and transportation x hourly rate				
Administrative services and overhead	Case management; program director x hourly rate Overhead (based on individual facilities)				

Table 2 Proposed worksheet, clinical cost estimator

similar to cost for a neurorehabilitation individual using a full spectrum of rehabilitation therapy services. The neurorehabilitation case requires more medical and therapeutic services; the NBI case requires more resources for supervision, safety, and behavior management. (Figure 1)

Post-hospital programs involve longer length of time due to the complex needs in this population. Lewis & Horn (2013) reported wide variability with lengths of stay within moderate to severe neurore-

habilitation and neurobehavioral samples. Mild brain injury (80% of all injuries) are less costly since they typically do not require facility-based supervision. Services for mild brain injuries are often provided through day treatment, home and community, and/or outpatient programs.

Conclusions

Approximately 5.3 million Americans must live with significant TBI-related disability that precludes return to an independent and productive life. Most TBI treatment currently occurs within a hospital system. Although these therapies stabilize patient condition and improve function as natural recovery progresses, many survivors leave the hospital system needing physical assistance and supervision for their safety. Fortunately, there are now **Figure 1** Example of allocation of clinical resources for neurobehavioral and neurorehabilitation care



many post-hospital rehabilitative services available to help improve their quality of life.

Significant evidence shows that systematic post-hospital care reduces disability while enhancing independence and productivity, making return to competitive employment possible for some individuals following moderate to severe injury. The most encouraging finding is the emphasis on continuum of care, which, when properly managed, may reduce cost and complications over time.

Traumatic brain injury is a chronic condition best addressed by a flexible system to provide care at any time following injury. Inpatient hos-

Nursing Diagnoses to Consider NANDA-I Nursing Diagnosis, 2012-2014

- Readiness for Enhanced Coping (Domain 9, Coping and Stress Tolerance; Class 2, Coping Responses)
- Readiness for Enhanced Self-Health Management (Domain 1, Health Promotion; Class 2, Health Management)
- Deficient Diversional Activity (Domain 4, Activity/Rest; Class 2, Activity/Exercise)
- Risk for powerlessness: At risk for perceived lack of control over a situation and/or one's ability to significantly affect an outcome (Domain 6, Self-Perception; Class 1: Self-Concept)
- Interrupted Family Processes: Change in family relationships or functioning (Domain 7, Role Relationships; Class 2: Family Relationships)

pital care may last 15-30 days, with the majority of persons needing additional therapy and 24-hour supervision post discharge. However, for less daily cost, an average of 6 months post-hospital care with 24-hour supervision, therapy, and community integration services may make it possible for them to return home with significantly less supervision. Costs decrease with decreasing level of care as the need for supervision decreases.

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Fall cranberries