Brief, Evidence Based Review of Inpatient/Residential rehabilitation for adults with moderate to severe TBI

Reviewer	**Peter Larking**
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Important Note:

- This brief report is not intended to replace clinical judgement, or be used as a clinical protocol.
- A limited review was conducted of key evidence based guidelines and selected reviews and systematic reviews. While searches were systematically executed only those papers and guidelines and systematic reviews immediately relevant to the topic where reviewed.
- The document has been prepared by the staff of the research team, ACC. The content does not necessarily represent the official view of ACC or represent ACC policy.
- This report is based upon information supplied to 5 August 2011.

Objectives

- To provide a brief report summarising the highest quality evidence available on inpatient/residential rehabilitation for adults with moderate to severe traumatic brain injury (TBI) with an emphasis on outlining those elements essential for best practice service delivery.[1] **(Note that inpatient/residential issues relating to management of behavioural disorders, alcohol/drug, mental health and vocational rehabilitation are covered in the accompanying ACC TBI Reviews).**

[1] The term moderate to severe TBI is based on terminology used in the ACC TBI Guideline; a Glasgow Coma Score of - 'moderate TBI' 9 to 12; and 'severe TBI' 3 to 8

KEY FINDINGS

- There is some evidence that inpatient rehabilitation improves self care and mobility and significantly improves functional outcome, social cognition and return to work **(Level 4)**[1]

- Multidisciplinary inpatient rehabilitation is more effective than a single discipline approach **(Level 2)**[1,2] In addition ABIKUS call for interdisciplinary protocols or integrated care pathways for the management of common problems[3] (**Level A**)[4].

- Earlier inpatient rehabilitation is associated with better outcomes such as shorter comas and lengths of stay, higher cognitive levels at discharge, better FIM scores, and a greater likelihood of discharge to home **(Level 2)**[1].

- Increasing rehabilitation intensity (4 hrs/5 days) reduces length of stay **(Level 1)**[1]**.**

- Increasing rehabilitation intensity improves functional outcomes 2 and 3 months post-injury but not necessarily at 6 months and later **(Level 1)**[1]**.**

- Intensive, structured cognitive rehabilitation improves attention, executive ability, memory and social communication skills even to several years post – injury **(Level 1)**[8].

- Inpatient rehabilitation results in higher rates of change in functional measures in the 18 -54 year olds compared to older subjects **(Level 3)**[1]**.**

- Readmission to inpatient rehabilitation greater than 12 months post injury is related to significant improvements in the Barthel Index at discharge for over 50% of patients **(Level 2)**[1]**.**

- Training in a transitional living setting during the last weeks of inpatient rehabilitation is associated with greater independence than inpatient rehabilitation alone (**Level 2**)[1,2].

- Guidelines reviewed endorse the need for a range of specialist services to be available to support treatment including, physiotherapists and occupational therapists with neurological expertise, neuropsychological services, and behavioural management services. **(Evidence level appears to be usually based on expert opinion)**[1,2].

Introduction

It is well accepted that rehabilitation after traumatic brain injury is a long-term process with many, varying impairments to be addressed over a time span that may require two years to achieve maximum recovery[3].

In New Zealand, ACC is the major contractor of services for the treatment and rehabilitation of those with TBI. As such it continues to seek to improve service design and delivery for its clients.

In the upper North Island of New Zealand a trial, 'Integrated Rehabilitation Service' for Traumatic Brain Injury (IRS-TBI) has recently been evaluated[10]. The service was designed to provide early identification and intensive rehabilitation, individually

tailored client-centred plans and seamless and effective community re-integration to all clients with moderate to severe TBI. The evaluation contrasted the results with that provided by ISIS, a South Island grouping, where existing Active Rehabilitation 'Usual care' services continued to be provided.
This evaluation found that

- In general processes were working reasonably well in the residential phase of the IRS-TBI service.
- There were issues around IRS-TBI managing clients with more complex needs and providing individual-tailoring of rehabilitation plans. In contrast at ISIS these issues appeared to be managed better.
- There were issues around IRS-TBI working flexibly with Maori clients and whanau.
- The average residential FIM gain for IRS-TBI clients was similar to that of ISIS clients.
- The average residential LOS was significantly longer for IRS-TBI clients compared to ISIS and international benchmarks.

Following on from this evaluation and in response to other initiatives a review was requested of the evidence for best practice for the rehabilitation of TBI clients in the inpatient phase of treatment.

This report has been prepared in response to this request. The focus is on the evidence for the delivery of services in the post-acute, inpatient phase of care (Fig 1). An attempt is made to review recent guidelines and research that have covered this topic to provide a synthesis of what services should be available, how they should be delivered, when they should be provided and by whom.

Methods and search

The literature search covered the period Jan 2000 to 12 August 2011. However guidelines reviewed included papers from earlier periods.
Databases searched included Ovid Medline, Embase and TRIP.
Database searches were supported by other internet searching as required.
Key search words included, traumatic brain injury, rehabilitation, post-acute, service design and service delivery.

Papers and guidelines were assessed using 'SIGN' methodology – see Appendix One.

Evidence rankings for recommendations are those used by the individual guidelines as indicated. These systems varied between the guidelines consulted.

Key documents were selected on the basis of their quality and relevance to the topic. This brief report is based on the findings of two main documents -

1. Efficacy and models of care following an acquired brain injury. Cullen, NR., Meyer, MJ., Candidate, J A., Bayley, M., Teasell, RT. Chapter 3. A quality systematic review. Evidence level 1+ (Evidence of recommendations is based on five levels of quality, A to E)[1].
2. Traumatic Brain Injury, Diagnosis, Acute Management and Rehabilitation. July 2006, NZGG/ACC – a high quality Guideline prepared using rigourous evidence based practice. Evidence level 1+ (Ranked recommendations A to C)[2.]

The Inpatient / residential phase

Following the acute phase and once they have achieved medical stability, people with TBI may return home or to a residential support service. However some TBI clients may need to be transferred directly to a specialised in-patient/residential facility (Figure 1).

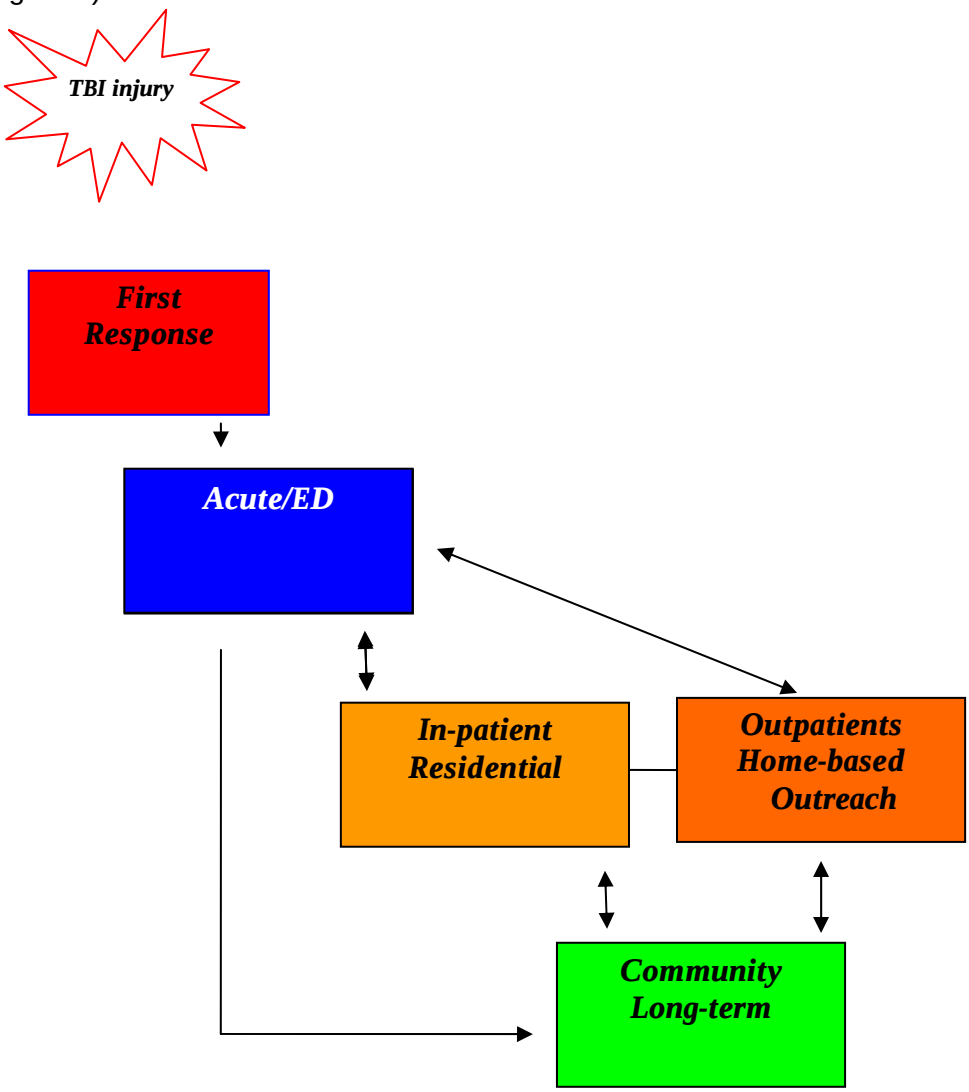

Figure 1. Client pathway from TBI Injury to Community

Discussion on key findings

The design of inpatient rehabilitation services is quite diverse and establishing a sound evidence base even for widely accepted practices is difficult. Inpatient rehabilitation typically begins when the patient is sufficiently medically stable to be transferred from acute care into a rehabilitation unit.

Benefits of an inpatient rehabilitation focus

The effectiveness of inpatient rehabilitation has been reviewed by Cullen et al[1]. They identified four studies that monitored various indices of improvement after inpatient rehabilitation programmes, three were retrospective studies and one of pre/post design, none were controlled. They concluded that there was level 4 evidence that inpatient rehabilitation improves self care and mobility and significantly improves functional outcome, social cognition and return to work. Readmission of severely head injured patients more than 12 months after injury also significantly improved Barthel Index scores. This evidence base for the effectiveness of inpatient rehabilitation is slight. A Cochrane review[9] concluded that for moderate to severe acquired brain injury, there is 'strong evidence' of benefit from formal intervention.

Effectiveness of multidisciplinary teams and the intensity of inpatient rehabilitation

The New Zealand TBI Guideline[2] accepts the need for multidisciplinary teams or interdisciplinary teams and notes that most specialist rehabilitation teams in NZ function in a interdisciplinary manner. ABIKUS[4] also endorsed the idea of multidisciplinary teams although their recommendation interestingly focussed on the need for integrated care pathways and protocols for the management of common problems.

It is claimed that multidisciplinary teams are necessary to an effective rehabilitation service. Cullen[1] concluded, based on the studies discussed below that there was level 2 evidence that multidisciplinary inpatient rehabilitation seems to be more effective than a single discipline approach. There was also level 2 evidence that the intensity of therapy predicts motor functioning but not cognitive gain[1].

Cullen[1] proposed that such a team may include, nursing care, physician monitoring, psychologist and social work intervention, physiotherapists, occupational therapists and speech therapists. In Sweden the team consists of a physician, nurses, occupational therapists, physiotherapists, a neuropsychologist, a social worker and a speech and language therapist[6].

Cullen[1] reviewed 7 studies that investigated the intensity of rehabilitation post ABI. Two studies were RCTS, one a cohort study, two non - randomised, controlled studies and two were case series. Numbers per study varied from 36 to 491. Based on the findings of one smaller RCT they concluded that there was level one evidence that increasing rehabilitation intensity reduces length of stay. Based on one single RCT they concluded that there was level 1 evidence that intensive rehabilitation improves functional outcome as measured by FIM and GOS scores at two to three months post injury but not necessarily at 6 months and beyond; This study delivered 4 hours of therapy a day, 5 days a week compared to 2 hours a day in the control group. Other reports suggest that intensity of therapy varies around these figures -

- The US, TBI model systems group suggest that patients may receive at least 3 hours a day, 5 to 7 days a week from a wide range of specialists[7]

- In Canada 3-5 hours a day[5]
- In Sweden 2-4 hours a day[6]

A Cochrane review[9] concluded that for moderate to severe acquired brain injury, there is strong evidence that more intensive programmes are associated with earlier functional gains and limited evidence that specialist in-patient rehabilitation and specialist multi-disciplinary community rehabilitation may provide additional functional gains.

Though some of the evidence cited above was based on RCTs in reality the evidence base that multidisciplinary teams are more effective than a single disciplinary approach is at best moderate, as is the evidence that more intense therapy results in superior outcomes.

Timing of rehabilitation.

The NZ Guideline[2] calls for careful assessment of the need for rehabilitation during the acute management phase. On their assessment of the evidence they concluded that starting rehabilitation early in the episode of care would result in better outcomes. The purpose of early referral was to determine appropriate referral and interim management to prevent onset of secondary complications. Assessment was to include determination of any residual physical, cognitive, emotional or behavioural deficits which would negatively affect function.

Cullen et al[1] believe that introducing a rehabilitation programme during the acute phase will assist in the overall recovery of those with TBI. They reviewed nine studies to ascertain the optimum time to introduce rehabilitation; four where cohort designs, two chart studies, two non-randomised studies and one a case – control study. Numbers of patients in the studies varied from 26 to 1866. A problem with the studies is that delayed rehabilitation may reflect more severe or complicated injuries[1], but given this limitation the authors concluded that earlier rehabilitation is associated with better outcomes than later rehabilitation (Level 2). For example, patients admitted to a comprehensive, integrated, post-acute brain injury rehab program less than 6 months from time of injury had superior outcomes compared to those admitted later[1]. Also there is some evidence that outcomes will be superior when the physical medical and rehabilitation assessments take place within 48 hours of admission[1]. Cullen[1] also state that this finding is consistent with current theories of neuronal plasticity which suggest that therapy can increase neuronal compensation and/or regeneration. Overall it is concluded that the evidence base for starting rehabilitation early is encouraging but far from proven.

Other factors affecting inpatient care

There is level 3 evidence from one case-control study that outcome scores including FIM will be greater in inpatient rehabilitation discharge patients in the 18 to 54 age group than in those over 55[1.]

A 1993 cohort study[1] found that cognitive and functional outcome measures were higher in those who received training in a ‘transitional living setting’ before discharge compared to those who did not. It was concluded that this provided level 2 evidence for the effectiveness of training in transitional living settings before discharge. This study was quite small however (n=31).

Cicerone et al[8] has conducted an extensive review of the evidence of effectiveness for various cognitive behavioural therapies after TBI. They concluded that there was

a substantial evidence base for use of these interventions for development of attention, memory, social communication skills, executive function, and for comprehensive-holistic neuropsychologic rehabilitation after TBI (Level 1).

Requirement for other specialist types of rehabilitation

Various guidelines considered that –

- there was a significant body of evidence for the effectiveness of physical rehabilitation to assist the recovery as far as possible of functional independence[2]
- there was a need for specialist psychological assessment services and behavioural management services for those with behavioural problems[4](ABIKUS C)
- there was evidence for the effectiveness of computer based technology for development of compensatory strategies (and as a means of gaining employment)[2]. (Evidence level not included in guideline)

Conclusions

This brief report is based mainly on the findings of two guidelines with a third referred to occasionally. All three guidelines appear to have followed rigorous evidence based processes to reach their recommendations. The quality of the research that has provided the evidence for these guidelines is unfortunately often of a questionable standard.

It should be noted that while the interests of ACC are in brain injury of traumatic origin most papers and guidelines are based on acquired brain injury which includes stroke amongst other aetiologies. The application of findings based on acquired brain injury is probably not wholly applicable to traumatic brain injury due to the particular nature of traumatic injuries. This further complicates the interpretation of the findings reviewed here.

The evidence for best practice around the design of services for treatment of patients in the post acute, inpatient phase is developing but currently insufficient to allow authoritative service design. It is concluded that the evidence base for best practice has yet to be established with certainty. One panel of systematic reviewers concluded that there is insufficient evidence to draw any conclusions regarding the ideal structure of a complete model of ABI care[1].

All that can be said is that the key findings listed here reflect the state of current thinking as to the nature of services that should be provided in the post-acute, inpatient phase and it can only be hoped that future research will provide a sounder understanding of the needs of moderately to severely injured TBI patients in this phase of care.

Reviews and levels of evidence

1. **Review**

Title: Traumatic Brain Injury: Diagnosis, Acute Management, and Rehabilitation. New Zealand Guidelines Group (2006). Wellington (New Zealand): New Zealand Guidelines Group[2].
Purpose: To establish best practice for the diagnosis and treatment of TBI.
Design: Systematic review
Location: New Zealand
Methods: Rigorous guideline development process
Results and Conclusion: This guideline provides recommendations for assessment and treatment of children and adults with traumatic brain injury. The target audience of this guideline is acute rehabilitation treatment providers, funding agencies, and individuals with traumatic brain injuries (TBI) and their carers. Levels of evidence are provided and defined by the New Zealand Guidelines Group grading system (Grades A-C and Good Practice Point) as follows: Level A is supported by good evidence - studies that are valid, consistent, applicable, and clinically relevant. Level B is supported by fair evidence - the studies are valid, but there are concerns about the volume, consistency, applicability, and clinical relevance of the evidence. Level C is supported by international expert opinion. Good Practice Point is a best practice recommendation generated by the Guideline Development Team when no evidence was available.
Quality: High quality guideline, Sign level – 1+.

2. **Review**

Title: Efficacy and models of care following an acquired brain injury. Cullen, NR., Meyer, MJ., Candidate, J A., Bayley, M., Teasell, RT. Chapter 3[1].
http://www.abiebr.com/set/3-efficacy-and-models-care-following-acquired-brain-injury/33-inpatient-rehabilitation
Purpose: To describe the evidence base for best practice care of those with acquired brain injury
Design: Systematic review
Location: Canada
Methods: Rigorous guideline development process. Individual papers were assessed on the Pedro scale. Recommendations were based on five levels of quality, A to E (see http://www.abiebr.com/set/1-introduction-and-methodology/16-determining-levels-evidence).
Results and Conclusion: The evidence is reviewed for best practice in the various phases care for those with acquired brain injury including a section on inpatient rehabilitation. Recommendations are given including with level of evidence.
Quality: Evidence level 1+.

3. **Review**

Title: ABIKUS Evidence based recommendations for the rehabilitation of moderate to severe acquired brain injury (2007)[4]
http://reseauconceptuel.umontreal.ca/rid=1HPXBFFGH-1TS657P-K2/abikus_guideline(karen).pdf
Purpose: To provide evidence based recommendations for rehabilitation of persons with moderate and severe Acquired Brain Injury (ABI) in the post acute period. The recommendations apply to all age groups unless otherwise stated.

Design: Systematic review
Location: Canada
Methods: Appears to have used a full guideline process. Bases recommendations on three levels of evidence A to C.
Results and Conclusion: Evidence based recommendations are set out covering such topics as, general principles for organization of rehabilitation services, early assessment and care, principles of use of medications behavioural rehabilitation and cognitive rehabilitation. Detailed discussion of the issues is not provided on the website.
Quality: Appears to have followed a rigorous methodology Evidence level 1+.

4. **Review**

Title: Cicerone KD, Langenbahn DM, Braden C, Malec JF, Kalmar K, Fraas M, et al. Evidence-based cognitive rehabilitation: updated review of the literature from 2003 through 2008. Arch Phys Med Rehabil;92(4):519-30. 2011[8].
Purpose: To update clinical recommendations for cognitive rehabilitation of people with traumatic brain injury (TBI) and stroke.
Design: Systematic review
Location: USA
Methods: Followed a thorough evidenced based systematic review procedure
Results: The authors concluded that there was a substantial evidence base for interventions for attention, memory, social communication skills, executive function, and for comprehensive-holistic neuropsychologic rehabilitation after TBI.
Conclusion: The authors concluded that there was sufficient evidence to implement treatments for cognitive disability after TBI.
Quality: The authors have followed a rigorous methodology. Evidence level 1+.

5. **Review**

Title: Turner-Stokes L, Disler PB, Nair A, Wade DT. Multi-disciplinary rehabilitation for acquired brain injury in adults of working age. *Cochrane Database Syst Rev* 2005(3):CD004170[9].
Purpose: To assess the effects of multi-disciplinary rehabilitation following ABI in adults
Design: Systematic (Cochrane) review
Location: England
Methods: Rigorous evidence based procedures
Results and Conclusion: For moderate to severe injury, there is 'strong evidence' of benefit for formal intervention. For patients with moderate to severe ABI already in rehabilitation, there is strong evidence that more intensive programmes are associated with earlier functional gains. There is 'limited evidence' that specialist in-patient rehabilitation and specialist multi-disciplinary community rehabilitation may provide additional functional gains,
Quality: The authors have followed a rigorous methodology, Evidence level 1+.

Appendix 1.

Level of evidence in the SIGN system

Sign criteria for classifying studies

1++ High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias

1+ Well conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias

1- Meta-analyses, systematic reviews or RCTs, or RCTs with a high risk of bias

2++ High quality systematic reviews of case-control or cohort studies *or* High quality case-control or cohort studies with a very low risk of confounding, bias, or chance and a high probability that the relationship is causal

2+ Well conducted case-control or cohort studies with a low risk of confounding, bias, or chance and a moderate probability that the relationship is causal

2- Case-control or cohort studies with a high risk of confounding, bias, or chance and a significant risk that the relationship is not causal

3 Non-analytic studies, eg case reports, case series

4 Expert opinion

References

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2. Traumatic brain injury: diagnosis, acute management and rehabilitation. New Zealand Guidelines Group/ACC. *www.nzgg.org.nz* 2006.

3. McElligott J, Carroll A, Morgan J, Macdonnell C, Neumann V, Gutenbrunner C, et al. European models of multidisciplinary rehabilitation services for traumatic brain injury. Am J Phys Med Rehabil;90(1):74-8

4. ABIKUS, Evidence based recommendations for the rehabilitation of moderate to severe acquired brain injury (accessed Aug 2011). *http://reseauconceptuel.umontreal.ca/rid=1HPXBFFGH-1TS657P-K2/abikus_guideline(karen).pdf* 2007.

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6. Lexell J, Rehabilitation of traumatic brain injuries in Sweden. *J Head Trauma Rehabil* 2007;22(4):229-33.

7. Greenwald BD. Traumatic brain injury and acute inpatient rehabilitation. http://msktc.washington.edu/tbi/findms.asp 2010.

8. Cicerone KD, Langenbahn DM, Braden C, Malec JF, Kalmar K, Fraas M, et al. Evidence-based cognitive rehabilitation: updated review of the literature from 2003 through 2008. Arch Phys Med Rehabil;92(4):519-30.

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10. Tai Kake, Helen Dougherty, & Sarah Clark. Summative Evaluation of the IRS-TBI Service. Final Report, November 2010, ACC Research.