Evidence for inpatient rehabilitation as an effective intervention

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Rehabilitation in inpatient settings is expensive and staff-intensive. It is necessary for such services to demonstrate effectiveness to justify this. In contrast to popular notions, evidence for the effectiveness of inpatient rehabilitation does exist and is reviewed in this article. In particular, there is very good evidence for specialized inpatient stroke care and rehabilitation.

Rehabilitation has been developing as a health intervention since the Second World War. It is based on the philosophy that interdisciplinary teamwork and holistic, patient goal-oriented practice are the keys to successful management of a disabling condition. Within the framework of disability defined by the World Health Organization (WHO), rehabilitation can be defined as:

> **'a problem solving and educational process aimed at reducing the disability and handicap experienced by someone as a result of disease always within the limitations imposed both by available resources and the underlying disease' (Wade, 1992)**

In hospital practice, this definition typically finds form as services that provide restorative therapy and discharge planning for people with sudden devastating illness that have major functional consequences, e.g. spinal cord injury or stroke, or for people with complex health and social conditions that preclude rapid discharge from acute care services, e.g. frail elderly. However, there are many other forms that rehabilitation can take in specialized circumstances, e.g. cardiopulmonary, cancer or chronic pain.

With the increasing recognition that health resources are scarce and that funding should follow evidence-based practice, there is a need for rehabilitation to demonstrate its effectiveness. Although research has increased in volume over the past 20 years, it has been difficult to perform because of problems, such as small samples, lack of consensus about appropriate outcome measures, heterogeneity of interventions, and inadequate length of follow-up. Studies are not easily comparable or amenable to meta-analysis.

Furthermore, inpatient rehabilitation occurs in a wide variety of settings: mixed rehabilitation units of predominantly frail elderly patients but with a mixture of medical diagnoses, through to specialized stroke units, geriatric orthopaedic units, spinal cord and traumatic brain injury (TBI) units. Hence, when considering the effectiveness of inpatient rehabilitation, it is necessary to consider specific groups individually. It is also necessary to consider whether the inpatient setting offers any advantages over other settings, such as community or domiciliary rehabilitation.

A problem that is frequently encountered in clinical practice, but hardly ever mentioned in research designs, is how to decide which rehabilitation setting is most appropriate for an individual patient. This takes the issue beyond simply considering whether inpatient rehabilitation is effective, to considering which of the patient's characteristics predict benefit from inpatient rehabilitation. Furthermore, when considering the medium to long-term outcomes following inpatient rehabilitation, it is important to appreciate the significant effect that post-admission rehabilitation services have in maintaining and improving the natural history of disabling health conditions. It is artificial to consider inpatient services in isolation, yet space limitations force the authors to do so in this review.

Finally, the nature of what constitutes a 'good' outcome complicates analysis of the evidence base. A lack of an agreed framework or standardization for measuring key endpoints has, in part, led to an explosion of possible outcome measures. This is discussed more fully in companion papers to this rehabilitation symposium.

To explore the evidence for the effectiveness of inpatient rehabilitation the authors conducted

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a literature search of MEDLINE, CINAHL and Cochrane Database of Systematic Reviews using the keyword 'rehabilitation'. The search was limited to 1980–2004, English language and human. The abstracts were read to identify meta-analyses, systematic reviews, review articles, controlled trials and quasi-experimental studies in each of the diagnostic areas listed above. The authors do not consider this a full systematic review, but it did give an excellent overview of the evidence.

STROKE

There are more data concerning stroke rehabilitation than for any other disabling condition. The acute neurological deficit, following stroke, with potential for both reduction in impairment and adaptation of the environment to improve both activity and participation, arguably lends itself better to the interdisciplinary approach than any other condition. Refinement of research methodology and an accumulation of comparable trials have meant that fairly definite conclusions can be drawn for the effectiveness of inpatient rehabilitation for stroke – at least at a service level.

A Cochrane systematic review has indicated that an organized multidisciplinary stroke unit service leads to a reduction in death, disability and the need for long-term institutional care when compared with conventional hospital care or home-based rehabilitation teams (Langhorne, 2004). Most of the available evidence concerns either comprehensive stroke units (that admit patients acutely and also provide rehabilitation), or rehabilitation stroke units that admit patients after the acute phase is complete. There is less complete evidence to support mixed rehabilitation units. The outcomes for 100 patients admitted to a stroke unit compared with a less organized system of care can be neatly summarized (*Table 1*). The key features of a stroke unit are listed in *Table 2*.

Cochrane reviews have also considered hospital at home (HAH) and early supported discharge (ESD) interventions for patients with stroke (Langhorne et al, 2004). HAH is defined as a service that provides active treatment by health professionals in the patient's home of a condition that would otherwise require acute hospital inpatient care, always for a limited period. ESD was defined as any service intervention that provided rehabilitation and support in a community setting with an aim of reducing the duration of hospital care. Neither review showed any significant difference in patient outcomes. HAH showed a trend towards greater hospital bed use and increased costs in the intervention groups. ESD showed significant reduction in length of stay (LOS) of 9 days, but overall costs of such services remain unclear.

PROXIMAL FEMORAL FRACTURE

This is a significant cause of mortality and morbidity in older people and is often the factor that leads to institutionalization. Specialized inpatient rehabilitation supervised by a geriatrician within a multidisciplinary team has recently been the subject of a Cochrane review (Cameron et al, 2004). This identified nine randomized controlled trials involving 1887 patients. Five of the trials were based on provision of rehabilitation in a geriatric-orthopaedic rehabilitation unit, two in a mixed assessment rehabilitation unit and two with an early multidisciplinary team intervention programme based on the orthopaedic ward.

The results show a trend towards reduction in the combined outcome of mortality and deterioration in functional status, which is not quite statistically significant: Odds Ratio (OR) 0.91(95% Confidence Interval (CI) 0.83–1.01). These were the only outcomes to be reported by all nine trials. Various studies reported LOS, readmissions, cost and carer burden and some limited conclusions can be made from these if taken within the

TABLE 1
Summary of the main outcomes in randomized controlled trials of stroke unit care, in terms of the outcomes for every 100 patients

	Stroke unit (%)	Conventional care (%)	% Absolute risk reduction, 95% CI
Independent at home	44	38	6 (2,9)
Dependent at home	16	16	0 (-2,2)
Institutional care	18	21	-3(-6,-1)
Dead	22	25	-3(-6,0)
Dead or institutional care	40	46	-6(-9,-3)
Dead or dependent	56	62	-6(-9,-3)

CI = Confidence Interval. From Warlow et al (2001)

TABLE 2
Core features of a stroke unit

Care coordinated by a multidisciplinary team
Team meets to discuss patients at least weekly (*Figure 1*)
Nurses have expertise in rehabilitation
Team consists of professionals interested and specializing in stroke
Regular in-service training for staff is provided
Involvement of carers in patient care

context of the studies analysed. The authors point to heterogeneity of the interventions, variable time to follow-up, different outcome measures and inadequate definition of comorbidity such as dementia to explain the wide range of results and give advice for trial design in the future.

For some patients an alternative to inpatient rehabilitation for proximal femur fracture is ESD. A systematic review by Cameron et al (2000) identified five cohort studies but only one RCT comparing ESD with an in-hospital care package. They conclude that ESD reduces LOS in hospital and is associated with higher rates of return to previous residential status. There was a non-significant increase in readmission rate after ESD. One of the important issues with ESD is appropriate selection of patients, since patients for trials of ESD are excluded if adequate social supports are unavailable or where there are complex comorbidities.

THE FRAIL ELDERLY

Rehabilitation in the elderly differs from that of younger patients. They have greater co-morbidity, including degenerative cognitive problems, multiple disabilities from multiple pathologies, less ambitious goals and greater polypharmacy. The literature has distinguished between two approaches: geriatic assessment units, which focus mainly on assessment and geriatric rehabilitation units (GRU), which focus on functional gain. The GRU trials have tended to include elderly people post-stroke, fractured femoral neck, or those deconditioned after medical or surgical illnesses in mixed wards, and incorporated rehabilitation delivered by an interdisciplinary team.

Figure 1. The case-conference is at the heart of interdisciplinary communication and teamwork.

The meta-analysis by Stuck et al (1993) demonstrated the efficacy of the GRU approach when compared with usual care on general medical wards. Six studies of 504 people in the intervention group and 586 in the control group showed a statistically significant reduction in mortality at 6 months (OR 0.65 95% CI 0.46–0.91) and an increased chance of living at home at 6 months (OR 1.8, 95% CI 1.28–2.53) and 1 year (OR 1.68, 95% CI 1.17–2.41). This analysis also showed improvements in physical and cognitive function.

The variability of the results can be partly explained by patient selection. Exclusion of too healthy subjects or subjects with a poor prognosis was associated with better results. This analysis also suggested that ambulatory follow-up post-intervention is associated with better outcomes. Targeting patients most likely to benefit from rehabilitation services remains at the forefront of literature as researchers attempt to better define the syndrome of frailty.

There has been no direct comparison of these inpatient rehabilitation services for the frail elderly with a similar group managed in the community. HAH for selected patients have been studied. The results have been summarized in a Cochrane review (Shepperd and Iliffe, 2004). The patients in these trials tended to be elderly patients with a mix of medical conditions and others recovering from elective surgery and were not typical of those who were evaluated in the GRU and/or geriatric evaluation and management unit trials. The studies showed no difference in patient health outcomes compared with usual hospital care. Although patients expressed greater satisfaction with HAH, carers expressed less. Hospital LOS was reduced but the cost-savings were offset by provision of hospital at home. These HAH schemes were not designed to provide comprehensive geriatric assessment, and the long-term outcomes that Stuck's meta-analysis showed as being improved following inpatient rehabilitation were not evaluated.

TRAUMATIC BRAIN INJURY

Aside from the general difficulties with rehabilitation research already mentioned, TBI research has specific issues, which greatly limits the kind of evidence available. Such issues include:

- The small numbers of patients and the ethical issues involving such patients (many of whom are young victims of motor vehicle accidents) in clinical trials
- The varied pathological nature (diffuse axonal, hypoxic or localized haemorrhagic) and location of the brain injuries

- The natural history of spontaneous recovery
- The premorbid health, intelligence and psychological state of the patient, his/her social support network and problems with measuring the severity of the initial injury.

Hence, there are no randomized controlled trials investigating the effectiveness of inpatient rehabilitation for TBI and the evidence-base depends on studies with quasi-experimental designs. These have been performed in several different settings.

In the setting of acute and/or subacute rehabilitation, three studies have used matched controls. Aronow (1987) matched 30 patients from an inpatient TBI programme with similar patients derived from an acute neurotrauma programme that received no formal rehabilitation and showed improved function and reduced dependency. A cost-effectiveness analysis suggested that the costs of inpatient rehabilitation would be recouped in 3 years. Cope and Hall (1982) compared outcome at 2 years in 34 patients who received subacute rehabilitation either before or after 35 days post-injury. No differences were noted in disability ratings or social status at follow-up, but the late admission group required twice the length of stay of the group who were transferred earlier to a rehabilitation unit.

In the post-acute setting, research has relied on using patients as their own controls. This is based on the premise that spontaneous recovery does not extend beyond 1–2 years and hence studies which utilize patients with greater than 1 year chronicity (the time since injury in these studies is several years) that show significant improvement are not unreasonable. Cope et al (1991) readmitted 145 patients with TBI 6–12 months post-injury. Institutionalization rates reduced from almost half to 15%, productive activity increased from 6% to 35% and hours of care reduced from 10.2 hours to 3.8 hours per day. Effects were confirmed in a subgroup of patients all greater than 1 year from the time of injury.

The management of behaviourally-disordered TBI patients is clinically one of the more difficult areas. Eames and Wood (1985) studied an intensive inpatient programme for 24 severely behaviourally-disordered patients with mean duration of 44 months post-injury. Two thirds of patients showed improvement in residential or placement options although the mean length of stay was very long at 12 months.

There have been no comparisons of inpatient *vs* community rehabilitation for TBI patients although a number of pre- and post-studies in the outpatient setting have looked at cognitive rehabilitation alone and shown some benefit.

SPINAL CORD INJURY

Before the first spinal cord injury (SCI) unit set up by Ludwig Gutman at Stoke Manderville in 1944, 80–90% of patients with spinal cord injury died within weeks. Research since the establishment of those units shows that, during the first 12 years after injury, the cumulative survival had risen to 88% of what could be expected in the absence of injury (De Vivo et al, 1991). Hence, it is now unethical to have a trial with a control group which does not receive this intervention. This, in addition to the low incidence of injury, the wide diversity of those injuries and the usual rehabilitation research difficulties of heterogenous interventions and non-standardized outcome measurement means that there are no randomized controlled trials, meta-analyses and even few quasi-experimental studies in this area.

Some studies compare outcome between early and delayed admission to spinal injuries centers. Delays in admission result in a significantly increased incidence of contractures (Yarkony et al, 1987), heterotopic calcification (Donovan, 1984), pressure sores and a significant lengthening of hospitalization (De Vivo et al, 1990). A British audit found the same results when comparing three groups of patients admitted within 1 week, between 1 week and 2 months, and over 2 months after injury (Aung and El Masry, 1997). A systematic review found only retrospective, observational studies to support early admission to a SCI unit and noted that, as a result of poor study design, the evidence to support this conclusion was weak (Bagnall et al, 2003).

Most data on the outcomes for patients with SCI following inpatient rehabilitation come from the Model Spinal Cord Injury Systems. The report of 13 763 patients injured since 1973 and treated at model systems of care throughout the USA showed clear improvement in gross neurological impairment as measured by the Frankel classification system. Those with incomplete cord lesions showed substantially greater improvement (De Vivo et al, 1991).

When considering functional outcome measurement, one study showed improvement in self-care and mobility skills as measured by the modified Barthel index for 711 patients who had undergone rehabilitation over an 8-year period. Even those with complete lesions showed decreased amount of attendant care needed (Yarkony et al, 1987). Discharge to a private residence in the community was reported in 94.1%

of patients having undergone spinal cord injury rehabilitation (De Vivo et al, 1991).

MULTIPLE SCLEROSIS

Two studies investigate the effect of inpatient rehabilitation for patients in the progressive phase of multiple sclerosis; one as multiple single case study design with 79 patients (Kidd and Thompson, 1997), the other as a waiting list stratified randomized controlled trial with 50 patients (Freeman et al, 1997). Both show short-term improvement in both functional and participation measures with little or no change in neurological impairment.

Whether these improvements can be sustained in the community, and for how long, is a question addressed by Francabandera et al (1988). Sixty-seven patients in the progressive phase of the disease, and mostly wheelchair users, were randomly allocated to either inpatient or outpatient rehabilitation. Functional state was then assessed every 3 months for 1 year. Those who had had inpatient rehabilitation had some initial functional advantage but by the end of the year both groups had functional states similar to before the intervention owing to the gradual progression of the disability. The evidence base thus provides limited guidance regarding inpatient rehabilitation for people with multiple sclerosis.

CONCLUSIONS

Despite practical difficulties of conducting research in rehabilitation, there is a growing evidence base for the effectiveness of inpatient rehabilitation, especially for stroke, frail elderly, TBI and SCI. There are many other conditions for which inpatient rehabilitation may be more effective than other models of care, or no care, but the evidence base is inadequate to draw firm conclusions. Further research should help identify characteristics of patients most likely to benefit from inpatient services compared to community-based services. HM

Conflct of interest: none

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KEY POINTS

- Inpatient rehabilitation following stroke is well supported by evidence from randomized controlled trials and meta-analysis, and should now be considered as standard care.
- Strong evidence from mainly non-randomized studies supports inpatient rehabilitation following spinal cord injury and traumatic brain injury.
- There is less high-quality evidence to guide decision-making about which patients benefit most from inpatient rehabilitation or who might derive similar, or more benefit, from rehabilitation in other settings.
- It is important to consider inpatient rehabilitation as one component of rehabilitation and disability services that span the continuum of care, from acute care hospitalization through to long-term community services, especially for progressive disorders such as multiple sclerosis.