The evidence for the cost-effectiveness of rehabilitation following acquired brain injury

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Economic evaluation assists in healthcare planning to make sure that limited resources are used in the optimal way by comparing the costs of alternative interventions over a broad range of parameters including physical health, social and psychological benefits etc.

The recently published guidelines, *Rehabilitation following acquired brain injury: national clinical guidelines*,[1] make wide-ranging recommendations. Given the current dearth of rehabilitation services in the UK, their implementation will require significant investment, so it is pertinent to consider the evidence for the cost-effectiveness of rehabilitation.

A central theme of post-acute rehabilitation is early, targeted intervention to restore independent function. If effective, this should lead to cost benefits in terms of reduced length of stay in hospital and reduced needs for long-term care in the community. Similarly, effective vocational rehabilitation should increase the opportunity for return to work or alternative employment, such that the individual ideally becomes financially self-supporting.

On the other hand, rehabilitation itself imposes a cost. More intensive programmes may in theory produce even faster results, but they cost more. Eventually a balance must be struck between the expense of providing the programme and the likely cost savings achieved. The evidence for cost-effectiveness may be gleaned from studies which have included formal economic analysis, or from secondary analysis of studies which have recorded outcomes that can be costed, such as length of stay, return to work etc.

Comparative research in the field of complex disability following acquired brain injury (ABI) poses several major challenges to traditional research methodologies:

- There is marked heterogeneity with respect to the patient group, the intervention and setting, and to the outcomes that are relevant at each stage of recovery.
- The application of randomised controlled trial designs is further confounded by small numbers, and by ethical considerations, since many patients with ABI may lack the mental capacity to give fully informed consent.
- The expanding body of evidence for effectiveness of multidisciplinary rehabilitation in other conditions (particularly stroke) makes it increasingly unethical to randomise patients to 'no treatment' or even 'standard' care.
- The length of time over which rehabilitation may have its effects (often months or years) is usually longer than any funded research project and hinders the use of 'wait-list' control groups.

As a result of these challenges, large experimental design studies are relatively few and far between in this field. Nevertheless, there is an increasingly strong evidence base for the effectiveness and cost-effectiveness of rehabilitation following acquired brain injury. The American Academy of Physical Medicine and Rehabilitation has developed a searchable database of the (American) literature on cost-effectiveness, which was reviewed by Cardenas *et al* in 2001.[2] In addition, as part of the National Service Framework for Long-Term Conditions, systematic reviews of the literature have been undertaken to assemble the evidence of effectiveness and cost-effectiveness of rehabilitation. These reviews are summarised briefly below.

Timely post-acute rehabilitation

In the American literature:

- Cope and Hall[3] in 1982 reported a comparative study where matched populations of equally severely damaged brain injured patients were divided into early (n = 16) and late (n = 20) admission to a rehabilitation programme. Those admitted later required twice the length of stay in rehabilitation to achieve similar outcomes to the group admitted early. The study findings implied potential cost savings of an average of $40,000 per patient in the early rehabilitation group.
- In a further study, Cope and colleagues[4] reported a single blind before-and-after evaluation of a system of post-acute rehabiltation programmes which demonstrated increased rate of return to home and employment, and also reduction in need for continuing care (attendant care hours reduced from an average of 9.7 to 4 hours per day). The greatest changes were seen in the moderately to severely disabled group of patients.

- Ashley[5] reported a detailed cost-analysis of a single case to assess the impact of a rehabilitation programme in terms of lifetime savings in care costs. In that case, 14 months post-acute rehabilitation led to a total lifetime cost saving of between $4.85 and $6.0 million after subtracting the rehabilitation cost ($450,525).
- Aronow[6] included a cost outcome analysis, which included both costs of care and opportunity costs, in a non-randomised comparison of patients discharged from a comprehensive rehabilitation programme and those discharged from a general neurosurgical unit who had effectively had no comprehensive rehabilitation. Selection problems led to mismatching of the groups so that the rehabilitation group were more severely disabled, but at least this bias would not favour the rehabilitation group. Overall, the cost of rehabilitating the 60 cases in the rehabilitation group was $1 million. Annual savings were calculated at $335,842 – a rate estimated to allow recouping of the treatment costs within three years.

Whilst there are some theoretical difficulties in extrapolating cost benefits from US healthcare settings to the UK, there is evidence from this side of the Atlantic that the same principles apply.

- Wood *et al*[7] reported that timely cognitive and behavioural rehabilitation for 76 patients following severe brain injury led to estimated life-time savings in the cost of care of over £1 million.
- Slade and colleagues[8] in Leeds reported a randomised controlled trial of standard ($n = 81$) versus intensive ($n = 80$) rehabilitation. Higher intensity rehabilitation was naturally associated with increased staff costs, but led to significantly shorter length of stay (mean reduction 14 days) resulting in an overall saving of £1,737 per patient[9] in the net cost of providing the rehabilitation programme.
- Nyein *et al*[10] reported small case series of 39 patients undergoing post-acute rehabilitation. Between admission and discharge there was a reduction of the median estimated weekly cost of community care from £600 to £168 ($p < 0.001$). These benefits were sustained at three months follow-up, and for the series as a whole, the initial cost of rehabilitation was offset by savings in the cost of continuing care within 11 months.

Comprehensive integrated traumatic brain injury (TBI) programmes

- In a Canadian study, Khan *et al*[11] reported evaluation over six years of an integrated interdisciplinary TBI programme of seamless care from the acute neurosurgical intervention to discharge to patient's homes, rehabilitation institutions and long-term care facilities. After an initial investment of $250,000, total net savings over the six years amounted to $21.8 million. Length of stay was reduced from 30.5 days to 12 days. However, the study did not evaluate the impact on health outcomes and the authors acknowledge that care must be taken to ensure that long-term outcomes for TBI patients are not compromised by shortening length of stay.

  The study also evaluated the feasibility of on-line transfer of essential patient information between rehabilitation services. After an initial investment of $1,000, the net cost-savings over five years were estimated at $1.4 million.

Vocational rehabilitation

- A before-and-after evaluation of a comprehensive programme by Ben-Yishay and colleagues[12] ($n = 94$) demonstrated that 84% of the previously unemployable/unproductive patients were able to achieve productive employment in some capacity. There was some fluctuation in sustainability of employment over three years follow-up. Nevertheless, 50–60% of the sample achieved long-term and cost-effective vocational outcomes, and these figures are broadly similar to those reported by Possl *et al*[13] in their seven-year follow-up study.
- Abrams *et al*[14] reported a cost-benefit analysis of a work re-entry programme for TBI patients in California. Seventy-five per cent of the study sample returned to work during the observation period, and the ratio of total taxpayer benefit to cost for the programme was 2:1, and the ratio of taxpayer benefit to state cost was 4:1.

Conclusion

In summary, there is now reasonably strong evidence that long-term cost savings would outweigh short-term rehabilitation costs in a UK setting for those with serious brain injuries. Greatest cost savings appear to arise in the low-volume, high-cost group of patients with more severe disability. The evidence supports the development of integrated rehabilitation systems to provide early integrated rehabilitation for patients following acquired brain injury, and also vocational programmes to support return to productive occupation. However, it should be recognised that brain injury is for life, and the long-term results of rehabilitation are most successful where ongoing support and supervision is available for those who require it.

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References

1 Royal College of Physicians and British Society of Rehabilitation Medicine. *Rehabilitation following acquired brain injury: national clinical guidelines* (Turner-Stokes L, ed). London: RCP, BSRM, 2003.
2 Cardenas DD, Haselkorn JK, McElligott JM, Gnatz SM. A bibliography of cost-effectiveness practices in physical medicine and rehabilitation: AAPM&R white paper. *Arch Phys Med Rehabil* 2001;**82**(5):711–9.

3 Cope N, Hall K. Head injury rehabilitation: benefits of early intervention. *Arch Phys Med Rehabil* 1982;**63**:433–7.

4 Cope N, Cole JR, Hall K, Barkans H. Brain injury: analysis of outcome in a post-acute rehabilitation system. Part 2: subanalysis. *Brain Injury* 1991;**5**:127–39.

5 Ashley MJ, Schultz JD, Bryan VL, Krych DK, Hayes DR. Justification of post-traumatic brain injury rehabilitation using net present value techniques: a case study. *J Rehabil Outcomes Measurement* 1997;**1**(5):33–41.

6 Aronow H. Rehabilitation effectiveness with severe brain injury: translating research into policy. *J Head Trauma Rehabil* 1987;**2**:24–36.

7 Wood RL, McCrea JD, Wood LM, Merriman RN. Clinical and cost effectiveness of post-acute neurobehavioural rehabilitation. *Brain Injury* 1999;**13**(2):69–88.

8 Slade A, Chamberlain MA, Tennant A. A randomised controlled trial to determine the effect of intensity of therapy on length of stay in a neurological rehabilitation setting. *J Rehabil Med* 2002;**34**(6):260–66.

9 Slade A, Tennant A, Chamberlain MA. Enhancing therapy: does it make a difference? (SSR proceedings). *Clin Rehabil* 1999;**13**(1):80.

10 Nyein K, Turner-Stokes L, Robinson I. The Northwick Park Care Needs Assessment (NPCNA): A measure of community care needs: sensitivity to change during rehabilitation. *Clin Rehabil* 1999;**13**(6):482–91.

11 Khan S, Khan A, Feyz M. Decreased length of stay, cost savings and descriptive findings of enhanced patient care resulting from an integrated traumatic brain injury programme. *Brain Injury* 2002;**16**(6):537–54.

12 Ben-Yishay Y, Silver S, Piasetsky E, Rattock J. Relationship between employability and vocational outcome after intensive holistic cognitive rehabilitation. *J Head Trauma Rehabil* 1987;**2**(1):35–48.

13 Possl J, Jurgensmeyer S, Karlbauer F, Wenz C, Goldenberg G. Stability of employment after brain injury: a 7-year follow-up study. *Brain Injury* 2001;**15**(1):15–27.

14 Abrams D, Barker LT, Haffey W, Nelson H. The economics of return to work for brain injury survivors: Vocational services are worth the investment. *J Head Trauma Rehabil* 1993;**8**(4):59–76.