



## Community NeuroRehab of Iowa 2017 Outcome Validation Study

**2017 Outcome Validation Study submitted by:**

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# Community NeuroRehab

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## Executive Summary

Community NeuroRehab's Outcome Validation Study was developed to measure the durability of outcomes achieved through participation in CNR's community-based neurobehavioral rehabilitation service. Information is provided on each discharging participant's avocational and vocational endeavors, behavioral supports, social role return, substance abuse, interfering psychiatric issues, level of caregiver involvement, and other factors affecting quality of life and level of autonomy. Data is collected in each of these areas at time of admission, discharge, and post-discharge follow-up. This study is reflective of the 57 discharges which have occurred since CNR's opening in 2010; however, due to four individual's readmissions, the study is based on data collected on 51 individuals.

The number of discharges per year has ranged from three in 2011 to fourteen in 2016. The 2017 cohort was the second smallest cohort with nine discharging individuals. The average age at admission was 45 years old, making this year's cohort the oldest cohort of admitting individuals. On average, the individuals discharged in 2017 experienced a ten-year gap between injury and admission to CNR, which is consistent with our cumulative average of eleven years.

Despite the 2017 cohort being more medically fragile than all other cohorts both pre- and post-injury, this factor did not appear to hinder the achievement of outcomes obtained. Data from the 2017 cohort showed the following:

- At time of admission, 100% of individuals were at risk of institutionalization, unnecessary hospitalization, incarceration or homelessness. At time of discharge, 88.89% of individuals returned to a lower level of care than he/she was at prior to admission. The only individual who did not discharge to a lower level of care returned to his/her pre-admission level of care due to an acute medical crisis. Follow-up was completed three to six months post discharge and 88.89% of individuals maintained or lowered their discharging level of care resulting in continued cost savings
- Unemployment decreased by 22.23% between pre-admission and follow-up.
- Prior to admission, 55.56% of individuals were using substances. At discharge, only 11.11% were utilizing illicit drugs or alcohol. And at the time follow-up, 100% of individuals were abstaining from drugs and alcohol.
- Access and utilization of community services increased by 33.33% between pre-admission and follow-up.
- Interfering psychiatric and behavioral problems decreased by 66.67% allowing for a greater return to pre-injury social role.

Along with the data points mentioned above, future studies will begin to take a deeper look at: the rate of occurrence and effect of multiple brain injuries, possible deterrents linked with standardized testing scores (MPAI-IV), a cross comparison of the durability of outcomes achieved for individuals who left CNR's residential program and transitioned into CNR's intermittent component of services, and the durability of outcomes achieved compared to length of time post injury.

## **2017 Outcome Validation Study: Introduction**

In 2008, the Iowa Department of Human Services (DHS) responded to a legislative request from State Representative Lisa Heddens for information on the status of out-of-state, Medicaid funded services for Iowans experiencing disability. The subsequent DHS report identified that (1) access to specialized services is not available on a consistent state-wide basis; (2) limited funding and “slot” limitations can result in Home and Community-Based Brain Injury Waiver Service (HCBS-BI) waiting lists and increased referrals to out-of-state service options; and, (3) the majority of Iowa adults with disabilities who were receiving out-of-state services had a brain injury or a brain injury that co-occurred with a mental health disorder. This review of services set the foundation of need that led to a collaborative, capacity building partnership between Community NeuroRehab of Iowa (CNR), DHS and Iowa Medicaid Enterprise, and the Iowa Department of Inspections and Appeals to meet the needs of this underserved population. This partnership led to the creation of what is now known as Community-based Neurobehavioral Rehabilitation Services.

### **CNR Treatment Model**

Following a brain injury, significant cognitive and behavioral changes are all too common and very problematic, hindering many rehabilitation efforts. HCBS-BI providers, nursing facilities and skilled nursing facilities predominately lack the ability to effectively address these secondary conditions of injury. The organizational leadership of CNR has expertise in working with individuals in all stages of recovery from a brain injury and has a vast amount of knowledge, skill and experience in mitigating the cognitive, physical, medical, behavioral, and psychosocial complications of brain injury. This expertise is passed to college-educated staff through hands-on, mentor-based training, which includes the internationally recognized Certified Brain Injury Specialist training program of the Academy of Certified Brain Injury Specialists (ACBIS). All CNR staff receive the ACBIS training within the first twelve months of employment, and CNR maintains a quality benchmark of greater than 80% of its staff attaining the national certification.

CNR’s comprehensive rehabilitation program provides individualized and intensive community-based neurobehavioral rehabilitation service that assists program participants in reestablishing skills and abilities lost due to injury. Our commitment to the development of mutually reinforcing partnerships with program participants and their support systems is key to the achievement of successful rehabilitation outcomes. It is our vision that participants served by CNR will have the opportunity to live, learn, work, and recreate in the community of their choice.

CNR’s person-centered approach to brain injury rehabilitation, focuses on treating participants with compassion, respect, and a full recognition of their dignity and individuality. CNR has a multi-year history of serving individuals with brain injury who experience secondary conditions that may include:

- Difficulty with attention, filtering, and focusing
- Prolonged confusion with significant memory and learning problems
- Difficulties with judgment and problem solving due to cognitive deficits
- Frequent agitation and behavioral upsets
- Seizure disorders and related behavioral difficulties
- Disruption of sleep/wake cycles
- Emergence of mental health problems or exacerbation of pre-existing mental health or substance misuse issues
- Other cognitive and behavioral problems that traditional rehabilitation programs are unable to effectively treat

CNR supports participants as they become more independent with instrumental activities of daily living, leading to the achievement of greater freedom and independence. Recovery is maximized by providing participants with a wide range of service interventions, designed to achieve treatment goals, that may include:

- Cognitive remediation, to include assistance with obtaining and use of assistive technology
- Behavioral supports that assist with self-identification of antecedent triggers and learning coping and compensatory strategies
- Sobriety support development, to include assistance in seeking services for substance abuse and co-occurring disorders
- Self-advocacy skill development and application to assist with navigating the service system, which includes opportunities to learn about brain injury and individual needs
- Treatment to address struggles with daily activities such as grooming, budgeting, shopping, household maintenance, etc.
- Prescriptive programming to promote generalization of skills and advance gains in outpatient treatment (OT, SLP & PT)
- Structured leisure time activities, community accessibility and safety (transportation provided, as appropriate, for goal-related activities)
- Assistance with pursuit of education and employment
- Progressive physical strengthening, fitness and retraining
- Health and wellness management, including medication management and dietary/nutrition support
- Assistance in coordinating and obtaining preventative, appropriate and timely medical and dental care, and any other professional services necessary to health and well-being
- Assistance and education to family, providers and other support system interests
- Transitional support and training
- Assistance with preparation for transition to less intensive services

### **The Measurement of the Outcomes Attained**

The CNR Outcome Validation Study attempts to capture the levels of independence and/or interdependence achieved through the rehabilitation process and includes the level of paid,

unpaid, or community supports needed at the time of discharge. The study provides an overview of demographics and function as it relates to daily activities, including avocational and vocational endeavors, behavioral supports, social role return, substance abuse, interfering psychiatric issues, level of caregiver involvement, and other factors that can impact quality of life and level of autonomy. The study has grown since its inception, and as the number of measurable outcomes increase, the study continues to assess long-term results, take on a longitudinal perspective and provide additional support to program design and state initiatives. Although many data points are collected, CNR has identified four measures which directly support the organization's mission. These four measures are:

- Ability to live in community of choice, with or without supports
- Participation in activities of interest post-discharge, including school, work, volunteer endeavors, and other validating pursuits
- Social role re-entry
- Self-directed care and level of care, paid and unpaid, provided by others

### **Study Design and Components**

CNR's outcome validation study is based on a model developed by the Neurologic Rehabilitation Institute of Ontario (NRIO) in 1997 and uses functional domains to assess the outcomes attained by program participants. The domains include: post-discharge life activity (vocational/ avocational and school/ training/volunteering); level of support required at discharge (paid and unpaid); the level of return to pre-injury social role; and the presence of interfering psychiatric or substance abuse problems. These domains and findings are consistent with research involving long-term outcomes of adult onset brain injury (NRIO Outcome Validation Study, 1997-2015); Kaponen (2002); Ponsford (2008); Whelan-Goodinson et. al., (2009); Silver (2001); VanReekum (1996); VanReekum (2006).

This report provides data obtained during CNR's first seven years of operation. As such, it compares results in 2017 to cumulative averages from 2011 through 2016. CNR has completed 57 discharges since the inception of this study, however, due to four individuals' readmissions a total of 51 individuals have been served.

Information is compared against external benchmarks as identified within the NRIO Outcome Validation Study. Results are additionally compared to the information reported within:

- Traumatic Brain Injury in Iowa: An Analysis of Core Surveillance Data 2008-2010  
By Dr. Ousmane Diallo and Megan Hartwig
- Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations, and Deaths  
Centers for Disease Control and Prevention (2002-2010)
- Traumatic Brain Injury in Prisons and Jails: An Unrecognized Problem  
Centers for Disease Control and Prevention

- Traumatic Brain Injury in a Prison Population: Prevalence and Risk for Re-Offending  
By W. Huw Williams, Avril J. Mewse, James Tonks, Sarah Mills, Crispin N.W. Bruggess and Gary Cordan (2010)
- Wood, Wood and Merriman (1998).

### **2017 Cohort Demographics**

In 2017, CNR moved away from the upward trend of an increasing number of discharges each year. With the exception of the 2015 cohort which occurred simultaneously with a major financial shift within the state to a system of Medicaid managed care, each cohort between 2011-2016 increased by at least three discharges per year. While there were fourteen discharges in 2016, the number decreased to nine discharges in 2017. In late 2017, the state went through another major shift that caused additional strain throughout the entire system when one of the three Managed Care Organizations withdrew their contract with Iowa DHS. This organization managed Medicaid benefits for over 200,000 Iowans, of which 23,000 were receiving Long-term Services and Supports. At the time of its withdrawal, this Managed Care Organization had oversight of almost 90% of the state's Medicaid members; CNR's census closely mirrored this ratio, with 80% of participants being impacted by this abrupt withdrawal.

### **Gender and Age Characteristics**

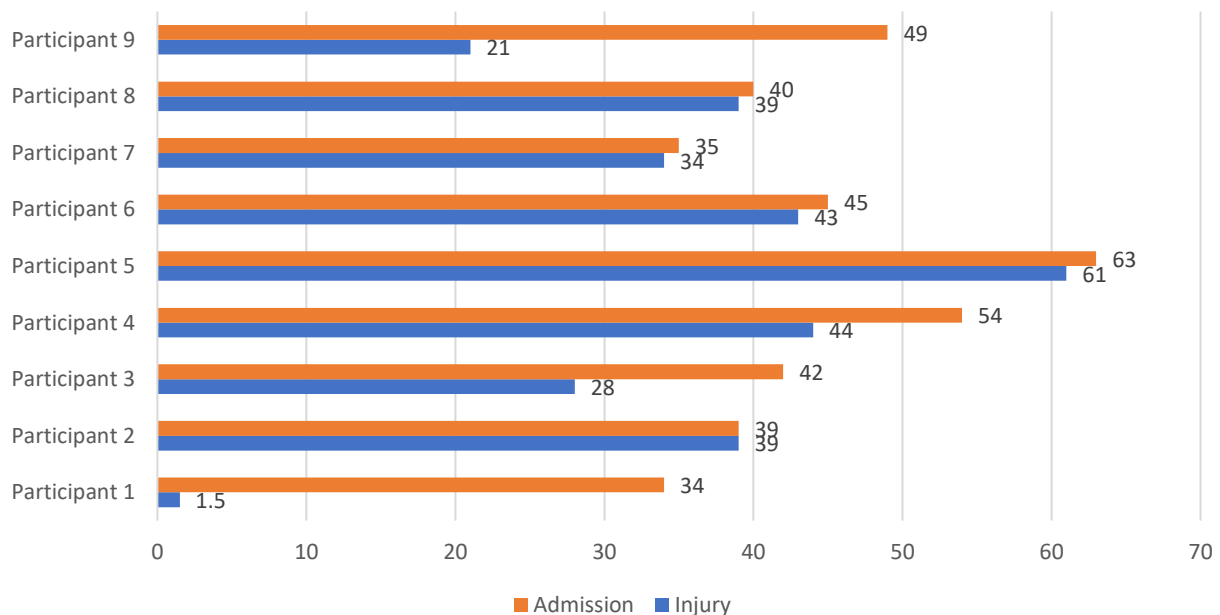
Historically, CNR has served twice as many men as women, which is in line with national injury trends reported by the Centers for Disease Control and Prevention (CDC). Of the nine participants discharged in 2017, six participants were male (66.7%) and three participants were female (33.3%). The 2016 cohort was the only year in which there were more females than males. The cumulative average of the male to female ratio between the years of 2011-2016 is 60.4% males to 39.6% females.

The average age at admission for the 2017 cohort was 45 years old making the 2017 cohort the oldest group of individuals. The closest cohorts to this age were 2014 and 2015 which had an average age of 42 years old upon admission.

The average age of injury for the 2017 cohort was 35 years old, with only one participant being injured in early childhood (1.5 years of age); all other individuals' injuries occurred after the age of 20 with five occurring after the age of 38. To date, the cumulative average age of injury for CNR participants is 28. The most recent data from the CDC reports the highest rates of TBI occur in children ages 0-14, older adolescents aged 15-19, and in adults 65 or older.

Cumulative Averages 2011-2016 Cohort Participant Characteristics		2017 Cohort
Male Gender	60.4%	66.7%
Female Gender	39.6%	33.3%
Age of Injury	28	35
Age at Admission	39	45

**2017: Age of Injury Compared to Age at Admission**



### Means of Injury

In 2010, the CDC reported falls as the leading cause of traumatic brain injury (TBI) in the United States accounting for 35.2% of injuries. Road traffic injury was the second leading cause of TBI at 17.3%, but resulted in the largest percentage of TBI-related deaths.

The predominant means of injury for the 2017 study cohort was motor vehicle crashes. Of the four participants that were in a MVA, the resulting brain injuries varied from intracranial hemorrhage, subarachnoid hemorrhage and subdural hematoma, concussion and cerebral infraction, and an unspecified skull fracture. Each of the individuals involved in MVAs suffered a loss of consciousness greater than twenty-four hours, with one participant remaining in a coma for nine months. Of the remaining five individuals in the 2017 cohort, two individuals



had an aneurysm or stroke, one individual suffered an assault resulting in a subdural hematoma, one individual fell as a young child secondary to a seizure disorder, and the remaining individual's injury was attributed to toxic poisoning by methadone (categorized as "other"). The greatest discrepancy between the 2017 data and CNR's cumulative data is found in the 22.22% of individuals in this cohort who suffered an aneurism compared to CNR's cumulative average of 8%.

Cumulative Averages 2011-2016 Cohort Primary Means of Injury		2017 Cohort
MVA	40.29%	44.44%
Assault	10.53%	11.11%
Hypoxia/Anoxia	13.97%	0%
Aneurysm	8%	22.22%
Fall	6%	11.11%
Sports	1.67%	0%
Other	19.81%	11.11%

### **Pre-Admission Placement**

Two individuals were receiving neurobehavioral supports out of state prior to being admitted to CNR, one for twelve months and the other for three months. Another individual was living in a nursing home prior to his/her admission to CNR, and two individuals were hospitalized prior to admission. Of the individuals who were hospitalized, one individual was hospitalized under an involuntary mental health commitment and the other individual was admitted directly from the hospital following his/her MVA.

Of the four remaining individuals, one of these individuals was incarcerated prior to admission and three individuals were previously living in the community with paid supports. Of these three individuals, two individuals were living within a Residential Care Facility and one individual was living at an Intermediate Care Facility for adults with Intellectual Disabilities.

Cumulative Averages 2011-2016 Cohort Placement Prior to CNR		2017 Cohort
Out of State	33.31%	22.22%
Nursing Home	11.48%	11.11%
Acute Rehab	6.48%	0%
Hospital	11.27%	22.22%
Incarceration	4.45%	11.11%
Living in the Community with Paid Supports	25.37%	33.33%
Living in Community with Unpaid Supports or No Supports	9.52%	0%

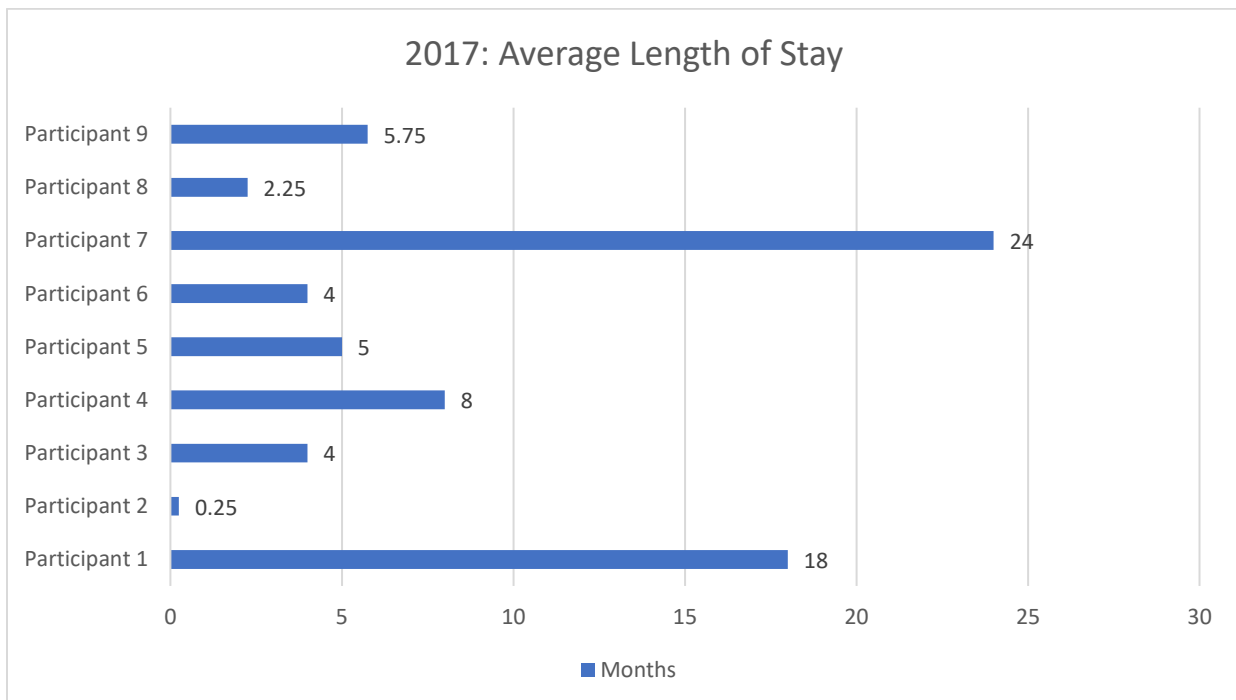
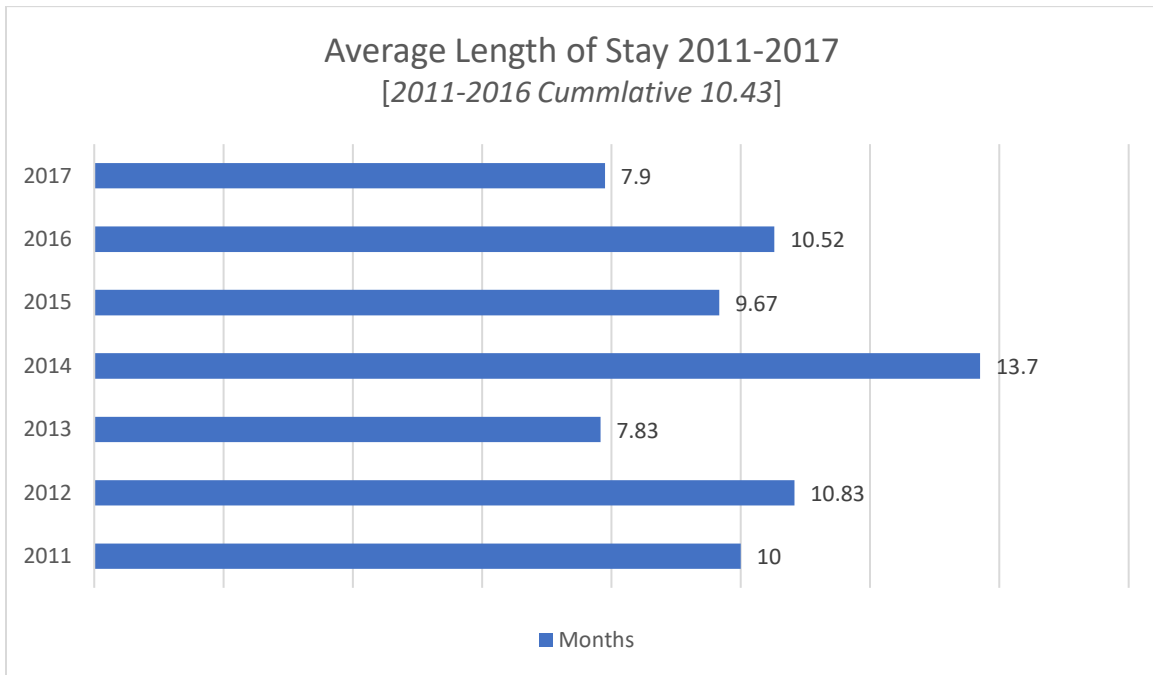
**Risk Category**

The Community-based Neurobehavioral Rehabilitation Service (CNRS) model was developed to prevent individuals with acquired brain injuries from experiencing institutionalization (out-of-state placement), hospitalization, incarceration, and homelessness. While the percentage of admitting individuals, who were at risk of out-of-state placement greatly decreased in 2017, the percent of individuals at risk of remaining in or being admitted to a higher level of care significantly increased. Within the 2017 cohort, only one individual was not at risk of a higher level of care or out-of-state placement which was due to his/her incarceration.

Cumulative Averages 2011-2016 Cohort Participant Admitted to Prevent:		2017 Cohort
Out-of-State Placement	52.09%	22.22%
Higher Level of Care	24.18%	66.67%
Incarceration	15.56%	11.11%
Homelessness	13.18%	0%

## Length of Stay

At the inception of CNRS, the average length of stay was greater than 12 months for an lowan receiving services through an out-of-state provider. The average length of stay for the 2017 cohort was 7.9 months. When compared to all other years referenced within this study, the 2017 cohort was the second shortest length of stay with the 2013 cohort being the shortest at 7.83 months. The next closet cohort was in 2015 with an average length of stay of 9.67 months. In all other years, length of stay ranged from 10-13.7 months.



<b>Comparative Review of Preadmission to Discharging Status</b>
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**Level of Care Needs**

CNR makes every attempt to maintain contact with participants post discharge to evaluate the durability of outcomes achieved. While one of the primary goals of rehabilitative services is placement into a lower level of care, CNR recognizes the importance of proper discharge placement to ensure that services received meet participants’ neurobehavioral support needs in the least restrictive environment possible.

Upon discharge, only two of the nine individuals discharged to a level of care which was higher than or equal to CNRS. One of the two participants was admitted to the hospital, and the other participant was discharged to a facility at the same level of care.

The remaining seven individuals returned to a lower level of care, receiving services within the community of their choosing. Two of these individuals discharged into the community and received CNR’s Intermittent hourly service. An additional two individuals discharged to HCBS-BI Supported Community Living homes with 11-24 hours of daily support. One individual discharged directly home with daily unpaid supports. The remaining two individuals discharged AMA with unpaid supports.

When comparing each individual’s pre-admission level of care to their discharging status, eight of the nine individuals discharged to a lower level of care than they were at prior to admission to CNR. It is of note, however, that two of these eight individuals discharged AMA to an environment that CNR felt was insufficient in meeting their neurobehavioral support needs. The one individual who did not return to a lower level of care, discharged to the same level of care as he/she was at pre-admission.

2011-2016 Cohort Cumulative Averages		2017
Participant Discharge Status		Cohort
Independent Living (No Supports)	13.31%	22.22%
Independent Living with Less Than 4hrs/daily of Paid Support	7.57%	22.22%
Independent Living 6-10hrs/daily of Paid Support	4.05%	0%
Independent Living 11-23hrs/daily of Paid Support	4.05%	11.11%
In Community with 24 hours of Paid Support	17.96%	22.22%
Living with Family Who Provide daily of Support	20.98%	11.11%
Group/Congregate Setting with 24 hours of Support	20.05%	11.11%
Out of State Placement	12.59%	0%

## Avocation/Vocational Return at Discharge

Gainful employment not only provides financial stability but it also plays a significant role in one's self esteem and independence. A 2006 study by Gordon Waddell and Kim Burton concluded that adults who are unemployed for more than twelve weeks are 4 to 10 times more likely to suffer from depression and anxiety. Within the TBI population, specifically, return to work occurs in less than 10-40% of people, with the greatest unemployment rates being among those with more severe TBIs, males, those with a substance abuse history, and in individuals with a lower pre-injury educational and/or vocational status.

To promote the functional application of work-related skills, CNR offers paid employment opportunities to all participants upon admission. Historically, most individuals are not employed prior to being admitted to CNR. The 2017 cohort was in line with this trend with six of the nine individuals not working prior to their admission however, all six of these individuals had worked at some point in their past. Of the remaining three individuals, two individuals were working in the community with supports, and one individual was working without paid supports.

When comparing pre-admission level of vocation to that at discharge, the majority of individuals maintained their same level of vocation. One individual was not working at time of his/her admission but was enrolled in school at the time of his/her discharge. Two individuals were not employed at the time of their admission but were working at the time of discharge. The remaining two individuals were working at the time of their admission but were not employed at the time of discharge.

Cumulative Averages 2011-2016 Cohort Work Status Prior to Admission (Post Injury)		2017 Cohort	Cumulative Averages 2011-2016 Cohort Work Status at Discharge		2017 Cohort
Student	1.19%	0%	Student	3.33%	11.11%
Not Working	78.68%	66.67%	Not Working	77.25%	55.56%
Working with Supports	11.46%	22.22%	Working with Supports	14.05%	22.22%
Working with No Supports	6.83%	11.11%	Working with No Supports	5.37%	11.11%
Self-Employed	1.85%	0%	Volunteer	0%	0%

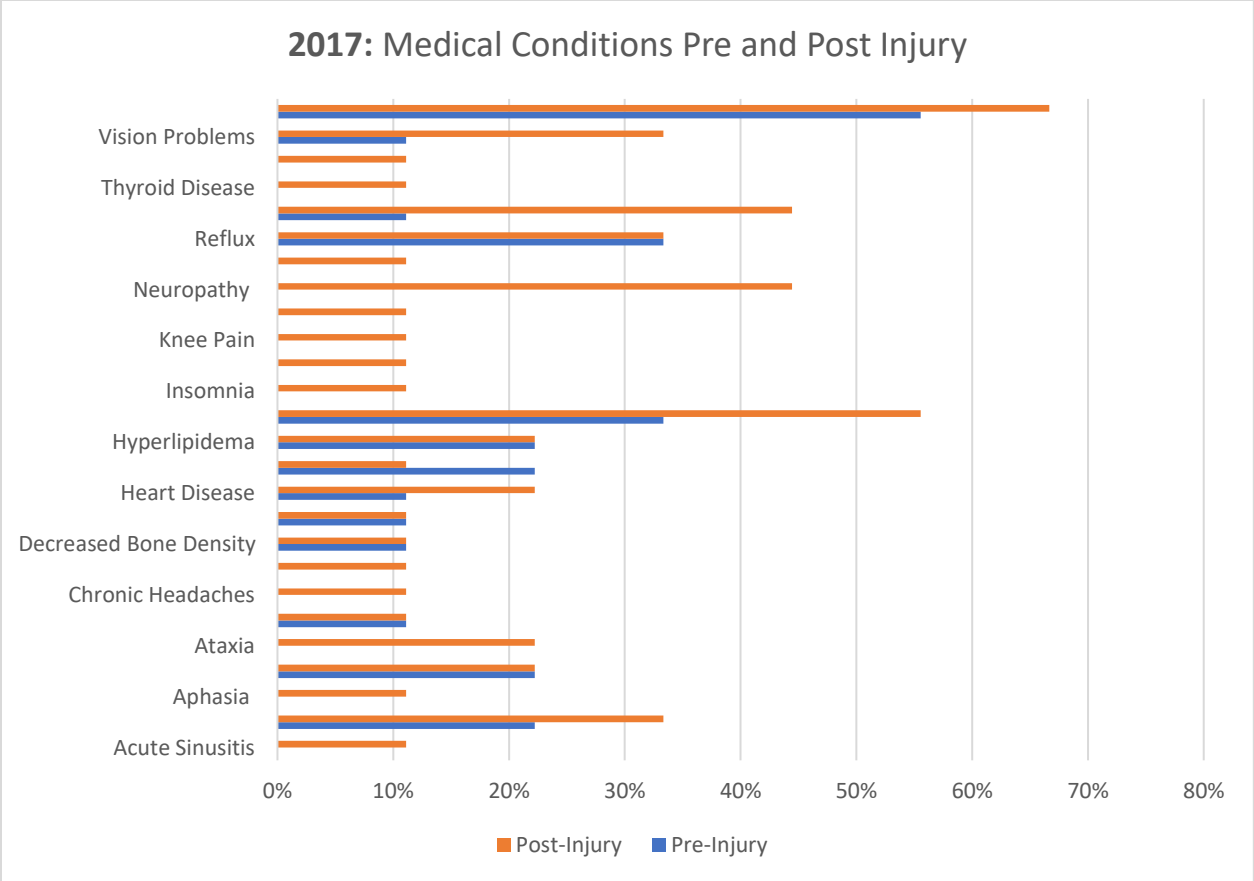
## Longitudinal Review of Coexisting Conditions and Statuses Pre- and Post-Injury

### Medical Conditions

Although a brain injury is initially a traumatic event, it can ultimately result in a chronic, life-long condition requiring coordinated care from a wide variety of health professionals. Common medical conditions following a brain injury include seizures, sleep disorders, neurodegenerative disease, psychiatric conditions, sexual dysfunction, bladder and bowel incontinence, and metabolic dysregulation. These conditions can last from a few months post-injury to years and perhaps even span across a lifetime. It is estimated that approximately one-third of individuals with a severe TBI will experience long-term physical complications or neuromotor abnormalities post-injury. An individual with a brain injury not only has a decreased life expectancy of nearly seven times greater than a non-injured peer, he/she also is 1.5 times more likely to die from a secondary condition.

In the 2017 cohort, two individuals reported no medical issues prior to their brain injury; post injury, one of these individuals reported one medical issue while the other individual reported six medical issues. One individual maintained the same medical diagnosis both pre and post injury. The remaining six individuals maintained their pre-injury medical diagnoses but reported up to seven additional medical diagnosis post injury. Overall, 77.77% of the 2017 cohort experienced a medical condition pre-injury, which is vastly greater than the cumulative average of 30.51% of individuals between the years of 2011-2016. Post injury, 100% of the 2017 cohort experienced a medical condition, compared to the cumulative average of 91.93%.

Cumulative Averages 2011-2016 Cohort Pre-Injury Medical Diagnosis		2017 Cohort	Cumulative Averages 2011-2016 Cohort Post-Injury Medical Diagnosis		2017 Cohort
No Medical Issues	69.46%	22.22%	No Medical Issues	9.83%	0%
1-2 Medical Issues	27.18%	33.33%	1-2 Medical Issues	39.33%	22.22%
3-4 Medical Issues	3.33%	22.22%	3-4 Medical Issues	20.67%	0%
5+ Medical Issues	0%	22.22%	5+ Medical Issues	31.93%	77.77%

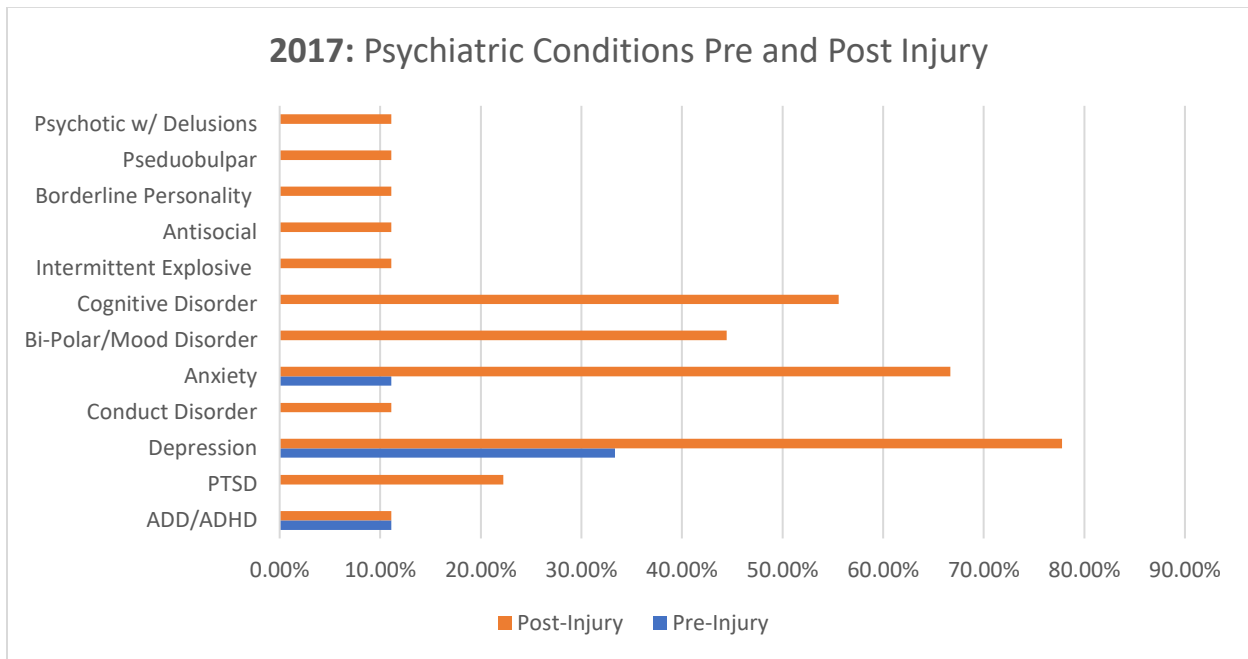


**Psychiatric Conditions**

Many factors such as age, gender, severity of injury, location of injury, and premorbid conditions play a role in the possible development of psychiatric conditions following a TBI. The most common psychiatric condition post-injury is depression. Individuals post-injury are at a 44.3% higher risk of being diagnosed with depression, compared to the general population’s risk of 5.9%. Other common post-injury psychiatric conditions include bi-polar disorder, generalized anxiety disorder, panic disorder, and schizophrenia.

While 44.44% of individuals in the 2017 cohort experienced a psychiatric condition prior to his/her injury, 100% of this cohort experienced one or more psychiatric conditions post injury. Of the four individuals who experienced a psychiatric condition both pre and post injury, one of the individuals experienced the exact same psychiatric conditions pre and post injury, and the other three individuals maintained their pre-injury psychiatric conditions but added additional psychiatric diagnoses post-injury. The most reported psychiatric condition post injury for the 2017 cohort was depression which affected 77.78% of individuals. The 2017 cohort data fell in line with the cumulative averages from 2011-2016 with 42.9% of individuals experiencing a pre-injury psychiatric condition and 92.6% experiencing a post-injury psychiatric condition.

Cumulative Averages 2011-2016 Cohort Conditions Prior to Injury		2017 Cohort	Cumulative Averages 2011-2016 Cohort Conditions Post Injury		2017 Cohort
Psychiatric	42.9%	44.44%	Psychiatric	92.6%	100%



### Substance Use

As the physical and psychological effects of a brain injury can go undiagnosed or misdiagnosed for long periods of time, brain injury is often referred to as a silent epidemic. This can lead to individuals self-medicating or experimenting with mis-guided home remedies. It is estimated that up to two-thirds of all individuals receiving TBI or substance mis-use rehabilitation have a co-occurrence of the two conditions. Furthermore, a person is ten times more likely to mis-use substances post-injury if they had engaged in such behaviors pre-injury. A 2007 study out of Ohio State University by John Corrigan reports that 50% of individuals post brain injury engage in substance misuse.

Within this year's cohort, three individuals had no history of substance use/abuse. Five individuals had substance use issues both pre- and post-injury, and one individual struggled with substance use/abuse pre-injury but not post-injury. Of those who used substances, most of the individuals struggled with the simultaneous use of alcohol and drugs. The occurrence of substance use/abuse pre- and post-injury in the 2017 cohort is reflective of the rate of substance use/abuse found in the cumulative data for the years of 2011-2016; slight variances are found in the simultaneous use of multiple drugs pre-injury and use of alcohol and drugs post-injury.



Cumulative Averages 2011-2016 Cohort Pre-Injury Substance Use/Abuse			2017 Cohort	Cumulative Averages 2011-2016 Cohort Post Injury Substance Use/Abuse			2017 Cohort
Abstained from Substances	32.17%	33.33%		Abstained from Substances	43.55%	44.44%	
Substance Use/Abuse	67.83%	66.67%		Substance Use/Abuse	56.45%	55.56%	
	Alcohol Only	23.6%	0%		Alcohol Only	13.6%	0%
	Marijuana Only	4.8%	0%		Marijuana Only	8.8%	0%
	Cocaine Only	0%	0%		Cocaine Only	0%	0%
	Meth Only	0%	0%		Meth Only	0%	0%
	Benzos Only	0%	0%		Benzos Only	0%	0%
	Other Pills Only	0%	0%		Other Pills Only	0%	0%
	Drugs and Alcohol	71.6%	83.33%		Drugs and Alcohol	58.4%	80%
	Multiple Drugs	0%	19.67%		Multiple Drugs	18.6%	20%

### Legal Problems

Involvement with the court system is quite common post injury and it is often intermixed with substance misuse. The CDC reports that 25-87% of inmates report injuries consistent with a TBI; this is compared to an 8.5% rate of reported occurrence by the general population. A 2009 study by W. Huw Williams et al. found that the 65% of adult male inmates who reported a history of TBI had a younger entry into the correctional system and a higher rate of re-offending when compared to their non-brain injured peers.

The 2017 cohort trended slightly low compared to the CNR's cumulative average of legal involvement for both pre- and post-injury. Five individuals in 2017 had no legal history pre- or post-injury. One individual had issues within the legal system pre-injury but not post-injury, and three individuals had legal involvement both prior to and after their brain injury. The 2017 cohort had the second lowest rate of legal involvement both pre- and post-injury when looking across all cohorts between 2011-2017.

Cumulative Averages 2011-2016 Cohort Pre-Injury Status		2017 Cohort	Cumulative Averages 2011-2016 Cohort Post-Injury Status		2017 Cohort
Legal Issues	56.26%	44.44%	Legal Issues	47.57%	33.33%

**Benchmark Comparisons from Wood, Wood, & Merriam (1998)**

	<b>2017 CNR Outcome Study</b>	<b>2011-2017 CNR Outcome Study Averages</b>	<b>Wood et. Al.</b>
<b>Average age of injury</b>	35	29	27.17
<b>Time between injury and admission (months)</b>	120	132	72.83
<b>Length of Stay (months)</b>	7.9	10.06	14.32
<b>Means of Injury</b>			
<b>MVA</b>	44.44%	40.88%	63%
<b>Fall</b>	11.11%	6%	9%
<b>Assault</b>	11.11%	10.61%	3%
<b>Intracranial Hemorrhage/ Aneurysm</b>	22.22%	10.11%	12%
<b>Hypoxia/Anoxia</b>	0%	11.97%	1%
<b>Encephalitis</b>	0%	0%	1%
<b>Other</b>	11.11%	18.57%	5%
<b>Pre-Admission Placement</b>			
<b>Home without paid support</b>	0%	8.16%	8%
<b>Supported housing</b>	33.33%	26.51%	36%
<b>Nursing home</b>	11.11%	11.43%	5%
<b>Hospital</b>	22.22%	12.84%	36%
<b>Neurobehavioral hospital (Out of state)</b>	22.22%	31.72%	9%
<b>Acute Rehab</b>	0%	5.56%	0%
<b>Incarceration</b>	11.11%	5.40%	12%
<b>Homelessness</b>	0%	0%	2%
<b>Discharge Destination</b>			
<b>Home without paid support</b>	11.11%	19.57%	4%
<b>Supported housing</b>	33.33%	27.10%	63%
<b>Residential unit</b>	44.44%	24.24%	26%
<b>Rehabilitation hospital</b>	0%	0%	2%
<b>Psychiatric hospital</b>	0%	4.2%	0%
<b>Behavior disorder unit</b>	0%	0%	4%
<b>Neurobehavioral hospital (Out of state)</b>	0%	10.57%	0%
<b>Other</b>	11.11%	22.71%	0%

## 2017 Outcome Indicators

The Outcome Validation Study examines the functional status of each individual prior to admission, at the time of discharge, and at six to twelve months post discharge. This information is used to assess the functional gains made in rehabilitation for the individual and for their cohort group within the Outcome Validation Study. The CNR Outcome Validation Study has identified nine key outcome indicators:

1. Mortality
2. Vocational/Pre-Vocational
3. Place of Living
4. Community Services
5. Psychological/Behavioral Supports
6. Social Role Return
7. Social Role Valorization
8. Social Living Issues
9. Substance Use

### Indicator 1: Mortality

A longitudinal study by CL Harrison-Felix et al. spanning four decades post-injury found that persons with a TBI have a mortality rate two times greater than their non-injured peers. Further, regardless of the severity of the injury, one's life expectancy is reduced by approximately seven years. Although increased mortality rates are seen across a vast array of conditions, when compared to their non-injured peers this study concluded the following increases in mortality rates with the greatest percentage of deaths being due to circulatory conditions:

Increase in Mortality Post TBI	Cause of Death
<b>49 Times</b>	<b>Aspiration Pneumonia</b>
<b>22 Times</b>	<b>Seizures</b>
<b>3 times</b>	<b>Pneumonia</b>
<b>3 times</b>	<b>Suicide</b>
<b>3 times</b>	<b>Other Respiratory Conditions</b>
<b>2.5 Times</b>	<b>Digestive Disorders</b>

At time of follow-up, no participants within the 2017 cohort were deceased. Across all years, two participants have died post discharge. One of these individuals died from complications following keto-acidosis and the other died due to complications following a seizure.

<b>Mortality</b>	Prior to Discharge
Participant is deceased (across all years)	0
	After Discharge
	2

**Indicator 2: Vocational/Pre-Vocational**

All individuals within the 2017 cohort were employed at some point in their lives. Of the six individuals who were not working at the time of their admission, three individuals were unemployed at the time of discharge and remained unemployed at time of follow-up and one individual is currently volunteering. Of the two remaining individuals who were not employed at time of admission, one was a student at time of discharge but has since been incarcerated for an alcohol-related offense, and one was working with supports at discharge and remains doing so. In regard to the two individuals who were working with supports at admission, one remained working at discharge while the other had stopped. However, both individuals were gainfully employed at follow-up. The remaining individual worked without supports prior to his/her injury and remained doing so throughout admission, discharge, and follow-up.

<b>Vocational/Pre-vocational</b>	Admission	Discharge	Follow Up
Working, full or part-time/ with no supports	11.11%	11.11%	11.11%
Working , full or part-time with job modifications	0%	0%	0%
Volunteer full or part-time	0%	0%	11.11%
Working with partial job coaching/work supports	0%	0%	22.22%
Working with full/daily job coaching/work supports	22.22%	22.22%	11.11%
Attending school or vocational training program	0%	11.11%	0%
Attending Sheltered Workshop program	0%	0%	0%
Attending Psycho-social Day Activity Program (not work oriented)	0%	0%	0%
Not working	66.67%	55.56%	44.44%
Other	0%	0%	0%

**Indicator 3: Place of Living**

At time of discharge, two individuals transitioned to CNR’s Intermittent hourly service; one of these individuals remained at this level of care and the other has since transitioned to independent living with occasional unpaid supports. Both individuals who discharged to HCBS-BI Supported Community Living homes with 11-24 hours of daily support remain at this level of care. One individual discharged directly home with daily unpaid supports but less than six months later was incarcerated. One participant was admitted to the hospital and then immediately taken into legal custody, and the last participant was discharged to a facility at the same level of care as CNR. Two individuals left AMA at time of discharge; one of these individuals remains at this level of care and the other was subsequently readmitted to CNR where he/she remains receiving CNRS.

Place of Living	Admission	Discharge	Follow Up
Independent Living with no support either professional or from family	0%	22.22%	11.11%
Independent Living with 2-4 hours daily of professional support	0%	22.22%	11.11%
Independent Living with 6-10 hours daily of professional support	0%	0%	0%
Independent Living with 11-24 hours daily of professional support	0%	11.11%	0%
Group/congregate Living with 24 hours/day support (not to include hospitalization or incarceration)	11.11%	22.22%	44.44%
Living with family member(s) providing occasional support 2-4 hours	0%	11.11%	11.11%
Living with family member(s) providing 6-10 support hours/day	0%	0%	0%
Living with family member(s) providing 24 hour/day support	0%	0%	0%
Living in institutional care setting (nursing home, RCF/ICF, hospital, other institution)	88.89%	11.11%	22.22%
Homeless	0%	0%	0%
Deceased	0%	0%	0%

#### Indicator 4: Community Services

Of the five individuals who were not receiving supports within their communities at time of admission, three of these individuals were discharged with community supports and remain in the community. One of these five individuals was discharged with community supports but was later incarcerated, and one individual was discharged to the hospital and then immediately incarcerated where he/she remains. Of the two individuals who left AMA, one remains in the community with no supports and the other individual was readmitted and therefore is currently receiving supports within the community.

Community Services	Admission	Discharge	Follow Up
Receiving no services	0%	22.22%	11.11%
Receiving some level of community services	44.44%	66.67%	66.67%
Receiving services but not in the community	55.56%	11.11%	22.22%
Deceased	0%	0%	0%

**Indicator 5: Psychological/Behavioral Supports**

At time of discharge, six individuals were participating in occasional professional psychological supports. At time of follow up, two were receiving no professional psychological supports while the remaining four individuals maintained the same level of involvement. The two individuals who were receiving weekly counseling at the time of discharge transitioned to occasional psychological supports at time of follow-up. The last individual, who was discharged to the hospital, was incarcerated receiving no professional supports for his/her injury at time of follow-up.

<b>Psychological/Behavioral Supports</b>	Admission	Discharge	Follow Up
No regular, professional psychological/psychiatric/behavioral supports (incarceration included)	11.11%	0%	33.33%
Weekly counseling (individual, groups, family)	11.11%	22.22%	0%
Occasional professional psychological, psychiatric, behavioral services	22.22%	66.67%	66.66%
Daily professional behavioral support worker	33.33%	0%	0%
Attending self-help recovery group(s)	0%	0%	0%
Other services (to include hospitalization and strictly medically-based support)	22.22%	11.11%	0%
Deceased	0%	0%	0%

**Indicator 6: Social Role Return**

Overall, the 2017 cohort reduced interfering psychiatric, substance abuse, and behavioral symptoms prohibiting social role return by 55.56% between time of admission and follow-up. Of the individuals who were able to return to their pre-injury social role, two were able to do so with zero modifications and three were able to return with moderate modifications.

<b>Social Role Return</b>	Admission	Discharge	Follow Up
Returned to pre-injury social role/0 modifications (e.g.: spouse, parent)	0%	33.33%	22.22%
Returned to pre-injury social role with modifications/supports	0%	11.11%	33.33%
Interfering psychiatric/substance abuse/behavioral problems affect social role and relationships (rate as minimal/moderate severe).	100%	55.56%	44.44%
Deceased	0%	0%	0%

**Indicator 7: Social Role Valorization**

Six of the nine participants' social role valorization remained at the same level when looking at time of discharge and follow-up. Two individuals experienced a decrease in social role valorization; one was discharged at an independent level of return to his/her family and later incarcerated, the other individual left AMA and was later re-admitted to CNR. The remaining two individuals experienced an increase in social role valorization.

<b>Social Role Valorization</b>	Discharge	Follow Up
Return to family, spouse, significant other with independent level	11.11%	11.11%
Return to family, spouse, significant other in a dependent mode	22.22%	11.11%
Requiring less than 2 hours a day of behavioral or psychological support (paid)	22.22%	22.22%
Requiring more than 2 hours a day of behavioral or psychological support (paid)	33.33%	33.33%
Attending program 3-5 days per week	0%	0%
Institutional placement	11.11%	22.22%
Deceased	0%	0%

**Indicator 8: Social Living Issues**

Eight of the nine individuals in the 2017 cohort experienced the same level of social living issues at time of discharge and follow-up. The one individual who experienced a change in social living issues was experiencing minimal social changes at discharge but was incarcerated at the time of follow-up.

<b>Social Living Issues</b>	Discharge	Follow Up
No significant changes in social role function	11.11%	11.11%
Some changes in social role function (personal, vocational, social difficulties)	22.22%	11.11%
Moderate change in social role function due to identified personality, behavior, cognitive change	33.33%	33.33%
Marked change in social role function due to identified personality, behavior, cognitive changes (not the "same person")	22.22%	22.22%
Unable to function in the community/requires structured environment	11.11%	22.22%
Deceased	0%	0%

**Indicator 9: Substance Use**

At the time of discharge, only one individual was engaged in substance use; this individual was subsequently discharged due to needing a higher level of care than CNR could provide. This individual was incarcerated, and therefore abstinent, at time of follow-up. The remaining eight individuals were abstinent at discharge and reported remaining abstinent at time of follow-up.

<b>Substance Use</b>	<b>Discharge</b>	<b>Follow Up</b>
Abstinent	88.89%	100%
Minimal alcohol use (1 drink or less per day)	0%	0%
Moderate (1-3 drinks/day or illegal drugs)	0%	0%
Heavy (3+ drinks/day or drug use to produce marked impairment /habituation)	11.11%	0%
Requiring/required Substance abuse treatment	0%	0%
Deceased	0%	0%

**Limitations of Study**

One limitation of this study is the lack of available research to utilize in benchmark comparisons. Initially, writers of this study looked at a literature search conducted by Geurtsen, van Heugten, Martina and Geurtis, 2009. Upon reviewing this report, only one of the papers included post-acute neurobehavioral rehabilitation, and it was accepted in September 1998 (Wood, Wood, and Merriman). Both of these studies cite the shortage of reliable research. "Given the present lack of high-quality studies, well-designed controlled studies (preferably RCTs) are necessary to further enhance the field of comprehensive treatment programs for patients with severe acquired brain injury" (Geurtsen, et al., 2009). With this information, the Wood, Wood, and Merriman study was selected as the most relevant to the CNR Outcome Validation Study.

An additional limitation is the size of this study. In CNR's seven-year history, a total of 51 individuals have received services. This small number limits CNR's ability to fully evaluate trends in data. As the subsequent annual studies are completed, the critical mass of discharged individuals will provide a more robust data set for analysis.

The last identified limitation of this study is the method in which information is collected. The Outcome Validation Study is developed by gathering information at different points in the rehabilitation and post discharge timeline, through phone interviews with participants, family members, and service providers. Thus, individual perceptions and time of follow up may skew the data.