Oregon Senate Bill 1528

OR SB1528 | 2022 | Regular Session

Summary
Directs Department of Human Services to provide specified services to individuals with brain injuries and to convene Traumatic Brain Injury Advisory Committee.

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Statement of David Kracke in Support of SB 1528

February 4, 2022

My name is David Kracke and I am Oregon's Brain Injury Advocate Coordinator charged with improving the lives of Oregon's brain injury survivors, a goal that we can all agree is important. One of the most significant acts that this body could take in furtherance of that goal is to pass SB 1528.

Oregon is recognized as a national leader when it comes to brain injury policy. We led the nation in 2009 with Max's law, the nation's first enacted youth sport's concussion law, continued with Jenna's law in 2013, and then again in 2020 with HB 4140, which will provide immediate academic accommodations to our concussed students upon their return to school.

With that being said, however, Oregon is failing to provide Brain Injury Resource Facilitation. We are one of only eleven states that does not have a Brain Injury Resource Facilitation program despite the fact that Brain Injury Resource Facilitation is an evidence-based best practice for our brain injury survivors, enhancing the survivor's quality of life while realizing significant cost savings to the state.

A robust Brain Injury Resource Facilitation program will require effort to implement, and luckily we are up to the task. We have the advantage of learning from other state's examples, we have access to some of the nation's leading experts for consultation purposes, and we have further evidence of the incredible benefits that Brain Injury Resource Facilitation brings.

While the concept of Brain Injury Resource Facilitation is simple, provide access to person-centered supports and services for Oregon's brain injury survivors, it is important to address the details that create the foundation of a robust Brain Injury Resource Facilitation program. To explain some of those details, I have created an exhibit packet that is being submitted with this statement.

Within that exhibit packet you will find the following:

• First-hand accounts from Brain Injury survivors expressing how their lives would have been improved if they had had access to Brain Injury Resource Facilitation;

• Preliminary results from a 2021 - 2022 Center on Brain Injury Research and Training (CBIRT) Survey indicating significant gaps in access to person-centered supports and services in Oregon;

• Evidence-based studies demonstrating the benefits of Brain Injury Resource Facilitation;

• An OHSU healthcare economic analysis identifying significant cost savings to the state associated with Brain Injury Resource Facilitation; and

• A pre-publication graphic demonstrating significant reduction in recidivism rates among brain injured inmates who receive Brain Injury Resource Facilitation post-release.

In addition to the written materials presented here, you will also hear direct testimony from a few of Oregon's brain injury survivors as they recount their personal experiences in this area, as well as three of the nation's leading experts on Brain Injury Resource Facilitation and brain injury medical treatment.

For these reason and more, I urge you to please support SB 1526. Thank you.

David Kracke

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Why we need Resource Facilitation

After TBI, most of the focus is on medical, physical, and emotional healing.

Survivors' and families' needs and desires go well beyond medical care, but we often do not know our legal rights, what can be made available to us, or how to find providers who understand brain injury.

- Employment
- Education
- Medical Services
- Social Services
- Mental Health
- Housing
- SSI and SSDI
- Legal representation
- Transportation
- Support Groups
- Volunteering
- Life Skills Development
- Assistive Technology
- Prevention of Additional TBIs

Resource Facilitators bridge the gaps for people who need accommodations but are unsure whether they could qualify and may lack resources or knowledge of how to secure them on their own.

Who can benefit from Resource Facilitation

My name is Cheryl. I now work full-time and advocate for people with disabilities through media arts and community service.

My recovery could have been smoother if I had had more information. My Master's in Speech-Language Pathology helped me in many ways, but I'd had over two decades of sports concussions and mild TBIs. After a serious bike wreck in 2010 when I was 35, my self-awareness was too impaired for me to know I should or even could get help. My doctor did not refer me to rehab until a speech therapist approached me and recommended I ask for a referral.

I tried to return to work, but supervisors offered support without an accommodation plan, which was inadequate. After taking medical leave, I resigned in shame. A **Resource Facilitator** could have supported me to recognize my needs were outside the reasonable range.

"I know I can do this job if you just let me come in only 5 hours a week."

My physical therapist sent me to a support group for teenagers. I only learned about adult support groups through a flyer. I was later referred to a Certified Rehabilitation Counselor.

The counselor helped me apply for para-transit, which restored my ability to travel independently. Learning about transportation options sooner through a **Resource Facilitator** would have freed my family from driving me to medical appointments during their workday.

Dani lost her friends and her ability to play the sports she loved after waking from a coma with substantial cognitive and physical impairments. She was suspended and expelled repeatedly from multiple high schools for her behavior after the brain injury.

She barely graduated after seven years and continues to struggle to find life direction. A **Resource Facilitator** may have been able to steer her toward information and support in such varied areas as dealing with trauma, connecting to other peers, adaptive sports, and advocating for more behavior supports in school.

“I tried to kill myself a few times, a lotta times actually. I walked in roads late at night. I overdosed a few times. I cut myself and hit my head against the walls. I heard if I had any big impact to my head, I could instantly die.”

Dani has held only one job as an adult and is housing insecure. A **Resource Facilitator** has the knowledge to assist people with disabilities to find appropriate housing, social supports, positive outlets for expressing oneself, and creating a plan for education and employment goals.

Brandon went from straight As to failing after a severe TBI. Although given an accommodation plan, his supports were not adequate for his impairment level. He did not recognize his legal right to address this.

A **Resource Facilitator** could have assisted him to discuss accommodations with his college or help him realize that taking one more year off could have benefitted him in working toward his degree.

“At Multnomah Bible College, I feel like there probably could’ve been more interaction with me on a personal level. I got an F because they didn’t teach it to me correctly.”

Brandon was in a supported living facility for several years. He now lives independently in his own apartment but would have preferred to move out sooner.

A **Resource Facilitator** might have helped him and his family manage his finances and search for housing with in-home supports to encourage independence sooner. He has become frustrated being a long-term volunteer at a bakery and is only now beginning to seek paid employment more than a decade after his injury.

Oregon Brain Injury Services and Supports Survey

Initial Findings

This data reflects the first 122 participants to complete the survey (51 stakeholders & 71 providers). We are continuing to collect data and will provide updated results when the study is complete.

Persons with Brain Injury

What has kept you from the service(s) you need?

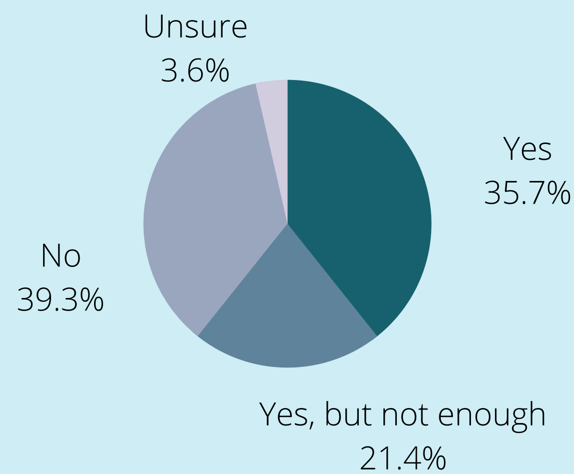
I was not aware of the services

57%

I don't understand the process to get services

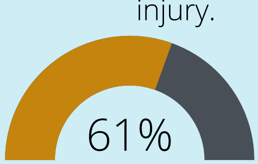
40%

Have you received the Case Management service(s) you need?

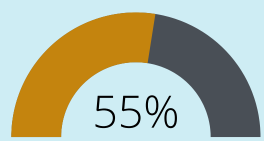


What could improve how you get the services and supports you need?

Having someone to turn to for support and to ask questions of, even years after my injury.



Having one person to help coordinate my services and supports.



This survey was conducted by the Center on Brain Injury Research and Training with funding from the Administration for Community Living's Traumatic Brain Injury State Partnership Program to gauge the state of services and supports for Oregonians with brain injury.

Is there anything else you would like to share about your experience getting the services you need or needed?

"I had to be my own case manager for a long time and it's nearly impossible when you have a brain injury."

"It was really hard. I had to ask and ask and ask for help and services. Nothing was offered."

"I spent 2 years at over 500 appointments and over 40 practitioners and today, I am in Illinois, Chicago area, receiving medical attention that could not or would not be available to me in Oregon. That is how bad it is in Oregon. I had to leave to get more cohesive TBI care. Oh, I'm still an Oregon resident. I'm living in a residential hotel while here for months. It is driving public services costs up, unemployment, homelessness, not to mention broken families and lives, on top of personal debt, and for some, death."

Is there anything else you would like to share about how your services are coordinated?

"I do it all myself! I wish I had a case manager who managed it all. However I have several, and they do not communicate with each other."

"What coordination? I didn't know this was an option."

"I didn't know case managers were available."

"I did not receive any case management services. No one ever suggested such although I asked. I didn't know how."

"Resources, medical providers, prescription sites, knowledge, are all so detached and disparate that navigating it all is like assault and battery to a Person with TBI. Clearly I'm disgusted by the experience and humiliation, so I'm sharing in hopes that you can make a difference."

Service Providers

40%

Indicate an unmet need for case management for individuals with brain injury in their community

55%

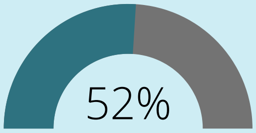
Perceive challenges in care coordination and navigating siloed systems of care as a barrier to providing services to individuals with brain injury

56%

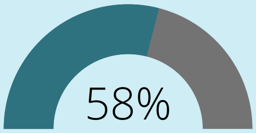
Indicate client access to a single, long term case manager to help coordinate their services and supports could improve care coordination

In your opinion, what are the biggest challenges for clients with brain injuries in obtaining the services they need?

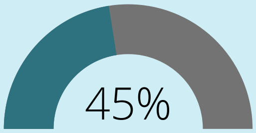
Client unaware of services



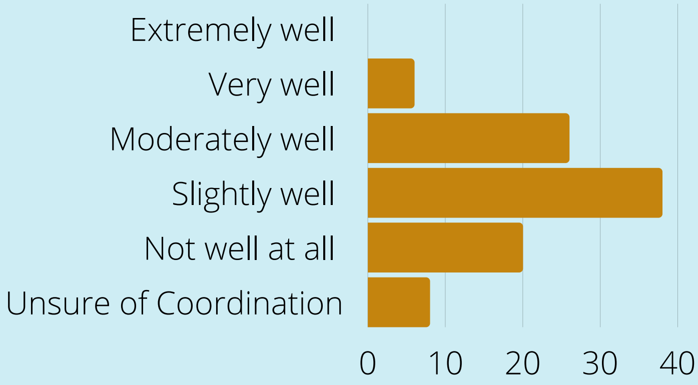
Client difficulty in understanding the process to get services



Providers unaware of additional brain injury services



How well coordinated are brain injury services and supports in your region?



Is there anything else you would like to share about barriers to services for clients with brain injury?

"For adults who are typically independent and who are living alone, TBI and disruption of executive functioning cause significant issues accessing and coordinating care. A nurse navigator or someone like that to help organize and help patients attend appointments and follow through with recommendations would help them tremendously. Children often have parent advocates to help them. Many adults do not."

"Too many systems interacting with these patients, the patient's need for services or level of impact is not as obvious, creating many frustrations for patients."

Is there anything else you would like to share about how services are coordinated for clients with brain injury?

"We have seen people shuffled from one place to another without the ability to properly address the brain injury and its implications. Often the client themselves are frustrated with or don't understand the process and so compliance with recommended treatment is low."

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Models of brain injury vocational rehabilitation: The evidence for resource facilitation from efficacy to effectiveness

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Abstract.
BACKGROUND: Resource Facilitation (RF) is an intervention developed to improve return to work (RTW) following brain injury. RF is an individualized treatment specializing in connecting patients and caregivers with community-based resources and services to mitigate barriers to return to work.
OBJECTIVES: Examine the effectiveness of the RHI RF program for a clinical prospective cohort of participants referred to this program from the State Vocational Rehabilitation agency.
METHODS: Participants were 243 participants with data drawn from the two sources: 33 from previous randomized controlled trial (RCT) control groups who did not receive RF and 210 from clinical patients discharged from the RHI RF program.
RESULTS: At discharge from RF, a greater proportion of the treatment group obtained employment than the control group [$X^2_{(1)} = 5.39$, $p = 0.018$]. When controlling for baseline level of disability, treatment group significantly predicted employment outcome (Wald = 4.52, $p = 0.033$) and participants in the treatment group were 2.3 times more likely to return to work than controls.
CONCLUSIONS: Previous RCTs have studied the RHI RF model and demonstrated significant efficacy. The findings from the present study are consistent with the employment rates found in the previous RCT's following RF, and also provide initial support for the clinical effectiveness of RF.

Keywords: Brain injuries, return to work, employment, rehabilitation, vocational

1. Return to work (RTW) after acquired brain injury (ABI)

Return to work after brain injury has always been regarded as a critical outcome metric in research, yet established continuums of rehabilitation services typically do not extend through vocational placement and follow-up. When vocational services do exist, they are often a) not brain injury specialized or b) integrated into an existing continuum of services, which typically results in people not receiving vocational rehabilitation services, or if they do, it is many years post-injury. In addition to the brain injury specific barriers to RTW, these system barriers compromise vocational outcome.

A variety of studies have demonstrated that approximately 30–40% of people with ABI ultimately return to work. A systematic review (Van Velzen, Van Bennekom, Edekaar, Sluiter, &

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Frings-Dresen, 2009) found that 40.8% of those with traumatic brain injury (TBI) and 39.3% with non-TBI returned to work. Inclusion criteria in this review included a) the subjects were working prior to their injury, b) were aged 18–65 years, and c) return to work was an outcome measure. Their review was based on a sample of 49 studies that met all of the inclusion criteria. It should be noted however that this study did not separate outcomes based on severity of injury.

A more recent study was completed using population estimates from the Traumatic Brain Injury Model Systems National Database (TBIMS-NDB) (Cuthbert et al., 2015). In this study, the investigators culled 3121 subjects from the database which were weighted to obtain population estimates to match the US TBI rehabilitation population based on both the Uniform Data System for Medical Rehabilitation (UDS, 2012) and the American Medical Rehabilitation Providers Association, eRehab (American Medical Rehabilitation Providers Association, 2012). Their sample was based on inclusion criteria that included less than 60 at the age of injury, not retired at injury, and alive two years post-injury. These investigators found that 39.6% were employed, which included paid legal or illegal work, with or without accommodations. Of these 39.6% that were able to RTW, 65% of them were employed full time.

A number of studies have found that severity of brain injury has a significant impact on return to work. For example, in 2002, Groswasser et al. found that 84% of subjects with mild TBI were able to RTW, and in another study of mild TBI, 78% were able to RTW (Hanlon et al., 1999). Dikmen and colleagues (Dikmen, Temkin, Machamer, Holubkov, Fraser, & Winn 1994) found that 37 percent of subjects with severe traumatic brain injury (TBI) had returned to work, 64 percent with moderate TBI, and 83 percent of mild TBI returned to work at two years post-injury.

Even these findings may however over-estimate rates of RTW for moderate and severe brain injury. Certainly not all people who need inpatient rehabilitation receive these services, and consequently, are not included into the TBIMS database. Individuals who are seen in their State Vocational Rehabilitation agency are typically many years post-injury, did not have access to specialized brain injury rehabilitation services, have developed multiple co-morbidities, have lost vocational skills and networks, in addition to presenting with persisting cognitive and neurobehavioral disabilities (often among others), making return to work a certain challenge. For example, Schopp, Johnstone, Unger, & Goldman (2003) found that only 18 percent of State Vocational Rehabilitation clients with TBI were successfully placed.

2. Barriers to RTW after acquired brain injury

Vocational rehabilitation of people with brain injury represents a significant challenge from all perspectives. Barriers to RTW span across individual and family variables, as well as social, environmental, and system/organizational domains. It is for these reasons that an effective approach to RTW following brain injury will not be a "medical" or a "vocational" model, but rather one that is capable of responding to the unique and individualized constellation of barriers, and the interactions that each case presents.

Critical individual barriers include neurobehavioral impairments (e.g., disinhibition, impulsivity, decreased initiation) or cognitive impairments (e.g., impaired goal setting or task monitoring, memory, attention) that are ubiquitous following ABI and can significantly affect job performance and adjustment in the workplace (Dikmen et al., 1994). Medical consequences of brain injury (e.g., posttraumatic seizures) or co-morbidities (e.g., depression or substance abuse) also represent barriers to RTW or work stability. Level of behavioral adjustment post-injury affect family adjustment (Kreutzer, Marwitz, & Kepler, 1992), which in turn influence recovery and adaptation. Further, changes in social roles typically result in increased emotional and economic burden for family members, making it even more difficult to sustain family advocacy and emotional engagement, as well as support for the family member with the brain injury (Kolakowsky-Hayner & Kishore, 1999; Kreutzer, Gervasio, & Camplair, 1994).

Social barriers include lack of reimbursement for services and the absence of brain injury expertise among the host of providers involved in the vocational rehabilitation of people with brain injury. Multiple providers (e.g., employment services and cognitive rehabilitation) do not typically collaborate, compromising the potential effectiveness of each of their interventions. Awareness of State agency resources is typically lacking, and access to these resources can be cumbersome and overwhelming. Further, States do not typically have an organized State plan for brain injury, resulting in service silos within and between State agencies with resulting service gaps.

Complicating the vocational rehabilitation process even more is the fact that, at least in moderate to severe TBI, most people will have chronic disability that is variable in type and severity over time (Corrigan & Hammond, 2013). In fact, the severity of TBI disability has been found to vary more often that it remains static in long-term follow-up studies. Further, the individual and social-environmental variables dynamically interact with each other, where, for example, a loss of a significant relationship can result in depression that, in turn, results in further impairment of memory, which then results in impaired vocational performance. On the other hand, successful cognitive rehabilitation may result in new compensatory strategies, that when integrated into the work setting, with improvement in self-efficacy, and then a better response to psychotherapy for depression. Again, brain injury vocational rehabilitation is neither medical nor vocational; it is of necessity an individualized process of eliminating or mitigating brain injury-specific and other barriers with a holistic scope.

3. Models of vocational rehabilitation for acquired brain injury

A systematic review of the literature on different types of vocational rehabilitation for people with ABI (Fadyl & McPherson, 2009) demonstrated that there have been essentially three different approaches that included a supported employment (SE) model, a "Program-based vocational rehabilitation model" often referred to as a comprehensive day treatment program (CDT) model, and a "vocational case coordination (VCC)" model. The development of SE for people with brain injury was a significant contribution to improving vocational outcome (Wehman et al., 1989; Wehman, Bricout, & Targett, 2000; Wehman et al., 2003). Wehman and colleagues modified the individual placement model for people with brain injury and there was a clear emphasis on individualized training at the work site through a job coach rather than through pre-placement training and intervention. In contrast, the CDT program provided individual and group treatment for cognitive, neurobehavioral, and psychological difficulties driven by a neuropsychological approach (Ben-Yishay, Silver, Piasetsky, & Rattock, 1987; Prigatano et al., 1994). These programs were typically provided services four or five days a week for approximately six months and included family education and training, as well as vocational trials, placement and follow-up. The first two studies on "vocational case coordination," the third approach, were completed by Malec and colleagues (Malec, Buffington, Moessner, & Degiorgio, 2000; Malec & Moessner, 2006). This approach features an individualized approach to promoting access to vocationally-related needs and ensuring integration of services to impact on vocational skills and workplace adaptation. The overall structure of these different models from Fadyl and McPherson (2009) are provided in Fig. 1.

These investigators also rated the quality of the research for each of these models to determine the relative strength of experimental support for their effectiveness. Their findings in this respect are summarized in Table 1.

The research by Malec and colleagues (2000, 2005) on VCC and the systematic review by Fadyl and McPherson (2009) provided the scientific background for the development of the RF model developed at the Rehabilitation Hospital of Indiana (RHI).

3.1. The RHI resource facilitation model

The clinical research team at RHI incorporated the findings from a best practices guide from 16 RF programs in the United States completed by the then Brain Injury Association on "Resource Facilitation" into the VCC model (Brain Injury Association, 2001). RF was defined as "a partnership that helps individuals and communities choose, get and keep information, services and supports to make informed choices and meet their goals. The collaborative process involves participants (individuals with brain injury and their personal support systems) working in partnership with facilitators (individuals who provide assistance in navigating systems) to achieve agreed upon goals" (p. 2). This guide provided information on best practices while the research on VCC provided evidence to inform the RHI RF model. Like these 16 RF programs, RHI's development of RF program began with funding in 2009 from the Health Resources and Services Administration (HRSA).

The efficacy of the RHI RF model has been investigated through two randomized controlled trials (RCT). In the first RCT (L.E. Trexler, L.C. Trexler, Malec, Klyce, & Parrott, 2010), 22 subjects with ABI were recruited either while in the acute rehabilitation unit or shortly thereafter. It was found that the RF group had a successful return to work rate of 64 percent compared to 36 percent in the control

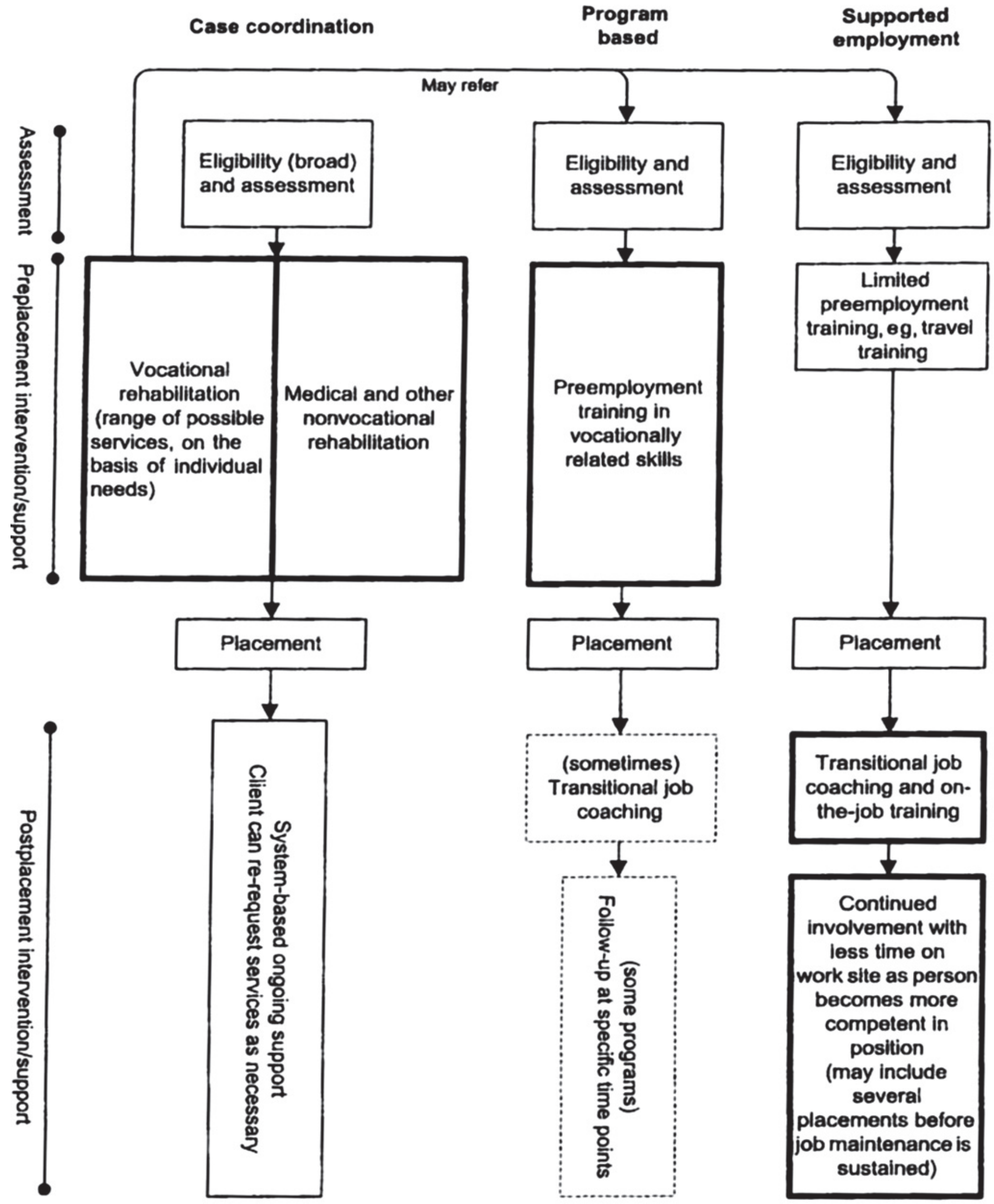

Fig. 1. Overview of the structure of three different types of vocational rehabilitation programs for brain injury (reproduced from Fadyl and McPherson, 2009 with permission).

group (Wald-Wolfkowitz $z = -3.27$, $P < 0.0001$). Further, the RF group was found to improve significantly more than the control on a measure of participation in activities at home and in the community relative to controls ($F = 9.11$, $P < 0.007$). A larger RCT of 44 subjects with ABI, again recruited while in an acute rehabilitation unit or shorter after being discharged, demonstrated that 69 percent of the RF group returned to employment compared 50 percent in the control group (Trexler, Parrott, & Malec, 2015). In addition, logistic regression analyses revealed that treatment group was a significant predictor of outcome (Wald = 4.91, $P = 0.027$), and RF participants with a goal of returning to work had 7 times higher odds of returning to productive activities relative to controls (95% confidence interval, (1.25, 39.15)). Based on these findings and the support for the efficacy of the RHI RF model, the Indiana Vocational Rehabilitation Services supported a prospective clinical cohort study to examine the effectiveness of

Table 1
Conclusions regarding the strength of the evidence for different types of vocational rehabilitation programs for brain injury

Comprehensive Day Treatment (CDT)	Supported Employment (SE)	Vocational Case Coordination (VCC)
Weak evidence for better vocational outcomes for those with TBI with CDT program	Weak evidence that SE "allows some individuals who have not been employed postinjury to be employed *specifically within the supported employment model*"	Moderate evidence that VCC "produces higher employment and productivity outcomes"
Weak evidence that that employment is maintained (approximately 50%)	Weak evidence that participants who receive SE are employed that lasts 90 days	Weak evidence that those who received VCC earlier after injury are employed earlier

RF. Further, as this trial was supported by the State Vocational Rehabilitation agency through referral of clients for RF, goals could be return to post-secondary education, although this was an infrequent goal.

4. Objectives

The overall objective of this study was to examine the effectiveness of the RHI RF program for a clinical prospective cohort of participants referred to this program from the Indiana Vocational Rehabilitation Services. Based on our previous research and previous research, we had two hypotheses that included 1) the participants in the RF prospective clinical cohort would demonstrate a significantly better rate of RTW or school, and 2) group assignment (RF versus controls) would predict outcome with baseline level of disability as a covariate.

5. Methods

5.1. Study design and population

The present study examined the vocational outcome for 243 participants (163 men and 80 women; mean age 38.59 ± 13.05 years) with data drawn from the two sources: 33 from the RCT control groups who did not receive RF and 210 from clinical patients discharged from the RHI RF program. Since the samples were from two different sources, the inclusion/exclusion criteria are different for each sample. For the control group, the inclusion criteria for the RCT was: a) TBI or diffuse encephalopathy including metabolic, infectious or toxic (but not due to alcohol abuse) encephalopathy, or intracranial hemorrhage, b) between 18–60 years old, c) English as a native language or non-native speaker with the assistance of a relative who is an English speaker or a translator, d) the individual with a brain injury had been employed at the time of injury, e) the individual had a return-to-work goal after the injury, and (f) participant or legal proxy consents to study participation. Exclusion criteria included: a) the presence of acute psychosis or the emergence of psychosis during the course of the study and b) history of treatment received for substance abuse within the preceding two years.

The obvious inclusion criteria for this clinical sample included a) a diagnosis of an acquired brain injury and b) a return to work or post-secondary school goal, or they would have not been appropriate clients of the State Vocational Rehabilitation agency. No explicit inclusion/exclusion criteria were applied to the clinical cohort sample. In general, participants who may have had an active psychosis were very likely excluded and some participants with alcohol or drug abuse to an extent to which would interfere with goal attainment were not admitted into RF. We also did not recommend RF for a few clients that had very severe physical, cognitive, and neurobehavioral impairment to an extent that the relative probability that they could become competitively and independently employed was very remote.

The duration of RF was on average nine months prior to the participant becoming competitively employed. Participants were then followed for 90 days to ensure that vocational supports were sustainable and that their employment adjustment was stable.

5.2. Measures

Return to either part- or full-time competitive work or post-secondary school was the main outcome measure, and data for the number of hours worked per week and type of work was available for 66% of the treatment sample that was successful for return to work or school. A successful outcome was recorded when the participant was able to sustain employment or return to school for the entirety of the interval between place and follow-up 90 days thereafter.

The Mayo-Portland Adaptability Inventory - 4 (MPAI-4) was designed to measure post-acute disability level in persons with brain injury (Malec, 2005). Change is MPAI-4 is also used to evaluate the effectiveness of rehabilitation programs. It consists of 28 total items and subscales measure cognitive and physical abilities, psychosocial adjustment and participation in activities at home and in the community. This measure was used as a covariate to determine if group assignment would predict employment outcome.

5.3. Statistical analyses

The present retrospective case-control study used control data from our previous RCT's as well as group data from a current clinical cohort who received RF services. Propensity scores were not utilized as the control group data were from subjects previously randomized to a control condition. However, baseline comparisons were used to ensure the groups were not statistically different from each other prior to treatment.

All analyses were completed using IBM SPSS version 24. Independent sample *t*-tests and Chi-square analyses were used to compare baseline variables between the two groups. A Chi-square analysis was used to compare the success rate in each group and logistic regression was used to predict employment status based on group assignment. Nagelkerke R^2 was used to estimate explained variance. There were no outliers, as assessed by examination of studentized residuals for values greater than three standard deviations. Effect size is reported as partial η^2. An effect size less than 0.05 was considered small; moderate, when between 0.05 and 0.25; moderately large, when between 0.25 and 0.50; and large when greater than 0.50. Significance levels were set at $p < 0.05$ and Bonferroni corrections were used to correct for multiple pairwise comparisons.

6. Results

Some very noteworthy demographic differences between the two groups were present at baseline: years post injury, age at injury, and injury type (see Table 2). As previously noted, the control group was derived from a previous RCT where subjects were recruited while in acute inpatient rehabilitation or shortly thereafter, and were a little more than two months post-injury. In marked contrast, the participants in the RF group in the present study were referred from Indiana Vocational Rehabilitation Services and were found to be, on average, over 9 years post-injury. Additionally, the age at injury for the RF group was found to be significantly younger (29.6 years) as compared to the control group which was on average 40 years old. This difference is likely attributable to significant differences between the two groups in terms of diagnosis, where there were more participants with stroke in the control group and more moderate to severe TBI subjects in the RF group.

6.1. Hypothesis 1: Success rate by group

Of the 210 participants in the treatment group, 69% ($n = 145$) were successful for return to competitive work. Six of these 145 successful outcomes were for participants that had a goal of return to school. Of the portion of the sample for which work hours and type of employment information was available, it was found that the average hours worked per week was 24.88 (sd = 10.38) and 36% of the successfully closed cases were full-time (30+ hours per week). The occupations to which they were placed are provided in Fig. 2. Almost half of the successful participants returned to either administrative support or laborer positions, but the other half were distributed across all other types of occupations. Of the 33 participants in the control group, 48% ($n = 16$) successfully returned to paid employment. This difference was significant, indicating a greater proportion of success in the treatment group than the control at the end of the treatment duration [$X^2_{(1)} = 5.39$, $p = 0.018$] (see Fig. 3).

6.2. Hypothesis 2: Treatment group predicts outcome with baseline level of disability as a covariate

The first model examined the relationship between baseline level of disability and employment. A logistic regression model was statistically significant, $\chi^2(1) = 9.92$, p = 0.002, but it should be noted that this model only explained 5.5% of the variance in productive activity and correctly classified 67.9% of the cases. Level of disability at baseline provided an exponential slope of 0.94 indicating that with every

Table 2
Patient characteristics and outcomes by group

Characteristic	Resource Facilitation ($n = 210$)	Controls ($n = 33$)	p
	Mean ± standard deviation	Mean ± standard deviation	
Age (y)	38.32 (13.28)	40.30 (11.54)	0.419
Years Post Injury	9.61 (10.30)	0.18 (0.10)	0.000
Age at Injury	29.61 (15.58)	40.30 (11.54)	0.000
Years of education	13.24 (2.21)	13.46 (2.24)	0.610
Baseline MPAI	42.36 (7.97)	43.70 (8.25)	0.373
	Frequency (%)	Frequency (%)	
Sex			
Male	142 (68%)	21 (64%)	
Female	68 (32%)	12 (36%)	0.692
Race			
White	191 (91%)	33 (100%)	
African American	16 (7.6%)		
Hispanic	3 (1.4%)		0.085
Diagnosis			
Mild TBI	2 (1%)	—	
Moderate to Severe TBI	152 (72%)	17 (52%)	
Stroke	33 (16%)	15 (46%)	
Other	23 (11%)	1 (3%)	0.001

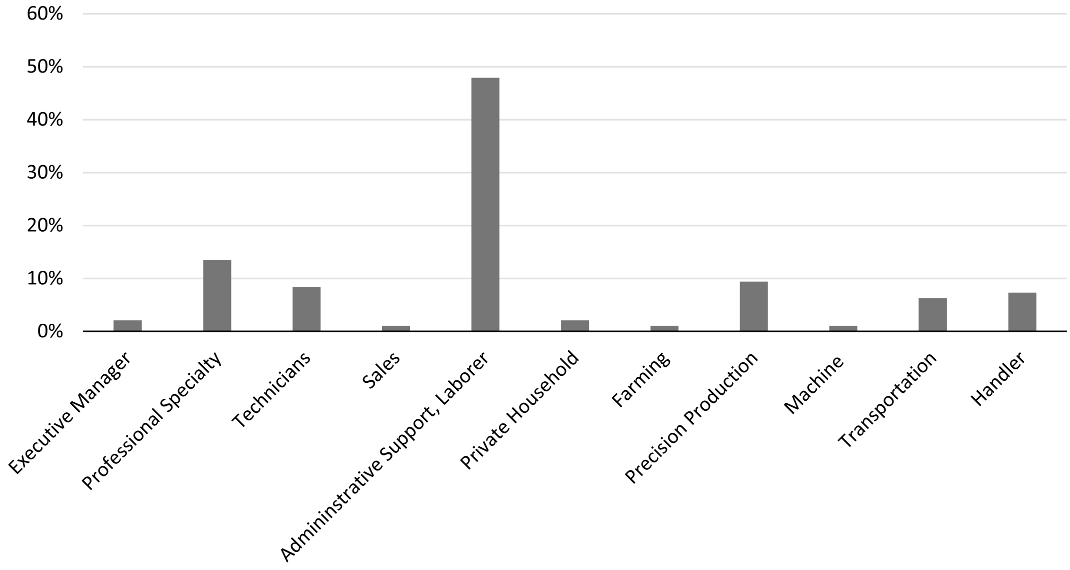

Fig. 2. Occupational categories for successfully closed cases.

one point increase in MPAI-4 T score (higher scores indicating a greater level of disability), the odds of successful employment declines by nearly one percent (Wald = 9.06, $p = .003$) (See Fig. 4).

Adding treatment group to the model and leaving level of disability as a covariate increased the models significance and improved the odds of successful employment for those in the treatment group. This model was also statistically significant, $\chi^2(2) = 14.41$, p = 0.001 and explained 8% of the variance in productive activity and correctly classified

Fig. 3. Employment Rates for RF and Control Groups.

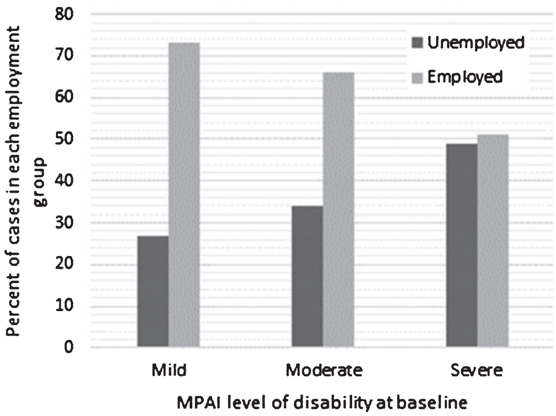

Fig. 4. Outcome by Initial Level of Disability.

Table 3
Summary of logistic regression analysis predicting employment

Variable	*B*	SE	Wald Statistic	*p*
Treatment Group	–0.824	0.388	4.52	0.033
Disability	–0.056	0.019	8.51	0.004

67.1% of the cases. When controlling for baseline level of disability, treatment group significantly predicted employment outcome (Wald = 4.52, $p = 0.033$) and participants in the treatment group were 2.3 times more likely to return to work than controls.

7. Conclusions

In conclusion, participants receiving RF had a higher employment rate than participants in past control groups. In fact, participants in the treatment group were over two times more likely to return to work than the control group when controlling for level of disability. As demonstrated by previous research, successful vocational outcome varied as a function of level of disability as measured by the MPAI-4, where 74% of participants with mild disability, 65% of participants with moderate disability, and 48% of participants with severe disability were successful with obtaining employment through RF. Further, the participants in RF were almost ten years post-injury as compared to the control group, which was slightly over two months post-injury. Additionally, the RTW rate of 69% for the RF cohort is considerably better than what the literature would suggest for people of ABI of approximately 40% for all levels of disability. The findings from the present study are also consistent with the RTW rates we found in our two previous RCT's. The present findings provide some initial support for the clinical effectiveness of RF for a sample referred by the Indiana Vocational Rehabilitation Services.

However, the present study has several limitations. Specifically, the sampling method in this study is not traditional, and although our control group was randomized into the control condition, our treatment group was not, therefore potentially adding bias to our study. In addition, some significant differences between the groups at baseline could confound some of the outcome variables, specifically time since injury, age at injury, as well as diagnosis. However, this sample is more representative of a clinical population seen in a State Vocational Rehabilitation agency, and likely better represents an otherwise ignored sector of the population previously underrepresented in clinical trials. Therefore, these findings support the transition from the established RF efficacy into clinical effectiveness.

The present study took place over different economic epochs, which could serve to influence RTW. The recession occurred from 2007 through 2011. Control group data was collected between 2008 and 2013, while data from the treatment group was collected between 2009 and 2012. Therefore, a larger proportion of data collection took place during the recession for the treatment group than the control groups. Therefore, it would seem unlikely that the changes in the economy served as a positive bias for RTW for the treatment group.

Although this study successfully demonstrates the effectiveness of RF, additional established predictors of employment success should be taken into account. For example, Cuthbert and colleagues found that age, race, gender, marital status, rehabilitation payment source, education, pre-injury work status, length of stay, and the disability rating scale (DRS) were significant predictors of employment two years post injury (Cuthbert et al., 2015). Due to our sampling methods, we were unable to use well-known predictors of outcome in our statistical analyses. This exclusion of key predictors likely led to the small effect size of our prediction model. Also, future studies in RF need to consider relationship between pre-injury rates of employment and post-RF employment and study change in occupational type from pre-injury to post-injury. Last, we were not able to evaluate durability or stability of employment for more than 90 days, and given that the disability associated with these injuries was likely chronic, and for some, the level of disability might get worse. This would therefore suggest a need for long-term surveillance to proactively monitor vocational adjustment and stability.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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Cost Savings to the State of Oregon due to Resource Facilitation for Individuals with Traumatic Brain Injury

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Introduction

This report examines potential cost savings to the state of Oregon if it implemented a state-wide brain injury resource facilitation program to support people with brain injury, including traumatic brain injury (TBI), and their families. In this context, resource facilitation is a system where trained navigators provide critical information concerning available services and supports to brain injury survivors and their family members.

Most calculations are based on program data for Iowa assembled by Geoffrey Lauer, Chief Executive Officer of the Brain Injury Alliance of Iowa. Iowa has an established resource facilitation program in place, which currently serves about 1,000 people per year. Oregon's population is 35 percent higher (Iowa: 3.1 million; Oregon: 4.2 million) implying that a similar program could enroll about 1,350 people with TBI annually.

I focus on four sources of cost savings that resource facilitation can create: savings due to (i) a shift from institutionalized care to home- and community-based services, (ii) a reduction in psychiatric inpatient stays, (iii) a reduction in the number of people enrolled in Medicaid, and (iv) a reduction in the number of people in jail. While high-quality, peer-review evidence on most of these channels is currently lacking, calculations using Iowa's program data and plausible assumptions suggest significant potential for resource facilitation to reduce state expenditures. Specifically, estimated annual savings are:

- Shift towards home- and community-based services: $267,799 annually.
- Avoidance of psychiatric inpatient stays: $70,000 annually.
- Reduction in the number of Medicaid enrollees: $18,935 annually.
- Reduction in the number of people in jail: $20,250 annually.

Longer-term cost savings could be of a magnitude higher. For instance, the 10-year discounted cost savings for a scenario where enrollment gradually increases to

1,350 program participants within five years of program initiation are estimated to be $3,600,916 under the assumption that annual cost savings per person with TBI do not extend over several years. Assuming further that costs savings for people with TBI who switch to home- and community-based services because of resource facilitation extend to an average of 10 years, would yield to even higher cost savings: the 10-year discounted costs savings for the same gradual enrollment scenario are estimated to be $13,987,407 in this case.

Source #1: Shift from institutionalized care to home- and community-based services (HCBS)

Context: People who require medical services provided in an institutional setting may alternatively receive home- and community-based services (HCBS). Providing home-and community-based services instead of institutional care has the potential of delivering substantial cost savings to the state: HCBS waivers are required to be cost neutral (i.e., not to exceed the state estimated expenditures for comparable levels of institutional care), and states that had non-institutional care programs experienced lower spending growth than states that did not have such programs in place (Kaye et al., 2009; Kitchener et al., 2006). However, not all people who could receive HCBS may know about this option. Resource facilitation has the potential to increase the number of people with TBI on HCBS by providing information and guidance.

Potential cost savings per person: There exists little evidence regarding potential cost savings due to HCBS. The most comprehensive study calculated average waiver and institutional costs by state and reported a potential cost savings of $164,193 per person and year for Oregon (Harrington et al., 2011). I estimate that the state of Oregon pays about 23.3 percent of average Medicaid costs (see Appendix for details), which implies that the state could save $38,257 annually per person switching from institutional care to HCBS.

Potential number of people affected: To my best knowledge, there are no studies examining the effect of resource facilitation on the number of people receiving HCBS. Iowa program data suggests that resource facilitation could avoid 7 institutional care cases per 1,000 people served.

Potential overall cost savings: Resources facilitation would reduce state expenditures by $267,799 annually under these assumptions.

Source #2: Psychiatric inpatient stays avoidance

Context: An analysis provided by the Oregon State Hospital showed that 188 out of 3,206 patients served at the hospital between January 1, 2016 and May 8, 2019, or 5.9 percent, had TBI as a primary diagnosis. This includes patients with a new TBI diagnosis and patients who were previously diagnosed with TBI. Resource facilitation could lower the number of people with TBI admitted to the state hospital by facilitating better care or better care coordination.

Potential cost savings per case: The average hospital expenses per inpatient day was $4,062 in Oregon in 2017.[1] A recent article in the Oregonian reported inpatient costs in the amount of $1,324 per day and patient, but did not mention whether these are costs to the state or overall costs.[2] In what follows, I conservatively assume that an inpatient stay costs the state on average $1,000 per day and patient.

Potential number of avoided cases: To my best knowledge, there are no studies examining the effect of resource facilitation on psychiatric inpatient stays. Iowa program data suggests that resource facilitation could avoid 7 stays per 1,000 people served, with each stay being on average 10 days long.

Potential overall cost savings: Resource facilitation could reduce state expenditures by a total of $70,000 annually under these assumptions.

Source #3: Reduction in the number of people enrolled in Medicaid

Context: Oregon currently covers about 850,000 people through its Medicaid program.[3] The state expanded its program with the Patient Protection and Affordable Care Act in 2014. Since then, all adults with income below 138 percent of the poverty level are eligible for Medicaid. Currently, 94 percent of Oregonians are insured.[4] People with TBI who were previously not enrolled in Medicaid might enroll in the program because they are unable to find work after their injury. Resource facilitation could support re-employment and therefore could reduce the number of people with TBI enrolled in Medicaid.

[1] https://www.kff.org/health-costs/state-indicator/expenses-per-inpatient-day-by-ownership/
[2] https://www.oregonlive.com/pacific-northwest-news/2019/05/oregon-mental-hospital-is-worlds-most-expensive-homeless-shelter-state-health-director-says.html
[3] https://www.medicaid.gov/medicaid/program-information/medicaid-and-chip-enrollment-data/report-highlights/index.html
[4] Author's calculations using the American Community Survey.

Potential cost savings per case: Average Medicaid expenditures for people with disabilities were $16,252 in Oregon in 2014.[5] Using this number as a proxy for Medicaid costs for people with TBI, and assuming an average state matching rate of 23.3 percent (own calculations; see Appendix for details), implies that the state pays on average $3,787 per Medicaid beneficiary with TBI.

Potential number of people affected: There exists clear evidence from peer-reviewed journal articles that resource facilitation has a positive effect on employment. In two randomized control trials taking place in Indiana, Trexler and colleagues have shown that resource facilitation increases employment rates of people with TBI by about 25 percent – a substantial program effect (Trexler et al., 2010, 2016).

Assuming that people with TBI are equally likely to be on Medicaid compared to the general population implies that 200 out of 1,000 cases of people with TBI are enrolled in Medicaid. Of these, 50 would be able to find a job due to resource facilitation if the employment effect of resource facilitation was 25 percent. Assuming further that one in five of them leave the program due to having found employment implies that 10 out of 1,000 people with TBI served by resource facilitation would leave Medicaid rolls due to employment.

Resource facilitation could also increase enrollment in Medicaid by encouraging some people with TBI to enroll in the program. In 2017, about 6 percent of people living in Oregon reported not having insurance.[6] Of these, 35 percent had an income below 138 percent of the poverty level. Applying the same numbers to people with TBI implies that about 20 out of 1,000 cases do not have insurance and could qualify for Medicaid based on their income. Assuming further that the program caused 25 percent of them to gain insurance implies that 5 people per 1,000 cases gain Medicaid insurance through resource facilitation.

Taken together, the net decrease in Medicaid enrollment due to resource facilitation is estimated to be 5 per year.

Potential cost savings: Resource facilitation would reduce state expenditures by $18,935 annually under these assumptions.

Source #4: Reduction in the number of people in jail

Context: Incarcerated people have a much higher prevalence of traumatic brain injuries (Farrer and Hedges, 2011; Slaughter et al., 2003; CDC, 2007). Resource facilitation could lower jail rates among people with TBI by providing resources and support.

[5] Conversation with Geoffrey Lauer and https://www.kff.org/medicaid/state-indicator/medicaid-spending-per-enrollee/

[6] Author's calculations using the American Community Survey.

Potential costs savings per avoided jail stay: I assume that jail stays cost the state $45 per person and day. This number is conservatively based on a study that reports costs of $85 per jail day for Kansas.[7]

Potential number of jail days avoided: Iowa program data suggests that resource facilitation avoids 18 jail stays, with an average length of 25 days.

Potential cost savings: Resource facilitation could reduce state expenditures by $20,250 annually under these assumptions.

Long-term cost savings

In this section, I report estimated cumulative 10-year savings per 1,000 people served by resource facilitation, as well as estimated 10-year cumulative savings under a scenario where program participation first increases before reaching a stable level. Table 1 shows total cumulative cost savings across all cost savings domains by scenario and year, and Table 2 shows cumulative discounted cost savings for the scenario with gradual enrollment and each of the cost savings domains. Discounted cumulative cost savings express future savings as present value using a discount rate, assumed to be 4 percent annually.

Table 1: Total cumulative cost savings by year

	Scenario: per 1,000 enrollees		Scenario: gradual enrollment increase		
Year	Cumulative undiscounted	Cumulative discounted	Enrollment	Cumulative undiscounted	Cumulative discounted
1	376,984	376,984	500	188,492	188,492
2	753,968	739,469	800	490,079	478,480
3	1,130,952	1,088,012	1,000	867,063	827,023
4	1,507,936	1,423,149	1,200	1,319,444	1,229,187
5	1,884,920	1,745,396	1,350	1,828,372	1,664,222
6	2,261,904	2,055,250	1,350	2,337,301	2,082,524
7	2,638,888	2,353,186	1,350	2,846,229	2,484,737
8	3,015,872	2,639,663	1,350	3,355,158	2,871,481
9	3,392,856	2,915,121	1,350	3,864,086	3,243,350
10	3,769,840	3,179,985	1,350	4,373,014	3,600,916

Total annual cost savings across all four domains described above is estimated to be $376,984. Cumulative 10-year cost savings if 1,000 people were served each year thus

[7] https://storage.googleapis.com/vera-web-assets/downloads/Publications/the-price-of-jails-measuring-the-taxpayer-cost-of-local-incarceration/legacy_downloads/price-of-jails-summary.pdf

Table 2: Cumulative cost savings by domain and year

Year	HCBS	Inpatient stays	Medicaid disenrollment	Jail avoidance
1	133,900	35,000	9,468	10,125
2	339,899	88,846	24,033	25,702
3	587,494	153,565	41,539	44,424
4	873,181	228,241	61,739	66,027
5	1,182,217	309,020	83,590	89,395
6	1,479,367	386,692	104,600	111,864
7	1,765,089	461,377	124,802	133,470
8	2,039,821	533,189	144,228	154,244
9	2,303,986	602,239	162,906	174,219
10	2,557,991	668,634	180,865	193,426

amount to $3,769,840. The corresponding discounted cumulative 10-year cost savings are $3,179,985. In a scenario where enrollment in resource facilitation starts at a lower level, increases during the first program years, and then reaches a plateau comparable of that found in Iowa (taking differences in population into account), cumulative 10-year cost savings are estimated to be $4,373,014 (undiscounted) and $3,600,916 (discounted), respectively. Cost savings due to a shift from institutionalized care to HCBS account for more than two-thirds of the total cost savings, followed by cost savings due to a reduction in inpatient stays, jail avoidance and, finally, Medicaid disenrollment.

The calculations thus far assume that resource facilitation only reduces costs during the year it is provided to people with TBI. This assumption seems not very realistic for some of the domains. Specifically, patients who switch to HCBS instead of using institutionalized care due to resource facilitation likely remain in HCBS for several years. As a result, the initial resource facilitation leads to further cost savings for the same patient during subsequent years.

As an alternative scenario, I assume that cost savings from HCBS extend to an average of 10 years. Under this assumption, cost savings from resource facilitation increase dramatically over time (Tables 3 and 4). The 10-year cumulative cost savings are estimated to be $13,907,945 (1,000 people served each year, undiscounted), $11,182,550 (1,000 people served each year, discounted), $17,609,936 (gradually roll-out, undiscounted), and $13,987,407 (gradually roll-out, discounted). The Appendix describes these calculations in further detail.

Table 3: Total cumulative cost savings by year, longer HCBS stays

	Scenario: per 1,000 enrollees		Scenario: gradual enrollment increase		
Year	Cumulative undiscounted	Cumulative discounted	Enrollment	Cumulative undiscounted	Cumulative discounted
1	376,984	376,984	500	188,492	188,492
2	1,021,767	996,968	800	704,318	684,479
3	1,934,349	1,840,701	1,000	1,616,900	1,528,212
4	3,076,473	2,856,045	1,200	2,987,449	2,746,625
5	4,448,139	4,028,551	1,350	4,839,198	4,329,508
6	6,011,090	5,313,183	1,350	6,949,182	6,063,761
7	7,765,326	6,699,581	1,350	9,317,401	7,935,399
8	9,672,590	8,148,945	1,350	11,892,207	9,892,040
9	11,732,882	9,654,380	1,350	14,673,601	11,924,377
10	13,907,945	11,182,550	1,350	17,609,936	13,987,407

Table 4: Cumulative cost savings by domain and year, longer HCBS stays

Year	HCBS	Inpatient stays	Medicaid disenrollment	Jail avoidance
1	133,900	35,000	9,468	10,125
2	545,898	88,846	24,033	25,702
3	1,288,684	153,565	41,539	44,424
4	2,390,618	228,241	61,739	66,027
5	3,847,503	309,020	83,590	89,395
6	5,460,604	386,692	104,600	111,864
7	7,215,750	461,377	124,802	133,470
8	9,060,379	533,189	144,228	154,244
9	10,985,013	602,239	162,906	174,219
10	12,944,482	668,634	180,865	193,426

Conclusions

The calculations presented here suggest potentially substantial cost savings of a brain injury resource facilitation program in Oregon. Most of these cost savings would come from redirecting people with TBI away from high-cost services to lower-cost services.

There are a number of reasons why actual cost savings might differ from the ones presented here. Brain injury resource facilitation may yield other possible cost savings or revenue increases to the state that are not included in this report, such as an increase in the income tax or a reduction in prison stays. Conversely, brain injury resource facilitation could increase program utilization, which in turn could imply higher costs to the state. Finally, most calculations presented in this report are based on program data from Iowa, and these might not translate exactly to Oregon.

The cost savings calculations presented here do not include all benefits of a brain injury resource facilitation program. For instance, better return to work prospects may lead to better social relationships. Similarly, brain injury resource facilitation could improve care for chronic conditions or lower homelessness rates, which could increase quality of life among people with TBI. Such benefits of brain injury resource facilitation often go hand in hand with cost reductions, if, for instance, better care coordination implies fewer visits to hospitals, but in some instances, they may imply higher costs through higher service utilization.

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Appendix

There are three federal matching rates relevant for Oregon's Medicaid program:[8]

- The traditional matching rate: The rate is 61.23 percent in Oregon for the 2020 fiscal year.[9]
- The newly-eligible matching rate: The federal matching rate is 90 percent starting 2020.
- The Children's Health Insurance Program (CHIP) matching rate: The rate is 84.36 percent in Oregon for the fiscal year.[10]

The number of newly eligible Medicaid recipients due to the ACA was estimated to be about 550,000 when 964,000 people were enrolled in the program in 2018.[11] KFF reported that about 850,000 people were enrolled in Medicaid in February 2019, and about 125,000 children enrolled in CHIP, for a total of about 975,000.[12] Based on these numbers, it is reasonable to assume that about half of the adult Medicaid population in Oregon is enrolled through the ACA. This implies the following fractions: 43.6 percent traditional Medicaid enrollees; 43.6 percent newly eligible Medicaid enrollees; and 12.8 percent CHIP enrollees. Applying the matching rates to these fractions implies a weighted average matching rate of 0.767 ($0.436 \cdot 0.6123 + 0.436 \cdot 0.9 + 0.128 \cdot 0.8436 = 0.767$), which in turn implies that the state of Oregon pays 23.3 percent of Medicaid and CHIP expenditures.

I assume that for a cohort of 7 people with TBI who switch to HCBS because of resource facilitation:

- One person stays on the program for three years;
- One person stays on the program for six years;
- One person stays on the program for eight years;
- One person stays on the program for 10 years;
- One person stays on the program for 12 years;

[8] https://www.kff.org/medicaid/issue-brief/understanding-how-states-access-the-aca-enhanced-medicaid-match-rates/

[9] https://www.kff.org/medicaid/issue-brief/understanding-how-states-access-the-aca-enhanced-medicaid-match-rates/

[10] https://www.kff.org/other/state-indicator/enhanced-federal-matching-rate-chip/

[11] https://www.healthinsurance.org/oregon-medicaid/

[12] https://www.medicaid.gov/medicaid/program-information/medicaid-and-chip-enrollment-data/report-highlights/index.html

- One person stays on the program for 14 years; and
- One person stays on the program for 17 years.

The average HCBS program duration is thus 10 years. I further assume that these people would not have switched to HCBS in the absence of resource facilitation during the 10-year period.

Based on these assumptions, the number of people with TBI who switched to HCBS due to resource facilitation is:

- 7 during the first program year;
- 14 during the second program year;
- 21 during the third program year;
- 27 during the fourth program year;
- 33 during the fifth program year;
- 38 during the sixth program year;
- 43 during the seventh program year;
- 47 during the eighth program year;
- 51 during the ninth program year;
- 54 during the tenth program year.

The results shown in Tables 3 and 4 then follow from using these numbers for HCBS cost savings.

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Economic Impact of Resource Facilitation: Workforce Re-entry Following Traumatic Brain Injury

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Introduction

This research note presents the economic impact of Resource Facilitation (RF) on traumatic brain injury (TBI) patients in Indiana. We focus on the ability of RF to enable patients with a TBI-related disability to reenter the workforce. Using estimates for the impact of RF on the workforce, we then proceed to estimate the potential dollar-impact of RF on wages, fringe benefits, payroll and income taxes, and disability insurance.

Estimation Methods

Job loss due to disability following TBI is not uncommon and is economically costly due to lost wages and workplace productivity. Additional costs such as potential public and private disability insurance payments also accrue TBI related accidents. . A major benefit of RF is the patients' return-to-work, with one study showing that patients treated with RF were 73% more likely to return to work than were patients undergoing standard treatments (Trexler, Parrott and Malec 2016).Here, we attempt to place a dollar value on the economic benefits of RF resulting from this increased return to the workforce.

Research on the number of TBI-related disabilities that are incurred each year is relatively sparse, and the literature doesn't contain an accurate estimate for Indiana. Therefore, we attempt to produce our own estimates of TBI-related disability prevalence in Indiana. We then use these disability estimates to determine the potential economic impact of RF. The first method seeks to estimate the annual incursion of TBI-related disability, while the second method seeks to estimate the aggregate pool of persons disabled by TBI, regardless of when their TBI occurred. In each case, we estimate the number of persons in each of various age groups with a TBI-related disability, use this number to estimate the number of additional persons that would return to work with RF treatment, and then estimate the expected wages, taxes, etc., for these potentially returned workers.

Tables 1 and 2 contain the results of each method. Table 1 shows the approximate age breakdown of TBI-related disabilities, and Table 2 details the estimated economic impact under each method.

Annual Incidence Estimate:

To estimate the annual incidence, we modify the methodology that was used in a previous research note to estimate the number of new cases of TBI-disability per year (Reid, McGeary and Hicks 2011).For this estimate, we use national annual TBI hospitalization incidence of 2.5 million cases from the CDC for 2015 (Centers for Disease Control and Prevention 2015). Based on population weights, we then estimate the number of TBI-related hospitalizations in Indiana to be 2,472 incidence per year. Based on the Selassie, Zaloshnja, Langlois et al. (2008) study, we distribute the 2,472 patients into different age categories. We then estimate the number of new TBI-disabilities incurred each year using the conditional probabilities of disability given hospitalization due to TBI observed (Selassie, et al. 2008). See Table 1, for the distribution of new TBI hospitalization incidence leading to disability by age group.

Using these TBI-disability incidence estimates, we now estimate the potential economic annual impacts of RF treatment on newly TBI-disabled patients. Since we are estimating the effects on those in the labor force, for each age group, we apply the labor force participation rates from Bureau of Labor Statistics to estimate the number of TBI-disability patients who were potentially employed prior to the TBI. The Trexler, Parrott and Malec (2016) study shows the probability of return-to-work with RF for TBI patients was 69%. From the existing literature, they found that the return-to-work probability without RF treatment for TBI patients was 40%. We apply these estimates on the TBI-disability estimates by age group for Indiana. The marginal impact of RF return to work is the number of potential patients returning to work after RF treatment minus the number of patients returning to work without RF treatment. We then estimate this marginal employment impact of RF return to work by age group. We find that 266 patients would additionally benefit from RF treatment by returning to work [i.e., they would not have returned to work without the RF treatment].

We now apply average wages by age group on the RF estimates to find the additional wages of marginal patients who received RF treatment and returned to work, who otherwise would not have returned to work without the treatment. We also estimate the potential fringe benefits of 45.77% that patients who now work would receive (BLS, 2016); payroll taxes of 15.3% for social security and Medicare (SSA, 2017); Federal income tax of 21% (IRS, 2016); and Indiana state tax of 3.3% (Flat tax, 2016).

We also estimate the potential Social Security Disability Insurance (SSDI) savings to the government due to patients returning to work after treatment. Since 30% of workers are covered under short-term disability through work that covers about 70% of wages, we also estimate the additional impact on private disability insurance after deducting the wages that they would have got from SSDI (National Compensation Survey: Employee Benefits in Private Industry in the United States, U.S. Department of Labor, Bureau of Labor Statistics, March 2006). Finally, we attempt to estimate the potential Supplemental Nutrition Assistance Program (SNAP) savings from 30% (assumed) of patients who returned to work after RF treatment and stopped participation in SNAP as a result. We also use the average SNAP household benefit in Indiana of $3,060 for our analysis (IN SNAP, 2016)

The economic impact on wages and benefits alone is estimated to be approximately $17.27 million. The revenues from taxes is about $2.15 million dollars. The potential savings from SSDI is $2.84 million and for private disability insurance is $1.5 million. The potential SNAP savings is about $0.24 million. The findings of this method are shown in Table 2.

Aggregate Lifetime Estimate:

The previous method (annual incidence estimate) accounts for the impact of RF on a single cohort of patients, for a single year. Disabled patients who return to work after RF are likely to continue working beyond a single year period. The cumulative annual effect of RF might be better represented by applying an impact analysis to the pool of all TBI-disabled persons rather than the annual incidence of TBI-disability. In 2015, the CDC reported an estimated pool of 3.2 to 5.3 million persons living with a TBI-related disability (Centers for Disease Control and Prevention 2015). Using the lower bound of this estimate, Indiana's share of the disabled pool is approximately 66,410 persons. See Table 1 last column for cumulative distribution by age group. Using annual TBI incidence by age group (calculated as in the previous method) and CDC mortality estimates by age group, adjusted to reflect increased mortality due to TBI, we simulate a stable state of the disabled population by age group. We then apply our economic impact estimates to the entire pool of TBI-disabled persons to determine the potential long-term impact of RF treatment.

Assuming that all persons in the pool underwent RF as part of a post-TBI treatment, around 7,255 additional persons would return to work, who would otherwise not have returned to work had they not received RF treatment. Accounting for the fact that disabled persons are likely to take a lower-paying job when they return to work, we attempt to provide a lower-bound estimate by assuming that disabled workers would have approximately half the earning power of the average individual. Under this assumption, the estimated annual impact of RF in Indiana is approximately $249.1 million in wages and benefits, $30.97 million in taxes, savings of $80.1 million in reduced disability insurance benefit payments and $6.6 million in SNAP impact. The detailed findings are shown in the last column of Table 2.

The results of the aggregate estimate are more indicative of the long-term annual impact of RF. While it may not be possible to provide retroactive RF for every patient who has ever suffered a TBI-disability, we can view the assumed impact of RF on the entire disabled pool as the potential cumulative annual economic impact of RF if it had historically been administered to all new TBI-disabled patients. Similarly, this cumulative impact demonstrates the potential annual impact of RF treatment after several years of application to new TBI patients.

Table 1: TBI-Related Disabilities per Age Group

	New Incidence	Cumulative Incidence
0 to 4	29	177
5 to 9	29	336
10 to 14	29	480
15 to 19	108	1,082
20 to 24	114	1,657
25 to 34	169	4,520
35 to 44	195	5,743
45 to 54	240	7,081
55 to 64	215	7,582
65 to 74	342	8,525
75+	1,002	29,227
Total	**2,472**	**66,410**

Table 2: Estimated Economic Impacts Attributable to RF

	New Incidence	Aggregate Lifetime Estimate
Employment	**266**	**7,255**
Wages	$ 11,844,570	**$ 170,875,856**
Fringe Benefits	$ 5,421,260	**$ 78,209,879**
Payroll Tax	$ 829,453	**$ 11,966,111**
Income Tax	$ 1,317,366	**$ 19,005,001**
Federal	$ 1,138,465	$ 16,424,075
State	$ 178,902	$ 2,580,926
Disability Insurance	$ 4,339,316	**$ 80,134,992**
Social Security	$ 2,837,856	$ 80,134,992
Private	$ 1,501,460	(Policy-Specific)
SNAP	$ 244,188	**$ 6,660,090**

Summary

In this research note, we estimate the marginal economic impact of RF treatment by estimating the potential TBI-disabled patients that would return to work after receiving the treatment, who otherwise would not return to work had they not received the treatment. We estimate the impact based on annual incidence and aggregate lifetime incidence. Table 2 summarizes the economic impact of both methods.

To illustrate the potential long-term impact of RF, let us assume that an average-earning 25-year-old suffers from a post-TBI disability. We assume also that this individual had private long-term disability insurance that covers 50% of lost wages until age 65, and that he is one of the patients who is able to return to work after RF treatment, but otherwise would not return to work at all. Assuming that he continues to earn average wages, benefits, etc., until retirement (age 65), the nominal career-total impact of his return to work total at approximately $2.94 million in wages and benefits, $0.80 million in state and federal taxes, $0.69 million in Social Security Disability Insurance payments, and $0.66 million in private disability insurance impact. These impacts are detailed in Table 3.

Table 3: Career Impact of RF for a 25-Year-Old TBI Patient

	RF Impact
Wages	**$ 2,019,270**
Fringe Benefits	**$ 924,220**
Payroll Tax	**$ 308,948**
Income Tax	**$ 490,683**
Federal	$ 424,047
State	$ 66,636
Disability Insurance	**$ 1,354,035**
Social Security	$ 688,800
Private	$ 665,235

Additional Impact

Our estimated economic impacts consider only the benefits related to gainful employment and are very conservative because we do not include the induced effects of those patients receiving the wages i.e., the household spending on goods and services would stimulate the economy. We also do not include potential unemployment benefits payments that would have been avoided for some patients. We do not include the potential re-admission hospital costs to Medicare/Medicaid of such patients. Many RF patients who do not return to work volunteer in the community in lieu of work (Trexler, Parrott and Malec 2016). The economic benefits from this unpaid community involvement are not considered here, but likely have both economic impact to the community, and quality-of-life improvement for the patient. Further investigation into this particular RF outcome is encouraged.

Further, in Indiana in 2012, there were 191 total Medicaid waivers related to TBI, for a total of approximately $4.5 million in benefits. Even if we assume the TBI waiver population is uniformly distributed among the TBI population, RF could mitigate a portion of the waivers expenditure, resulting in a cumulative annual economic benefit of at most $2.3 million.

The study comes with certain limitations as well. Quality state-level TBI data does not exist or is not readily available. Recent estimates of the annual incursion of TBI-related disabilities are not available. The impact of TBI-disability on future earning potential is unclear. In each of these cases, we have used simplifying assumptions to estimate these values based on other less detailed data. More detailed data would allow several assumptions to be removed from our calculations, thereby improving the accuracy of our estimates.

Applying RF treatment to the entire cohort of patients with a TBI-disability every year may not be feasible. The differential impact of RF on return-to-work is estimated to be about 29%. Approximately 40% of TBI-disabled patients would reenter the workforce without RF, while another 31% will fail to return to work even with RF treatment. This implies that the economic impact of RF is concentrated among a subset of the total TBI-disabled population. Table 4 demonstrates that wages are concentrated among the better educated, and to a lesser extent, the male populations. If treating all TBI-disabled patients is not feasible, using simple classification tools such as Table 4 along with the patient's expected remaining working years could help identify patients with the greatest potential for economic impact due to RF. Further research could be conducted to better identify the patients who would only return to work with the assistance provided by RF treatment.

Table 4: Median Earnings by Education Level and Gender

	Total	Male	Female
Less than high school graduate	$20,361	$23,668	$15,510
High school graduate (includes equivalency)	$28,043	$33,235	$22,345
Some college or associate's degree	$33,820	$41,407	$28,285
Bachelor's degree	$50,595	$61,589	$41,763
Graduate or professional degree	$66,857	$84,006	$56,181
Total	$36,231	$42,106	$30,602

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Centers for Disease Control and Prevention. 2015. "Report to Congress on Traumatic Brain Injury in the United States: Epidemiology and Rehabilitation." Atlanta, GA: National Center for Injury Prevention and Control; Division of Unintentional Injury Prevention.

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Selassie, Anbesaw W., Eduard Zaloshnja, Jean A. Langlois, Ted Miller, Paul Jones, and Claudia Steiner. 2008. "Incidence of Long-term Disability Following Traumatic Brain Injury Hospitalization, United States, 2003." *The Journal of head trauma rehabilitation 23.2* 123-131.

Trexler, Lance E., Devan R. Parrott, and James F. Malec. 2016. "Replication of a Prospective Randomized Controlled Trial of Resource Facilitation to Improve Return to Work and School After Brain Injury." *Archives of Physical Medicine and Rehabilitation 97.2* 204-210.

Calculation Data Sources

Centers for Disease Control and Prevention – 2007 Worktable 23R, mortality by 10-year age groups

2015 Report to Congress (listed as a reference) – annual TBI cases, TBI hospitalization chance

American Community Survey – 2015 United States population, 2015 Indiana population

Selassie (from references) – TBI hospitalization age distributions, disability probabilities by age group

Bureau of Labor Statistics – 2014 labor force participation rates by age group

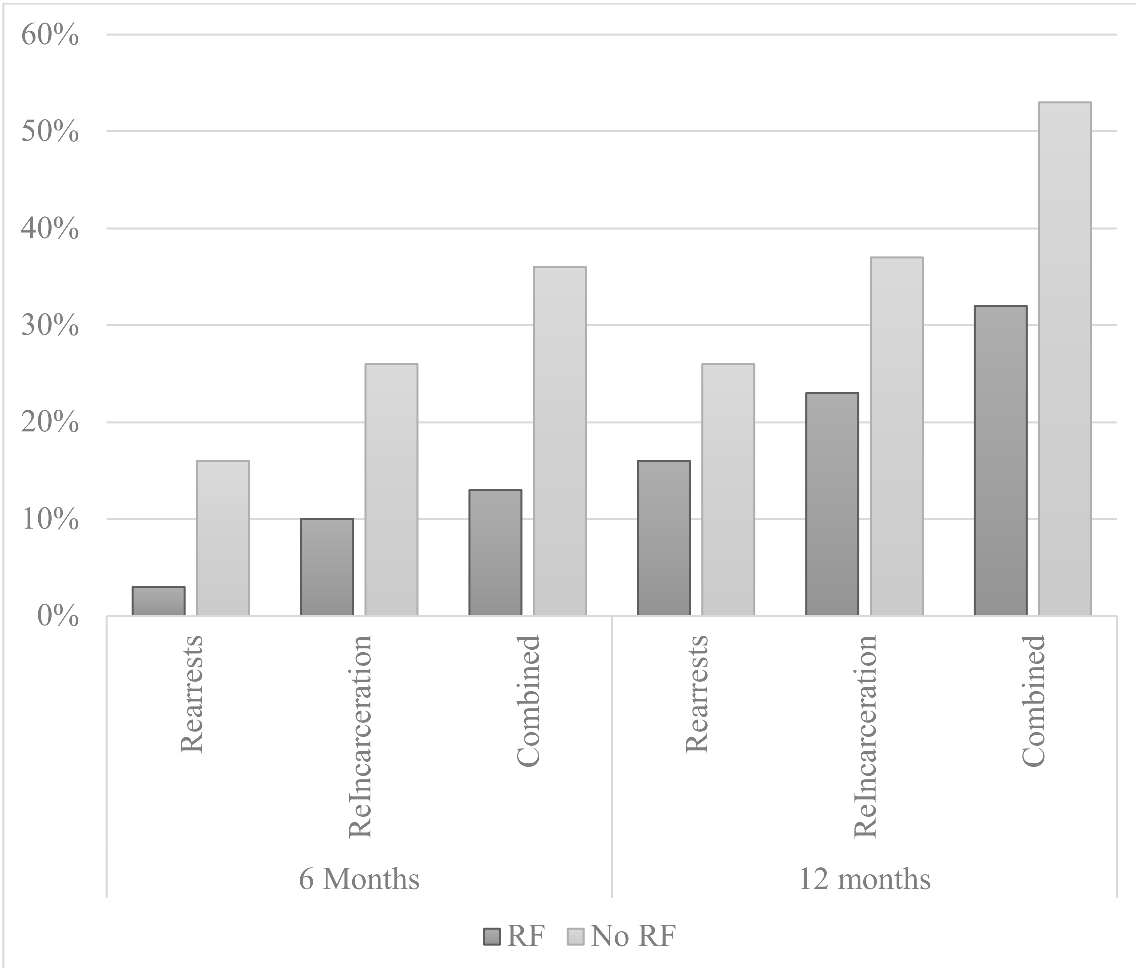
Quarterly Workforce Indicators – average 2015 monthly wage by age group (all quarters)

Social Security Administration – 2017 Payroll Tax Rate

Internal Revenue Service – Average 2016 Federal Income Tax Rate

IN Tax Code – 2016 Flat Income Tax Rate

Figure 1. Six and Twelve Month Measures of Recidivism for RF Treatment Group vs. Non-RF Comparison Group



Note: Resource Facilitation (RF)

This graph is from Dr. Trexler's 2020 study of recidivism rates when brain-injured inmates received brain injury resource facilitation post-release. As demonstrated in the graph, brain injury resource facilitation significantly reduces the recidivism rate among this group of brain-injured individuals resulting in enhanced quality of life for the individual, enhanced community benefit, and reduced cost to the Department of Corrections.

Trexler, L. (2020). Figure 1. Six and twelve month measures of recidivism for RF treatment group vs. non-RF comparison group. Unpublished manuscript.