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## Abstract

Outcome studies related to the post-acute rehabilitation of the traumatically brain injured (TBI) have focused on quality-of-life issues. There has been little attention paid to cost/benefit relationships. Two-hundred-eighteen patients were rated at admission and discharge on the Disability Rating Scale (DRS) and on a living status scale. Costs of care in different living status settings (private living quarters with professional help, long-term care facility, psychiatric hospital, etc.) were obtained and analyzed by the two scales to demonstrate the cost/benefit relationships. The study showed a statistically significant benefit and cost savings, over time, for those patients receiving post-acute rehabilitation. These benefits are in addition to improved quality-of-life benefits. In the last ten to twelve years, rehabilitation has seen the introduction and maturation of an entirely new subspecialty: head-injury rehabilitation. Major emphasis has been placed on improving acute medical care for and rehabilitative management of the traumatically brain injured (TBI) patient. Perhaps of equal importance has been the development of post-acute rehabilitation programs for these patients.

Nineteen-eighty saw the founding of the National Head Injury Foundation at a time when there existed fewer than one dozen specialty programs for the TBI population. Since that time, NHIF has grown considerably as has the number of specialty programs, some seven hundred-plus across the country [1].

Many of these programs are designed to provide “post-acute” rehabilitation services such as “Community Re-entry” or “Transitional Living” [2,3,10]. While these programs may impact outcome and quality-of-life issues, there has been little attention paid to cost/benefit issues.

In 1982, a five-year longitudinal study conducted at Santa Clara Valley Medical Center reported annualized costs of TBI at \$4.4 billion annually in the United States in 1974 dollars [4]. This study, however, did not address cost/benefit concerns as they relate to the efficacy of “post-acute” rehabilitation efforts. The present study sought to provide insight into both the rehabilitative efficacy and the cost/benefit relationship of “post-acute” rehabilitation for the TBI patient.

## Method

The study was conducted in an a posteriori fashion by reviewing patients who had been treated in a “post-acute” rehabilitation setting. The setting offered both residential and outpatient programs with therapeutic interventions in physical therapy, occupational therapy, speech/language pathology, educational therapy, exercise physiology, counseling, clinical psychology, neuropsychology, vocational rehabilitation, and nursing. Such comprehensive models [5,6,7,8] always adapt programs of therapy to the requirements of the individual patient. Yet, it is important to look at overall outcomes by groupings of patients into categories that can be broadly compared across several rehabilitation settings. This study involved 218 patients who were rated at admission and at discharge on two scales—the Disability Rating Scale (DRS) [9] and the Living Status Scale. The latter is a scale developed by the authors for the purpose of this study and is shown in Table 1.

**TABLE 1**  
**Living Status Scale**

0	Unknown	
1	Private living quarters	- self-care or with spouse - independently - or with parents if <25
2	Private living quarters	-supervision by family, friend, or companion - may have roommate -no regular, planned involvement in performance of activities - or with parents if >25
3	Private living quarters	-active help from family, friend, or companion - may have roommate
4	Private living quarters	-active professional help (nursing, paid aide, etc.), i.e. CNS, WALC
5	Senior citizen center with private living facility and communal food service	
6	Board and care home/group home	
7	Long-term care facility	-convalescent hospital - unlocked

8	Acute or rehab hospital	-alcohol, drug, or physical rehabilitation included
9	Locked facility	-psychiatric, geriatric, mental hospital, jail, or rehabilitation facility
10	Deceased	

Living status categories were assigned a range of annualized cost of care reflective of costs to private payers across the country. Annualized costs of care associated with the various levels of the living status scale were determined by confidential polling of insurance rehabilitation specialists and service providers (Table 2). Mean costs representative of those seen throughout the United States are presented in Table 2.

**TABLE 2**  
**Living Status Costs<sup>1</sup>**

Living Status	Mean Dollar <sup>2</sup> Cost Per Day	Mean Dollar Cost Per Year
9	625	238,875
8	1150	419,500
7	160	58,400
6	150	54,750
4 with aide, 16 hrs	160	58,400
4 with LVN, 16 hrs	384	140,160

1. Figures quoted have a national perspective and may vary by region of the country.

2. Mean figures were compiled on the basis of released confidential information from two sources.

The patients were rated on the aforementioned scales either at the actual time of admission or discharge or by a panel of five clinical supervisory staff reaching consensus via discussion after discharge from the program and immediately prior to this study. The clinical supervisory staff was not aware as to the nature of this study or its purpose.

The resultant data was reviewed on the basis of groupings produced by the two scales. Groups of patients rated in various disability categories were analyzed for absolute change in disability rating score and for change in disability category. Groups of patients rated in various living status categories were analyzed for change in living status category as well as admission and discharge disability categories. These changes were analyzed for statistical significance using the Wilcoxin Matched Pairs Signed Ranks test.

### Results

Analysis of absolute changes in DRS score from admission to discharge showed that the vast majority of patients demonstrated an improvement of one or more points on the DRS. (Wilcoxin Matched Pairs Signed Ranks Test - DRS discharge improved from admission, mean 97.57, cases 189, -ranks:DRS discharge worse

than admission, mean 28.83, cases 3, +ranks:DRS discharge equal to admission, 26 ties. 218 cases, Z = -11.9034, 2-tailed P = .0000.)

Analysis of changes in DRS scores was conducted to determine if DRS score changed sufficiently to cause a disability category change from admission to discharge. Percentages of patients achieving category changes from admission to discharge and relative statistical significance are presented in Table 3.

**TABLE 3**  
**Percentage Changes in Disability Rating Scores from Admission to Discharge**

Admission	Veg. Severe	Ext. Severe	Severe	Mod. Severe	Mod. Partial	Mild	None
Ext. Severe N-9	11%	33%	22%	22%			11%
Severe N-21			33%	43%	10%	14%	
Mod. Severe N-53				19%	43%	24%	9% 5%
Moderate N-105					30%	31%	31% 8%
Partial N-27						33%	41% 6%
Mild N-2							50% 50%
None							

Outcomes were reviewed as a function of living status at admission for DRS scores at admission and discharge. Figure 1 illustrates the differences between admission and discharge DRS scores for patients admitted from various levels on the living status scale. There was a statistically significant improvement in disability category achieved by all groups, with the exception of the Level 7 group or those patients coming from convalescent facility settings and the Level 6 group which was too small to allow for statistical analysis.

Figure 2 illustrates the progression of living status at admission to living status at discharge. As can be seen, each of the groups demonstrated statistically significant improvement in living status from admission to discharge at P=.001 except Level 4 patients (P=.007). Level 6 was too small to allow for statistical analysis.

When the groups were analyzed on the basis of admission DRS scores for progression in living status from admission to discharge, statistically significant change was observed in all groups except the extremely severely disabled group at P=.001 (Wilcoxin Matched Pairs Signed Ranks Test). The mild disability group was too small to allow for statistical analysis.

Lastly, Table 4 illustrates the annual costs associated with the various living status levels and annual cost savings presented for the actual percentages of cases realizing those savings. Cost savings

are also presented assuming a twenty year life expectancy. The twenty year life expectancy was chosen due to the fact that the mean age of the group studied was 34 years.

**TABLE 4**

**Change in Living Status Category and Resulting Annualized Cost Savings**

Changes	Cost Savings Per Year <sup>1</sup>	Cost Savings for 20 Years	% of Patients Changing in this Category in Study <sup>2</sup>
9 to 3-1	238,875	4,777,500	62%
9 to 4 with aide	180,475	3,609,500	14%
9 to 6	184,125	3,682,500	10%
9 to 7	180,475	3,609,500	5%
8 to 3-1	419,500	8,390,000	72%
8 to 4 with aide	361,100	7,222,000	15%
8 to 6	364,750	7,295,000	9%
8 to 7	361,100	7,222,000	2%
7 to 3-1	58,400	1,168,000	30%
7 to 4 with aide	-0-	-0-	20%
7 to 6	3,650	73,000	10%
6 to 3-1	54,750	1,095,000	100%
4 to 3-1	58,400	1,168,000	57%

1 Values from Table 2. Amounts determined by subtraction of lowest from highest.

2 Data from Figure 2

**Discussion**

It should be understood that patients admitted from Living Status Categories One, Two, and Three were admitted due to instability of those living arrangements. For example, families may have become unable to continue their involvement or behavioral deterioration of the patient may have occurred such that the viability of the living arrangement was compromised. Rehabilitation was initiated to avoid the necessity of placement in more restrictive and potentially higher cost settings on a long-term basis. As we review the spectrum of DRS scores observed at admission for these categories, it becomes clear that living status at admission was not predictive of level of disability. Therefore, one cannot assume that patients in these living status categories have little to no disability prior to post-acute rehabilitation programming.

A review of discharge DRS scores for patients admitted from Living Status Categories One, Two, and Three demonstrates statistically significant improvement in level of disability (P=.005, Wilcoxin Matched Pairs Signed Ranks Test) as well as in living status at discharge for Levels 2 and 3 (P=.0005, Wilcoxin Matched Pairs Signed Ranks Test). Level 1 patients returned to

Level 1 at discharge. It is possible to have greater confidence in the long term viability of the patient's discharge living status, as overall disability has been reduced, giving the patient better skills with which to live.

It should be noted that the data presented for Level 9 cases on the living status scale assumes that patients would remain in locked psychiatric care for a period of a year or more. The actual length of stay for the 21 patients studied averaged 28 months, thus allowing the logical assumption of a stay of longer than a few weeks.

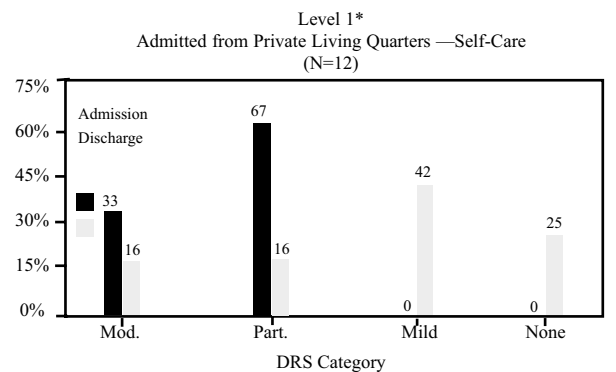
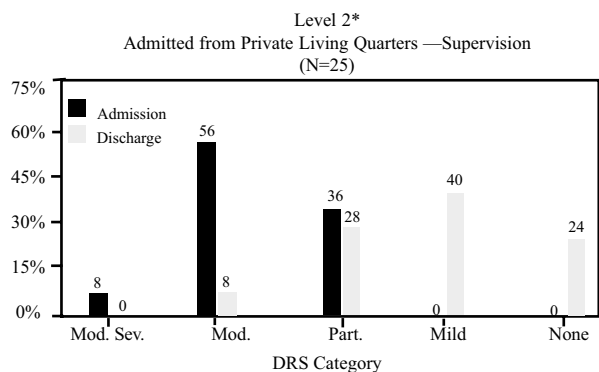
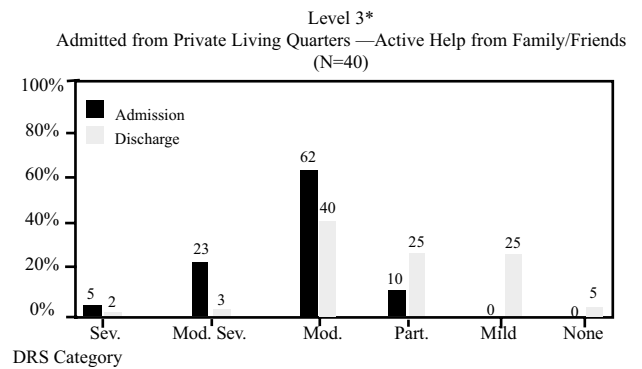
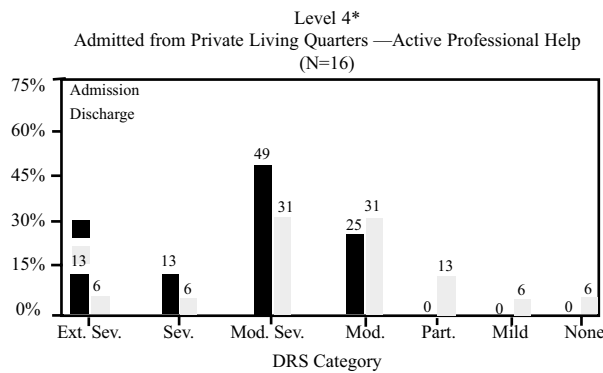
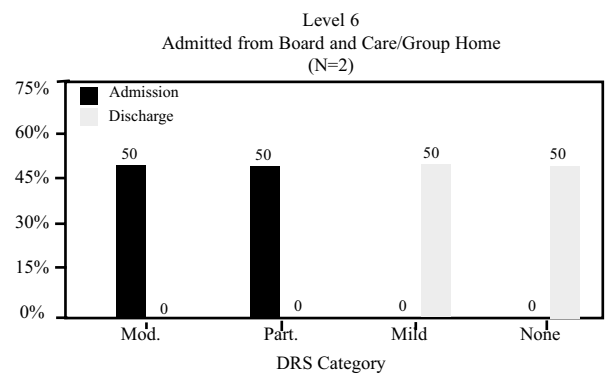
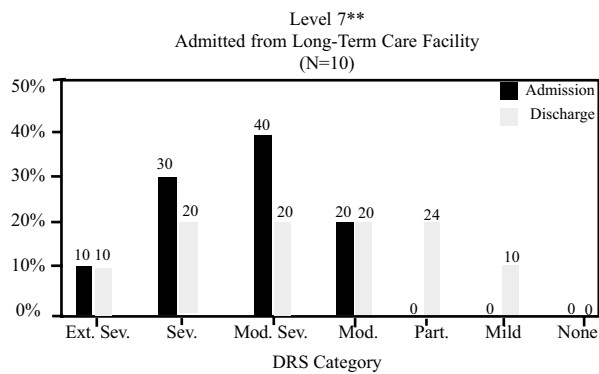
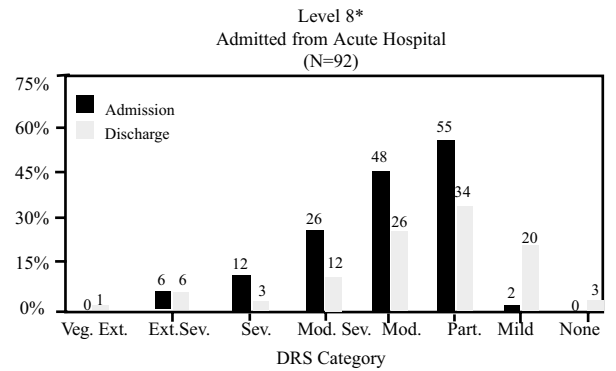
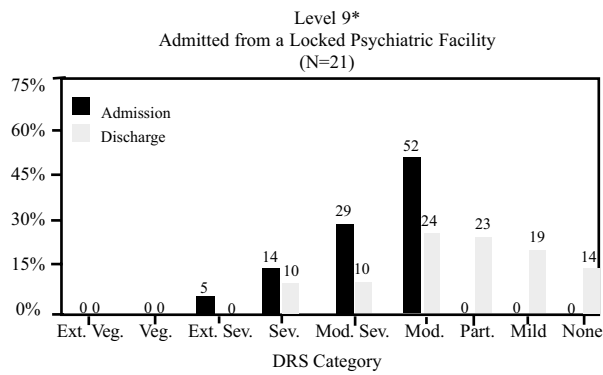
While statistical significance was not reached by the Level 7 group (Figure 1) for change in disability rating (P=.0592) or for change in living status (P=.0277) (Figure 2), the quality of life was sufficiently changed through rehabilitation to allow a living status change for more than half the group.

The data presented addresses the question of whether or not post-acute rehabilitation services for the TBI patient can be effective in disability reduction as well as in the overall reduction of costs associated with provision of care for these patients. It is clear that disability reduction occurs as measured by the DRS scale (Table 3). It is also clear that substantial cost savings can be realized (Table 4) by provision of post-acute rehabilitation services both to patients in Living Status Categories 4 through 9 as well as for patients who are unstable in Living Status Categories 1 through 3 (Figure 2).

Post-acute rehabilitation services may be provided to some patients at the same or lesser cost when compared to the cost of the living status category prior to admission. It may, therefore, be of little to no financial risk to provide these services. This study suggests that there is a great likelihood of disability reduction and cost savings over the long term.

This study has focused on cost/benefit issues to provide insight into the fiscal ramifications of provision of post-acute rehabilitation services. While financial matters should not be the sole determinant of the type of care a patient receives, this data suggests that services which enhance the quality of life for the TBI patient and his/her family are also likely to provide substantial financial relief to responsible parties.

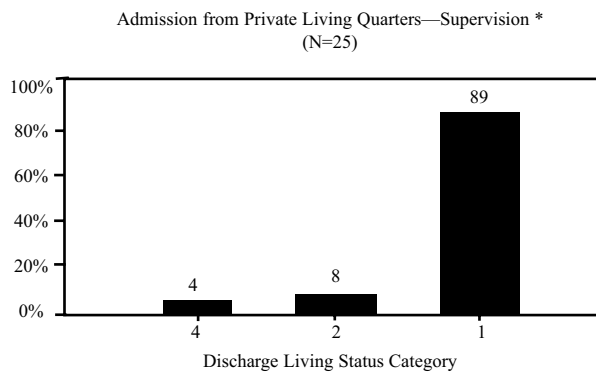
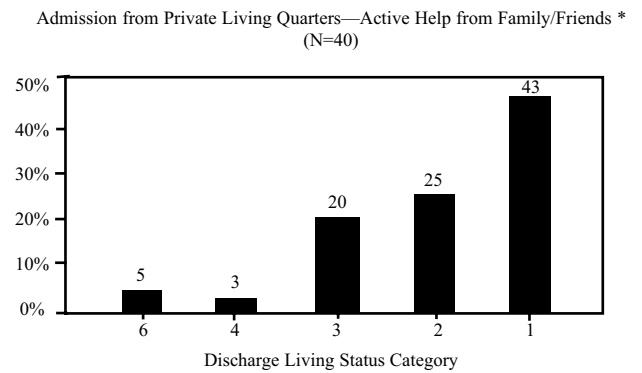
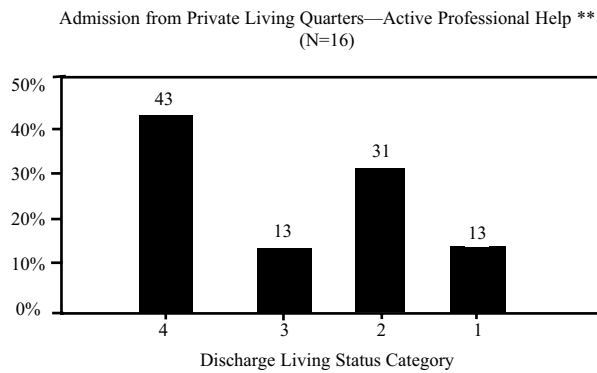
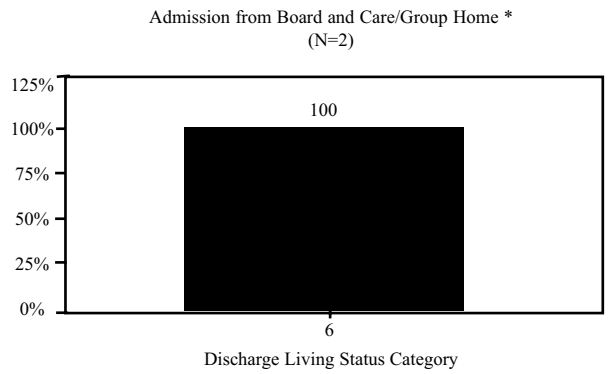
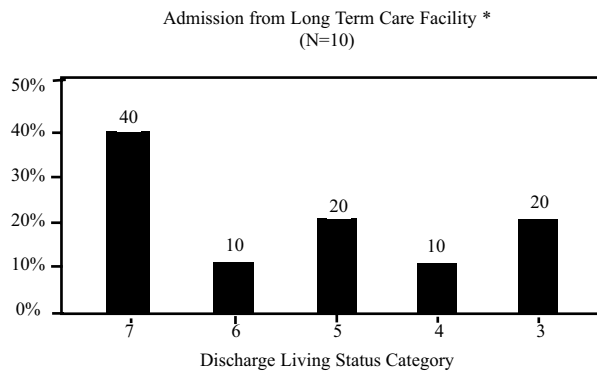
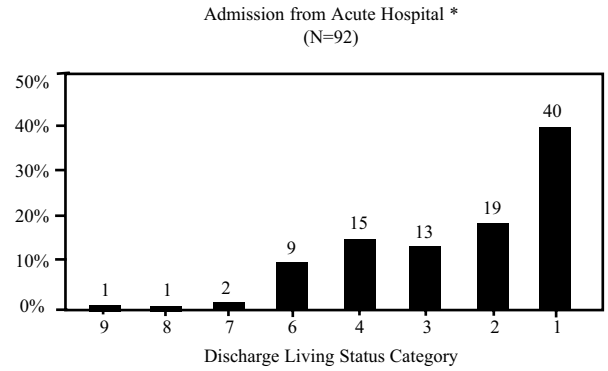
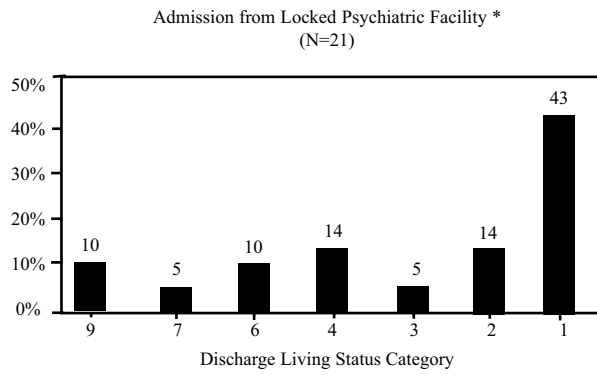
**Figure 1**  
**Differences Between Admission and Discharge DRS Admitted for Various Levels**  
**on the Living Scale Expressed in Percentages of Patients**



\*Statistical significance at .001 or better

\*\* No statistical significance

**Figure 2**  
**Progression of Living Status at Admission to Discharge Expressed in Percentages of Patients**



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