

Evidence Review

Segmented Rehabilitation: A Rapid Review

Rapid review of inpatient and outpatient rehabilitation models of care which focus on vocational or independent living outcomes for people after mild to moderate acquired brain injury.

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The content of this report may not involve an exhaustive analysis of all existing evidence in the relevant field, nor does it provide definitive answers to the issues it addresses. Reviews are current at the time of publication, April 2013. Significant new research evidence may become available at any time.

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Accompanying documents to this report

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Executive Summary

In early 2013 the Victorian Transport Accident Commission (TAC) commissioned a review of evidence related to segmented rehabilitation for increasing vocational outcomes in adults with brain injury, including effectiveness and model of care protocols. This report outlines the findings of the review to assist the TAC to understand whether transition to a segmented rehabilitation services model would result in improved outcomes for people with brain injury and reduce attendant care costs and assist in planning further research in the area.

The rapid review was undertaken using a literature search of the following electronic databases: Medline, PsycInfo, CINAHL, EMBASE, and Cochrane Database of Systematic Reviews (searched from 1980 to February 2013). A search of Google Scholar also identified relevant conference abstracts with the anticipation that research in this area is likely to be in its infancy. All full text papers were assessed by two reviewers for both inclusion eligibility, and level of evidence. The review identified insufficient literature to conduct a meta-analysis, with only one publication addressing segmented rehabilitation, one publication addressing streaming in-patient rehabilitation, and five publications relevant to understanding the efficacy of integrating vocational rehabilitation into inpatient rehabilitation models of care.

The review concludes that at this time there is no evidence that segmented rehabilitation models of inpatient care improves the level of competitive employment or return to study outcomes, or any other outcomes, after brain injury. It also found no evidence of the efficacy or outcomes from streaming inpatients according to common goals. There was limited evidence that streaming inpatients into neurocognitive versus neurophysical impairment groups decreases length of stay of inpatient care but no evidence that this subsequently improves the level of competitive employment or return to study outcomes after acquired brain injury (ABI).

It is important to differentiate that a lack of evidence does not provide evidence of a lack of effect. Because of the lack of high-quality evidence from which to draw firm conclusions and the absence of studies specifically investigating the use of a segmented (programmatic) rehabilitation model of inpatient rehabilitation, the question of best practice remains unanswered. As such, there is insufficient evidence to allow people with ABI, clinicians or policy makers to make informed decisions on the appropriate use of segmented (programmatic) approaches to inpatient rehabilitation, or in fact, any inpatient models of vocational rehabilitation.

Recommendations for further research in the area of vocational rehabilitation and segmented rehabilitation for persons with brain injury are recommended. It is suggested that research should first commence with a survey of clinical practice in the area of vocational rehabilitation, focusing in particular on inpatient approaches to return to work and study, as well as segmented rehabilitation approaches. Such a survey should be undertaken internationally, given that current Australian models of rehabilitation are not representative of the breadth of possible models available. Studies of rehabilitation approaches are also required, and funders should insist on best-practice designs, such as randomised controlled trials or interrupted time series studies. The significance of changing staff culture should not be underestimated in such studies, however, given that vocational goals do not currently form a large part of routine brain injury inpatient care.

Background

In 2013, the Transport Accident Commission (TAC) requested a rapid review of the evidence on the effectiveness of segmented rehabilitation models of care. TAC requested this information to understand whether segmented rehabilitation services would result in improved outcomes for people with brain injury and reduce attendant care costs. The focus of rehabilitation would be based on return to work (RTW), return to school and daily living skills. Existing models of care were evaluated to determine whether there is any evidence to support Segmented Rehabilitation. The theory is that having people in rehabilitation streams with similar goals provides shared/common motivation and a more targeted rehabilitation service, therefore having greater success or likelihood of success with achieving their goals.

Return to work is an important stage in rehabilitation after acquired brain injury (ABI), being associated with better quality of life(1), as well as reducing financial costs associated with being unemployed(2). Return to work and return to study (vocational) rehabilitation skills are most commonly being commenced in Australia only after inpatient rehabilitation has completed. This delayed referral is thought to result in delayed outcomes; however the current system of acute and inpatient rehabilitation in Australia does not specifically target return to work, vocation or independent living early during rehabilitation after mild/moderate ABI and thus, little choice is available to patients or funding agencies/insurers. Earlier commencement of vocational rehabilitation would require a change in model of care. Segmented rehabilitation, otherwise known as a programmatic approach to rehabilitation, may offer one such model of care.

Segmented rehabilitation was operationalised as a model of care that streams patients into groups based on either the goal of their rehabilitation (vocation/study versus functional skill development), their clinical presentation of deficits (cognitive versus physical) or their living situation (intending to return to living with support versus living independently). For the purposes of this rapid review, the model of care remained broad to identify inpatient and outpatient vocational models which ideally separated (segmented) patients into occupationally focused groups (those intending to return to work versus those intending to return to living and working in the home).

The Research Questions

What is the evidence for segmented rehabilitation with respect to increasing return to work and/or study, independence, community integration, reducing care costs and/or improving mental health after mild/moderate brain injury?

What is the evidence for streaming patients with common goals during inpatient rehabilitation with respect to increasing return to work and/or study, independence, community integration, reducing care costs and/or improving mental health after mild/moderate brain injury?

Method

Objective

The objective of this rapid review is to provide TAC with the current state of evidence about segmented rehabilitation for increasing vocational outcomes in adults with brain injury, including effectiveness and model of care protocols.

Search Strategy:

The literature search was undertaken in the following electronic databases: Medline, CINAHL, PsycInfo, EMBASE, and Cochrane Library (inclusive of database of systematic reviews, DARE, CCTR) (searched from 1980 to February 2013). Reference lists of the Evidence-Based Review of Moderate To Severe Acquired Brain Injury (ERABI), included studies, and review articles were hand searched for citation tracking purposes. Google Scholar was searched to identify grey literature, specifically conference abstracts. The exploded Medline terms used for searching were Craniocerebral Trauma; Stroke; Anoxia; Hypoxia, Brain; ((brain or head or intracran* or cerebr* or cerebellar or brainstem or vertebrobasilar) adj3 (injur* or infarc* or isch?em* or thrombo* or apoplexy or emboli* or h?emorrhag* or h?ematoma* or aneurysm* or anoxi* or hypoxi*)); (encephaliti* or mening*).

One reviewer independently reviewed identified titles and abstracts. Studies were sought in full text if they appeared eligible for inclusion against the criteria; however limits were not applied for the term “segmented rehabilitation” based on an understanding that the term was unlikely to be located. Two reviewers (JM and KL) reviewed all full text papers to determine eligibility. A third reviewer (NL) acted as an arbitrator in cases where consensus was not achieved.

Refinements, Searching and Reporting Constraints:

Inclusion Criteria: English language studies of segmented rehabilitation or vocational rehabilitation that fulfilled the following criteria were included in the review:

- i. **Type of study:** studies which generated level 4 evidence or higher (Table 1) were sought(3). The author accepts that the best available evidence is that which is least susceptible to bias, such as that provided by Levels 1 and 2 of the NHMRC levels of evidence (Table 1). However a broader search strategy included studies more prone to bias (Levels 2, 3 and 4) given the anticipated infancy of research in this area. Qualitative research studies and conference abstracts were additionally sourced.
- ii. **Type of intervention:** studies that involved the application of a segmented rehabilitation model of care for adults following acquired brain damage. For the purpose of this review, segmented rehabilitation was operationalised as a model of care that streams patients into groups based on either the goal of their rehabilitation (vocation/study versus functional skill development), their clinical presentation of deficits (cognitive versus physical) or their living situation (intending to return to living with support versus living independently). This definition remained broad to identify inpatient and outpatient vocational models of care with the goal of locating studies which ideally separated inpatients into

occupationally focused groups (those intending to return to work versus those intending to return to living and working in the home).

- iii. **Types of participants:** studies that explicitly involved human participants in which ≥80% of patients have had an ABI and remaining patients have had an ABI-like diagnosis. Acquired Brain Injury is operationalised within this review as having a focus on traumatic brain injury. Acquired brain injury may be as a result of trauma, disruption to the supply of oxygen to the brain, stroke, tumours, infection (eg meningitis), poisoning or substance abuse(4). All participants in the included studies will be of working age (16 years to 70 years) but not necessarily seeking employment or having been in employment at the time of injury.
- iv. **Types of outcome measures:** studies that discussed/included measures of return to work or study, independent living, community integration, depression, mental health, quality of life, cost [no studies were excluded on the basis of outcomes].

Table 1: NHMRC Levels of Evidence(3)

Level	Intervention ¹
Level I ²	Evidence obtained from a systematic review of all relevant randomised controlled trials (level II studies)
Level II	Evidence obtained from at least one properly-designed randomised controlled trial
Level III-1	Evidence obtained from well-designed pseudorandomised controlled trial (i.e. alternate allocation or some other method)
Level III-2	Evidence obtained from comparative studies (including systematic reviews of such studies) with concurrent controls: <ul style="list-style-type: none"> • Non-randomised, experimental trial³ • Cohort study • Case-control study • Interrupted time series with a control group
Level III-3	Evidence obtained from a comparative study without concurrent controls: <ul style="list-style-type: none"> • Historical control study • Two or more single arm study⁴ • Interrupted time series without a parallel control group
Level IV	Evidence obtained from case series with either post-test or pre-test/post-test outcomes
Level V	Expert opinion without explicit critical appraisal

1 Definitions of these study designs are provided on pages 7-8 *How to use the evidence: assessment and application of scientific evidence* (3)

2 A systematic review will only be assigned a level of evidence as high as the studies it contains, excepting where those studies are of level II evidence.

3 This also includes controlled before-and-after (pre-test/post-test) studies, as well as adjusted indirect comparisons (ie. utilise A vs B and B vs C, to determine A vs C with statistical adjustment for B).

4 Comparing single arm studies ie. case series from two studies. This would also include unadjusted indirect comparisons (ie. utilise A vs B and B vs C, to determine A vs C but where there is no statistical adjustment for B).

Organisation of evidence

Each study was classified by the level of evidence it represents (Table 1). Levels of evidence and other quality-rating schemes start with a hierarchy of research designs that range from the greatest to least ability to reduce bias and conclude with assessment of the soundness with which the research was carried out. Generally speaking, Level 1 studies produce the strongest and most definitive evidence. Level 2 studies produce tentative conclusions. Levels 3 and 4 merely suggest causation. No conclusions regarding treatment efficacy can be drawn from Level 5 evidence. Thus, recommendations from included studies were summarised as being:

- strong evidence: findings are supported by the results of two or more RCTs of at least fair quality ('fair' quality defined as a PEDro score of four or higher) (level 1 evidence)
- moderate evidence: findings are supported by a single RCT of at least fair quality (level 2 evidence)
- limited evidence: findings are supported by at least one level 3 study (cohort studies, single group interventions, etc.) and
- conflicting evidence: disagreements between the findings of at least two RCTs or where RCTs are not available between two non-RCTs. Where there are more than four RCTs and the results of only one was conflicting, the conclusion was based on the majority of the studies, unless the study with conflicting results was of higher quality.

Data extracted from all studies included: authors and date of study; number of participants; setting; study design, intervention and outcomes; and description of findings. Data synthesis for analysing the content of studies was restricted to presenting studies in tables; this method is designed to facilitate appropriate understanding of the current literature and provide methodological focus for planning future studies.

The intention was to conduct a meta-analysis if there was sufficient clinical and statistical homogeneity. In line with published recommendations for reviews of treatment efficacy, planned quantitative synthesis of located studies excluded non-randomised trials (5, 6). The methodological quality of included randomised controlled trials, if located, were planned to have been assessed by one rater using the PEDro scale to assist with classification of levels of evidence. The PEDro scale has established reliability and provides a score out of 10 (7).

Results

Of the 7103 papers retrieved using the search strategy, 26 papers required full-text review and of these, 8 papers met inclusion criteria, including two systematic reviews (See Appendix: PRISMA flow diagram (8)). There were no randomised controlled trial literature which investigated the merits or otherwise of a segmented approach to in-patient rehabilitation.

Segmented Rehabilitation

We identified one publication that was relevant in addressing this research question(9). The paper by Babicki & Miller-McIntyre describes the steps to moving from a traditional service model towards a programmatic model of care, however it does not report on the efficacy or efficiency of the programmatic (segmented) model of care. While the purpose of the paper was to outline the role of a clinical nurse in implementing the change to a programmatic model of care from a traditional service model where a multidisciplinary team approach to care meant that each discipline sets separate goals, advantages of the programmatic model were also proposed in this paper.

“The programmatic model is defined as an integrated delivery care system for a specific diagnostic group of patients using an interdisciplinary team with a central program director” (pp. 84). The programmatic model of rehabilitation is described as ensuring that a single set of interdisciplinary patient goals are set and that all rehabilitation is delivered to meet these goals in an integrated way; rather than having each discipline set separate goals, all rehabilitation is focused only on the team goal/s in a programmatic model.

Table 2: Segmented Rehabilitation Data Extraction

Author	Sample	Location of Rehab	Intervention	Level of Evidence / Methodology	Results/Conclusion
Babicki C, Miller-McIntyre, K. . A rehabilitation programmatic model: the clinical nurse specialist perspective. Rehabilitation Nursing. 1992;17(2):84-6.	-	Inpatient	-	Level 5 evidence Opinion/narrative	Advantages of a programmatic model include truly interdisciplinary patient goals, the delivery of completely integrated services, and specialised services directed only at patients with brain injury.

Streaming In-patient Rehabilitation

We identified one publication that was relevant in understanding streaming in-patient rehabilitation (10). Streaming inpatients in TBI rehabilitation according to their functional deficits (neurocognitive versus neurophysical) led to improved Functional Independence Measure (FIM) efficiency and lower Disability Rating Scale in both streams, and reduced Length of Stay (LOS) for the neurophysical stream compared to traditional rehabilitation (historical control).

Table 3: Streaming In-patient Rehabilitation Data Extraction

Reference	Sample	Location of Rehab	Intervention	Level of Evidence / Methodology	Results/Conclusion
Cullen N, Vimalasan, K., Aznar, T., Taggart, C. . Presentation at 9th World Congress on Brain Injury International Brain Injury Association; Edinburgh, United Kingdom. 2012.	Acquired Brain Injury service	Inpatients Toronto Rehabilitation Institute (TRI)	Introduced a functionally-based rehabilitation program that streamed patients into two groups based on clinical presentation of functional deficits: 1) predominantly neurocognitive impairment (NC); and 2) predominantly neurophysical impairment (NP). The objective was to examine the efficacy of the functionally-based streaming program compared to the traditional, diagnosis-based rehabilitation program previously in	Level 4 evidence Case-controlled study with historical control group Participants with moderate to severe TBI during 1999-2009. A case-controlled design was used to compare outcomes of participants before and after implementation of the functionally-based streaming program. A historical control group consisted of 69 TBI patients admitted to the program prior to 2002, who were retrospectively	Tailoring a rehabilitation program to patients' functional needs rather than to their diagnosis appears to be useful in maximising function as suggested by the improved Functional Independence Measure efficiency and lower DRS scores in patients who participated in the streaming program Trend towards reduced rehabilitation Length of Stay in the NP-streamed group. Future research examining longer-term functional outcomes

			place at Toronto Rehabilitation Institute	assigned to the NP or NC stream based on Functional Independence Measure (FIM) motor transfer scores.	could further clarify the benefits of a streaming program.
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Integrating Vocational Rehabilitation into in-patient Rehabilitation

We identified five publications relevant to understanding the efficacy of integrating vocational rehabilitation (including paid, volunteer and study) into inpatient rehabilitation models of care (1, 2, 11-14). While together these publications do not answer the research questions about the efficacy of a segmented approach to rehabilitation, nor whether streaming patients improves outcomes in vocational outcomes, understanding whether there is any evidence to support how to best organise inpatient rehabilitation to maximise return to work or study may assist TAC to guide their research priorities in this area.

There are various types of vocational rehabilitation approaches which have been reviewed over the years however it remains unclear which is the best approach and when is the best time to commence vocational rehabilitation(15). Among the services identified in the publications to date, some may be regarded as specialist brain injury vocational programs while some are brain injury services with a vocational element within their overall program, and some are generic vocational, educational or training providers that accept people with brain injury(16). Fadyl & McPherson (11) report that the three main models described in the literature for vocational rehabilitation after ABI are:

- Program based job skills training and placement assistance
- Individual placement model of supported employment
- Case coordinated rehabilitation

Successful return to work following Traumatic Brain Injury varies widely and success ranges from 11-82%(17); a systematic review reports that 41% of ABI survivors who were employed prior to sustaining a ABI are in work at 1 and 2 years post injury(18, 19). So, while return to work is often regarded as the ultimate measure of the effectiveness of ABI rehabilitation there appears to be little focus during in-patient rehabilitation on vocation and no agreement on the best time to commence vocational rehabilitation or on what approach achieves the highest success rates (18, 19).

Table 4: Integrating Vocational Rehabilitation into in-patient Rehabilitation Data Extraction

Author	Sample	Location of Rehab	Intervention	Level of Evidence / Methodology	Results/Conclusion
Fadyl JK, McPherson KM. Approaches to vocational rehabilitation after traumatic brain injury: a review of the evidence. The Journal of head trauma rehabilitation. 2009 May-Jun;24(3):195-212.	-	-	Review of 3 categories of Vocational rehabilitation: 1. Program based model, 2. Supported employment, 3. Case coordinated approach	Level 2 evidence Systematic Review of 23 research articles. Only classified as clinical trials	There is little clear evidence to suggest what should be considered the “best practice” approach to vocational rehabilitation & the question remains unanswered
Cullen N, Chundamala J, Bayley M, Jutai J. The efficacy of acquired brain injury rehabilitation. Brain injury : [BI]. 2007 Feb;21(2):113-32.	-	-	Review of Vocational rehabilitation (within a broader review of the efficacy of TBI rehabilitation)	Level 3 evidence Systematic Review: Return to work efficacy was the focus of n=3 studies (1 x cost-benefit analysis, 1 x case series, and 1 x outcome study).	There is limited evidence that vocational rehabilitation results in greater total taxpayer benefits than either total program operational costs or government costs; that the majority of patients become gainfully employed or full-time students; and that patients with the most significant cognitive impairments benefit most from vocational services.
Radford K, Phillips J, Drummond A, Sach T, Walker M, Tyerman A, et al. Return to work after	N=94 (40 TBI VR and 54 UC) with n=15 (16%) dropouts	specialist multidisciplinary TBI service, based in a large hospital	This study aimed to determine whether a TBI Voc Rehab intervention was	Level 3 evidence Cohort study Work outcomes of	More TBI-VR participants returned to work than UC. People with moderate/severe TBI

<p>traumatic brain injury: Cohort comparison and economic evaluation. Brain Injury. 2013;27(5):507-20</p>	<p>at12mo. Diagnosis of TBI (hospitalised for at least 48hrs) aged >16 years and in paid or voluntary work or education at the time of injury</p>	<p>in Nottingham, UK, providing rehabilitation in the community.</p>	<p>more effective at work return and retention 12 mos post-injury than usual care (UC). Secondary aim was to explore the feasibility of collecting economic data to inform a definitive trial.</p>	<p>TBI-VR were compared to UC. 94 participants with TBI (40 TBI-VR) who were working at time of injury. Primary outcome was RTW.</p>	<p>benefited most. This positive trend was achieved without greatly increased health costs, suggesting cost-effectiveness. This study justifies the need for and can inform a definitive Randomised Controlled Trial (RCT).</p>
<p>Johnstone, B., Vesell, R., Bounds, T., Hoskins, S., Sherman, A. Predictors of Success for State Vocational Rehabilitation Clients with Traumatic Brain Injury. <i>Arch Phys Med Rehab</i> 2003 84: 161-167</p>	<p>N=78 (high dropout n=57 leaving only n=21 followed up)</p>	<p>Out-patient</p>		<p>Level 4 evidence Observational Study: Vocational services data from the Missouri Division of Vocational rehab</p>	<p>Results cannot be generalised, small sample size.</p>
<p>Murphy L., Chamberlain, E., Weir, J., Berry, A., Nathaniel-James, D., Agnew, R. Effectiveness of vocation rehabilitation following acquired brain injury: Preliminary evaluation of a UK specialist rehabilitation programme. <i>Brain Injury</i> 2006; 11; 1119-1129.</p>	<p>N=232 Age 17-62 (1/3 participants 5-35 post injury)</p>	<p>Rehab UK Centres Out-patient</p>	<p>2 components: 1. Centre-based pre-vocational rehab. phase to provide intensive basic cognitive rehab to those who have not received it before (over 12 weeks, group programme) 2. in-situ voc trials</p>	<p>Level 4 evidence Audit: Data gathered by examining the admin data bases and paper based records at 3 centres over 3 year period to evaluate the effectiveness of</p>	<p>Vocational rehab offering educational and experiential leaning opportunities is effective in enabling participants with severe acquired brain injuries to return to paid employment</p>

			phase for those who had already undertaken comprehensive rehab (placed in work placements for minimum 4 weeks, typically last 6-9 mths)	voc rehab programme.	
Abrams D, Barker, L.T., Haffey, W., Nelson, H. . The economics of return to work for survivors of traumatic brain injury: Vocational services are worth the investment. Journal of Head Trauma Rehabilitation. 1993;8:59-76.	N=142	Work Reentry Program (San Diego, USA) Unclear whether inpatient/outpatient	Individualised work re-entry program	Level 4 evidence Cost-benefit analysis of persons with TBI who participated in an individualised work re-entry program.	During the first year of the program, 65% (n=92/142) obtained employment. During the entire study period from October 1988 to June 1992, 75% (n=106/142) obtained employment. This resulted in a 2:1 ratio of total taxpayer benefit to total program operational cost and a 4:1 ratio of total taxpayer benefit to state cost.

Recommendations and implications

Implications based on the available Research

Conclusions regarding segmented rehabilitation: There was *no* evidence that segmented rehabilitation models of inpatient care improves the level of competitive employment or return to study outcomes after ABI, or any other outcomes. One paper discussed segmented brain injury rehabilitation, discussing the implementation of the approach and the need for common goals(9).

Conclusions regarding streaming inpatients to work on common goals or based on other factors: There was *no* evidence of the efficacy or outcomes from streaming inpatients according to common goals; there was *limited* evidence that streaming inpatients into neurocognitive versus neurophysical impairment groups decreases length of stay of inpatient care but no evidence that this subsequently improves the level of competitive employment or return to study outcomes after ABI (10).

Conclusions regarding efficacy of vocational rehabilitation. There was *limited* evidence of the efficacy of vocational rehabilitation and that vocational rehabilitation results in greater total taxpayer benefits than either total program operational costs or government costs (1). There is *no* evidence to the best approach to vocational rehabilitation, nor of programs which are best undertaken during inpatient rehabilitation rather than post-rehabilitation (community-based) programs.

Recommendations for Clinical Practice

There is insufficient evidence to allow people with ABI, clinicians or policy makers to make informed decisions on the appropriate use of segmented (programmatically) approaches to inpatient rehabilitation, or in fact, any inpatient models of vocational rehabilitation. As such, without further research, it is not possible to make any clinical recommendations.

Recommendations for research

The proportion of people who are unable to return to work or study after brain injury, the poverty of available research on models of inpatient rehabilitation which stream patients into groups to specifically aim at early return to work, and the absence of any ongoing research on segmented rehabilitation models, suggest that new research is an urgent priority.

Effectiveness studies in the past have focused on whether better outcomes were associated with receiving RTW/S services or not. These "Yes/No" global assessments typically showed that vocational rehabilitation services help some clients. Before determining a new research program, the research weaknesses in the

area of RTW/S need highlighting, as these weaknesses often undermine the validity of study findings to date and prevent us being able to compare different approaches to RTW/S across studies:

- While randomised controlled trials (RCT) (Figure 2) are the gold standard for determining the effect of an intervention or service, studies of this type have not been undertaken to evaluate RTW/S services. Thus, because of the weak methodology of most of the studies done (non-RCT), one cannot conclude that a service is effective (or ineffective); any positive results could be due to clients simply receiving a service or because they received more attention than they would otherwise. With few exceptions, the studies in this review used weak pre-post designs, anecdotal approaches or retrospective data mining.
- The studies in this review used very small samples. Frequently, the degree to which the group of patients studied represents the full ABI population is not discussed. This is important since only a small fraction of people with ABI seeking or wanting to return to work ever receive RTW/S rehabilitation.

The lack of studies located in this exhaustive search indicates the important role of policy-makers in rectifying the paucity of research focused on evaluating methods to help people successfully RTW after ABI. Inadequate RTW rehabilitation, coupled with non-ABI specific RTW programs which focus on assistance to job-seek, to fill out applications, modifying a work setting and job-placement services don't increase RTW rates in individuals with ABI(20). Neither are attempts to return individuals to their previous work environments where their performance is scrutinised by those who are most familiar with their pre-injury skills(21). People with brain injury, clinicians and policy makers should work together to ensure that the evidence required is collected as quickly as possible by encouraging involvement in rigorous research which investigates ABI-specific RTW programs.

Rigorous research should apply the right research design to a specific clinical question; no single design has precedence over another, rather the design chosen must fit the particular research question (22). To understand the efficacy of one model of rehabilitation over another, future research should use a randomised controlled trial design (or clustered randomised controlled trial) (Figure 2)(23) where participants (or clusters) are randomly allocated to receive either segmented rehabilitation or usual rehabilitation, or an interrupted time series design (Figure 3)(23).

First step research to better understand segmented rehabilitation should commence using survey methodology: surveys can be used as part of a quantitative or a qualitative methodology. Qualitative surveys try to elicit qualitative data from surveys or questionnaires by providing open ended questions that try to encourage a lengthy response and then treat this data as qualitative data by coding and analysing it. Such surveys would permit a deeper understanding of segmented rehabilitation, for example its inclusion and exclusion criteria, timing, theoretical underpinnings, and likely benefits. Based on the existing review of research, it is anticipated that services in the United Kingdom, Canada and the United States use varied segmented rehabilitation approaches and thus, an international survey is recommended.

Figure 2: Randomised Controlled Trial Design

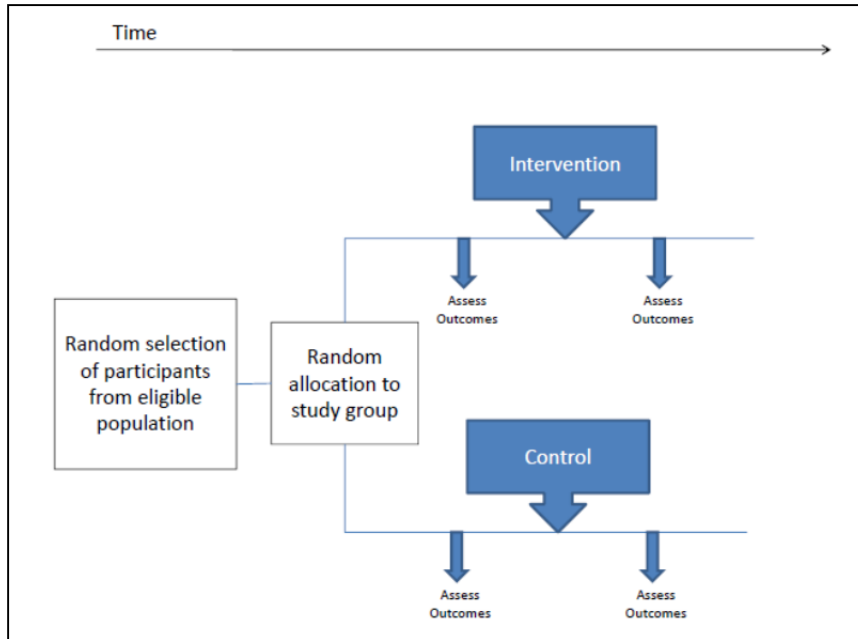
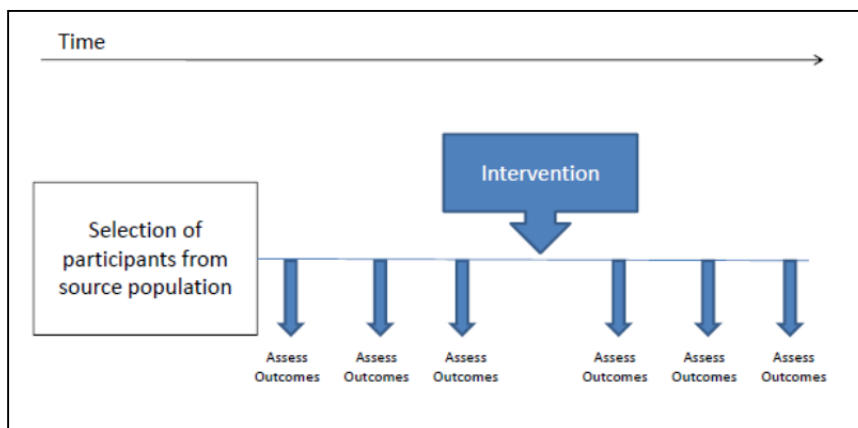


Figure 3: Interrupted Time Series Study Design



To understand the benefits of ABI segmented rehabilitation programs, testing of elements or of the model may be considered. Recommended features of an ABI segmented rehabilitation program (goal-oriented programmatic approach) to be tested in future research studies includes:

- use with patients with mild to moderate impairment levels (not severe brain injury)
- use with patients in inpatient brain injury rehabilitation, potentially necessitating change in staff culture
- segmentation based on either impairment type (neurocognitive versus neurophysical) or identified goals (functional/basic ADL goals versus return to work/return to study goals)
- early focus on meaningful goals to address return to work or study during inpatient rehabilitation.

Research in the area of vocational rehabilitation should not be restricted to testing the segmented rehabilitation approach as reviewed in depth in this report. All interventions identified in this rapid review (see above) should be considered, as should research into the process of changing clinician behaviour to implement a vocational rehabilitation program early after brain injury. Vocational rehabilitation is clearly an area of importance for brain injury rehabilitation, and well-designed research could result in large benefits to both clinical practice and health care policy.

Conclusions

Our current Australian rehabilitation programs focus inpatient therapies on basic activities of daily living goals (e.g. mobility, self-care, discharge to home environment), despite the acknowledgement that vocational outcomes (e.g. return to work, return to study) have enormous potential to reduce the financial burden of brain injury (2). An Australian follow-up study of vocational outcomes demonstrated that at two-years post-brain injury 58% of patients were unemployed. However, in a further follow up at five years, of those who were in employment at two years, 32% were no longer employed (24). These figures highlight the importance of this issue and the potential impact of determining the most effective and efficient model of care for addressing outcomes beyond improving basic activities of daily living (ADL) goals and the complexity of this area of rehabilitation.

Because of the lack of high-quality evidence from which to draw firm conclusions and the absence of studies specifically investigating the use of a segmented (programmatic) rehabilitation model of inpatient rehabilitation, the question of best practice remains unanswered. One conclusion we suggest can be drawn from the evidence is that focusing on vocational rehabilitation during inpatient rehabilitation is warranted in Australia. While using a streamed approach was associated with a decreased length of stay in the one paper located (10), the paper by Babicki and Miller-McIntyre (9) suggests that a significant investment in changing practice is required to move from a service model (usual practice) to a segmented (programmatic) rehabilitation model. Ultimately, it remains unclear which components of vocational rehabilitation are most effective, in which contexts, and whether streaming inpatients according to their post-discharge goals and occupation influences outcome. Further research is needed to understand these issues.

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Appendix: PRISMA Flow Diagram

PRISMA Flow Diagram

