The use of International Classification of Functioning, Disability and Health in Motor Neurone Disease Rehabilitation

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Abstract

Motor Neurone Disease (MND) is a relatively rare but fatal progressive neurodegenerative disorder of the motor system in adults. It causes diverse and challenging symptoms and disability. Given the broad spectrum of needs, current “gold-standard” management is “multidisciplinary care” which includes neurological, rehabilitative and palliative care. This thesis focuses on the rehabilitation phases of multidisciplinary care through investigation of disability from the perspective of persons with MND and their caregivers using cross sectional and predominantly qualitative methodology. Six linked studies address current gaps in evidence-based practice and in services in MND rehabilitation. The studies review existing evidence for multidisciplinary care in MND, and explore the perspectives of MND patients and their caregivers on disability and service gaps. They further describe the disability impact of MND using a standardised framework endorsed by the World Health Organisation – the International Classification Functioning, Health and Disability (ICF) and finally, investigate the effectiveness of a peer support program, which complements rehabilitation in people with MND.

Participants with a diagnosis of MND (n=44) were recruited from a tertiary MND clinic. This work was predominantly designed to test the hypothesis that issues relevant to multidisciplinary rehabilitation care from the perspective of the patient and caregiver can be addressed utilising the ICF framework. Gaps in evidence and service provision can then be identified to optimise clinical care in both clinical and research settings.

Study 1 presented a systematic review of the effectiveness of multidisciplinary rehabilitation and care for MND. Despite some suggestion that multidisciplinary care improves quality of life and reduces hospitalisation and disability; findings were inconclusive as quality of evidence was poor. This study highlighted gaps in current research relating to methodological rigour and appropriate study designs and appropriate outcome measures.

Studies 2 and 4 described the patient and caregiver’s perspective of MND-related disability and highlighted gaps in service and also the impact of MND on caregivers, thus allowing recommendations to be made for optimisation of clinical care and further development of service provision and health policies for people with MND and their caregivers. In particular, the need for coordinated care by neurology, rehabilitation and palliative care services (“neuropalliative rehabilitation” model) was highlighted.

Studies 3, 4 and 5 moved a step towards addressing the current lack of a standardised language and consensus for the care for people with MND and their caregivers by mapping their disability experience and relevant environmental factors onto the ICF framework. Study 5
in particular explored relevant personal factors which have been identified as important but not yet been classified within the ICF.

Study 6 was a small interventional study (n=7) that explored the value of a peer support program in persons with MND. Whilst the numbers were too small to make conclusive findings, it demonstrated the feasibility of such programs in persons with MND.

In conclusion, the gaps in MND care identified should be prioritised for future service development using the “neuropalliative rehabilitation” model of care. For improved consensus of care and communication amongst treating clinicians, the framework of International Classification of Functioning, Disability and Health should be further explored in this population through development of a “core set”.
Declaration

This is to certify that,

i. the thesis comprises only my original work towards the MD except where indicated in the Preface

ii. due acknowledgement has been made in the text to all other material used,

iii. the thesis is less than 100,000 words in length, exclusive of tables, maps, bibliographies and appendices.
Preface

I certify that this thesis is my original work. I am indebted to my colleagues who provided valuable assistance in the following areas:

Fary Khan: Advice and review of all chapters.
Paul Talman: Assistance with recruitment of participants through distribution of invitation letters, screening of exclusion criteria and confirmation of diagnosis.
Bhasker Amatya: Data entry and statistical support.
Susan Mathers: Review of Chapter 4.

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   Fary Khan: Advice and review of manuscript.
   Susan Mathers: review of manuscript.

   Paul Talman: Assistance with recruitment of participants through distribution of invitation letters, screening of exclusion criteria and confirmation of diagnosis
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9) Ng L, Khan F. Use of the International Classification of Functioning, Disability and Health to describe patient-reported disability: A comparison of Motor Neurone Disease, Guillain-Barré Syndrome and Multiple Sclerosis in an Australian cohort. Disabil Rehab, accepted June 2011. Fary Khan: Advice and review of manuscript

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Glossary

**International classification of functioning, disability and health (ICF)**
A classification system developed by the World Health Organisation that provides a framework to code a wide range of information about health and health-related domains. It uses a standardised common language permitting communication about health and health care across the world in various disciplines and sciences.

**Domains**
A practical and meaningful set of related physiological functions, anatomical structures, actions, tasks or areas of life. The ICF domains are described from the perspective of the body, the individual and society in two basic lists: (1) Body Functions and Structures and (2) Activities and Participation.

The terms activities and participation replace the formerly used terms “impairment”, “disability” and “handicap”, extending the scope of the classification to allow positive experiences to be described.

**Body functions**
Physiological functions of body systems (including psychological functions).

**Body structures**
Anatomical parts of the body such as organs, limbs and their components.

**Impairment**
Problems in body function or structure such as a significant deviation or loss.

**Activity**
Execution of a task or action by an individual.

**Participation**
Involvement in a life situation

**Contextual factors/Environmental factors/Personal factors**
These consist of factors extrinsic to a person (such as environmental factors) and intrinsic to a person (such as personal factors). Environmental factors make up the physical, social and attitudinal environment in which people live and conduct their lives. Personal factors are those that influence a person “functioning” and are currently being developed by the World Health Organisation.
**Functioning**  
This is an umbrella term encompassing all body functions, activities and participation.

**Disability**  
This is an umbrella term for impairments, activity limitations or participation restrictions.

**Rehabilitation**  
This is a problem-solving educational process aimed at reducing disability and increasing participation experienced by someone as a result of disease or injury. The aim is to optimise a person’s physical, psychological, social, vocational, avocational and education potential in the presence of physiological or anatomic impairment and environmental limitations.

**Multidisciplinary care**  
This includes any intervention delivered by two or more disciplines under medical supervision that aims to maximise activity and participation. The disciplines could include nursing, physiotherapy, occupational therapy, speech pathology, orthotics, dietetics or nutrition, social work (SW), psychology, neuropsychology and spiritual counselling (chaplains).

Multidisciplinary care varies in its content, intensity and frequency, and is tailored to an individual’s needs.

**Palliative care**  
Palliative care is an approach that improves the quality of life of patients and their families facing the problem associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial and spiritual.
## Glossary of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AAC</td>
<td>Augmentative and Alternative Communication</td>
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<tr>
<td>ALS</td>
<td>Amyotrophic Lateral Sclerosis</td>
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<tr>
<td>ALSFRS</td>
<td>Amyotrophic Lateral Sclerosis Functional Rating Scale</td>
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<td>ALSSS</td>
<td>Amyotrophic Lateral Sclerosis Severity Scale</td>
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<tr>
<td>BRSM</td>
<td>British Society of Rehabilitation Medicine</td>
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<tr>
<td>CCT</td>
<td>Clinical controlled trial</td>
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<td>CPI</td>
<td>Clinical Practice Improvement</td>
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<td>CSI</td>
<td>Caregiver Strain Index</td>
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<td>DASS</td>
<td>Depression, Anxiety and Stress Scale</td>
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<tr>
<td>EFNS</td>
<td>European Federation of Neurological Societies</td>
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<tr>
<td>ECU</td>
<td>environmental control unit</td>
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<tr>
<td>EMG</td>
<td>electromyography</td>
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<tr>
<td>FALS</td>
<td>familial Amyotrophic Lateral Sclerosis</td>
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<td>FVC</td>
<td>Forced vital capacity</td>
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<td>GBS</td>
<td>Guillain-Barré Syndrome</td>
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<td>ICF</td>
<td>International Classification of Functioning, Disability and Health</td>
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<tr>
<td>IQR</td>
<td>interquartile range</td>
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<td>IRT</td>
<td>item response theory</td>
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<td>LMN</td>
<td>lower motor neurone</td>
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<td>LOS</td>
<td>length of stay</td>
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<td>LTNC</td>
<td>long-term neurological conditions</td>
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<td>MDC</td>
<td>multidisciplinary care</td>
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<td>MND</td>
<td>motor neurone disease</td>
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<td>MQOL</td>
<td>McGill Quality of Life questionnaire</td>
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<td>MRC</td>
<td>Medical Research Council</td>
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<td>MS</td>
<td>Multiple Sclerosis</td>
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<td>NHHRC</td>
<td>National Health and Hospitals Reform Commission</td>
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<td>NIV</td>
<td>non-invasive ventilation</td>
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<td>NPCs</td>
<td>needs and provision complexity scale</td>
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<td>NSF</td>
<td>National Service Framework</td>
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<td>OD</td>
<td>other design</td>
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<td>OT</td>
<td>occupational therapy</td>
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<td>PEG</td>
<td>percutaneous endoscopic gastrostomy</td>
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<td>PT</td>
<td>physiotherapy</td>
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<td>QoL</td>
<td>quality of life</td>
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<td>QR</td>
<td>quality requirements</td>
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<td>RCT</td>
<td>randomised controlled trial</td>
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<td>Abbreviation</td>
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<tr>
<td>SEIQoLDW</td>
<td>Schedule of the Evaluation of Individual Quality of Life</td>
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<td>SD</td>
<td>standard deviation</td>
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<td>SOD1</td>
<td>superoxide dismutase-1</td>
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<td>SP</td>
<td>Speech pathology</td>
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<td>SRB</td>
<td>Self-rated burden</td>
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<td>SW</td>
<td>social work</td>
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<td>UCL</td>
<td>Utrecht Coping List</td>
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<td>UK</td>
<td>United Kingdom</td>
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<td>US</td>
<td>United States of America</td>
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<td>UMN</td>
<td>upper motor neurone</td>
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<td>VAS</td>
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<td>Box 5.1</td>
<td>Key skills in neuropalliative rehabilitation</td>
<td>128</td>
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</table>
Motor Neurone Disease (MND) is a relatively rare but fatal neurodegenerative disorder of the motor system in adults. It has a reported population incidence of between 1.5 and 2.5 per 100,000 per year worldwide with the only established risk factors being age and family history. In Australia, approximately 1,300 people currently live with MND and in 2005, 499 people died from MND [1]. There are few other statistics known (such as the costs of MND care in Australia) as MND is not separately reported by the Australian Bureau of Statistics [2]. The disease occurs throughout adult life, with the peak incidence between 50 to 75 years of age and is more common in men (3:2) [3]. MND is characterised by the loss of motor neurones in the cortex, brain stem, and spinal cord, manifested by upper and lower motor neurone signs and symptoms affecting bulbar, limb, and respiratory muscles. Death (usually from respiratory failure) follows on average two to four years after onset, but some may survive for a decade or more [4].

MND is a devastating condition with unknown aetiology and no current cure. The symptoms in MND are diverse and challenging and include weakness, spasticity, limitations in mobility and activities of daily living, communication deficits and dysphagia, and in those with bulbar involvement, respiratory compromise, fatigue and sleep disorders, pain and psychosocial distress. The International Classification of Functioning, Health and Disability (ICF) [5], defines a common language for describing the impact of disease at different levels: impairment (body structure and function), limitation in activity and participation (see Figure 1.1). Within this framework MND related impairments (weakness, spasticity), can limit “activity” or function (decreased mobility, self-care, pain) and “participation” (driving, employment, family, social reintegration). “Contextual factors”, such as environmental (extrinsic) and personal factors (intrinsic) interact with all the other constructs to shape the impact of MND on patients and their families. The impact of MND upon patients, their caregivers (often family members) and on society is substantial, often beginning long before the actual diagnosis is made, and increasing with increasing disability and the need for medical equipment and assisted care [6].

Given the broad spectrum of needs, current management spans from diagnosis (acute neurological needs) through to symptomatic and supportive rehabilitation and palliative care. It should be noted however, that although care of MND spans a broad spectrum and “multidisciplinary care” includes neurological, rehabilitative and palliative care, the focus of this research is on the rehabilitation phases, hence discussion of acute neurological and palliative care aspects are limited. Rehabilitation is defined as “a problem solving educational process
aimed at reducing disability and increasing participation experienced by someone as a result of disease or injury’ [7]. Although it is sometimes effective in reducing impairment, its principal focus is to reduce symptoms and limitations at the level of activity and participation, through holistic interventions, which incorporate personal and environmental factors.

Figure 1.1 The interactions between the various components of the ICF (adapted from [5])

In Australia, where there is a wide geographical spread of people with MND, a proportion are cared for by tertiary multidisciplinary MND clinics (such as those in Adelaide, Brisbane, Melbourne, Sydney and Perth) where they are commonly seen on a three-monthly basis with most of the care services then delivered primarily in the local community setting through referrals by the tertiary MND clinic. Others are cared for predominantly through general neurology clinics. Access to rehabilitation and palliative care services is variable and can be very limited [8]. The MND associations (non-profit charitable, consumer based institution) around Australia complement the care of approximately 900 people with MND around Australia through services such as equipment loan and provision of advice, education and support to those affected by MND and to health care professionals [1]. In addition, MND Australia fundraises, promotes awareness and supports research in MND. The level of access to multidisciplinary clinics, which is the current recommended practice [9, 10], is comparable to the
Netherlands [11] and Italy [12] and superior to Ireland [13] and Scotland [14]. However, models of care vary internationally. For example, rehabilitation physicians predominantly coordinate the care of persons with MND in the Netherlands whilst there is little involvement of rehabilitation physicians in Australia [11]. The role of consumer organisations such as MND associations is also variable – their role is much more active in Australia and the United Kingdom (UK) than in the Netherlands [1, 11, 13, 14].

1.1 Issues in the care of patients with MND

The generally rapid and relentless progression of MND creates a significant challenge not only to people with MND and their caregivers (usually their families) in terms of adjustment but also to health professionals in their ability to provide effective and responsive care management that meet the complex and variable needs of people with MND across disciplines and organisations. It is essential therefore for the interface between neurology, rehabilitation and palliative care to ensure co-ordinated care for people with MND rather than duplicating services.

Under the UK Department of Health’s National Service Framework for Long-term Neurological Conditions [15], MND is a “progressive condition” with a rapid deteriorating course. This framework includes 11 quality requirements (QR), which provide guidance of care to anyone living with a neurological condition:

- Provision of information and co-ordinated person-centred care (QR1)
- Improvement of access to neurological services for diagnosis and treatment (QR2)
- Improvement of care of people experiencing a neurological or neurosurgical emergency (QR3)
- Improvement of access to rehabilitation so that disability can be targeted with the aim of achieving and maintaining the greatest possible level of independence and social inclusion (QR 4-6).
- Provision of flexible services and packages of care to help people live as independently as possible according to their own choices (QR 7-8)
- Improvement of palliative care services for people in the later stages of their illness (QR9)
- Support families and caregivers (QR10)
- Provision of appropriate neurological care in hospital and other health and social care settings (QR11)

The need to challenge discrimination and reduce inequalities and ensure that all are treated with respect and dignity applies across the QRs.
By international comparison, Australia has a good health system with many strengths, including a universal health care system (Medicare). However, as highlighted by a recent report from the National Health and Hospitals Reform Commission (NHHRC), there is need for health reform to meet the challenge of caring for chronic disease [16]. Four themes have been identified:

- Taking responsibility – ensuring that there is individual and collective action to build good health and wellbeing, by people, families, communities, health professionals, employers and governments;
- Connecting care - comprehensive care for people over their lifetime;
- Facing inequities - recognising and tackling the cases and impact of health inequities;
- Driving quality performance – better use of people, resources and evolving knowledge.

In relation to MND, particular gaps in coordinated integration of care have been highlighted, such as education (to patients, families and health professionals regarding care of MND), access to a key worker model for coordination and communication, timely and appropriate referrals (eg. for palliative care), funding for high-needs patients, access to respite care and after hours support [8].

Accordingly, both the National Service Framework and NHHRC stress areas that are particularly relevant to people with MND:

a) the importance of connected, integrated, comprehensive health care that is person-centred and flexible
b) access to subacute rehabilitation services to enable achievement and maintenance of the greatest possible level of independence and social inclusion
c) improvement of palliative care services for people in the later stages of their illness, including advance care planning.

These areas are strongly supported by MND Australia [8, 17]. In addition, the needs of caregivers and the integral role of community care services including respite and case management in supporting people with MND and their families have been highlighted [17].

1.2 Barriers which affect the development and implementation of recommendations in the care of patients with MND

There are a number of barriers however, which affect the development and implementation of the above recommendations specifically in the care of patients with MND and their caregivers:

1) Despite the recommendation for multidisciplinary rehabilitation and palliative care, the evidence base for rehabilitation is unclear. This includes whether organised multidisciplinary care does indeed achieve better outcomes than the absence of such services in persons with MND; which types of programmes are effective and in which setting; whether a greater intensity (time or expertise or both) of rehabilitation leads to
great gains; which specific outcomes are influenced (survival, dependency, social integration, mood, quality of life); and whether there are demonstrable cost benefits for multidisciplinary care in MND.

2) The effectiveness of specific interventions that complement rehabilitation, such as peer support programs, is unclear.

3) MND is a rare condition; hence many are not experienced in its care. This is compounded by the patchiness of guidelines for the care of MND, which often focus in certain areas only such as respiratory management instead of comprehensive multidisciplinary rehabilitation and palliative care.

4) There are significant difficulties involved in conducting trials to build the evidence base in MND care in terms of logistical and ethical considerations. Motor Neurone Disease is not only relatively rare; it is also fatal and associated with rapidly progressive disability. Recruitment and attrition are major issues.

5) A further major issue with clinical trials in MND relates to the current available outcome measures, which are often generic, and do not capture the entire spectrum of issues in MND, nor reflect change adequately.

6) The experience of disability from the perspective of the MND patients and their caregivers, which is important for their comprehensive person-centred care, has not been elucidated.

7) There is limited understanding of the impact of MND on caregivers.

8) There is no common language for the management of disability in MND within the multidisciplinary setting or international setting, nor consensus of what issues should be addressed in multidisciplinary care programs for patients with MND that incorporates the patients’, caregivers’ and treating clinicians’ perspective.

1.3 Hypothesis

The main hypothesis of this research is that issues relevant to multidisciplinary rehabilitation care from the perspective of the patient and caregiver can be addressed utilising the ICF framework. Gaps in evidence and service provision can be identified to optimise clinical care in both clinical and research settings.
1.4 Objectives
This thesis incorporates 6 linked studies conducted in an Australian community cohort through the Royal Melbourne and Bethlehem Hospitals in Victoria, aiming to address some of the issues discussed above.

The specific aims of the individual studies are:

1) To determine the evidence-base for current disability management for MND, including the evidence for multidisciplinary care (Study 1)

2) To describe the disability profile and health-care needs for persons with MND in an Australian sample from the perspective of the patients and caregivers to identify current gaps in knowledge and service provision (Study 2).

3) To use the ICF World Health Organisation disability framework to describe patient-reported disability in MND and to identify relevant environmental factors that impact upon their experience of MND and to compare this to other conditions (Guillain-Barré Syndrome and multiple sclerosis) to determine a set of ICF categories that may be common to long-term neurological conditions (Study 3).

4) To use the ICF framework to compare disability in MND from the patient and the caregiver perspective and to describe the impact of MND on carer burden (Study 4)

5) To identify relevant personal factors affecting the experience of living with MND from the perspective of persons with MND in an Australian cohort (Study 5).

6) To determine the effectiveness of a peer-support intervention in MND on the management of neuropsychological sequelae to enable recommendations relating to the role of such interventions in the care of MND (Study 6).

7) To develop recommendations for optimal rehabilitation care through incorporation of the above objectives.

1.5 Overview of Methods (see Figure 1.2)
To capture the range of experiences in real life context, a combination of quantitative and qualitative approaches is often necessary. A Priority-Sequence Model is used in this research where a principal method is selected and the effectiveness of this method optimised before using a different method to improve the main data collection strategy [18].
Qualitative research is best suited to explore questions about human interaction and how this is interpreted. It is more useful than quantitative methods for capturing the lived experiences of persons with MND. Therefore it is the predominant method used for describing the disability profile and health-care needs for persons with MND and their caregivers; for linking these disability and environmental factors into the ICF framework; and for describing personal factors in MND. This included in-depth interviews with patients with MND and their caregivers, followed by the linkage and mapping of patient-reported disability due to MND.

Quantitative methods however, are better for obtaining specific information on the effectiveness of a peer-support intervention on neuropsychological sequelae using pre-existing outcome measurement tools. A pre-post design was used where all participants who wished to participate in the intervention were offered the intervention. The same outcome measures were then applied at baseline (before the intervention), at 6 weeks after the intervention and at 12 months to determine if the early effects of the intervention were longer lasting.

A more detailed description of methodology is provided in Chapter 3.

1.5.1 Setting and Participants

A community-based MND group was recruited through a tertiary MND multidisciplinary clinic that services Victoria, Australia, including metropolitan and rural regions. Selection criteria included diagnosis of MND according to the El Escorial criteria [19] as diagnosed by a neurologist, residence in Victoria, community-based (non hospital inpatient), ability and willingness to give informed consent, and aged 18 and above. Details of diagnosis were confirmed by a neurologist (PT) with a subspecialty interest in MND. Exclusion criteria included severe cognitive issues or dementia and other substantial medical, neurological or psychiatric disorders. Screening of exclusion criteria was done by a neurologist (PT) through consultation of the medical records and liaison with the treating clinicians of the patients. These studies were approved by the Melbourne Health and Calvary Healthcare Bethlehem Human Research and Ethics Committees.

All participants (n=59) who met the criteria were contacted by mail and invited to participate in the studies. Those who replied affirmatively (n=44) were contacted by telephone by the primary author who explained the study further and organised an interview appointment.

Recruitment and all interviews were undertaken between September 2009 and February 2010. Thirty-nine interviews were conducted by the primary author and 5 interviews by an independent trained research assistant, who had received a three-day training session from the primary author in assessments (see “Questionnaires”) and observed in a pilot process to
confirm achievement of an acceptable standard. 44 persons with MND were interviewed. 7 patients lived alone with no caregiver. 37 agreed to have their caregivers interviewed during the same appointment and they were interviewed separately. Caregivers were defined as the person who lives with the person with MND and provides them “with the most care and assistance” [20]. Participants were interviewed at a venue of their choice (half were interviewed at home or at hospital and half over the telephone) for one hour with rest breaks.

Seven MND participants further underwent a peer support intervention and completed a second assessment at 6 weeks post intervention and a third assessment 12 months later.
Figure 1.2 Overview of study plan and methods

Study 1
Systematic (Cochrane) review of multidisciplinary care (rehabilitation) in MND

Total cohort
MND patients attending a tertiary multidisciplinary clinic at Bethlehem Hospital
N=59

N=44 patients and their 37 caregivers (7 did not have caregivers)
consented to participate (15 of the 59 patients from the total cohort declined to respond)

Study 2 - Qualitative analysis
Cross-sectional survey of patients and caregivers to determine the disability profile and identify gaps in service provision through open-ended followed by set questionnaires

Study 3 - Qualitative analysis
N=44 (MND patients)
Secondary analysis of data
Mapping of problems reported by 1/3 of patients to the ICF
Comparison of data to similar data previously collected in a Guillain-Barré syndrome and multiple sclerosis cohort

Study 4 - Qualitative and descriptive quantitative analysis
N=37 (caregivers)
Secondary analysis of data
Mapping of problems reported by 1/3 of caregivers to the ICF
Comparison to mapping of problems reported by 1/3 of patients to the ICF.
Additional analysis of set questionnaires on the impact of MND on caregiver psychological well-being and carer burden

Study 5 - Qualitative analysis
N=44 (MND patients)
Secondary analysis of data
Identification of personal factors reported by patients (not yet classified in the ICF)

Study 6 - Quantitative analysis
N=7 patients (5 caregivers)
Pre-post interventional trial examining the effectiveness of a peer-support program through set questionnaires (standardized outcome measurements tools)
1.6 Overview of the thesis

This thesis incorporates 6 linked studies (studies 1-6) conducted in an Australian community cohort through the Royal Melbourne and Bethlehem Hospitals in Victoria.

Chapter 2 highlights the impact of MND and issues surrounding the optimal care of MND, including the interface between neurology, rehabilitation and palliative care, is expanded in the next chapter. The role of rehabilitation and how the ICF framework can be applied to multidisciplinary care in MND is further described. An update in the symptomatic and disability management of MND is provided and incorporates issues encountered over the spectrum of disease, including activity and pain related issues, respiratory and dysphagia issues and psychosocial changes. Recent trends, developments and future research in rehabilitation approaches that maintain and restore functional independence and quality of life are presented.

Chapter 3 expands on the methodology used in this thesis.

Chapter 4 (Study 1) comprehensively explores the current evidence-base for multidisciplinary care in MND, through a systematic review involving the identification of clinical trials and observational studies and performance of a “best evidence” synthesis. Concerns about the method of application of evidence-based practice, especially of randomised controlled trials in rehabilitation settings are discussed and alternative approaches offered.

Chapters 5-9 (studies 2-6) are the experimental chapters. A description of the disability profile and gaps in service provision as determined from the perspective of an Australian cohort of 44 MND participants and their 37 caregivers, is provided in Chapter 5 (Study 2). Chapter 6 (Study 3) builds on the findings in Chapter 5 by linking patient-reported disability and environmental barriers in MND to ICF categories. In addition, these findings are compared to similar data collected for two other long-term neurological conditions (Guillain-Barré syndrome and multiple sclerosis). Chapter 7 (Study 4) focuses on the comparison of the MND-related ICF categories identified by patients (as reported in Chapter 6) to those identified by their caregivers; and further expands on the impact of MND on caregivers. Chapter 8 (Study 5) identifies personal factors, which have been identified as a significant aspect in the experience and care of MND but are currently not yet classified in the ICF. Chapter 9 (Study 6) reports on a pre-post study of the 7 MND participants who underwent a peer-support intervention to determine the effectiveness of such an intervention on neuropsychological sequelae and the role of peer-support intervention in the rehabilitative care of MND.

Chapter 10 provides conclusions from the findings of the research and recommendations for optimal care in MND. The next chapter provides an overview of an update in MND care.
Chapter 2 - Motor Neurone Disease: Causes, Classification and Treatments

This chapter examines the current literature on the impact of MND and issues surrounding the optimal care of MND, including the interface between neurology, rehabilitation and palliative care. A brief overview is given on the causes and classifications of MND. The role of rehabilitation and how the ICF framework can be applied to multidisciplinary care in MND is described and an update in the symptomatic and disability management of MND is provided, incorporating issues encountered over the spectrum of disease, including activity and pain related issues, respiratory and dysphagia issues and psychosocial changes. Recent trends, developments and future research in rehabilitation approaches that maintain and restore functional independence and quality of life are presented.

2.1 Introduction

Motor neurone disease (MND), also commonly known as amyotrophic lateral sclerosis (ALS), is a chronic neurodegenerative disorder of the motor system in adults, characterised by the loss of motor neurones in the cortex, brain stem, and spinal cord, manifested by progressive upper and lower motor neurone signs and symptoms affecting bulbar, limb, and respiratory muscles [21]. It was first described by Charcot in the nineteenth century [22] and is also known by the eponym “Lou Gehrig’s Disease”, after the famous baseball player who was affected with the disease. Death usually results from respiratory failure and follows on average two to four years after onset, but some may survive for a decade or more [4].

MND is a relatively rare disease with a reported population incidence of between 1.5 and 2.5 per 100,000 per year [23] and a prevalence of 2.7-7.4 per 100,000 population [24]. Age is the most important risk factor and the disease occurs throughout adult life, with the peak incidence between 50 to 75 years of age [25]. MND occurs more commonly in men than in women in a ratio of 3:2 [3].

MND is lifelong and persons with MND live with a range of problems that affect every day functional activities. As mentioned in Chapter 1, the ICF [5], defines a common language for describing the impact of disease at different levels: impairment (body structure and function), limitation in activity and participation. Within this framework MND related impairments (weakness, spasticity), can limit “activity” or function (decreased mobility, self-care, pain) and “participation” (driving, employment, family, social reintegration). “Contextual factors”, such as environmental (extrinsic) and personal factors (intrinsic) have an impact on the persons with MND, their families and the society. MND therefore has personal costs such as reduced quality
of life and also significant economic costs which may result from increased demand for health care, social services, and caregiver burden.

2.2 Impact of MND

The burden of disease and economic impact of MND upon patients, their caregivers (often family members) and on society is substantial, often beginning long before the actual diagnosis is made, and increasing with increasing disability and the need for medical equipment and assisted care [6]. It has been estimated that basic patient equipment costs (including hospital bed, electric wheelchair, augmentative communication equipment) can cost over USD$40,000 whilst mechanical ventilation costs roughly USD$200,000 a year [6]. These costs do not include earnings loss, therapy costs, and formal and informal care, which often make up the bulk of costs but are often not calculated. Within Australia, provision of care for people with terminal illness largely falls onto informal, unpaid caregivers, usually family and/or friends [26]. In a recent study of Australian persons with MND in the community (n=44) [27], 1/3 required help 2-3 times a day for personal care whilst 1/3 required the presence of someone most of the time. A quarter of these 44 persons with MND received assistance solely from family. It is therefore not surprising that primary caregivers have been estimated to spend a mean of 9.5 hours a day caring for patients even where there is paid assistance [28]. Whilst the informal care costs for persons with MND in the community (by families and others) is not known, these costs account for 43% of total costs in other neurodegenerative conditions [29] (where disability is less marked, such as in multiple sclerosis) and is likely to be as substantial if not more, in MND. Finally, it is well documented that a huge proportion of health care dollars are spent in the last 30 days of a person’s life [30]. This is particularly pertinent in a rapidly fatal condition such as MND.

2.3 Epidemiology and risk factors

The collection of epidemiological data is challenging due to the low incidence rates of MND. However, the establishment of a number of population-based registers worldwide (mainly in Europe and Australia), has enabled a clearer understanding of MND epidemiology. The incidence and mortality rates of MND have slowly increased over decades [31, 32], likely at least partly due to longer life expectancy [33] with improved medical management and supportive care. Incidence rates range between 1.5 and 2.5 per 100,000 per year [23]; whilst prevalence rates range between 2.7-7.4 per 100,000 population [24] which equates to roughly 25,000 in North America [34], 5000 in the UK [35] and 1200 in Australia [36]. The incidence may be higher in Caucasians than in other ethnic groups (African, Asian, Hispanic) but this has been difficult to determine due to methodology variations in studies of non-Caucasian populations [37].
Age and family history are the only well-established risk factors for MND. There is class II evidence that smoking is also a risk factor [38]. Evidence for other risk factors such as physical activity and exposure to heavy metals is conflicting [39-41].

Geographically, the cluster of “Western Pacific ALS” during the 20th century in Guam, the Kii peninsula of Japan and Papua New Guinea has suggested an environmental contribution to MND pathogenesis. However, whilst a number of hypotheses have been proposed, including the dietary consumption of cycad (Cycas circinalis) [42], no definitive cause has been found [43].

The role of genetics is important in MND. Familial MND, more commonly referred to as familial ALS (FALS), accounts for 10% of MND whilst a number of genetic loci have been found to be associated with idiopathic MND (remaining 90%) suggesting genetic susceptibility in pathogenesis [44-46]. At least fifteen chromosomal loci have been linked with familial MND. Familial MND is phenotypically and genetically heterogeneous. Majority of familial MND are autosomal dominant in nature and 20% are linked to FALS type 1 or the superoxide dismutase (SOD1) gene [47]. Other autosomal dominant familial MND include FALS types 3 [48], 5 [49], 6 (FUS gene) [50, 51], 7 [52], 8 [53], 9 (ANG gene) [54], 10 (TARDBP gene) [55], 11 (FIG4 gene) [56], NF-H gene [57], DAO gene [58], X-linked [59] and MND with FTD [60]. Autosomal recessive familial MND includes FALS 2 [61] and 5 [62].

2.4 Aetiology and Pathogenesis

Although the aetiology of MND remains unknown, current evidence suggests that multiple interacting factors contribute to motor neurone injury in MND. The working hypothesis is that MND, like many other chronic diseases, is a complex genetic condition, and the relative contribution of individual environmental and genetic factors are likely to be relatively small [23]. The three key pathogenetic hypotheses are genetic factors, oxidative stress, and glutamatergic toxicity, which result in damage to critical target proteins such as neurofilaments and organelles such as mitochondria [63-65].

Pathological findings in MND vary depending on the clinical variant. Most patients have the ALS variant where large α-motor neurones in the brainstem and spinal cord degenerate leading to progressive weakness and muscle atrophy whilst loss of upper motor neurones result in spasticity and hyper-reflexia [66]. MND is generally regarded as a multisystem disease -- motor neurones are the earliest and most prominently affected groups of cells but small interneurones in the spinal cord and motor cortex [67], and cortical motor cells are also lost. As a result, retrograde axonal loss and gliosis in the corticospinal tracts occurs, accompanied by involvement of sensory, spinocerebellar pathways and neuropsychological changes [68, 69].
Mechanisms of selective motor neurone death are unclear and most current hypotheses are based on animal models [69]. These include: SOD1-mediated toxicity, excitotoxicity, cytoskeletal derangements, mitochondrial dysfunction, apoptosis and others. SOD1 converts superoxide, a toxic by-product of mitochondrial oxidative phosphorylation, to water or hydrogen peroxide. More than 100 mutations are known [47, 70, 71] and all but one mutation cause dominantly inherited disease. However, how mutant SOD1 leads to motor neurone degeneration is unclear. It is well established though that SOD1-mediated toxicity in MND is not due to loss of function but instead to a gain of toxic properties [72, 73] as SOD1 null mice do not develop MND [74]. The role of excitotoxicity in MND is also unclear. The hypothesis is that excessive levels of excitatory neurotransmitter glutamate may initiate a cascade that results in motor neurone death. Lending support to this is the finding that glutamate levels are elevated in a subset of MND patients [75] and that riluzole, an antiglutaminergic drug improves survival in persons with MND [76]. Another hypothesis is that SOD1 may induce protein aggregates that are toxic to motor neurones [77]. However, a recent study suggested that accumulation of aggregates were more likely a result of end-stage disease rather than a contributor to MND pathogenesis [78]. Leading on from the abnormal protein aggregation hypothesis however is the cytoskeletal derangement hypothesis. Neurofilament proteins (neurone-specific intermediate filaments) are the most abundant structural protein in mature motor neurones and aggregates of neurofilament proteins are commonly seen in MND. Mitochondrial dysfunction is postulated as another mechanism as mitochondria in MND patients show abnormal morphology and biochemistry [79].

2.5 Classification

The spectrum of MND can be classified into the following clinical phenotypes:

ALS is the most common form (85%) and includes upper motor neurone (UMN) and lower motor neurone (LMN) pathology.

Progressive muscular atrophy is a progressive LMN disorder and if remains confined to LMN involvement, is consistent with prolonged survival compared with ALS. In the largest study to date (n=962) [80], 91 patients initially diagnosed with progressive muscular atrophy had a longer median survival than 871 patients with ALS (48 versus 36 months). After approximately 80 months, however, the estimated survival in progressive muscular atrophy was about the same as that of ALS. Some individuals with progressive muscular atrophy never develop UMN signs clinically. However, despite the lack of signs, these patients frequently have UMN pathology [81]. In the above study, UMN signs developed in 20 of the 91 patients (22%) initially diagnosed with progressive muscular atrophy [80]. This generally occurs within two years of symptom onset.
Primary lateral sclerosis is a progressive UMN disorder. It progresses the slowest and has the longest survival compared to the other phenotypes [82]. It is also characterised by lack of weight loss, and absence of LMN findings on examination or electromyography in the first four years after symptom onset [83]. Although some individuals never develop clinical LMN signs, most do later in their clinical course [84]. There have been case reports however, of pathological findings of isolated UMN involvement [85].

Progressive bulbar palsy is a progressive UMN and LMN disorder affecting the cranial muscles. Occasionally, only bulbar involvement is seen but more commonly, UMN and LMN signs and symptoms spread to involve other areas (bulbar-onset MND).

The flail arm syndrome is characterised by progressive severe LMN weakness and wasting mainly affecting the arms (particularly proximally). There is a 9:1 male predominance [3] and these patients have a slower rate of progression both to the spread of signs and symptoms in other body segments and to development of respiratory muscle weakness [86].

The flail leg syndrome is characterised by progressive LMN weakness and wasting in the distal leg. These patients also have a slower rate of progression to involvement of other body segments and to the development of respiratory muscle weakness [86].

It is now clear that a proportion of MND patients have additional features such as frontotemporal dementia, autonomic insufficiency, parkinsonism, supranuclear gaze paresis, and/or sensory loss. These patients may be considered to have “ALS plus syndrome” [3].

2.6 Diagnosis

The diagnosis of MND is clinical and includes the presence of UMN and LMN signs, progression of disease and the absence of an alternative explanation.

There is no single diagnostic test at present that can confirm or entirely exclude the diagnosis of MND. Clinicians rely mainly on clinical history and examination, supported by electrodiagnostic studies and negative findings in neuroimaging and laboratory studies.

Clinically, asymmetric limb weakness is the most common presentation (80%). In upper limb onset, patients may report difficulty with fine-motor tasks such as buttoning or writing. In lower limb onset, patients may report issues resulting from foot drop, such as tripping whilst walking or running. Bulbar onset is next most common (25%) with reports of slurred speech or swallowing difficulties. Occasionally, pain and muscle cramping, fatigue, weight loss, dyspnoea or other respiratory symptoms may be the initial symptoms [87]. Physical findings may confirm UMN
involvement (weakness, spasticity, hyperreflexia, slowness of movement, extensor plantar responses) and LMN involvement (fasciculations, muscle wasting, weakness).

Electrodiagnostic studies involve electromyography (EMG) and nerve conduction studies. EMG aids identification of LMN loss – the most frequently recognised abnormalities on EMG are fasciculation and spontaneous “denervation” discharges (fibrillation potentials and positive sharp waves) [88]. Nerve conduction studies are important to exclude differential diagnoses. Motor conduction block should be absent in MND and motor and sensory conduction velocity and compound motor action potentials should be (almost) normal in both arm and leg [89].

Differential diagnoses are shown in Box 2.1. The list of differential diagnoses is rather extensive, yet most other diagnoses can be ruled out through careful history, physical examination, and selective diagnostic testing, which may include MRI of the brain and spine, electrodiagnostic studies, complete blood count, serum chemistries, and thyroid function tests. Heavy metal screen is indicated only if there has been exposure. Antiganglioside antibodies (GM1 antibodies) may be helpful in the setting of multifocal conduction block [87].
**Box 2.1 Differential diagnoses of MND [87]**

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<tr>
<th>Disorders that focally involve the spinal cord</th>
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<tbody>
<tr>
<td>• cervical and lumbar spondylosis</td>
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<tr>
<td>• multiple sclerosis, syringomyelia</td>
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<tr>
<td>• tumours</td>
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<tr>
<td>• aterio-venous malformations</td>
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<tr>
<td>• infarction</td>
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<tr>
<td>• congenital dysplasias of the brainstem of spinal cord</td>
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<tr>
<th>Neurogenic and myogenic diseases with LMN symptoms similar to MND</th>
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<tr>
<td>• multifocal motor neuropathy with conduction block</td>
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<tr>
<td>• postpoliomyelities</td>
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<tr>
<td>• muscular atrophy</td>
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<tr>
<td>• Kennedy’s disease</td>
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<td>• myasthenia gravis</td>
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<td>• heavy metal intoxication</td>
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<td>• hyperthyroidism</td>
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<td>• hyperparathyroidism</td>
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<tr>
<td>• Joseph disease</td>
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<td>• hexosaminidase A deficiency</td>
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</tbody>
</table>
The (Revised) El Escorial World Federation of Neurology criteria [19, 90] were designed for research purposes but allow an assignment of diagnostic certainty (see Box 2.2 and 2.3).

**Box 2.2: El Escorial criteria for the diagnosis of MND/ALS [90]**

<table>
<thead>
<tr>
<th>The diagnosis of MND/ALS requires:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. the presence of:</td>
</tr>
<tr>
<td>(A:1) evidence of LMN degeneration by clinical, electrophysiological or neuropathologic examination,</td>
</tr>
<tr>
<td>(A:2) evidence of UMN degeneration by clinical examination,</td>
</tr>
<tr>
<td>(A:3) progressive spread of symptoms or signs within a region or to other regions, as determined by history or examination, together with</td>
</tr>
<tr>
<td>B. the absence of:</td>
</tr>
<tr>
<td>(B:1) electrophysiological and pathological evidence of other disease processes that might explain the signs of LMN and/or UMN degeneration, and</td>
</tr>
<tr>
<td>(B:2) neuroimaging evidence of other disease processes that might explain the observed clinical and electrophysiological signs.</td>
</tr>
</tbody>
</table>

**Box 2.3 Diagnostic categories based on El Escorial criteria for the diagnosis of MND/ALS [19, 90]**

<table>
<thead>
<tr>
<th>Clinically Definite ALS: is defined on clinical evidence alone by the presence of UMN, as well as LMN signs, in three regions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinically Probable ALS: is defined on clinical evidence alone by UMN and LMN signs in at least two regions with some UMN signs necessarily rostral to (above) the LMN signs.</td>
</tr>
<tr>
<td>The terms Clinically Probable ALS - Laboratory-supported and Clinically Possible ALS are used to describe these categories of clinical certainty on clinical and laboratory criteria or only clinical criteria:</td>
</tr>
<tr>
<td>Clinically Probable - Laboratory-supported ALS: is defined when clinical signs of UMN and LMN dysfunction are in only one region, or when UMN signs alone are present in one region, and LMN signs defined by EMG criteria are present in at least two limbs, with proper application of neuroimaging and clinical laboratory protocols to exclude other causes.</td>
</tr>
<tr>
<td>Clinically Possible ALS: is defined when clinical signs of UMN and LMN dysfunction are found together in only one region or UMN signs are found alone in two or more regions; or LMN signs are found rostral to UMN signs and the diagnosis of Clinically Probable - Laboratory-supported ALS cannot be proven by evidence on clinical grounds in conjunction with electrodiagnostic, neurophysiologic, neuroimaging or clinical laboratory studies. Other diagnoses must have been excluded to accept a diagnosis of Clinically possible ALS.</td>
</tr>
<tr>
<td>Clinically Suspected ALS: it is a pure LMN syndrome, wherein the diagnosis of ALS could not be regarded as sufficiently certain to include the patient in a research study. Hence, this category is deleted from the revised El Escorial Criteria for the Diagnosis of ALS.</td>
</tr>
</tbody>
</table>
In clinical practice however, the El Escorial criteria are too stringent; as a result early MND is missed and 25% of patients may die from MND without ever meeting the criteria [91]. In 2006, a consensus meeting held at Awaji-shima aimed to resolve these issues by recognising the equivalence of clinical and EMG data in detecting chronic neurological change, thus integrating EMG and clinical neurophysiological data into an algorithm [92]. The application of the “Awaji algorithm” to the revised El Escorial diagnostic criteria for diagnosis of MND appears to increase the sensitivity of the El Escorial criteria for MND diagnosis (95% sensitivity vs. 18% using clinical El Escorial criteria and 53% combining clinical and EMG El Escorial criteria)[93] without losing specificity [94]. This increased sensitivity applies in particular to bulbar onset patients (sensitivity improved from 38% to 87%) and for patients with El Escorial “clinically possible ALS” (from 50% to 86%) [92].

2.7 Measurement Tools

There is a number of outcome measurement tools used in MND. They can be broadly divided using the ICF framework [5] into those that measure impairment and activity limitation (“disability”) and those that measure participation limitation (“handicap”) and quality of life. There is often overlap, however, in the domains as most outcome measures precede the introduction of the ICF framework. Some measures are MND-specific whilst others are generic.

A range of impairment and activity limitation measurement tools are listed in Box 2.4. The Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS) is currently the most commonly used. It was developed to enable measurement of a broader range of “disabilities” and minimise inclusion of impairment measurements to allow analysis of disability components [95], and was revised in 1999 to incorporate assessments of respiratory function [96]. The revised version is a 48-point measure with excellent validity and reliability, and can be administered over the phone [97]. It is determined by scoring 0-4 for each of the twelve domains (speech, salivation, swallowing, handwriting, cutting food and handling utensils, dressing and hygiene, turning in bed and adjusting bed clothes, walking, climbing stairs, dyspnoea, orthopnea and respiratory insufficiency). A lower score indicates more disability.
Box 2.4 Impairment and activity limitation measurement tools used in MND

<table>
<thead>
<tr>
<th>Generic measures [98]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Independence Measure [99]</td>
</tr>
<tr>
<td>Barthel Index [100]</td>
</tr>
<tr>
<td>Rehabilitation Activities Profile [101]</td>
</tr>
<tr>
<td>Frenchay Activities Index [102]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MND-specific measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norris Amyotrophic Lateral Sclerosis Scale [103]</td>
</tr>
<tr>
<td>Appel Amyotrophic Lateral Sclerosis Scale [104]</td>
</tr>
<tr>
<td>ALS Severity Scale [105]</td>
</tr>
<tr>
<td>Amyotrophic Lateral Sclerosis Functional Rating Scale [106]</td>
</tr>
</tbody>
</table>

Participation limitation is a significant issue from the perspective of persons with MND and their caregivers [27], yet it is poorly covered by existing outcome measurement tools. Given the relentlessly progressive and fatal nature of MND, quality of life is one of the most important areas to address in MND. However, quality of life is a broad concept, and not easily incorporated in a single outcome measurement. Most outcome measures are generic and may not be sensitive to changes specific to a rapidly progressive condition such as MND. Within the generic measurement tools, some measure health-related status (for example, SF-36 or Sickness Impact Profile) whilst others are more specific for measurement of quality of life [e.g. McGill Quality of Life Questionnaire, direct-weight version of the Schedule of the Evaluation of Individual Quality of Life (SEIQoLDW)] [107]. The SEIQoLDW [108] is useful as it can be used for both patients and their caregivers. However, this scale is time intensive [109] and whilst it may be of great value in identifying those factors which contribute to the psychosocial well-being of an individual with MND, it does not necessarily reflect aggregate quality of life in persons with MND [110]. Although measures specific for MND, such as the ALSAQ-40 [111] have been developed for use, they have yet to be widely taken up. Some are heavily weighted towards physical function (e.g. ALSAQ-40) and do not include an existential element (perception of purpose, meaning of life, capacity for personal growth) relevant for persons with MND [107]. Recently, a modified version of the McGill questionnaire was validated as an MND-specific quality of life questionnaire (the ALSSQOL) [112], and a shortened version is currently undergoing validation in a multi-centre study.

Choice of outcome measures is a significant issue in MND clinical trials. The outcome measures used may not capture the entire spectrum of issues in MND, nor reflect change adequately. Whilst survival is clinically important and easy to measure, there are several reasons to consider use of other outcomes [113]. Survival can be influenced by many interventions that do not clearly alter disease progression, such as enteral feeding [114]. The
use of survival as an endpoint also mandates large trials that treat patients for long periods of time, thus very few patients will experience the event being measured [113]. Most importantly, the objective of many trials is not to alter the underlying pathology of disease but to reduce symptoms and limitations at the level of activity and participation, and to improve quality of life, hence outcome measures should address these domains.

2.8 Pharmacological management

Riluzole is the only drug that has been shown to prolong survival (by about two to three months) [76]. Although the precise mechanism of action in MND is unclear [115], riluzole is thought to reduce glutamate-induced excitotoxicity by inhibiting glutamic acid release, blocking NMDA-receptor mediated responses and by direct action on the voltage-dependent sodium channel [116].

A dose of 100mg daily is reasonably safe. The elimination half-life is 12 hours and the recommended dosing is 50mg twice daily. Riluzole is generally well tolerated and the most significant adverse effects are gastrointestinal and hepatic. These are mostly reversible after stopping the drug.

Costs of riluzole are relatively high (approximately $10,000/year in the US) [76] and it is approved only in select countries (e.g. United States of America, Australia, Canada and many European countries). Current guidelines [9, 10] recommend treatment as soon as possible after diagnosis with the following criteria predicting those most likely to benefit: “definite or probable ALS” by El Escorial criteria, symptoms present for less than five years, vital capacity of greater than 60% of predicted and no tracheostomy.

Unproven treatments are an area of increasing interest to physicians and patients alike. It has been estimated that almost 80% of patients take high-dose vitamins, minerals, or other nutriceuticals despite no proof of benefits for any of these in MND (only creatine and vitamin E have been examined for efficacy) [117]. Whilst many drugs have shown promise in preclinical trials, to date none have proven to be of benefit in MND (apart from riluzole) in human clinical trials (see Table 2.1) [118]. A frequently updated list can be found on the ALS Association website (www.alsa.org).
Table 2.1 Drug treatments with unproven outcomes in MND (adapted from [10])

<table>
<thead>
<tr>
<th>No benefit observed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-Acetylcysteine</td>
</tr>
<tr>
<td>Ciliary neurotrophic factor (CNTF)</td>
</tr>
<tr>
<td>Verapamil</td>
</tr>
<tr>
<td>Gabapentin</td>
</tr>
<tr>
<td>Topiramate</td>
</tr>
<tr>
<td>Lamotrigine</td>
</tr>
<tr>
<td>Celecoxib</td>
</tr>
<tr>
<td>Minocycline [119]</td>
</tr>
<tr>
<td>Coenzyme Q10 [120]</td>
</tr>
<tr>
<td>Insulin-like growth factor (IGF-1)</td>
</tr>
<tr>
<td>Selegiline</td>
</tr>
<tr>
<td>Vitamin E</td>
</tr>
<tr>
<td>Creatine monohydrate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>In trial phase:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arimoclomol</td>
</tr>
<tr>
<td>Ceftriaxone</td>
</tr>
<tr>
<td>Gene therapy</td>
</tr>
<tr>
<td>Lithium*</td>
</tr>
<tr>
<td>Pramipexole</td>
</tr>
<tr>
<td>Talampanel</td>
</tr>
<tr>
<td>Memantine</td>
</tr>
</tbody>
</table>

*a recent double-blind randomised controlled trial in the United States and Canada was stopped early for futility and it is likely that lithium will not demonstrate therapeutic benefit [121]*

Although some of these drugs are currently available for other indications, off-label use in MND is not recommended for a number of reasons [122] including:
- Lack of intensive safety measures outside of a clinical trial. For example, information showing poor outcomes for treated patients in the minocycline and topiramate trials became apparent only after grouped data were studied.

- Using an off-label medication during the conduct of a clinical trial can impede or slow enrolment in a trial, which has the effect of increasing risk to subjects in the trial.

There is also a range of treatments other than drugs with variable safety profiles from “benign” nutritional supplements to potentially dangerous therapies such as chelation, dental amalgam removal, or administration of unknown substances said to be stem cells [122].

MND is a life-threatening disease, but clearly some treatments can reduce quality or length of life; hence it is critical for patients to be given the information they need to avoid these [122].

2.9 Multidisciplinary care

2.9.1 Definition of multidisciplinary care in MND

With no cure currently available, the challenge in MND is to prolong independence, prevent complications and optimise quality of life. This is best met by a multidisciplinary team with a focus on symptomatic, rehabilitative and palliative care [9, 10]. The multidisciplinary team (see Figure 2.1) comprises of a group of clinical professionals with expertise in MND, directed by a physician, who work as an integrated unit to provide seamless care which is patient-centred, flexible and responsive to the evolving nature of the condition [123], and aims to maximise activity and participation. The literature presented in this review includes all levels of evidence for multidisciplinary care of MND (including randomised and clinical controlled trials, case studies and expert opinion).
Figure 2.1 The multidisciplinary team in MND (adapted from [123])
2.9.2 Evidence for multidisciplinary care in MND
A recent Cochrane review [124] found that in the absence of randomised controlled trials, the “best” evidence to date (based on five observational studies) suggests some advantage for quality of life without increasing healthcare costs, reduced hospitalisation and improved disability. The evidence for survival is conflicting. However, the absence of proof that multidisciplinary care is effective must not be interpreted as proof that this approach is ineffective. There are multiple, well-defined interventions, such as nutritional support and respiratory support, and interventions by physical, occupational and speech therapists which have individually had significant impact on disease course. Hence, the gap in available trial data showing efficacy when offered simultaneously in a multidisciplinary setting should not at all implicate therapeutic nihilism in the treatment of MND.

2.9.3 Applying the ICF framework to multidisciplinary care in MND
Rehabilitation is defined as “a problem solving educational process aimed at reducing disability and increasing participation experienced by someone as a result of disease or injury” [7]. Although it is sometimes effective in reducing impairment, its principal focus is to reduce symptoms and limitations at the level of activity and participation, through holistic interventions, which incorporate personal and environmental factors. The rehabilitation perspective is much broader than the “medical” perspective, and emphasises the understanding that a person’s health and functioning is associated with a condition or disease, and not merely a consequence of it. The rehabilitation model works well with the World Health Organisation’s ICF framework [125] which is multifaceted. It includes the perspectives of the physicians with regards to the management of complex and interacting symptoms in MND, the therapists’ views in terms of managing change in functional status in activities of everyday living and importantly, also the perspective of the persons with MND and their caregivers which may differ from the others.

The aim of the ICF classification system is to provide a common language and framework for the description of health and health-related states. The domains in the ICF are divided into a) Body Functions and Structures; and b) Activities and Participation. These terms replace the previously used terms “impairments” and “handicap”. The ICF domains for people with a health condition such as MND describe what persons with MND can do or does do. “Functioning” is an umbrella term encompassing all body functions, activities and participation; similarly “Disability” includes impairments, activity limitations or restriction in participation. The ICF acknowledges that environmental factors (physical, social and attitudinal environment in which people live and conduct their lives) and personal factors (intrinsic influences such as self-efficacy, positive adaptation) interact with all the other constructs within the ICF (see Figure 2.2).
A person with MND can therefore present to rehabilitation with various combinations of deficits, which can be classified according to the ICF:

- “Impairments” are problems with body (anatomical) structures or (physiological) function (such as weakness, spasticity, dysphagia).
- “Activity limitation” (disability) describes the difficulties that a person may have in executing everyday tasks (reduced mobility and self care, pain).
- “Restriction in participation” relates to problems experienced by a person with involvement in societal participation and life situations (driving, work, family, psychosocial activities).
- “Contextual factors” include:
  - “environmental” factors (such as access to medical care); and
  - “personal factors” including gender, race, self-efficacy, coping style and social and educational background.

All these constructs combine to affect the person’s experience of living with their condition.

The ICF can be used to further facilitate and optimise clinical care through the development of “core sets”. These are ICF categories selected by experts (patients, caregivers, clinicians) that list issues in impairment, disability, participation environmental factors that need to be addressed in multidisciplinary care settings. This has been done in other neurological conditions such as stroke [126], multiple sclerosis [127] and Guillain-Barré syndrome [128]. A set of relevant ICF categories have not been identified in MND and would be very useful in both clinical and research settings given the rare incidence of MND and diverse and challenging nature of the symptoms. However, it should also be recognised that even with the core set yet to be developed, the ICF model itself is useful to busy clinicians as it serves as a prompt of the different constructs that affect the experience of disease and therefore as a reminder for clinicians to address the entire bio-psycho-social impact of disease. Further, it has been highlighted that current outcome measures do not capture the entire spectrum of issues in MND (see section 2.7 Measurement Tools); use of the ICF could contribute towards development of appropriate outcome measures for MND.
2.9.4 Service models and standards: Interface between neurology, rehabilitation and palliative care

MND is a “progressive” long-term neurological condition. The symptoms in MND are diverse and challenging and include: weakness, spasticity, imitations in mobility and activities of daily living, communication deficits and dysphagia, respiratory compromise, fatigue and sleep disorders, pain and psychosocial distress [21]. The National Service Framework [15] was developed by the department of Health in the UK to provide quality requirements (QRs) for the inspection authorities (the Healthcare Commission and the Commission for Social Care Inspection) to use in measuring local progress for long-term neurological conditions. It advocates the need for integrated care and joined-in services in the delivery of multidisciplinary care. Included within its guidelines are 11 QRs, which make recommendations for specialist neurology, rehabilitation, and palliative care services to support persons with MND to the end of their lives. The interface between neurology, rehabilitation and palliative care ensures coordinated care for persons with MND rather than duplicating services.
Current guidelines [9] state that specialised multidisciplinary clinical referral should be considered for persons with MND to enable optimal health care delivery. However, even within multidisciplinary clinics, there is a shortfall in service provision from the perspective of persons with MND and their caregivers. A recent study (n=44 persons with MND, n=37 caregivers of persons with MND) [27] showed that despite a universal health system (Medicare) and accessibility to a specialised MND multidisciplinary clinic, gaps included a) the limited understanding and availability of assistive technology to facilitate function and decrease reliance on caregivers, b) advice regarding employment and driving and c) limited psychosocial support from the caregivers’ perspective. In a different study also based in Australia (patient n=503, caregiver n=373) comparing the extent to which existing supportive service models met the needs of four neurodegenerative disorders (MND, multiple sclerosis, Parkinson’s disease, Huntington’s disease), the caregivers of persons with MND reported the lowest quality of life and were most distressed by fatigue and tiredness [129].

The gaps in service most likely relate to a) variations in service by local community providers compounded by the absence of care by rehabilitation or palliative care physicians, b) lack of consensus about what issues should be addressed in multidisciplinary care programs for persons with MND that incorporates the patients’, caregivers’, and treating clinicians’ perspective and c) poor understanding of allied health roles. The healthcare needs of persons with MND can be difficult to determine due to variable MND disease severity and progression. The limitations in activity and participation can be subjective and are not always easy to quantify with the differing perspectives of the persons with MND, their caregiver, treating health professionals and by the community as a whole. The “insider” lived experience of disablement is important in the context of providing effective clinical care. Information from such insights can guide service policy, planning, development and resource utilisation. Use of the ICF for this purpose has been discussed in Section 2.9.3.

The recent guidelines for persons with long-term neurological conditions (including MND) recommend the interface between neurology, rehabilitation and palliative care to address the diagnostic, restorative and palliative phases of illness [130]. Neurologists assess, diagnose and manage disease. Involvement of palliative care physicians at an earlier stage of disease is important for management of distressing symptoms (such as nausea, vomiting and breathlessness). While rehabilitation physicians can contribute to care by assisting with disability management and adaptive equipment provision (such as strategies and aids for communication, mobility and ability to perform activities of daily living; procedures for spasticity, pain control; and behaviour management), they can struggle as disease advances, while palliative care teams may struggle at stages where disease is not advancing. These issues may be addressed by cross-referral and closer collaboration between different services.
A proposed model for service interaction in caring for persons with MND shows involvement of neurologists and palliative care teams in the acute and terminal phases of care, with a relatively smaller role for rehabilitation physicians. However rehabilitation plays a major role in long-term care and support (over years) in the more slowly progressive phase [130]. Early rehabilitation intervention and treatment has much to contribute to improve health and quality of life prior to accumulation of disability through symptomatic and supportive therapies to enhance functional independence and community integration and reduce barriers (such as lack of knowledge about treatment, economic constraints) [131]. Disability management in MND should also be planned, with deficits should be anticipated (over time) to avoid “crisis management”. Early palliative care intervention too has much to offer particularly in symptom management, respite care, and in addressing the psychological and spiritual issues that have been shown to have a greater bearing on quality of life in MND than physical functioning. An earlier palliative care referral allows the development of a relationship of trust while communication is generally easier, and mutual education and support of treating physicians and other disciplines in issues around communication and dying [132].

As patients deteriorate the rehabilitation and palliative care approaches can overlap, i.e. “neuropalliative rehabilitation”. Key skills in neuropalliative rehabilitation include: understanding disease progression, symptom control, managing expectations, issues relating to communication, addressing end of life issues, legal issues (mental capacity, wills), specialist interventions (ventilation), equipment needs, counselling and support, and welfare advice [130].

The gaps and deficiencies in MND care and services need to be addressed by collaborative work practice - clinicians need to respect others with expertise in related areas; co-ordination should occur between services; communication between specialties and between specialist and local services needs to improve [133, 134].

**2.10 Multidisciplinary care issues in MND**

MND is a fatal disease with a challenging progressive course that results in a broad and ever-changing spectrum of care needs. Symptoms are varied (see Box 2.5) and need to be carefully assessed and managed. The timing of provision of appropriate care is important as whilst information needs to be provided when patients are psychologically in the right frame of mind, the options of certain interventions may be time-limited as the disease continues to progress.
### Box 2.5 Symptoms experienced by MND patients (adapted from [135])

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weakness</td>
<td>94%</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>90%</td>
</tr>
<tr>
<td>Dyspnoea</td>
<td>85%</td>
</tr>
<tr>
<td>Pain</td>
<td>73%</td>
</tr>
<tr>
<td>Weight loss</td>
<td>71%</td>
</tr>
<tr>
<td>Speech issues</td>
<td>71%</td>
</tr>
<tr>
<td>Constipation</td>
<td>54%</td>
</tr>
<tr>
<td>Cough</td>
<td>48%</td>
</tr>
<tr>
<td>Sleep issues</td>
<td>29%</td>
</tr>
<tr>
<td>Emotional lability</td>
<td>27%</td>
</tr>
<tr>
<td>Drooling</td>
<td>25%</td>
</tr>
</tbody>
</table>

### 2.10.1 Respiratory management

Most deaths in MND are due to respiratory failure as a consequence of respiratory muscle weakness, hence the diagnosis and management of respiratory symptoms is important (Figure 2.3) [117]. Counselling may be initiated at the time of diagnosis especially if respiratory symptoms are present and/or forced vital capacity (FVC) is <60% of predicted. Early symptoms may be suggestive of nocturnal hypoventilation (e.g. frequent arousals, morning headaches, excessive daytime sleepiness, and vivid dreams) rather than overt dyspnoea [117]. It is important to discuss the options of respiratory choices, including tracheostomy and ventilatory support well before these are clinically indicated to enable advance planning or directives. It is also important to offer patients information about the terminal stages of MND and reassure regarding terminal hypercapnoeic coma and resulting peaceful death, as many may fear “choking to death” [136].
Figure 2.3 Respiratory management algorithm in MND (adapted from [117])

Diagnosis MND

Symptom evaluation and PFTs
- Initiate NIV counselling
- Consider Pneumovax and flu vaccine

Orthopnea or SNP < 40cm or MIP < -60cm or pO₂ < 4% from baseline or FVC < 50%

Consider NIV

NIV tolerated?

NO

Further education regarding documented benefits. Evaluate reasons for noncompliance.

YES

Ongoing evaluations and adjustment of pressures

Reintroduce NIV

Successful

Referral for palliative care (consider hospice)

Not successful

Unable to maintain pO₂ > 90%, pCO₂ < 50mmHg or unable to manage secretions

Consider invasive ventilation

PCEF < 270 L/min

Suction machine
- Manual assisted cough
- Mechanical inxsufflator
- Treat sialorrhea / phlegm

Text in bold = evidence-based
Text in italics = consensus-based

PFT = pulmonary function tests; PCEF = peak cough expiratory flow; NIV = noninvasive ventilation; SNP = sniff nasal pressure; MIP = maximal inspiratory pressure; FVC = forced vital capacity (supine or erect)
Respiratory function should be evaluated every three months from the time of diagnosis. Whilst FVC is the most commonly used [137] and significantly predicts survival [138], it can be insensitive to slight changes in muscle strength [139]. The maximal inspiratory pressure (MIP) also requires a mouthpiece. The maximal sniff nasal inspiratory force or sniff nasal pressure (SNP) may be more appropriate especially in those with bulbar weakness (no mouthpiece) and has been found to be more sensitive to changes in diaphragmatic and respiratory muscle strength [140, 141]. It is also more reliably recorded in the later stages of MND and is more sensitive, although less specific than FVC for predicting six-month mortality [142].

Initial management can include chest physiotherapy and postural drainage, especially if the patient has difficulty clearing secretions from the chest [143]. A suction machine may also be helpful for this purpose. Preventing respiratory infections is a primary goal and pneumococcal and influenza vaccines should be administered. Respiratory muscle exercise can be instituted and may delay the onset of ventilatory failure [144].

Non-invasive ventilation (NIV) should be considered for patients with respiratory insufficiency (see Figure 2.3 for criteria) and is especially helpful overnight for symptomatic nocturnal respiratory compromise although it is also often used in addition, during the day as the disease progresses. A recent Cochrane review concluded that NIV significantly improves quality of life when tolerated and may prolong survival in those with normal to moderately impaired bulbar function especially if used for ≥ 4 hours a day [145]. Successful use of NIV is dependent on respiratory therapists and patients working closely and patiently through the adjustment phase of NIV, especially with selection and tolerance of face masks. A small dose of anxiolytic may assist with the process in select patients. Bulbar involvement and executive dysfunction may also impact negatively on compliance [117].

Invasive ventilation should be offered when longer-term survival is the goal. Careful counselling is necessary with regards to benefits and burden (expense, intensive physical support with suctioning and nursing care, high caregiver burden) as many may not be able to manage invasive ventilation at home, thus requiring residential care (nursing home) placement [117, 146]. Not all residential facilities manage invasive ventilation, which might further restrict options of placement. Approximately 10-20% of persons with MND elect invasive ventilation. However, of those who do undergo invasive ventilation (including those administered at the time of acute respiratory failure without advance discussion), there appears to be good acceptance and satisfactory quality of life [147].
2.10.2 Communication
Dysarthria is common as a result of bulbar involvement and can be a source of significant frustration to the persons with MND and their families. Early changes include nasality or reduced vocal volume and changes in oral movement rates and speech rates [148]. As weakness and spasticity of the oral and laryngeal muscles increase, imprecise consonant production, hypernasality, harsh vocal quality, slowed rate of speech and breath volumes affect intelligibility [149]. Speech pathologists can teach the patient to slow speech rate, exaggerate articulation and improve respiratory efficiency through phrasing [21]. Palatal lift and palatal augmentation prostheses may also be of some use to reduce the hypernasal aspect of dysarthria [150]. As intelligibility worsens, augmentation of communication may be achieved with devices ranging from simple pen and paper or alphabet/word communication boards to more high-tech keyboard-based and computerised instruments. Environmental control units that use movement input from any part of the body (eg. eye gaze) can be used in very advanced disease [151]. Whilst some of these devices can be expensive, they help the patient and caregivers stay connected, respond to their need and discuss complex important issues, including medical information [152]. For those who have no voluntary motor control for communication, brain-computer interface that use electroencephalogram signals are being researched [153].

2.10.3 Swallowing and nutrition
Dysphagia affects a third of persons with MND at onset and the majority by late disease [154]. It increases the risk of suboptimal caloric and fluid intake and can worsen weakness and fatigue [155]. Aspiration pneumonia (13%) is a contributor to respiratory complications and is associated with increased mortality with mean survival time post-infection of 2 months [156].

More than 50% of persons with MND report difficulties in the oral preparatory stage of swallowing (preparation of food for propulsion to the pharynx) [157]. Symptoms include jaw weakness, fatigue, drooling, choking on food and slow eating. In addition, loss of upper limb function and fear of choking or depression can further impact on self-feeding abilities and oral intake [158]. A speech pathologist can perform a bed-side assessment and/or further imaging (eg videofluoroscopy) to evaluate the degree of dysphagia. Mild dysphagia can be managed with specific interventions such a alteration of food consistency, upright positioning, small bolus size, soft collar for neck extensor weakness and the chin-tuck technique, in which the person flexes their neck to the anterior chest wall as they swallow, narrowing the inlet to the larynx and reducing the chance of food aspiration. Dieticians monitor nutritional status through body weight, percentage weight loss and body mass index. Common advice includes high calorie diets, texture modification and prescription of nutritional supplements [159]. Patients may show nutritional compromise even before bulbar symptoms become significant [158] as in addition to muscle wasting, persons with MND at all stages of disease often do not meet their energy
requirements [160]. Dehydration is also a common and important problem contributing to fatigue and thickened secretions [21].

As dysphagia progresses, evidence (Level B) suggests a percutaneous endoscopic gastrostomy (PEG) or equivalent (eg. radiologically inserted gastrostomy) is indicated to supplement oral intake (as long as this remains safe) for weight maintenance [161]. PEGs prolong survival but there is currently little evidence regarding the impact of PEG on quality of life [114]. Timing of a PEG can be challenging. Weight loss (a loss of 5-10% of body weight implies nutritional risk [21]) and FVC should be considered (PEGs should be placed before FVC falls below 50% of predicted [162] as risks of laryngeal spasm, localised infection, gastric haemorrhage, technical difficulties of PEG placement and respiratory arrest increase [163, 164]).

Sialorrhoea can be a significant issue in MND and is generally not related to increased saliva production but rather to impaired ability to swallow saliva, combined with facial weakness causing labial incompetence and neck weakness causing the head to tip forward [21]. Improved positioning, use of a cervical collar and orolingual exercises may be helpful. Medications such as anticholinergics and tricyclics can also be trialled [165], as can suction machines. In the US, most commonly used medications are amitriptyline, glycopyrrolate, atropine and propantheline [166]. However, medications may further thicken secretions, hence should be used with caution in those with respiratory insufficiency or poor cough. More recently, botulinum toxin injected into the salivary glands (parotid, submandibular) appears to be safe and has been used to treat sialorrhoea with beneficial effects lasting approximately 3 months [167, 168]. Thick oropharyngeal secretions may be treated with increased fluid intake, humidification of air, cough augmentation, suction machines and guaifenesin [166].

2.10.4 Exercise
The effects of exercise and safe therapeutic range in MND are poorly understood. It is generally accepted that weakness and muscle fibre degeneration may be accelerated by overwork or heavy exercise as it is already functioning close to its maximal limits [169]. However, inactivity leads to deconditioning and disuse weakness. In addition, muscle and joint spasticity can cause pain, contractures and further loss of function. A recent Cochrane review [170] identified two trials (n = 52), which addressed therapeutic exercise in MND. The trials examined the effects of moderate intensity, endurance type exercise on spasticity, and effects of moderate intensity resistance type exercises in MND. Although one of the trials reported improvement in function and quality of life, both trials were too small to determine to what extent strengthening exercises were beneficial or harmful in this population [170]. In view of the paucity of evidence to guide exercise prescription, the current recommendations are [171]:
• Stretching exercise to improve flexibility to maintain muscle length and joint mobility and prevent contractures.
• Strengthening exercise of sub-maximal (low, non-fatiguing) intensity, with degree of resistance tailored to muscle strength.
• Aerobic/endurance exercise may improve cardio-respiratory fitness and is probably safe but adequate oxygenation, aeration and carbohydrate load is important to reduce oxidative stress load.

2.10.5 Mobility and activities of daily living

In early stages of disease, rehabilitation aims to prolong independence in mobility and activities of daily living, prevent complications such as falls, contractures, and musculoskeletal pain, maintain strength, range of movement and conditioning through an appropriate exercise program, educate the patient and family about the disease, provide psychological support, evaluate the home for safety and teach energy conservation techniques [172].

As weakness worsens, the physiotherapist can instruct the patient and family in safe transfer techniques (eg. between bed and chair, in and out of cars), optimise gait pattern and provide gait re-training with appropriate gait aids (eg. walking frame, sticks) and orthoses (ankle-foot orthosis to facilitate foot clearance during gait and stabilise knee to prevent falls). Occupational therapists can fabricate with upper limb orthoses to assist with fine motor function. For example, patients with distal weakness can improve hand function with wrists braced in 30° extension which improves efficiency of grip and addition of a universal cuff can assist those with weak grasp in feeding and typing [21]. Other adaptive equipment is also provided, such as built-up cutlery for eating, Velcro fasteners for dressing, long-handled aids, and bathroom equipment (rails, over-the-toilet frames, bath boards, shower chairs, commodes).

Wheelchairs are generally eventually required although introduction of a wheelchair whilst a patient is still ambulant, for intermittent community use, is important to enhance energy conservation. Future needs should be anticipated and considered when prescribing a powered wheelchair (eg. reclining, tilt-in-space, custom seating, and modifiable control system) to optimise independence and social interaction whilst preventing contractures, compression nerve palsies, skin breakdown and aspiration. A motorised scooter may be more appropriate for some patients [21]. Other equipment such as hospital beds with pressure-relieving mattress and hoists for lifting might also be required. Caregiver training in the use of hoists is important to prevent injury.
2.10.6 Assistive Technology

Assistive technology can have a dramatic effect on restoring and maintaining independence, a sense of control and quality of life and is an integral component of the rehabilitative process in the care of persons with MND.

The use of assistive technology in MND can be broadly divided into 1) technology that assists with mobility; 2) communication, including computer access, and 3) environmental control units (ECU), with significant overlap and integration amongst the three categories. In a recent study of 44 persons with MND currently receiving multidisciplinary care, limited understanding and availability of assistive technology to facilitate function and decrease reliance on caregivers was identified as an area for improvement. There is a general lack of awareness especially around available environmental control technology even amongst health professionals [173]. It must however also be stressed that, in general, it is essential for patients, families and therapists to work closely together when prescribing and using assistive technology to ensure the correct, safe and optimal use of such aids and equipment; and to anticipate future needs especially with the expense of such technology. Close collaboration with specialised providers of assistive technology that can also supply back-up technical support is also crucial.

Assistive technology for mobility

Difficulties in bed mobility can result in significant complications including the development of pressure areas and pain. It also increases caregiver burden and stress [21] especially if caregivers have to wake overnight to turn the patient or to assist with any body posture changes. Electrically controlled beds facilitate management of dependent oedema, transferring in/out of bed and can ameliorate pain, which may or may not be related to spasticity [174]. Controls should be appropriate for the patient’s disability (mounted close to a functional limb) or an ECU could be used [175].

Powered wheelchairs are essential for independent mobility as lower limb weakness progresses. Persons with MND often wish they had received their powered chairs sooner and generally feel satisfied that their chair is good value for money despite the high costs (range USD$20,000-35,000) [176]. They are suitable for indoor and/or outdoor use although features may vary depending on the terrain. These chairs can be controlled in a variety of ways and further integrated with systems to enable communication and ECUs [177]. Additional features such as recline, tilt-in-space and custom seating serve to optimise independence and social interaction whilst preventing contractures, compression nerve palsies, skin breakdown and aspiration [21] and facilitate swallowing and breathing.
**Assistive technology for communication and computer access**

As intelligibility in MND worsens, Augmentative and Alternative Communication (AAC) is required. AACs can improve quality of life by optimising function and assisting with decision making [178]. AACs range from no or low technology (gestures, communication boards with letters) to high-tech electronic communication devices or computers that allow the user to have voice output, send e-mail and surf the web [178]. For example, speech-generating devices such as LightWRITERs are commonly used. These devices can be used as long as there is voluntary motor movement (including eye gaze). The specific access method depends on the abilities of the patient – for example, pointing with a body part or pointer, adapted mice or joysticks or switches and scanning technology can be used. For those who have no voluntary motor control for communication, a recent case study using a brain-computer interface system has been reported and appears promising [179]. The emotional aspect of using an alternative form of communication however can result in significant patient resistance and acceptance as the ability to speak and use language is what distinguishes us from all other species [178, 180]. Hence, acceptance of an AAC may take weeks to months.

A source of significant frustration for those with speech difficulties is use of the telephone. Technology is available and varies from country to country. In the United States, “Speech to Speech” technology can be used, where trained communication assistants are used by the patient to complete phone calls. They are trained to use superior equipment to hear the caller and place the call, then repeat verbatim what the caller says so the call is completed successfully [181].

Computer technology is fast advancing and options include different types of keyboards, mouse alternatives, switches, interfaces, mounting systems, integrated communication/computer access packages, software and systems. For those who have some proximal arm control, track balls, type writing sticks and forearm supports may be useful. In persons with MND who have more severe upper limb weakness, head tracking systems, on-screen keyboards and voice recognition software may be required. Text-entry software such as Dasher (which is free) can be used whenever a full-size keyboard cannot be used such as on a palmtop computer or with a joystick, touchscreen, trackball, headpointer, or eyetracker [181]. There are also many mouse alternatives available – eyegaze system, foot control mouse, head tracking mouse, joysticks and switch-adapted mouse.

**Environmental control units**

Environmental control systems offer sophisticated electronics to enable people with a range of impairments and severe disability to use a wide variety of electrical devices. Aids may include unobtrusive control units (eg. remote control for TV), home security (door intercoms, door...
release and alarms), adapted telephones (such as hands-free control) and lighting and heating/cooling systems [182]. These environmental control units may be used to facilitate function and decrease reliance on carers, improve family dynamics and improve patients’ self-esteem [182].

“Smart homes” refer to any technology that automates a home-based activity but are used by many to describe interactive systems that allow an occupant to control home activities from a central access point (eg. computer, personal digital assistant or remote-control device) [183]. They are becoming increasingly common and affordable (range from USD$200 to $100,000) and in relation to people with disability, can be divided into five classes: 1) incorporation of intelligent objects such as doors or window shade via remote control or motion-activation 2) use of wired or wireless networks for information exchange such as computer-controlled thermostat or lighting 3) “connected homes” that use of electronic networks that reach beyond the home such as management of appliances remotely or internet grocery shopping or a falls monitoring system that triggers external alerts 4) “learning homes” that link to computers which analyse patterns of activity and manage appliances accordingly and 5) “attentive homes” that control technology in anticipation of human needs [184]. The latter two classes are still in development phases; however, there is a growing body of evidence supporting the first three classes of smart homes. A randomised controlled trial (n=104) found that provision of individualised assistive technology and home modifications (eg. ramps, bath rails, medical alert bracelets and security lighting) in frail elderly patients resulted in less decrease in functional independence, reduced medical care costs and reduced hospitalisations [185]. As for class 3 homes, a randomised trial of spinal cord injury patients showed that telehealth interventions improved one-year health outcomes [186]; similarly telerehabilitation interventions in stroke, brain injury and multiple sclerosis found improvements in arm/hand function [187]. In an MND population, as disability becomes severe and travelling difficult and a proportion of patients stop coming to clinic; telehealth could supplement the provision of care.

Some persons with MND themselves or have family members have engineering or technological backgrounds and create their own ECU. For example, a person with MND reports that with little functional use of upper or lower limbs, and with voice commands, line-of-sight or through the head array on his electric wheelchair, he is able to control the computer pointer without a mouse. He has integrated software systems, which allows him to control many electronic devices from his bed or wheelchair with microphones and other input devices. For example, he is able to control lights, heating, television (on/off, volume, record programs), internet radio, speak to visitors at his door using audio/video cameras, lock or unlock his front door, call for help regardless of where he is in the house through intercoms, access the emergency helpline, use word processors with speech recognition and mouse pointer control,
access the internet (e-mail and browse internet), speak to family and caregivers using audio/video cameras through internet access and adjust his electric bed [188].

There are many possible ways to increase independence and quality of life in those who have disability. Assistive technology should be considered in persons with MND. Patients and therapists should push the boundaries and be creative. Especially as newer generations become more technologically savvy, the potential is unlimited and inventors, researchers, manufacturers, vendors, clinicians and consumers need to work together to realise that potential.

2.10.7 Bladder, Bowel and Sexuality
Although bowel and bladder sphincters are generally spared, bowel, bladder and sexual dysfunction may be much more common (30%) than reported to health professionals by persons with MND [27]. These areas are in general poorly studied in MND. Constipation is likely to be common with inactivity and poor nutritional intake and can be treated with a regular bowel program with intake of fibre/bulking agents and adequate fluids. Suppositories, stool softeners and enemas may be required. In a group of 38 persons with MND who underwent urological evaluations, 47% had micturition symptoms and urodynamics studies found a range of UMN abnormalities [189]. Where urinary urgency is an issue, oxybutinin may be helpful. Contributory factors to incontinence, such as urinary tract infections, drinking large amount of fluids late in the day and dependent oedema causing nocturia when the legs are elevated overnight should be considered and treated. Wasner et al [190] suggested a prevalence of 62% (n=62) in sexual dysfunction with issues including decreased libido and passivity of the patient and partner due to physical weakness and the body image changes. The wide variation in reported prevalence in bowel, bladder and sexual dysfunction suggests that patients may not volunteer this information; hence its inclusion in routine enquiries might help to encourage reporting and thus the facilitation of appropriate treatment, such as sexual counselling and suggestion of specific techniques.

2.10.8 Pain
Pain is common in MND, especially in the later stages. Musculoskeletal pain from weakness and resulting postural changes can be ameliorated with range of motion exercises, adequate support in sitting and supine positions and proper lifting and transfer techniques to prevent undue traction on weakened joints. Fatigue and depressive symptoms may also worsen a patient’s experience of pain.

Spasticity and muscle spasms are not an uncommon source of pain and with the current paucity of supporting evidence, this is often treated with stretching exercises in combination with a muscle relaxant (baclofen is the drug of choice) [191]. Baclofen should be started at low doses
(5mg twice to three times daily) and slowly increased (up to 100mg a day in divided doses). Baclofen however can be associated with muscle weakness. Tizanidine (2mg twice daily up to 24 mg a day) is likely as efficacious but it is associated with dry mouth. Other options include clonidine (25 µg twice a day) which can cause hypotension, drowsiness and bradycardia and benzodiazepines which can cause sedation and habituation and respiratory depression. Dantrolene is not recommended as it can cause excessive muscle weakness in MND [192]. Intrathecal baclofen is rarely required but may be indicated in those with intractable spasticity, needing more than the maximum oral dose [193]. There are few reports of use of botulinum toxin for spasticity in MND in literature. Caution is advised as persons with MND may be more prone to developing generalised weakness after being injected with botulinum toxin A to treat spasticity [194].

Muscle cramps can cause severe pain and discomfort and are a result of spontaneous activity of motor units induced by contraction of shortened muscles [195]. The list of potentially useful drugs for cramps is extensive, implying efficacy of individual agents is low and variable and the evidence base weak. In the US, quinine (35%), baclofen (19%), phenytoin (10%), and gabapentin (7%) were the preferred agents [166]; in Europe, choices were quinine (58%), benzodiazepines (40%), magnesium (25%) and carbamazepine (23%) [196]. In 2006 however, the US Food and Drug administration restricted the use of quinine sulfate in the US to treatment of malaria falciparum because of concerns regarding severe adverse events, including cardioarthymias, thrombocytopaenia, severe hypersensitivity reactions and serious drug interaction [197].

In advanced disease, pain often results due to immobility. Adequate mattress support, range of motion exercise and frequent turning of the patient are essential. Equipment such as motorised beds that slowly rotate from the side to side can be useful for reducing caregiver burden [21]. Analgesia such as nonsteroidal anti-inflammatory drugs or narcotics (oral or sublingual) may also be required (with careful respiratory status monitoring in the latter). Intramuscular delivery of medications should be avoided due to muscle wasting [151].

2.10.9 Fatigue and sleep disorders

Fatigue is a common disability in MND – 77-83% in recent studies [27, 198] but understudied and often overlooked by clinicians [199]. It is unrelated to clinical strength as a large component of fatigue in MND has a central origin [200]. Fatigue in MND does not correlate directly with gender, educational level, disease duration, physical function, quality of life, dyspnoea, depression or sleepiness [198]. However, contributory factors may include sepsis (including aspiration), depression and/or anxiety, pain, hypoventilation, positioning, sleep disruption and effortful activity and these should be treated where possible. It may manifest as reduced energy, difficulty in maintaining sustained attention and increased motor weakness, incoordination and
gait difficulties. No double-blind, placebo-controlled trials have been performed for treatment of fatigue. Physostigmine is sometimes prescribed but not necessarily effective [201]. Modafinil appears to be well-tolerated in a recent small open-label study (n=15) and may reduce symptoms of fatigue [202]. Rehabilitation strategies involve pacing activities (regular rest breaks), energy conservation and fatigue management strategies, addressing sleep disorders, consideration of exercise to improve fitness if appropriate and treating other exacerbating factors.

High incidence of sleep disturbance in MND has been reported with pain, micturition, and choking listed by patients as the most common causes for awakening [203]. Other contributors to poor sleep include abnormal nocturnal movements such as periodic leg movements or fragmentary myoclonus, which was demonstrated on polysomnography in almost all patients with fatigue [203]. Such movements may be treated with controlled release carbidopa-levodopa (Sinemet CR) [204]. Antihistamines (eg. diphenhydramine) and other sedatives (eg. Chloral hydrate 250-500mg, benzodiazepines) can also be considered once respiratory causes for sleep disturbance have been ruled out (see section 1.10.1 for the treatment of respiratory-related sleep disturbance).

2.10.10 Cognition and Behavioural Impairment
Cognitive impairment is increasingly recognised in MND -- 50% are thought to have frontal executive deficits (see Box 2.6) [205]. Visuospatial function, praxis and memory storage are usually spared [206-208]. Use of memory aids such as diaries, planners and structured daily routine is encouraged. Other conditions (depression, anxiety, fatigue) and medications (anticholinergics, benzodiazepines) should be monitored as they can worsen cognitive function.

Behavioural changes unrelated to mood or cognition has also been noted although estimates of prevalence vary widely [209]. Marked apathy occurs in an estimated 55% of persons with MND [210]. This correlates with deficits in verbal fluency but not depression, disease duration, FVC or ALSFRS scores and may be related to fatigue, respiratory weakness, impaired sleep, anxiety or medication [209]. It may also be a psychological coping mechanism [209].

In a subset of persons with MND (approximately 5%), clear fronto-temporal dementia (also known as fronto-temporal lobar degeneration) is the presenting picture with severe behavioural dysfunction (insidious onset with gradual progression, altered social conduct, impaired regulation of personal conduct, emotional blunting, loss of insight) that begins before motor weakness becomes obvious [209]. In addition, those with fronto-temporal dementia may exhibit disinhibition, restlessness, reduced empathy, lack of foresight, impulsiveness, social withdrawal, verbal stereotypes, verbal or motor perseveration and/or sexual hyperactivity [211].
Management of behavioural and cognitive deficits can be challenging and begins with the identification of these issues. An assessment by a neuropsychologist is often helpful in terms of defining the deficits and provision of cognitive and behavioural remediation strategies. Education and counselling of the patient and family is important. No trials have been conducted in efficacy of pharmacological interventions in this area; however the use of antidepressants and antipsychotics may be considered.

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<tr>
<th>Box 2.6 Cognitive deficits in MND (adapted from [209])</th>
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<td>Attention and concentration</td>
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<td>Working memory</td>
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<td>Cognitive flexibility (rigidity)</td>
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<td>Response inhibition</td>
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<td>Memory</td>
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2.10.11 Pseudobulbar affect
Pseudobulbar affect describes sudden uncontrollable outbursts of laughter or tearfulness and is a result of bilateral corticobulbar tract degeneration [212]. It is common, affecting between 50-70% of persons with MND [213] especially those with the bulbar form of MND. Pseudobulbar affect can have a significant impact on anxiety and emotional frailty [213], social functioning and relationships in persons with MND as these sudden, frequent, extreme, uncontrollable emotional outbursts may lead to severe embarrassment and social withdrawal [214].

Despite the prevalence of this issue, less than 15% ask for treatment [215]. Education of the persons with MND and their family and friends assists with understanding and acceptance of these pathological and involuntary outbursts and is an important component of the appropriate treatment of pseudobulbar affect. Crying associated with pseudobulbar affect is easily incorrectly interpreted as depression; laughter may be embarrassing. Pharmacological treatment can include amitriptyline (10-150mg nocte, starting with 10mg and slowly increasing the dose) which also has the positive benefit on weight loss and loss of appetite [215] or fluvoxamine (100-200mg daily). A more recent study (n=140) showed that dextromethorphan and quinidine in combination appears to be more effective in reducing the frequency and severity of psudobulbar affect and to improve quality of life) [216]. However, side effects are also more common (nausea, dizziness, gastrointestinal complaints) [216].
2.10.12 Psychosocial issues

MND is a devastating condition, which takes its toll on the patient and family especially as the disease progresses, and loss of independence occurs. Rates of depression and anxiety are reported to be 0-44% and 0-30% respectively in persons with MND [217] and depression does not appear to increase in more advanced disease [218]. Quality of life also appears to be more dependent on psychological and existential factors than physical factors [219, 220]. Amongst caregivers, 23% are depressed [221] and caregiver strain is often significant as a result of increased caregiving time, cognitive impairments in persons with MND, emotional labour and socio-economic considerations [28, 222, 223]. Hence, referrals to support groups and counselling and education of patients and their families (often their caregivers) are essential.

Frank discussions facilitate understanding of the disease and improve coping skills. Carer support (both physical and emotional) and respite care should be discussed. Referrals to the local MND associations are also recommended as these provide patients and families with ongoing support, resources and equipment needs. Psychotherapy should also be considered to assist with coping strategies [224]. Antidepressants such as amitriptyline and selective serotonin reuptake inhibitors may be used, the former being also useful for other symptoms such as drooling, pseudobulbar affect and insomnia. Anxiety is difficult to measure due to physical confounding symptoms such as shortness of breath, muscle cramps and restlessness. Anxiety can be treated with psychotherapy and training in relaxation and breathing techniques, as well as participation in support groups. It is generally thought that the rates of anxiety increase in the pre-terminal stage [217], hence anxiolytics at this time such as benzodiazepines should be offered. With good support, mental health and quality of life can remain stable despite deteriorating physical health [225].

2.10.13 End of life issues

It is important to establish an open environment of communication with persons with MND and their families from the time of diagnosis. Specialist palliative care providers should be involved as early as possible. Discussions should take place early, well before specific decisions need to be made. The actual timing of when to introduce these discussions however can be challenging and will depend on a number of factors including coping skills, depression and anxiety, cultural issues and functional status [226]. Some triggers may include the patient or family initiation of discussion, severe psychosocial distress, pain requiring high dosages of analgesia, dysphagia, dyspnoea and functional loss in two body regions [226]. Given the progressive nature of the disease, the patient eventually has to choose between life-sustaining therapies (respiratory assistance, feeding tubes) and terminal palliative care whilst considering issues relating to quality of life, burden of therapies, their own wishes and those of their family. It is important that clinicians caring for MND patients and their families appreciate and communicate the significance of life-threatening symptoms, monitor decision-making capacity, ensure that multiple possible end of life scenarios are anticipated and managed with all options provided
(including hospice care), review advance care directives and comprehensively consider and aggressively manage symptoms [227].

Medications should be available for all patients who are deteriorating and may be approaching the terminal phase, although the terminal phase may be difficult to recognise as there is usually slow deterioration until a quicker change leads to death within a few days or less [228]. Medications should include morphine to relieve dyspnoea and pain, midazolam to relieve distress and agitation and glycopyrronium bromide or hyoscine hydrobromide to reduce chest secretions, delivered parenterally [228]. Cultural and spiritual issues should also be addressed [226, 229]. Although many persons with MND fear the terminal stages of MND, with good palliative care, the later stages can be a time of fulfilment and peace for both persons with MND and their families [228].

Bereavement in MND occurs in both the patient and their family and continues, in families, after the death of the patient. Some families feel relieved of their caregiver burden and the burden of losses for the patient but also have feelings of guilt that they feel these emotions; hence support is vital in this area [230].

2.10.14 Conclusion
MND is a complex and challenging condition with no cure. As such, integrated and coordinated health care delivery and services are needed for comprehensive care for persons with MND using the neuropalliative rehabilitation model with the aim of maximising activity and participation and optimising quality of life. Many areas in MND are poorly understood, with research often further hindered by the logistical and ethical difficulties. Further research is needed into appropriate study designs; outcome measurement; the evaluation of optimal settings, type, intensity or frequency and cost-effectiveness of multidisciplinary care; and the different phases of MND, covering the spectrum of care required for this patient population. The interface between neurological, rehabilitative and palliative components of care, and caregiver needs should be explored and developed to provide long-term support for this population.

The next chapter discusses the methodology used in this thesis.
Chapter 3 – Methodology in MND rehabilitation research

This chapter describes the general method used for all six studies. Individual differences to the overall method are included in the methods section of each study. This chapter describes the application of the Priority-Sequence Model that combines qualitative and quantitative methods and maps each study using the ICF as a theoretical framework. Key issues and limitations for multifaceted complex interventions in rehabilitation and pragmatic service environments are also presented, as are issues specific to MND.

3.1 General overview

As Study 1 was a systematic review of multidisciplinary care (rehabilitation) in MND, its methods were entirely different to the remaining 5 (experimental) studies. The methods for Study 1 will be described in brief in this chapter (section 3.2) as a detailed description is given in the next chapter (Chapter 4). Sections 3.3-3.5 cover the ethics process, subjects and assessments conducted. Section 3.6 presents three different methodological models (Priority-Sequence Model, ICF model, Medical Research Council model), key methodological challenges for complex interventions in rehabilitation and in MND as a condition, the justification for the choice of methodological model for this thesis and how the studies map onto the different models.

3.2 Methods for systematic review (Study 1, Chapter 4)

A review was done with the aim of assessing the effectiveness of multidisciplinary care (rehabilitation) in adults with MND, looking especially the types of approaches that are effective (settings, intensity) and the outcomes that are affected. A thorough literature search was conducted in the following sources:

- The Cochrane Neuromuscular Disease Group Specialised Register (11 May 2009)
- The Cochrane Central Register of Controlled Trials (The Cochrane Library Issue 2, 2009)
- MEDLINE (1966 to April 2009)
- EMBASE (1980 to April 2009)
- CINAHLPlus (1937 to April 2009)
- AMED (1985 to April 2009)
- LILACS (1982 to April 2009).

Randomised and controlled clinical trials were sought, that compared multidisciplinary care in MND with either routinely available local services or lower levels of intervention; or studies that compared multidisciplinary care in different settings or at different levels of intensity. In addition, studies of “other designs” (such as observational studies) were also selected with the acknowledgement that such studies could only be of limited contribution to the best evidence synthesis.
A “best evidence” synthesis was performed based on methodological quality. Studies were grouped in terms of setting and intensity (high or low) of therapy and this was most clinically relevant. Outcome measures were categorised where possible according to the ICF [5] into those that focused on:

- impairment - for example, muscle weakness, forced vital capacity (FVC);
- disability or limitation in activity - for example, Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS) (the domains of ALSFRS include speech, salivation and swallowing; turning in bed, walking, climbing stairs; dressing and hygiene, handwriting, cutting food; and respiratory insufficiency, dyspnoea, orthopnoea);
- restriction in participation, and environmental or personal context, or both - for example, patient and caregiver mood, satisfaction with services, social integration.

The following sections relate to Chapters 5-9 (Studies 2-6).

3.3 Ethics

This research was approved by the Melbourne Health and Calvary Healthcare Bethlehem Human Research and Ethics Committees. These committees are constituted and operate in accordance with the National Statement on Ethical Conduct in Human Research 2007 [231]. As required by protocol, all participants received a participant information and consent form written in plain language, which they signed after they had had an opportunity to ask questions and receive an explanation concerning the project from the primary investigator (Louisa Ng). All research data was kept in a coded fashion, labelled with a unique study code, and kept in a locked office at the Royal Melbourne Hospital, Royal Park Campus. Coded information was then entered into a password protected database once all information had been collected.

3.4 Subjects

A community based MND group was recruited through a tertiary MND multidisciplinary clinic that services Victoria, Australia, including metropolitan and rural regions. Invitation letters, which included an expression of interest page and a stamped addressed envelope, were distributed at the MND clinic at Bethlehem Hospital by one of the neurologists (Paul Talman).

Selection criteria included diagnosis of MND according to the El Escorial criteria [19] as diagnosed by a neurologist, residence in Victoria, community-based (non hospital inpatient) and ability and willingness to give informed consent. Community-based patients were chosen to minimise the effect on function due to being acutely unwell. Details of diagnosis were confirmed by a neurologist (PT) who has a subspecialty interest in MND. Participants were deemed to have adequate cognition if they appeared grossly cognitively intact based on simple observation during the interviews, were able to understand the questions and give informed consent.
Exclusion criteria included severe cognitive issues or dementia and other substantial medical, neurological or psychiatric disorders. Screening of exclusion criteria was done by a neurologist (PT) through consultation of the medical records and liaison with the treating clinicians of the patients.

Fifty-nine participants met the criteria and received letters of invitation to participate in the study. Of these, forty-four replied affirmatively and were then contacted by telephone by the primary author who explained the studies further and organised an interview appointment. Thirty-seven of these participants had caregivers who also consented to being part of the studies. Participants could choose not to have their caregiver interviewed but all participants consented to have their caregivers interviewed. Caregivers were defined as the person who lives with the person with MND and provides them "with the most care and assistance" [20].

With regards to the 15 participants who declined, 9 were male, 6 were female. Four lived in rural areas whilst 11 lived in metropolitan areas. Reasons for declining are as follows:

- 1 declined as his caregiver (wife) declined.
- 2 declined as they were too short of breath.
- 5 could not be contacted at all.
- 1 had caregiver who declined on her behalf as she was too cognitively impaired.
- The remaining (6) did not wish to give a reason for declining.

3.5 Assessments and data collection

Recruitment and all interviews were undertaken between September 2009 and February 2010. Thirty-nine interviews were conducted by the primary author and 5 interviews by an independent trained research assistant, who had received a three-day training session from the primary author in assessments (see “Questionnaires”) and observed in a pilot process to confirm achievement of an acceptable standard. Both (primary author and the trained research assistant) also participated in 3 half-day structured ICF workshop at Melbourne Health. The workshop involved education about the model and core ICF principles, and practical application and linkage rules for ICF.

Forty-four persons with MND and their 37 caregivers were interviewed separately but often during the same appointment. Participants were interviewed at a venue of their choice (half were interviewed at home or at hospital, and half over the telephone) for one hour with rest breaks.
3.5.1 Questionnaires

Interviews commenced with an open-ended self-report questionnaire. Participants were asked, "What are the main problems you face in your everyday life? If possible, can you list and prioritise up to 10 issues that you feel are the most pressing problems you face in everyday life?" Participants were asked to include intrinsic factors that impacted on their experience of these problems, such as their ability to cope. Caregivers were then asked the same question. No additional questions, prompts, suggestions of expected specific problems or checklists were given in order to gain first-hand information about problems due to MND. Some who had difficulties with verbal communication chose to write their responses and/or use communication devices.

From the participant responses (available from authors), listed problems were categorised thematically under major disability headings, which included: impairments in body structure or function (e.g., fatigue, spasticity/cramps/spasms, emotions, shortness of breath, weakness, loss of bladder and bowel function), activity limitations (e.g., self-care, mobility, and communication) and participation restrictions (e.g., employment, social life). For example, if participants reported difficulties with showering or dressing, these issues were categorised as "self-care" under the "activity limitation" heading.

Each problem reported was linked with the standardised ICF checklist containing 128 categories ([232] and with 45 additional categories (available from authors) derived from previous reports involving other neurological conditions (multiple sclerosis and Guillain-Barré syndrome [233]). We considered the ICF checklist comprehensive enough for use in the MND population because it has been used in many other neurological conditions. Any categories reported by MND participants that had not been reported in other neurological conditions were added in. Barriers (hindrances) were identified as a major influence on a person's ability to engage in activity, participation and good health practices.

Authors trained in ICF (LN, BA) used the linking rules to match each problem reported by the participant with an appropriate code from the ICF categories (second level). Consensus between health professionals was used to decide which categories should be linked to each answer. After data extraction, both reviewers compared their results and any disagreements were resolved by a trained third health professional (FK).

All problems relating to personal factors (currently not coded within the ICF) were grouped under "personal factors" and categorised thematically separately under major headings, which included: demographic factors (gender, race, age, educational status), emotional states (depression, stress, anxiety, fear), coping strategies and styles (problem-based coping, denial),
personality, beliefs (includes self-efficacy, religious beliefs and values, personal and cultural), attitudes (of the patient) and “other” (perceived social support).

Self-administered (patient) questionnaires followed the open-ended questionnaire:

1) Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS-R) to determine severity of MND for purposes of stratification. This is a 48-point measure of disability in MND with excellent validity and reliability, and can be administered over the phone [97]. It is determined by scoring 0-4 for each of the twelve domains (speech, salivation, swallowing, handwriting, cutting food and handling utensils, dressing and hygiene, turning in bed and adjusting bed clothes, walking, climbing stairs, dyspnoea, orthopnea and respiratory insufficiency). Patients were arbitrarily grouped into 4 levels: level 1 (ALSFRS 0-12), level 2 (ALSFRS 13-24), level 3 (ALSFRS 25-36), level 4 (ALSFRS 37-48). A lower score indicates more disability.

2) socio-demographic and medical status questionnaire

3) items from the needs and provision complexity scale (NPCS) for long term neurological conditions - domains include medical care needs, nursing care, rehabilitation needs (including vocational support), personal care, support for the caregiver, equipment and accommodation [234].

4) Depression, Anxiety Stress Scale (DASS) [235] – This is a 21-item instrument, consisting of three 7-item self-report scales that have been designed to measure the negative emotional states of depression, anxiety and stress. Participants rate the extent to which they experienced each state over the past week on a 4-point Likert rating scale. It has acceptable to excellent internal consistency and concurrent validity.

5) McGill Quality of Life questionnaire (MQOL) [236] – The MQOL is a valid and reliable 16-item questionnaire, with each question rated from 0 (not at all) to 10 (extremely). There are five domains, two of which are health related (physical well being, physical symptoms) and three are non-health related (existential well being, psychological symptoms and support). For each domain, the score is the mean of the values of the relative items. A total rate is obtained as the mean value of the score of the five domains. In addition, the participant is asked to indicate his/her self perceived quality of life in the past two days in a single item scale (MQOL-SIS), rated from 0 (very bad) to 10 (excellent).

6) Brief COPE [237] – This is coping inventory of 14 subscales (active coping, planning, positive reframing, acceptance, humour, religion, using emotional support, using instrumental support,
self-distraction, denial, venting, substance use, behavioural disengagement and self-blame). Each subscale has two items. It has good reliability and validity and is a brief measure that assesses several responses known to be relevant to effective and ineffective coping.

No scales were used to screen for cognitive impairment. These participants had already been screened for severe cognitive issues or dementia (exclusion criteria). Whilst it is quite possible that some had mild cognitive impairment, participants appeared grossly cognitively intact based on simple observation during the interviews. They were able to understand the questions posed and give their informed consent. Although research increasingly suggests the presence of cognitive impairment, this is generally of the frontal executive type and relatively mild, hence not easily detectable with common instruments such as the Folstein mini-mental examination (MMSE), and also why it was previously thought that MND did not affect cognitive function. Therefore adding a scale such as the Folstein MMSE would not have achieved much and at the same time made the interview process even longer and hence more laborious. Such cognitive impairment also does not preclude MND participants from undergoing the interview. Extensive neuropsychological testing was beyond the scope of this thesis.

Patient responses were clarified and confirmed with caregivers where appropriate after the caregiver interviews and also with medical records wherever possible. Patients were taken to be the expert on their illness especially in terms of symptomology such as pain. For example, if they reported pain, and this was not reported by their caregiver or in their medical records, they were nevertheless recorded as having pain from their perspective. The issues that directly related to caregivers were clarified with the caregivers. For example, the level of care required (once a day vs 2-3 times a day vs someone most of the time) could be, and was clarified with caregivers. Where there were disagreements, these were resolved by consensus between the caregiver and the patient. An example of such a disagreement would be where a patient reported requiring constant care whilst her caregiver reported that she only required care 3 times a day. From the patient’s perspective, if she had severe communication issues, she might have felt that she required constant care because if someone came to the door, she would not be able to communicate with that person. However, in terms of care for her basic needs, she might have only required care 3 times a day. Following discussion between the patient and her caregiver, they might decide that she could ignore the doorbell if she was alone in the house and hence, could be documented as requiring care 3 times a day as opposed to constant care.

Caregivers also completed the DASS, MQOL and Brief COPE. In addition, they completed:

1) Self-rated burden (SRB) [238] – This is a single rating scale scored in millimetres along a 10cm line (score range 0-100). Caregivers were asked to indicate on the scale “how
burdensome you feel caring for your partner is at the moment”. “0” indicated no strain at all and “100” indicated much too straining. A higher score indicated higher subjective burden. SRB has been demonstrated to be a feasible and valid measure of subjective burden amongst informal caregivers of stroke patients [238].

2) Caregiver strain index (CSI) [239] – This measures caregiver stress and consists of 13 items that describe stressful aspects of caregiver (eg. inconvenience, confining). The caregiver indicates the aspects that are stressful using a “yes” (score = 1) or “no” (score = 0). A score of ≤ 7 out of 13 indicates caregiver strain. The construct and predictive validity was established using 85 family caregivers of elderly patients [239].

Participants were offered peer support intervention (see section 3.5.2) as they underwent baseline interviews. Of the 44 persons with MND, seven accepted the intervention and completed a second assessment at 6 weeks post intervention (T1) and a third assessment 12 months (T2) later. All questionnaires were repeated at T1 and T2 apart from the open-ended self-report questionnaire (see section 3.5.1). In addition, these seven participants were asked a single question at T1 and T2 on “how satisfied were you with the peer support program” (“0” indicating not satisfied at all to “10” indicating very satisfied).

3.5.2 Intervention

Seven participants were in a single group that received a 6-week group face-to-face community-based peer support program called “LifeMoves” (Jan-Feb 2010) that was delivered at Bethlehem Hospital. The LifeMoves program is a pre-existing program previously offered only to patients of Royal Melbourne Hospital with neurological disorders (since 2002). It was designed to augment a traditional rehabilitation approach by targeting the social and emotional consequences of a neurological condition. Since 2010, LifeMoves has been offered at various locations in the community by the not-for-profit “peers inspiring peers” organisation and is no longer restricted to Royal Melbourne Hospital patients, nor delivered at the Royal Melbourne Hospital. The format, however, has not changed. All LifeMoves programs are based on participant generated discussions [240] with the aim of empowering and supporting members. As such, each program is unique. Examples of common topics include “coming to terms with change, “loss and grief” and “communicating with family and friends”.

Three experienced facilitators with different neurological diagnoses (not MND) facilitated the group. All facilitators had previously attended a LifeMoves program personally and a 4-week, 3-hour weekly structured training program to orient them to program objectives and the promotion of skills that enabled the use of experiential knowledge.
The original plan had been to recruit close to 20 participants and to run 2 groups. The recruitment process started off reasonably well with the first group recruited within a few months. This was in contrast to the peer support programme run by the local MND association which had not been able to find a single participant for the past 2-3 years. A second group for the peer support programme was actually recruited. Unfortunately the main facilitator fell ill and was no longer able to facilitate any groups. There were two main challenges to running this second group at a later time. Firstly, the patients themselves were rapidly deteriorating and secondly, by nature of their condition, the patients had complex physical and emotional needs making them a challenging group to facilitate and I was not able to find a suitable and adequately trained facilitator. (Unfortunately the original facilitator did not recover from her illness even after a prolonged period of time). Hence, the second peer support programme was never run, thus reducing the numbers significantly and pushing up the “decliner rate”.

3.5.3 Statistical analysis
Descriptive analysis was used to describe the study population (demographics, ALSFRS, NPCS, patient satisfaction with program) and their reported problems. Results were described by mean and standard deviation (SD) for continuous non-skewed data and as frequency (%) for categorical data.

As for classification of reported problems using the ICF, as is common practice, only categories in which at least one third (33%) of participants reported a problem were chosen for describing the disability profile of MND. The frequency of participant-reported problems in the components body function, body structure, activities and participation and environmental factors due to MND were compared with categories linked for persons with Guillain-Barré syndrome and for persons with multiple sclerosis [23] and also to MND caregivers. If the participant repeatedly assigned one ICF category, it was counted once only to avoid bias. Categories in the components activities and participation and environmental factors common to all three neurological conditions (MND, multiple sclerosis and Guillain-Barré syndrome) were reported, together with the frequency (number and percentage) reported by each condition.

The other outcomes, DASS, MQOL, Brief COPE, CSI and SRB were reported by median and interquartile range (IQR).

3.6 Choosing a methodological model
A number of methodological models could have been used in the studies to address the objectives of this thesis. As mentioned in Chapter 1, however, qualitative approaches and the priority-sequence model (which combines qualitative and quantitative approaches) was the primary chosen methodological model for this thesis. The three main models considered were:

1) Priority-sequence model [18]
2) ICF model [5]
3) The U.K. Medical Research Council (MRC) model [241]

There are benefits and limitations to each of these models, which will be discussed, in further
detail in the following sub-sections. It is also important to note that there is no framework or
model that fully covers the continuum of the studies in this thesis. In addition, these models do
not necessarily take into account the methodological issues from a health services perspective.
For example, the patients were recruited from a single stand-alone tertiary MND
multidisciplinary clinic hence generalisation to other settings is limited. These limitations will be
discussed in greater detail in Chapter 10.

As the main objective of the thesis is to capture issues relevant to multidisciplinary rehabilitation
care from the perspective of the patient and caregiver, i.e. understand their lived experience,
and to identify gaps in evidence and service provision, it was felt that a predominantly
qualitative approach would be most useful. Qualitative approaches are much more inductive
(moving from observation to hypothesis) than deductive (testing a hypothesis) and are by no
means the most methodologically rigorous nor provide the highest grades of evidence.
However, robust methodology (such as randomised controlled trials within the MRC model),
even with modifications, may not be feasible in certain areas of rehabilitation especially in a rare
and fatal condition like MND, to capture the full range of experiences and the real-life context in
which these experiences occur.

3.6.1 Mapping the studies using the priority-sequence model
A combination of quantitative and qualitative approaches has been used in this thesis to capture
and evaluate the range of experiences in real life context. Qualitative approaches are often
come better suited to understanding human interaction, behaviour and their experiences [242].
However, quantitative approaches can then be used to help evaluate and interpret results from
principally qualitative studies and vice-versa. A Priority-Sequence Model is used in this research
where a principal method is selected and the effectiveness of this method optimised before
using a different method to improve the main data collection strategy [18].

In Studies 2-5 (Chapters 5-8), a qualitative approach is predominantly used to gather
information on the disability profile, health-care needs and contextual factors (environmental
and personal factors) relevant to patients with MND and their caregivers. Further evaluation
and interpretation of these reports was then conducted using quantitative methods to determine
the frequency and extent of the identified issues. (see Table 3.1)

Study 6 (Chapter 9) on the other hand uses a predominantly quantitative approach.
Quantitative methods in general, aim for reliability and rely on standardised tools [242].
However smaller qualitative approaches can be preliminarily used to generate a hypothesis on which a principally quantitative study can then be designed. Based on qualitative information gathered from the previous studies (2-5), it was hypothesised that a peer-support intervention would improve perceived social support and hence impact positively on neuropsychological sequelae (anxiety, depression, stress, quality of life, coping strategies). A pre-post design was then used, where all participants who wished to participate in the intervention were offered the intervention, and standardised outcome measurements were administered at baseline (before the intervention), at 6 weeks after the intervention and at 12 months (see Table 3.1).

It should be mentioned that there were three specific methodological issues that were considered especially in Study 6. The number of recruited participants was very small (n=7) for a number of reasons, which are further discussed in Chapter 9. It is worth noting that a similar peer-support program offered annually by MND Victoria has not run for the past three years due to lack of participants. Despite this, it was still felt to be worthwhile exploring the role of peer support as an intervention for persons with MND as there is no current literature supporting or negating its role in MND despite its theoretical basis (further discussed in Chapter 9) and economic viability (inexpensive to run). Use of a control group was considered which would have been selected from the initial 59 patients contacted. However, the fact that the controls would have consisted of patients who did not wish to participate in the peer support program alone would have added significant bias to the methodology. Furthermore, it was unlikely, given the small number of participants, that comparison with control would have yielded conclusive findings in any case. The use of item response theory (IRT) based methodology [243] was also considered. This is a method for evaluating the nature of gains and losses more effectively at an individual level in addition to change at a group level. The key advantages to IRT methodology over more conventional methods (classical test theory) [244] are: a) direct relationship is established between ability level and parameters of individual items as opposed to relying on overall scores across item and b) that there is no need to use correlation to a reference group so that level of ability can be defined independently of any sample. Application of IRT methodology is challenging as it has not yet been incorporated into SPSS and this methodology is complex. The value of IRT is limited in a very small sample of n=7 and therefore has not been used. Extensive use of IRT methodology is most useful for the creation of tools in health care services to monitor population health on a large scale as well as identify those who need and are most likely to benefit from treatment on a more individual level [245]. Item and scale analysis within the framework of IRT can ensure reliable, valid, and accurate measurement of participant trait levels; and identification of items that are informative or problematic can help investigators better understand the domains they are measuring, and their target populations.
Table 3.1 Mapping of the studies in this thesis using the priority-sequence model (Adapted from [18])

<table>
<thead>
<tr>
<th>SEQUENCE DECISION</th>
<th>Principal Method: Quantitative</th>
<th>Principal Method: Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complementary Method: Preliminary</td>
<td>1. Qualitative preliminary Qual -&gt; QUANT Purposes: small qualitative study helps guide the data collection in a principally quantitative study * can generate hypotheses; develop content for questionnaires.</td>
<td>2. Quantitative Preliminary Quant -&gt; QUAL Purposes: Smaller quantitative study helps guide the data collection in a principally qualitative study * can guide purposive sampling, establish preliminary results to pursue in depth.</td>
</tr>
<tr>
<td>STUDY 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complementary Method: Follow-up</td>
<td>3. Qualitative Follow-up QUANT -&gt; qual Purposes: smaller qualitative study help evaluate and interpret results from a principally quantitative study * can provide interpretations for poorly understood results, help explain outliers.</td>
<td>4. Quantitative Follow-up QUAL -&gt; quant Purposes: smaller quantitative study helps evaluate and interpret results from a principally qualitative study * can generalise results to different samples, test elements of emergent theories.</td>
</tr>
<tr>
<td>STUDY 2, 3, 4, 5</td>
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The priority-sequence model is simplistic in many ways and, for example, does not fully cover methods such as those used in Study 4 where concurrent qualitative and quantitative methods are used. One of the most significant limitations to qualitative methodology is that whilst qualitative models are ideal for exploration and identification of issues, they do not usually “answer questions”. Hence the evidence base does not move past the hypothetical phase. In
addition, more specifically in relation to the MND population, qualitative research generally involves detailed interviews which are extremely challenging in the physically and emotionally fragile MND population who often experience high level of fatigue, difficulties with communication (severe dysarthria), respiratory issues (need to stop frequently to catch their breath and can only hold short conversations at a time), and who also experience sensitive, emotional issues (rapid progression, loss of independence, end of life issues).

3.6.2 Mapping the studies onto the ICF framework
An alternative framework, onto which the studies can be mapped, is the ICF. The ICF provides a unified and standard language and framework for the description of health and health-related states [5]. It has two parts, each with two components:

Part 1. Functioning and Disability
   a) Body Functions and Structures
   b) Activities and Participation

Part 2. Contextual Factors
   c) Environmental Factors
   d) Personal Factors

Each component can be positive or negative [5]. Functioning is positive whilst disability is negative; environmental factors can be facilitators (positive) or barriers/hindrances (negative). The rehabilitation process aims to identify and focus interventions on the negative aspects such as symptoms and limitations at the level of activity and participation and barriers in the environment to achieve the most optimal functional and social reintegration outcomes. Hence the negative aspects are generally more relevant in rehabilitation.

The ICF can be further qualified by the use of performance and capacity qualifiers [5]. The performance qualifier describes what a person does in his/her own environment whilst the capacity qualifier describes a person’s ability to execute a task or an action in a standard environment. Qualifiers are numeric codes 0-4 (0 no problem, 1 mild problem, 2 moderate problem, 3 severe problem, 4 complete problem) that specify the extent of functioning or disability in that category or the extent to which an environmental factor is a facilitator or barrier. The use of qualifiers is time-intensive (which can make the already challenging interview in these fragile patients even more difficult) and for the purposes of identifying issues relevant to multidisciplinary rehabilitation care from the perspective of the patient and caregiver (as opposed to determining the extent of each issue), qualifiers were a lesser priority. Within a rehabilitation setting, the timing of which rehabilitation goals to address is often a bigger priority than the severity of the issue per se. For example, returning to work may be a severe problem, however, the goals initially may be to target mobility, a milder problem to enable the person to return home from a hospital setting before other problems, which may be “more severe”, may be
addressed. In general, issues identified were negative (eg. disability, environmental barriers) aspects as this was more relevant within the rehabilitation setting. The lack of qualifiers however, does mean that the data collected will be less useful in the future development of an ICF-based scale of disability in MND patients.

Based on the ICF framework, Study 1 fits into all parts of the ICF whilst Studies 2, 3, and 4 fit into the functioning and disability part and the environmental factors component of the contextual factors. Study 5 fits into personal factors component of the contextual factors and Study 6 fits into both components of the contextual factors (see Figure 3.1).

Figure 3.1 Mapping of the studies in this thesis onto the ICF framework ([5])

Functioning and Disability
   Body Functions and Structures
   Activities and Participation

Contextual Factors
   Environmental Factors
   Personal Factors

Study 1

Studies 2, 3, 4

Study 5

Study 6

The major limitations of using the ICF framework is that no personal factors are currently classified, representing a significant gap in the “biopsychosocial” nature of the framework. This is especially relevant in rehabilitation where personal factors are often important barriers and/or facilitators to this process; rehabilitation aims to enhance facilitating factors whilst underplaying the negative factors to achieve the most optimal functional and social reintegration outcomes.

For example, education (for patients and families) is an integral part of MND management but information provided must be appropriate to the patient’s educational level; timing of end of life issues depend on a number of factors including coping skills, depression and anxiety, cultural issues and functional status [226]; and technological aids (which can vary considerably in cost) need to suit the patient’s socio-economic status, which impacts on their ability to fund these aids. If these personal factors were not adequately identified and considered, the effectiveness of the rehabilitative process would be significantly affected. It is also common in rehabilitation, for example, for the rehabilitation team to experience challenges when engaging patients and their families in areas such as physical therapy, education or discharge planning. Often, personal beliefs and perceptions regarding these aspects need to be explored, identified and specifically targeted to optimise the rehabilitation process. For example, fear of falls impacting
on engagement in physical therapy is not uncommon especially following a fall and this needs to be identified and targeted to enable resumption of active engagement by the patient in physical therapy to prevent further falls.
3.6.3 Methodological challenges for complex interventions (rehabilitation) in MND and the Medical Research Council model

There are a number of challenges in research methodology for the evaluation of complex interventions such as rehabilitation, both at the individual and at the organisational level. Rehabilitation and its components (such as peer support programs) are considered complex interventions as these interventions generally contain several interacting components within the treatment itself, which is generally multifaceted, and also within those delivering and receiving the intervention (patients, therapists, contexts -- “the black box of rehabilitation”). All these components are interdependent and the proportional contribution of each individual component is often unknown [246]. For example, it can be difficult to determine if a treatment effect is as a result of the intervention protocol or an individual therapist, or if it is the environmental in which it is provided or related to intrinsic characteristics of the patient or indeed to intrinsic characteristics of other patients within a group setting (such as in group-based peer support). In addition, rehabilitation is an individualised process, which results in a degree of flexibility and tailoring of the intervention, thus further increasing the complexity of intervention.

Another significant challenge to consider is that of pragmatic service environments. Rehabilitation is a health service and as such, is shaped by a number of organisational and external influences. For example, resource availability and allocation, infrastructure, policies and cultural influences are some of the many elements, which impact on rehabilitation services and their delivery. These interventions, therefore, are often defined pragmatically, according to local settings (which can vary wide from country to country and also within regions within each country), rather than implemented from a theoretical basis. This makes it more difficult to evaluate complex interventions and also to generalise the results.

The UK Medical Research Council (MRC) framework is one of the most commonly used frameworks that help researchers recognise and adopt appropriate research methods in the area of complex intervention. There are five phases in the original MRC framework (see Box 3.1). The original framework focused on the development and evaluation of randomised controlled trials (RCTs) for complex interventions [241], which are generally recognised as providing the highest grade of evidence [247]. Conventionally, RCTs involve parallel groups that are randomised to receiving and not receiving an experimental, therapeutic, preventative or diagnostic procedure and are then followed up to determine the effect. The new guidelines [248] expand on other randomised designs if the conventional RCT design is not appropriate (see Box 3.2).
Box 3.1 Phases of developing randomised controlled trials of complex interventions. Adapted from [241].

**Preclinical** – identification of the evidence that the intervention might have the desired effect.

**Phase 1 (modelling)** – identification of the components of the intervention and their interrelationships. May include qualitative testing through focus groups and preliminary surveys.

**Phase II (exploratory trial)** – Description of the constant and variable components of a replicable intervention and feasible protocol for comparing the intervention with an appropriate alternative.

**Phase III (definitive randomised controlled trial)** – comparing a fully defined intervention with an appropriate alternative with an appropriate statistical power and strong defensible methodology.

**Phase IV (long term implementation)** – determine whether intervention and results can be replicated by others in uncontrolled settings over the long term.

Box 3.2 Experimental designs for the evaluation of complex interventions. Adapted from [248].

**Individually randomised trials** – individuals are randomly allocated to receive an experimental intervention or an alternative such as standard treatment, a placebo or remaining on a waitlist.

**Cluster randomised trials** – groups are randomly allocated to experimental or control intervention.

**Stepped wedge designs** – overcomes practical or ethical objects to experimentally evaluating an intervention where there is some evidence of effectiveness or which cannot be delivered to the whole population at once. A randomised phased implementation is used where eventually the whole population will receive the intervention.

**Preference trials and randomised consent designs** – treatment allocation is based on patients’ preference or patients are randomised before seeking consent.

**N of 1 design** – individuals undergo interventions with the order or scheduling decided at random to assess between and within person change.

Whilst these randomised designs may overcome many practical or ethical challenges, they are not always practicable depending on the intervention involved and the target population. In MND, the rapidly progressive and fatal nature of the disease itself causes immense logistical and ethical challenges. Withholding intervention even where there is no robust evidence to support its effectiveness but where patients perceive potential benefit (such as peer support
interventions) is unethical. Delaying intervention is often equivalent to withholding intervention, as the patient will often no longer be able to undergo intervention “when their turn comes”, due to progression of the disease or death. Hence, phased implementations and wait list controls are challenging. The rarity of the disease also often means recruitment is difficult as the potential population for recruitment is limited to begin with; the high level of disability and the type of symptoms (such as fatigue and respiratory involvement) makes participation in trials that require travelling (again, such as in face-to-face peer support interventions) even more difficult as access is often restricted. Hence, the recruitment of sufficient patients for multiple groups in situations where there is a significant possibility of inter-group bias (such as in group-based peer support interventions) is also challenging. Finally, interventions or designs that take a prolonged period of time (such as N of 1 design) are also difficult for a number of reasons. Not only do patients often deteriorate, the deterioration can be rapid but also unpredictable. Hence the patient can often be very different intrinsically even in a period as short as a few weeks. For example, it would not be unusual for a patient to be well enough to consent to a baseline interview but die within a week before the interview can be conducted. Interventions that are irreversible and/or where it is unclear how long the effects might last for (such as peer support interventions) are also not appropriate for these designs as it would be very difficult to determine if any effects were due to the initial intervention or subsequent scheduled interventions.

Given the limited feasibility of experimental approaches outlined in Box 3.1, observational designs need to be considered, with the understanding that there is significant limitation to the reliable estimates of effect with these methods and that conclusive findings are often only found where interventions have rapid, large effects [248]. However, observational designs can still contribute to assessment of feasibility of interventions (acceptability, compliance, delivery of interventions, recruitment and retention) and in a very limited way, to the effectiveness of such interventions.

As the MRC framework is primarily geared towards the development and evaluation of RCTs, it is not the most appropriate framework for the studies in this thesis and therefore it has not been chosen as the preferred methodological model.

The next chapter focuses on a systematic review that explores the current evidence-base for multidisciplinary care in MND.
Chapter 4 – Systematic review: Multidisciplinary care for adults with amyotrophic lateral sclerosis or motor neurone disease

There is currently no systematic review that addresses multidisciplinary care in MND. This chapter presents the current available evidence base for multidisciplinary care in MND especially for outcomes such as quality of life, impairment, activity limitation and participation restriction.

4.1 Background

Motor Neurone Disease, also often known as ALS, is the most common chronic neurodegenerative disorder of the motor system in adults. Its causes, classifications and management for the various disabilities (including physical, cognitive, psychosocial) have been discussed in Chapter 2. In the absence of a cure or indeed any medical intervention, which might stop the progression of MND, the focus is on symptomatic, rehabilitative and palliative therapy.

The World Health Organisation developed the ICF [5] in 2001, which aimed to develop a common language for describing the impact of a disease at different levels. How this relates to MND is also discussed at length in Chapter 2.

Motor Neurone Disease is a “progressive” long-term neurological condition that affects a person for life. The symptoms in MND are diverse and challenging and include: weakness, spasticity, limitations in mobility and activities of daily living, communication deficits and dysphagia, and in those with bulbar involvement, respiratory compromise, fatigue and sleep disorders, pain and psychosocial distress [21]. As mentioned in Chapters 1 and 2, the National Service Framework [15] which was developed by the department of Health in the UK to provide QRs for the inspection authorities (the Healthcare Commission and the Commission for Social Care Inspection) to use in measuring local progress for long-term neurological conditions advocates the need for integrated care and joined-in services. Included within its guidelines are 11 QRs which make recommendations for specialist neurology, rehabilitation and palliative care services to support people with MND to the end of their lives. The interface between neurology, rehabilitation and palliative care ensures co-ordinated care for persons with MND rather than duplicating services. This is consistent with current guidelines recommending multidisciplinary care published by the European Federation of Neurological Societies (EFNS) [10].

Rehabilitation may be defined as "a problem-solving educational process aimed at reducing disability and handicap (participation) experienced by someone as a result of disease or injury" [7]. Rehabilitation interventions in chronic and progressive neurological diseases, such as MND, are not expected to alter the underlying pathology of disease, although they are sometimes
effective in reducing impairment. The principal focus of rehabilitation, therefore, is on reducing symptoms and limitations at the level of activity and participation, through holistic interventions, which include personal and environmental factors.

Systematic reviews have demonstrated that holistic multidisciplinary rehabilitation is effective in other neurological conditions such as multiple sclerosis [249], acquired brain injury [250] and in stroke [251, 252], but the evidence base for the effectiveness of multidisciplinary rehabilitation in people with MND is not yet established. One systematic review [170] identified two trials (n = 52) which addressed unidisciplinary interventions in MND. These included effects of moderate intensity, endurance type exercise on spasticity, and effects of moderate intensity resistance type exercises in MND. Both trials, however, were too small to determine to what extent strengthening exercises were beneficial or harmful in this population.

This review aims to identify the existing evidence for multidisciplinary care in adults with MND and in doing so also identify the gaps in current knowledge. We will also discuss issues for future expansion of the evidence base by traditional research and other methods.

4.2 Objectives
To assess the effectiveness of multidisciplinary care in adults with MND or ALS. We will explore specifically the following areas:

- Does organised multidisciplinary care achieve better outcomes than the absence of such services in persons with MND or their caregivers, or both?
- Which type of programmes are effective and in which setting?
- Does a greater intensity (time or expertise, or both) of rehabilitation lead to greater gains?
- Which specific outcomes are influenced (survival, dependency, social integration, mood, quality of life?)
- Are there demonstrable cost benefits for multidisciplinary care in MND?

4.3 Methods - Criteria for considering studies for this review
4.3.1 Types of studies
All randomised controlled trials (RCTs) and clinical controlled trials (CCTs) that compared multidisciplinary care in MND or ALS with either routinely available local services or lower levels of intervention; or studies that compared multidisciplinary care in different settings or at different levels of intensity.

Due to ethical difficulties with conducting RCTs in this area, we included observational studies or studies of “other designs” (described in the review as “ODs”), such as cohort studies and
cross-sectional studies, in the “Discussion” with the understanding that the contribution of such studies to best evidence synthesis would be limited.

4.3.2 Types of participants
All those with a clinical diagnosis of possible, probable or definite MND or ALS according to the El Escorial criteria [19, 90], regardless of clinical pattern (for example bulbar or limb onset).

4.3.3 Types of interventions
For the purposes of this review, multidisciplinary care was defined as any intervention delivered by two or more disciplines, directed by a physician (neurologist or rehabilitation medicine or palliative care physician, or both), which was designed to be patient-centred, with an in-built flexibility and responsiveness that reflected the evolving nature of the condition [123], and aimed to maximise activity and participation, as defined by the domains of the ICF [5].

Allied disciplines included nursing, physiotherapy (PT), occupational therapy (OT), speech pathology (SP), orthotics, dietetics or nutrition, social work (SW), psychology, neuropsychology and spiritual counselling (chaplains).

Settings could include inpatient settings, where care is delivered 24 hours a day in a hospital ward or specialist rehabilitation or palliative care unit; outpatient settings which may be within a hospital or in the community; and home-based settings which are set within the patient’s own home and local community.

Intensity could be divided into “high-intensity” where there was input from at least two disciplines for a minimum of thirty minutes per session and total duration of at least two to three hours of interrupted therapy per day for at least four days per week, and “low-intensity” where the intensity and duration was less than that provided in inpatient multidisciplinary care settings and was dependent upon the type of setting and available resources [249].

Because the care needs of persons with MND can be broad and variable, and multidisciplinary care targets the particular needs of individual persons, it is probable that the actual content of multidisciplinary care may vary from patient to patient. Therefore, we included any study that stated or implied multidisciplinary care provided it satisfied the definition as stated above.

The control condition was defined as a lower level or different type of intervention such as “routinely available local services” (for example, medical and nursing care) or “minimal intervention” (such as “information only”), waiting list conditions, interventions given in different settings and lower intensity of intervention.
We excluded studies that assessed the effect of therapy from single disciplines (for example, physiotherapy), or any unidisciplinary intervention or modality (for example, physical exercise).

4.3.4 Types of outcome measures
Outcome measures reflected the burden of disease on patients and their caregivers and on the services provided for them. They were categorised where possible according to the ICF [5] into those that focused on:

- impairment - for example, muscle weakness, forced vital capacity (FVC);
- disability or limitation in activity - for example, Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS) (the domains of ALSFRS include speech, salivation and swallowing; turning in bed, walking, climbing stairs; dressing and hygiene, handwriting, cutting food; and respiratory insufficiency, dyspnoea, orthopnoea);
- restriction in participation, and environmental or personal context, or both - for example, patient and caregiver mood, satisfaction with services, social integration.

Many of the above scales predate the introduction of the concepts of the ICF domains. The outcome measures cross over the boundaries between the concepts of impairment, disability and participation. For example, ALSFRS lists impairments such as dyspnoea and orthopnoea, as well as disabilities like walking or climbing stairs. Other important outcomes such as survival and quality of life are not strictly covered by the ICF concepts (although there is again cross-over of boundaries between ICF concepts and these outcomes). Nevertheless, the ICF provides an important framework, which allows the use of a common standardised language worldwide, hence its application in this review.

Outcome time points were divided into short-term (up to three months), medium-term (three to 12 months) and long-term (at least 12 months) outcomes for both primary and secondary outcomes.

Primary outcomes focused on domains within Quality of life. For example, the Short Form-36 (SF-36), Visual Analogue Scale (VAS on life satisfaction and well-being).

Secondary outcomes were as follows:

- Outcomes that related to impairment - for example, forced vital capacity (FVC)
- Outcomes that related to disability or limitation in activity - for example, Amyotrophic Lateral Sclerosis Severity Scale (ALSSS) and ALSFRS
- Outcomes that related to restriction in participation, and environmental or personal context, or both - for example, Caregiver Strain Index (CSI), Utrecht Coping List (UCL)
- Survival
Hospitalisation such as readmissions and hospital length of stay (LOS)
Cost-effectiveness of care

Adverse events that may have resulted from the intervention were also reported. Serious adverse effects were defined as those events that were life-threatening or required prolonged hospitalisation.

4.4 Methods - Search methods for identification of studies

4.4.1 Electronic searches
We searched The Cochrane Neuromuscular Disease Group Trials Specialised Register (11 May 2009) and The Cochrane Central Register of Controlled Trials (The Cochrane Library Issue 2, 2009) using the following search items:

“amyotrophic lateral sclerosis” or “motor neuron(e) disease” or motoneuron(e) disease combined using AND with “ambulatory care” or “rehabilitation” or “hospitalization” or “Physical Therapy Modalities” or “home care services, hospital-based” or “home care services” or inpatients” or “outpatients” or “multidisciplinary” or “interdisciplinary or integrated to multimodal”, “cognitive therapy”, “Behavior Therapy”, “Social Work, “Dietetics”, “Dietary Services”, “Gait Disorders, Neurologic” and “Counseling”.

This strategy was adapted to search MEDLINE (January 1950 to April 2009) (Box 4.1), EMBASE (January 1980 to April 2009) (Box 4.2), AMED (January 1985 to April 2009) (Box 4.3), CINAHL Plus (1937 to 2009) (Box 4.4) and LILACS (January 1982 to April 2009) (Box 4.5). We considered articles in all languages, with a view to translation if necessary.
Box 4.1 MEDLINE search strategy (1950 to April 2009)

1 exp motor Neuron Disease/
2 moto$1 neuron$1 disease$1.mp.
3 moto?neuron$1 disease$1.mp.
4 Amyotrophic Lateral Sclerosis.mp.
5 or/1-4
6 exp Rehabilitation/
7 Palliative care/
8 Ambulatory Care/
9 exp Hospitalization/
10 exp Physical Therapy Modalities/
11 Home Care Services, Hospital-Based/
12 home care services/
13 inpatients/ or outpatients/ or inpatient$1.mp. or outpatient$1.mp.
14 behavior therapy/ or cognitive therapy/
15 exp Social Work/
16 Dietetics/
17 exp dietary services/
18 gait apraxia/ or gait ataxia/
19 Gait Disorders, Neurologic/
20 Counseling/
21 (multidisciplinary or interdisciplinary).mp.
22 Interdisciplinary communication/
23 “Delivery of Health Care, Integrated”/
24 Combined Modality Therapy/
25 (((rehabilitat$1 or home) adj2 care) or palliat$3 or physiotherap$ or physical therap$ or speech or occupation$ or social work).mp.
26 (cognitiv therap$ or behavior therap$ or counsel?ing or nutrition or diet$5 or food).mp.
27 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26
28 randomized controlled trial.pt.
29 controlled clinical trial.pt.
30 randomized.ab.
31 placebo.ab.
32 drug therapy.fs.
33 randomly.ab.
34 trial.ab.
35 groups.ab.
36 or/28-35
37 (animals not (animals and humans)).sh.
38 36 not 37
39 38 and 27 and 5
Box 4.2 EMBASE search strategy (1980 to April 2009)

<table>
<thead>
<tr>
<th>1</th>
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<tbody>
<tr>
<td>2</td>
<td>Clinical Trial/</td>
</tr>
<tr>
<td>3</td>
<td>Multicenter Study/</td>
</tr>
<tr>
<td>4</td>
<td>Controlled Study/</td>
</tr>
<tr>
<td>5</td>
<td>Crossover Procedure/</td>
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<tr>
<td>6</td>
<td>Double Blind Procedure/</td>
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<tr>
<td>7</td>
<td>Single Blind Procedure/</td>
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<tr>
<td>8</td>
<td>exp RANDOMIZATION/</td>
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<tr>
<td>9</td>
<td>Major Clinical Study/</td>
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<td>10</td>
<td>PLACEBO/</td>
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<tr>
<td>11</td>
<td>Meta Analysis/</td>
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<tr>
<td>12</td>
<td>phase 2 clinical trial/ or phase 3 clinical trial/ or phase 4 clinical trial/</td>
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<tr>
<td>13</td>
<td>(clin$ adj25 trial$).tw.</td>
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<tr>
<td>14</td>
<td>((singl$ or doubl$ or tripl$ or trebl$) adj25 (blind$ or mask$)).tw.</td>
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<td>15</td>
<td>placebo$.tw.</td>
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<td>16</td>
<td>random$.tw.</td>
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<td>17</td>
<td>control$.tw.</td>
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<td>18</td>
<td>(meta?analys$ or systematic review$).tw.</td>
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<td>19</td>
<td>(cross?over or factorial or sham? or dummy).tw.</td>
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<tr>
<td>32</td>
<td>28 or 29 or 30 or 31</td>
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<td>exp rehabilitation/</td>
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<td>hospitalization/</td>
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<td>physiotherapy/ or home physiotherapy/</td>
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<td>(cognitiv therap$ or behaviot$ therap$ or counsel?ing or nutrition or diet$5 or food).mp.</td>
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<td>Random allocation/</td>
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<td>3</td>
<td>Double blind method/</td>
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<td>exp Clinical Trials/</td>
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<td>6</td>
<td>((singl$ or doubl$ or treb$ or trip$) adj25 (blind$ or mask$ or dummy$)).tw.</td>
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<td>control$.tw.</td>
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<td>15</td>
<td>(multicenter or multicentre).tw.</td>
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<td>or/1-16</td>
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<td>19</td>
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<td>18 or 19 or 20 or 21</td>
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<td>17 and 22</td>
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<td>Rehabilitation/</td>
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<td>Palliative care/</td>
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<td>exp physical therapy modalities/</td>
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<td>41</td>
<td>(cognitiv therap$ or behavio?r therap$ or counsel?ing or nutrition or diet$5 or food$).mp.</td>
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<td>42</td>
<td>24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41</td>
</tr>
<tr>
<td>43</td>
<td>23 and 42</td>
</tr>
</tbody>
</table>
Box 4.4 CINAHL search strategy (1982 to April 2009)

| S50  | S49 and S26 and S18 |
| S49  | S48 or S47 or S46 or S45 or S44 or S43 or S42 or S41 or S40 or S39 or S36 or S35 or S34 or S33 or S32 or S31 or S30 or S29 or S28 or S27 |
| S48  | (MH "Palliative Care") or (MH "Hospice and Palliative Nursing") |
| S47  | palliat$ or physiotherap* or physical therapy or speech or occupation* or social work |
| S46  | home N3 care |
| S45  | rehabilitat* n3 care |
| S44  | (MH "Combined Modality Therapy") |
| S43  | (MH "Health Care Delivery, Integrated") |
| S42  | multidisciplinary or interdisciplinary |
| S41  | (MH "Multidisciplinary Care Team+") |
| S40  | (MH "Counseling") |
| S39  | S38 and S37 |
| S38  | (MH "Apraxia") or (MH "Ataxia") |
| S37  | (MH "Gait") |
| S36  | (MH "Nutrition Services+") |
| S35  | (MH "Dietetics") |
| S34  | (MH "Social Work") |
| S33  | (MH "Behavior Therapy") or (MH "Cognitive Therapy") |
| S32  | (MH "Inpatients") or (MH "Outpatients") |
| S31  | (MH "Home Rehabilitation") or (MH "Home Health Care") or (MH "Home Respiratory Care+") |
| S30  | (MH "Physical Therapy+") |
| S29  | (MH "Hospitalization") |
| S28  | (MH "Ambulatory Care") |
| S27  | (MH "Rehabilitation") |
| S26  | S25 or S24 or S23 or S22 or S21 or S20 or S19 |
| S25  | als or mnd |
| S24  | amyotroph* |
| S23  | charcot* disease |
| S22  | moto* neuron* disease* |
| S21  | motoneuron* disease* |
| S20  | (MH "Amyotrophic Lateral Sclerosis") |
| S19  | (MH "Motor Neuron Diseases") |
| S18  | S17 or S16 or S15 or S14 or S13 or S12 or S11 or S10 or S9 or S8 or S7 or S6 or S5 or S4 or S3 or S2 or S1 |
| S17  | TI random* or AB random* |
| S16  | (TI (cross?over or placebo* or control* or factorial or sham? or dummy)) or (AB (cross?over or placebo* or control* or factorial or sham? or dummy)) |
| S15  | (TI (clin* or intervention* or compar* or experiment* or preventive or therapeutic) or AB (clin* or intervention* or compar* or experiment* or preventive or therapeutic)) and (TI (trial*) or AB (trial*)) |
| S14  | (TI (meta?analys* or systematic review)) or (AB (meta?analys* or systematic review)) |
| S13  | (TI (single* or doubl* or tripl* or trebl*) or AB (single* or doubl* or tripl* or trebl*)) and (TI (blind* or mask*) or AB (blind* or mask*)) |
| S12  | ABAB design* |
| S11  | PT clinical trial or PT systematic review |
| S10  | (MH "Factorial Design") |
| S9   | (MH "Concurrent Prospective Studies") or (MH "Prospective Studies") |
| S8   | (MH "Meta Analysis") |
| S7   | (MH "Solomon Four-Group Design") or (MH "Static Group Comparison") |
| S6   | (MH "Quasi-Experimental Studies") |
| S5   | (MH "Placebos") |
| S4   | (MH "Double-Blind Studies") or (MH "Triple-Blind Studies") |
Box 4.5 LILACS search strategy (1982 to April 2009)

(Ex C10.574.562 [motor Neuron Disease] OR Tw motor neuron$ disease$ OR Tw motoneuron$ disease$ OR Tw motoneuron$ disease$ OR Tw Amyotrophic Lateral Sclerosis OR ALS OR MND) AND (Ex E02.831 [130] OR Mh Palliative Care OR Mh Ambulatory Care OR Ex E02.760.400 [exp Hospitalization] OR Ex E02.779 [Physical Therapy Modalities] OR Mh Home Care Services, Hospital-Based OR Mh home care services OR Mh inpatients OR Mh outpatients OR Tw inpatient$ OR Tw outpatient$ OR Mh behavior therapy OR Mh cognitive therapy OR Ex I01.880.792 [Social Work] OR Mh Dietetics OR Ex N02.421.242 [dietary services] OR Mh gait apraxia OR Mh gait ataxia OR Mh Gait Disorders, Neurologic OR Mh Counseling OR Tw multidisciplinary OR Tw interdisciplinary OR Mh interdisciplinary communication OR Mh Delivery of Health Care, Integrated OR Mh Combined Modality Therapy) AND ( Tw rehab$ OR Tw palliat$ OR Tw home care OR Tw physiotherap$ OR Tw physical therap$ OR Tw speech OR Tw occupation$ OR Tw social work OR Tw cognitiv therap$ OR Tw behavior therap$ OR Tw behaviour therap$ OR Tw counseling OR Tw counseling OR Tw nutrition OR Tw diet$ OR Tw food) [Words]
In addition, based on the above search strategy, we selected well-designed, published observational studies of multidisciplinary care in MND or ALS with controls ("other designs": ODs) [253] where the diagnosis was clearly stated, the interventions clearly described and the outcomes clearly reported for all patients. These studies included prospective cohort studies or case control studies with concurrent controls or cross-sectional studies. We also considered retrospective case series of more than five participants, where patients were treated consecutively. We have reviewed this non-randomised evidence in the “Discussion” section of the review. We deemed this strategy necessary because we were expecting very few, if any, RCTs or CCTs on this particular topic.

4.4.2 Searching other resources
We checked the bibliographies of trials identified and contacted their authors and known experts in the field, seeking published and unpublished trials. We also handsearched the most relevant journals, including Amyotrophic Lateral Sclerosis and Other Motor Neuron Disorders.

4.5 Methods - Data collection and analysis
4.5.1 Selection of studies
Two authors (LN, FK) independently screened all abstracts and titles of studies identified by the search strategy for inclusion and appropriateness based on the selection criteria. Once all potentially appropriate studies were obtained, two authors (LN, FK) independently evaluated each study for inclusion. If necessary, we obtained further information to determine whether the trial met the criteria. If no consensus was met about the possible inclusion or exclusion of any individual study, we made a final consensus decision by discussion amongst all the authors (LN, FK, SM). If there was still no consensus agreement regarding inclusion or exclusion of the study, then we planned to submit the full article to the editorial board for arbitration. Authors were not masked to the name(s) of the author(s), institution(s) or publication source at any level of the review.

4.5.2 Data extraction and management
The authors independently extracted the data from each study that met the inclusion criteria. All studies that met the inclusion criteria were to be summarised in a “Characteristics of included studies” Table provided in the Review Manager (RevMan) software developed by the Cochrane Collaboration [254] to include details on design, participants, interventions and outcomes.

4.5.3 Assessment of risk of bias in included studies
As recommended by the Cochrane Handbook for Systematic Reviews of Interventions [255], we used the “Risk of bias” tool for studies of other designs (ODs) even though no RCTs or CCTs were found. We addressed six specific domains: sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting and "other issues". We judged
each domain to determine if the criteria had been met, which in turn indicated the risk of bias and the overall quality of each study (Table 4.1).

Table 4.1 Levels of quality of individual studies

<table>
<thead>
<tr>
<th>Judgement of risk of bias</th>
<th>Quality rating of study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of bias of all domains low</td>
<td>High methodological quality = “high quality study”</td>
</tr>
<tr>
<td>Unclear or high risk of bias for one or more</td>
<td>Low methodological quality = “low quality study”</td>
</tr>
<tr>
<td>domains</td>
<td></td>
</tr>
<tr>
<td>High risk of bias for most domains</td>
<td>Very low methodological quality = “very low quality study”</td>
</tr>
</tbody>
</table>

Two authors (FK, LN) independently assessed risk of bias and reached a consensus. Any disagreements were resolved by the third author (SM). It is recognised that the “Risk of bias” tool was developed for RCTs and the six domains are not necessarily appropriate for ODs. Studies of other designs would generally not meet the criteria for the first three domains (sequence generation, allocation concealment, blinding). Any OD, regardless of the quality of the study or of the reporting of the study, would therefore at best be a “low quality study”. However, we still used this tool as its general structure and the assessments appeared useful to follow when creating a risk of bias assessment for ODs.

4.5.4 Measures of treatment effect

It was not possible to perform measures of treatment effect due to the methods and the nature of the available data in the studies.

4.5.5 Unit of analysis issues

We analysed studies of other designs (ODs) with the understanding that they could only contribute in a limited way to the best evidence synthesis.

4.5.6 Dealing with missing data

If insufficient data were available, then we contacted primary authors of potentially eligible studies to provide data or clarification, or both. If the data were unavailable or insufficient, we would have reported the study but not included it in the final analysis.

In addition, we excluded studies with fatal flaws (withdrawals by more than 40% of patients; total or nearly total non-adherence to the protocol; or very poor or non-adjusted comparability in the baseline criteria).
4.5.7 Assessment of heterogeneity
We conducted statistical analysis as described in the *Cochrane Handbook for Systematic Reviews of Interventions* [255]. It was not possible to conduct a comprehensive quantitative analysis due to the variability of methods used and the nature of available data in each study (for example, data and type of intervention were heterogeneous, means were not provided).

4.5.8 Assessment of reporting biases
We minimised publication bias [256] by sourcing unpublished data where possible.

4.5.9 Data synthesis
It was not possible to perform quantitative analysis due to clinical heterogeneity; instead we performed a best evidence synthesis using the GRADE approach as recommended by the *Cochrane Handbook for Systematic Reviews of Interventions* [255]. This defines the quality of studies as the extent to which one can be confident that an estimate of effect or association is close to the quantity of specific interest, based on criteria such as within-study risk of bias (methodological quality), directness of evidence, heterogeneity, precision of effect estimates and risk of publication bias [3].

The GRADE approach specifies four levels of quality (Table 4.2). The highest quality rating is for randomised trial evidence. Evidence may be downgraded to moderate, low, or even very low quality evidence, depending on the presence of the five factors (Table 4.3).

**Table 4.2 Levels of quality of included studies in the GRADE approach**

<table>
<thead>
<tr>
<th>Underlying methodology</th>
<th>Quality rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randomised trials or double-upgraded observational studies</td>
<td>High</td>
</tr>
<tr>
<td>Downgraded randomised trials or upgraded observational studies</td>
<td>Moderate</td>
</tr>
<tr>
<td>Double-downgraded randomised trials or observational studies</td>
<td>Low</td>
</tr>
<tr>
<td>Triple-downgraded randomised trials or downgraded observational studies or case series/case reports</td>
<td>Very low</td>
</tr>
</tbody>
</table>
Table 4.3 Factors that may decrease the quality level of included studies

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Limitations in the design and implementation of available studies</td>
<td>suggesting high likelihood of bias</td>
</tr>
<tr>
<td>2. Indirectness of evidence</td>
<td>(indirect population, intervention, control, outcomes)</td>
</tr>
<tr>
<td>3. Unexplained heterogeneity or inconsistency of results</td>
<td>(including problems with subgroup analyses)</td>
</tr>
<tr>
<td>4. Imprecision of results</td>
<td>(wide confidence intervals)</td>
</tr>
<tr>
<td>5. High probability of publication bias</td>
<td></td>
</tr>
</tbody>
</table>

The GRADE approach applies well to all types of studies including ODs. For example, if observational studies yielded large effects and there was no obvious bias explaining those effects, the evidence could be rated as moderate or even high quality if the effect was large enough. "Very low quality", on the other hand, could include studies with critical problems and unsystematic clinical observations.

We will highlight the strength of study findings discussed and gaps in current literature and identify future research directions in the “Discussion”.

4.5.10 Subgroup analysis and investigation of heterogeneity
We conducted subgroup analysis based on intensity of multidisciplinary care as this provided the most clinically useful information.

4.5.11 Sensitivity analysis
We performed no sensitivity analysis.
4.6 Results

4.6.1 Description of studies
Electronic and manual searches identified 1413 references with our search criteria. Of these, seven passed the first screening review and were selected for closer scrutiny.

4.6.2 Included studies
We found no RCTs no CCTs that compared multidisciplinary care in MND or ALS with either routinely available local services or lower levels of intervention; nor were there trials that compared multidisciplinary care in different settings or at different levels of intensity.

4.6.3 Excluded studies
We excluded two trials [257, 258] as they were unidisciplinary (physiotherapy only) and therefore did not fulfil review criteria. The remaining five studies, which included one with two reports [13, 259-263] met the criteria for “other designs” (ODs) and are described in the “Discussion”. All seven studies are listed in Table 4.4.

Table 4.4 Characteristics of excluded studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calzada-Sierra 2001 [259]</td>
<td>Not a RCT or CCT</td>
</tr>
<tr>
<td>Chio 2006 [260]</td>
<td>Not a RCT or CCT</td>
</tr>
<tr>
<td>Dal Bello-Haas 2007 [257]</td>
<td>Unidisciplinary (physiotherapy only)</td>
</tr>
<tr>
<td>Drory 2001 [258]</td>
<td>Unidisciplinary (physiotherapy only)</td>
</tr>
<tr>
<td>Traynor 2003 [13]</td>
<td>Not a RCT or CCT</td>
</tr>
<tr>
<td>Van den Berg 2005 [261]</td>
<td>Not a RCT or CCT</td>
</tr>
<tr>
<td>Van der Steen 2009 [262]</td>
<td>Not a RCT or CCT</td>
</tr>
<tr>
<td>Zoccolella 2007 [263]</td>
<td>Not a RCT or CCT</td>
</tr>
</tbody>
</table>

Footnotes
CCT = controlled clinical trial
RCT = randomised controlled trial
4.7 Discussion

4.7.1 Summary of main results

We identified no RCTs or CCTs in this review that addressed the effectiveness of multidisciplinary care in MND or ALS. Five studies, including one with two reports [13, 259-263] met the criteria for “other designs” (ODs) and are described in Table 4.5.

Table 4.5 Characteristics of observational studies

<table>
<thead>
<tr>
<th>(A) Low-intensity multidisciplinary care</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traynor 2003 [13]</strong></td>
</tr>
<tr>
<td><strong>Methods</strong></td>
</tr>
<tr>
<td><strong>Participants</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Interventions</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Risk of Bias</td>
</tr>
<tr>
<td>--------------------------------------</td>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Incomplete outcome data addressed:</td>
</tr>
<tr>
<td>Free of selective reporting:</td>
</tr>
<tr>
<td>Free of other bias:</td>
</tr>
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<td></td>
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</tr>
</tbody>
</table>

**Quality rating of the study**

Low

**Methods**

Prospective cohort study

**Participants**

n = 221 (Piemonte and Valle d’Aosta Register for ALS, PARALS)

Intervention n = 97, control n = 124

Italy

**Interventions**

Treatment: 8-weekly multidisciplinary ALS clinic (neurologists, pneumonologists, radiologists, rehabilitation physicians, geneticists, physical therapists, dietologists, dieticians, psychologists, neuropsychologists, social workers)

Control: 6-monthly general neurology clinic
| Outcomes | Primary outcome: nil  
Secondary outcome: survival, hospital readmissions and length of stay  
Follow up duration: from 1995 and 1996 to 31 December 2003 (long-term follow up) |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------|
| Risk of bias | Adequate sequence generation: no  
Allocation concealment: no  
Blinding: no  
Incomplete outcome data addressed: unclear, drop-outs not stated  
Free of selective reporting: yes. Survival and use of hospital-based services (rate of readmission and duration of hospital stay) were reported.  
Free of other bias: no  
- Observational study  
- ALS centre cohort “slightly younger”, “underwent percutaneous gastrostomy (PEG) and non-invasive ventilation (NIV) more frequently“ - age, PEG and NIV can affect survival outcomes positively  
- Frequency of clinic visits different (8-weekly ALS clinics versus 6-monthly) |
| Quality rating of the study | Low |
| Methods | Prospective cohort study |
| Participants | n = 126 (ALS Registry in Puglia)  
Intervention n = 84, control n = 42  
Italy |
| Interventions | 3-monthly multidisciplinary ALS clinic (neurologist, pulmonologist, physical and speech therapists, nutritionist, psychologist)  
Control: 6-monthly general neurology clinic |
| Outcomes | Primary outcome: nil  
Secondary outcome: survival  
Follow up duration: January 1998 to June 2004 (long-term follow up) |
| **Risk of bias** | Adequate sequence generation: no
Allocation concealment: no
Blinding: no
Incomplete outcome data addressed: yes. Whilst “4 patients (3%) were lost to follow up” and “were not included”, these data would have had minimal effect on the overall outcome, given n = 126.
Free of selective reporting: yes. The main outcome was survival, which was reported.
Free of other bias: no
- Observational study
- ALS clinic cohort higher percentage of riluzole (61% versus 48%, P = 0.02)
- Frequency of clinic visits different (3-monthly ALS clinic versus 6-monthly) |
| **Quality rating of the study** | Low |
| **van den Berg 2005 [261]** | **Methods** | Cross-sectional study |
| **Participants** | n = 208 (from all regions of the Netherlands through the Dutch Neuromuscular Patient Association and 2 national referral centres for patients with motor neuron disease)
Intervention: n = 133, control n =75
Netherlands |
| **Interventions** | Multidisciplinary ALS clinic (consultant in rehabilitation medicine, physical therapist, occupational therapist, speech pathologist, dietician and social worker)
Control: general ALS care (general practitioner or physician in nursing home or consultant in rehabilitation medicine not fulfilling criteria for multidisciplinary ALS clinic)
Frequency of clinic visits not provided |
| Outcomes | Primary outcome: Short Form-36 (SF-36), Visual Analogue Scale (VAS on life satisfaction and well-being)  
Secondary outcome:  
Impairment - nil  
Activity limitation - Amyotrophic Lateral Sclerosis Severity Scale (ALSSS), Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS)  
Participation restriction - Caregiver Strain Index (CSI)  
Personal context - Utrecht Coping List (UCL)  
Follow up duration: nil (cross-sectional study) |
| --- | --- |
| Risk of bias | Adequate sequence generation: no  
Allocation concealment: no  
Blinding: no. Only outcome assessors were blinded: “Data was collected by a nurse who was blinded for type of care”.  
Incomplete outcome data addressed: unclear  
Free of selective reporting: no. Utrecht Coping List and Caregiver Strain Index listed in Methods, but not reported.  
Free of other bias: no  
  - Cross-sectional study |
| Quality rating of the study | Very low |
| Methods | Cross-sectional study |
| Participants | n = 208  
Intervention: n = 63, control n = 35  
Netherlands  
Same group of patients as van den Berg 2005 [261] |
| Interventions | Multidisciplinary ALS clinic (as per van den Berg 2005 [261])  
Control: general ALS care (as per van den Berg 2005 [261]) |
| **Outcomes** | Primary outcome: nil  
Secondary outcome: healthcare costs (direct and indirect, as calculated by a 6-month cost diary filled in by participants combined with the Dutch guidelines for cost analysis in healthcare research, standardised for the year 2003 which includes contacts with doctors, hospitalisation, medications, care provision by caregivers, paramedical treatments and contacts, home adaptations and aids and appliances)  
Follow up duration: nil (cross-sectional study) |
| **Risk of bias** | Adequate sequence generation: no  
Allocation concealment: no  
Blinding: no. Only outcome assessors were blinded: “Data was collected by a nurse who was blinded for type of care”.  
Incomplete outcome data addressed: no. Only data for 98 participants who fulfilled further inclusion criteria (filled in cost diary for at least 3 months and time of onset of symptoms 3 years or less) were included in final data analysis. These criteria were not mentioned until the “results” section.  
Free of selective reporting: yes  
Free of other bias: no  
Cross-sectional study |
| **Quality rating of the study** | Very low |

(B) High-intensity multidisciplinary care

<table>
<thead>
<tr>
<th>Calzada-Sierra 2001 [259]</th>
<th>Methods</th>
<th>Pre-post case series</th>
</tr>
</thead>
</table>
| **Participants** | n = 6  
Cuba |
| **Interventions** | 41 hour/week intensive rehabilitation programme with a multidisciplinary team (neurologists, specialist physicians, physiotherapists, logopaedists (speech therapists), defectologists, psychologists) for 4 weeks |
### Outcomes

<table>
<thead>
<tr>
<th>Primary outcome: nil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary outcome:</td>
</tr>
<tr>
<td>Impairment - forced vital capacity (FVC)</td>
</tr>
<tr>
<td>Activity limitation - Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS)</td>
</tr>
<tr>
<td>Follow up duration: 4 weeks (short-term follow up)</td>
</tr>
</tbody>
</table>

### Risk of Bias

<table>
<thead>
<tr>
<th>Adequate sequence generation: no</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocation concealment: no</td>
</tr>
<tr>
<td>Blinding: no</td>
</tr>
<tr>
<td>Incomplete outcome data addressed: unclear, as no mention of drop-outs</td>
</tr>
<tr>
<td>Free of selective reporting: yes, as FVC and ALSFRS were reported</td>
</tr>
<tr>
<td>Free of other bias: no</td>
</tr>
</tbody>
</table>

- Pre-post test
- Small number of patients (n = 6)
- Unclear setting (inpatient versus outpatient)
- Unclear regarding actual intensity of rehabilitation (this was reported as 41 hours/week in the abstract but as 38 hours/week in the methodology)
- Unclear how intensity of rehabilitation was delivered (41 hours a week exceeds the working hours of the week for many therapists)
- Unclear if ALS participants could tolerate such intensity of rehabilitation

### Quality rating of the study

Very low

These studies were conducted in four different countries (Italy, Ireland, Cuba, Netherlands) and all were written in English apart from one [259] in Spanish. They involved a total of 905 participants: four of the studies, including one with two reports [13, 260-263] included between 126 and 344 participants; one study [259] included six participants. In terms of setting, four studies [13, 260-263] were conducted within an outpatient setting and involved low-intensity care. One study [259] involved high-intensity multidisciplinary care but the setting could not be verified despite attempts to contact the author. For the purposes of this review, the studies have been divided according to the intensity of the intervention.
(A) Low-intensity multidisciplinary care
Of the four studies in this category, three [13, 260, 263] were prospective, population-based cohort studies and one was a cross-sectional study with two reports [261, 262] comparing multidisciplinary care clinics to general neurology clinics (control).

The three prospective cohort studies [13, 260, 263] were similar in study design and outcomes (mainly survival). All three identified a reasonably sized cohort (126 to 344 participants) through a local ALS-specific register and compared patients who attended a multidisciplinary ALS clinic varying from six to 12-weekly to those who attended general neurology clinics where visits occurred six-monthly. There were some differences in the make-up of the multidisciplinary teams but all were physician-led and included at least four therapists of different disciplines. One Irish study [13] and the other two Italian studies [260, 263] highlight differences in practice not just between countries but also within regions of the same country.

van den Berg 2005 [261] conducted a cross-sectional study of 208 participants with ALS, and was the only study in this review which included caregivers. Multidisciplinary ALS clinics were compared to controls where care was given by either a general practitioner, a physician in a nursing home or by a rehabilitation physician. Frequency of clinic visits in this study was not reported and there was no subsequent follow-up period in the study design. In a separate report of the same study [262], cost estimates of treatment in a multidisciplinary care clinic versus general care were provided.

(B) High-intensity multidisciplinary care
Calzada-Sierra 2001 [259] conducted a pre-post study where six patients with ALS attended a 41-hour per week intensive rehabilitation programme with a multidisciplinary team for four weeks (short-term follow up).

Quality of the evidence
We identified no RCTs or CCTs. Of the ODs, three cohort studies [13, 260, 263] were rated to be of “low quality” while the remaining two studies [259, 261, 262] were of “very low quality” due to unsystematic clinical observations and presence of critical problems. Calzada-Sierra 2001 [259] reported on a case series with a very small number of participants (n = 6) and did not describe the setting of the programme, nor consistently report the number of hours of therapy. van den Berg 2005 [261], on the other hand, reported selectively and outcomes from many measures were not mentioned, whilst van der Steen 2009 [262] only analysed data from 98 of the 208 participants. The assessment of risk of bias of individual studies is provided in Table 4.5.

Results of observational studies are summarised in Table 4.6.
### Table 4.6 Results of observational studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Statistical analysis</th>
<th>Results</th>
<th>Author's conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(A) Low-intensity multidisciplinary care</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traynor 2003 [13]</td>
<td>Kaplan-Meier analysis, log-rank sum test, Cox proportional hazard model</td>
<td><strong>Primary outcome - not addressed</strong></td>
<td>ALS patients who received their care at a multidisciplinary clinic had a better prognosis than patients attending a general neurology clinic and suggested that active and aggressive management enhanced survival, particularly among ALS patients with bulbar dysfunction</td>
</tr>
<tr>
<td></td>
<td><strong>Secondary outcome - survival:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improved survival of ALS clinic cohort versus general neurology cohort</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>median 7.5 months longer (677 versus 448 days log rank = 11.6, ( P = 0.0007 ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>29.7% improvement 12-month mortality (( Z = 6.25, P &lt; 0.0001 ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10.7% improvement 24-month mortality (( Z = 1.64, P = 0.051 ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>For bulbar onset patients</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9.6 months longer (median 657 versus 363 days, ( P = 0.0007 ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>39% improvement 12-month mortality (( Z = 5.65, P &lt; 0.0001 ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>18% improvement 24-month mortality (( Z = 1.87, P = 0.03 ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No significant differences in mortality for limb onset ALS patients (( P = 0.38 ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ALS clinic was an independent covariate of survival (HR = 1.47, ( P = 0.02 ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 attributes were significant independent predictors of diminished survival: attendance at general neurology clinic, increasing age at diagnosis, bulbar onset disease, short delay in diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Results</td>
<td>Primary outcome - not addressed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary outcome - survival and hospitalisation</td>
<td>Improved survival in ALS multidisciplinary care cohort (median 10 months longer, 1080 versus 775 days, ( P = 0.008 )) and hospitalisation (frequency mean 1.2 (SD 0.9) admissions per patient versus mean 3.3 (SD 1.8), ( P = 0.0003 ), duration of hospital stay (mean 5.8 (SD 9.5) days versus mean 12.4 (SD 31.6) days, ( P = 0.001 ))</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Author's conclusions | Improved survival was seen in patients with ALS attending tertiary ALS centres, independently of all other known prognostic factors, possibly through a better implementation of supportive treatments. Moreover, because of these centres, hospitalisation rate was markedly reduced, thus offering a cost-effective service to patients with ALS and to the community as a whole. |

**Zoccolella 2007 [263]**

| Statistical analysis | t-test, Chi\(^2\) test, Kaplan-Meier method, log-rank tests, Cox proportional hazard model |

<table>
<thead>
<tr>
<th>Results</th>
<th>Primary outcome - not addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary outcome - survival</td>
<td>No difference in median survival time from the diagnosis (17.6 months, versus 18 months, log-rank = 0.11, ( P = 0.76 )) No difference in median survival time for bulbar onset ALS (11.7 range 2.9 to 27.2 versus 23 months range 7.2 to 36.8) No effect on survival in multivariate analysis at 12 months (HR 0.91, 95% CI 0.44 to 1.89, ( P = 0.9 )) after correction for age, sex, El Escorial World Federation Neurology criteria at diagnosis, time from onset to diagnosis, riluzole use and percutaneous gastrostomy or non-invasive ventilation application</td>
</tr>
</tbody>
</table>

| Author's conclusions | Management of ALS by multidisciplinary clinics does not improve survival regardless of site of symptom onset |

**van den Berg 2005**

<p>| Statistical analysis | Chi(^2) test, t-test. Multivariate linear regression analysis. |</p>
<table>
<thead>
<tr>
<th>Results</th>
<th>Primary outcome - quality of life (QoL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Improved select mental health domains of QoL (SF-36 in multidisciplinary ALS cohort)</td>
</tr>
<tr>
<td></td>
<td>Mental Summary Score (4.28*, 95% CI 1.2 to 7.4, P = 0.01)</td>
</tr>
<tr>
<td></td>
<td>Social functioning (15.0*, 95% CI 6.8 to 23.3, P &lt; 0.001)</td>
</tr>
<tr>
<td></td>
<td>No difference in other QoL domains of SF-36</td>
</tr>
<tr>
<td></td>
<td>Physical Summary Scale (-1.22*, 95% CI -4.2 to 1.7, P = 0.42)</td>
</tr>
<tr>
<td></td>
<td>Physical functioning (?0.63*, 95% CI -8.6 to 7.4, P = 0.88)</td>
</tr>
<tr>
<td></td>
<td>Role functioning-physical (-1.1*, 95% CI -11.5 to 9.3, P = 0.83)</td>
</tr>
<tr>
<td></td>
<td>General health perception (0.94*, 95% CI -5.2 to 7.0, P = 0.76)</td>
</tr>
<tr>
<td></td>
<td>Body pain (-2.49*, 95% CI -10.9 to 5.9, P = 0.56)</td>
</tr>
<tr>
<td></td>
<td>Vitality (4.02*, 95% CI 2.2 to 10.3, P = 0.21)</td>
</tr>
<tr>
<td></td>
<td>Role functional-emotional (5.1*, 95% CI -7.7 to 18.0, P = 0.43)</td>
</tr>
<tr>
<td></td>
<td>Mental health (4.5*, 95% CI -0.2 to 9.2, P = 0.06)</td>
</tr>
<tr>
<td></td>
<td>No difference in QoL (VAS life satisfaction and well-being)</td>
</tr>
<tr>
<td></td>
<td>subjective QoL (3.2*, 95% CI -3.4 to 9.8, P = 0.34)</td>
</tr>
<tr>
<td></td>
<td>subjective health (-0.53*, 95% CI -7.0 to 5.9, P = 0.87)</td>
</tr>
</tbody>
</table>

*B-coefficients with adjustments made for sex, age, marital status, education, ALS type, ALS Functional Rating Scale and Utrecht Coping List

| Secondary outcome - activity limitation, coping, caregiver strain |
| No difference in ALSFRS (mean 25.6 versus 26.1, P = 0.67) |
| No results for ALSSS, UCL and CSI provided |

| Notes | Authors reported “no significant adjusted difference in QoL was found in caregivers of patients with multidisciplinary or general ALS care”. It is unclear as to how this conclusion was made as no outcome measure was linked to caregiver QoL in the methods section and no results were given to substantiate this conclusion. |
| Author's conclusions | High standard of care (multidisciplinary ALS care) improves mental quality of life in patients with ALS |

| van der Steen 2009 Statistical analysis | Mann-Whitney U-test, Kruskall-Wallis test |
| [262] | Results | Primary outcome - not addressed
       | Secondary outcome - healthcare costs
       | No significant difference in monthly costs between multidisciplinary ALS clinic cohort versus general neurology cohort (1336 Euros versus 1271 Euros, P = 0.234)
       | No significant difference in monthly costs between bulbar onset ALS patients versus spinal onset ALS patients (1557 Euros versus 1273 Euros, P = 0.567)
       | **Author's conclusions** | Building on their previous report (van den Berg 2005) [261], multidisciplinary ALS care provides a better quality of life in patients with ALS without increasing medical costs

| (B) High-intensity multidisciplinary care

| Calzada-Sierra 2001 [259] | **Statistical analysis** | Wilcoxon test for paired series
       | Results | Primary outcome - not addressed
       | Secondary outcome - impairment, activity limitation
       | Improved forced vital capacity (FVC) and ALSFRS (Z: 2.2013; P = 0.027)
       | **Note** | Domains of ALSFRS: speech, salivation, swallowing; turning in bed, walking, climbing stairs, dressing and hygiene, handwriting, cutting food; orthopnoea, dyspnoea and respiratory insufficiency
       | Individual participant data on each domain provided but no consistent improvement seen in any particular domain(s) across the 6 participants
       | **Author's conclusions** | Intensive, multifactorial rehabilitation treatment for 4 weeks improved the FVC and ALSFRS in all patients with ALS and no complications were seen

| Footnotes
ALS = amyotrophic lateral sclerosis
ALSFRS: Amyotrophic Lateral Sclerosis Functional Rating Scale
ALSSS: Amyotrophic Lateral Sclerosis Severity Scale
CSI: Caregiver Strain Index
FVC = forced vital capacity
MDC = multidisciplinary care
QoL = quality of life
UCL: Utrecht Coping List
VAS = visual analogue scale
(A) Low-intensity multidisciplinary care

Three “low quality” observational cohort studies [13, 260, 263] and one “very low quality” cross-sectional study with two reports [261, 262] compared multidisciplinary care clinics to general neurology clinics.

Traynor 2003 [13] (n = 344) found that median survival of the ALS clinic cohort was 7.5 months longer than for patients in the general neurology clinic cohort (log rank = 11.6, P < 0.0007). Prognosis of bulbar onset patients was extended by 9.6 months (P = 0.0007) if they attended the ALS clinic. This “low quality” study suggests that ALS patients (particularly those with bulbar dysfunction) who receive multidisciplinary care may have a better prognosis than patients attending a general neurology clinic.

Chio 2006 [260] (n = 221) found improved survival (median 1080 versus 775 days, P = 0.008) and reduced hospitalisation (reduced readmission frequency 1.2 versus 3.3, P = 0.003 and duration of hospital stay 5.8 versus 12.4 days, P = 0.001) in the tertiary ALS centres cohort. This study demonstrates that multidisciplinary care may improve prognosis. Although authors suggested that their approach was cost-effective they provided no cost analysis data for multidisciplinary care to substantiate this.

In contrast, Zoccolella 2007 [263] (n = 126) found no difference in median survival time between the ALS clinic and the general neurology clinic cohorts (17.6 months versus 18 months, logrank = 11, P = 0.76).

All three studies were of similar quality, limited by their observational nature with greater patient variability inherent in a population-based study. Therefore the possibility of unknown factors that may play in role in the differences in results cannot be excluded. In addition, the multidisciplinary care cohort in Zoccolella 2007 [263] had a lower rate of receiving riluzole (66% versus 98.8% in Traynor 2003 [13]) and non-invasive ventilation (2.5% versus 6% in Traynor 2003 [13] and 15.4% in Chio 2006 [260]) compared to their counterparts in the other two studies, which may partly explain the differences in results. Others have also hypothesised that a referral centre bias may have contributed to the differences as patients attending ALS referrals centres tend to present with a younger age at onset and a longer time to diagnosis, which are factors associated with a better survival [264, 265].

van den Berg 2005 [261] (n = 208) found improved quality of life on SF-36 mental health domains (mental summary scale beta-coefficient 4.28, 95% CI 1.2 to 7.4, P = 0.01 and social functioning beta-coefficient 15.0, 95% CI 6.8 to 23.3, P < 0.001) in their multidisciplinary care cohort, but not other SF-36 domains. There was selective reporting evident and the results of
ALSSS, UCL and CSI were not provided. These measures assess loss of function, coping and caregiver strain respectively. The authors concluded that a high standard of care improved mental health domains of quality of life in ALS patients but did not make a difference to quality of life of caregivers. Whilst multidisciplinary care may improve quality of life mental health domains in ALS patients, insufficient evidence was provided to substantiate any results for the caregivers. In a separate report of the same study group, van der Steen 2009 [262] found no difference in healthcare costs in the multidisciplinary care cohort when compared to the general clinic cohort. However, only data from 98 participants were analysed. The remaining data were excluded on the basis that costs diaries had been filled in for less than three out of the recommended six months by the participants and/or onset of ALS symptoms was more than three years at the time of the study. The justification for such criteria was not clear and this particular set of inclusion criteria was not mentioned in the methodology section of the study. The costs of multidisciplinary care may be similar to the costs of a general neurology clinic and it is therefore a cost-effective intervention within the first three years of symptom onset, but insufficient evidence was provided to substantiate cost comparisons as the disease progresses.

The best evidence synthesis from these three “low quality” studies [13, 260, 263] (691 participants) and one “very low quality” study with two reports [261, 262] (208 participants) suggests that for low-intensity ALS/MND multidisciplinary care there was:

- “low level quality” conflicting evidence for survival outcomes (two studies [13, 260] showed improvement, one [263] did not) and improved hospitalisation (fewer readmissions and shorter length of stay) [260]; and
- “very low level quality” evidence for improvement in some mental health domains of quality of life [261] at no increased cost [262].

(B) High-intensity multidisciplinary care
One “very low quality” pre-post study examined intensive multidisciplinary care. Calzada-Sierra 2001 [259] (n = 6) found that a four-week 41-hour per week intensive multidisciplinary rehabilitation program improved impairment and activity (function) as measured by forced vital capacity (FVC) and ALSFRS (Z: 2.2013; P = 0.027) respectively. Data were difficult to interpret given that only individual data for each domain were reported for all six participants by the authors. No consistent improvement in any specific domains across the participants was noted. Further, no information on the type of setting and therapy was provided. It was difficult to imagine how the intensity of 41 hours per week therapy was delivered, and indeed tolerated, by ALS patients. The authors’ conclusions for improvement in FVC and ALSFRS following intensive multidisciplinary care could not be justified. It is however possible that such care could result in some functional improvements in individuals.
The best evidence synthesis from this “very low quality” study [259] suggests that for high-intensity ALS/MND multidisciplinary care there was:

- “very low level” quality evidence for improvement in impairment and activity limitation.

None of the studies reported any adverse effects attributable to multidisciplinary care.

4.7.2 Potential biases in the review process

Limitations of findings

This review highlighted a number of limitations in the included studies. These include the following.

- A small number of studies were identified and all were methodologically weak.
- No comparison of multidisciplinary care in different settings or at different intensities was possible.
- There were no studies that provided direct evidence that organised multidisciplinary care achieved better outcomes than the absence of such services in persons with MND or their caregivers, or both.
- Minimal information was provided regarding the content of multidisciplinary care (for example, modalities, duration and intensity of therapy, and the spectrum of care targeted).
- Outcomes varied considerably from survival to service use, to respiratory function, to functional ability and quality of life.
- Local practices tended to vary in different countries (Ireland, Italy, Cuba, Netherlands) (and also within different regions of the same country) making it harder to interpret and compare outcomes.
- Survival was the main outcome in three studies [13, 260, 263] and whilst site of onset (bulbar versus spinal) was clearly defined, which is important given the association of bulbar onset ALS with poorer prognosis, it was unclear if other distinct MND phenotypes, such as Flail Arm, Flail Leg and Primary Lateral Sclerosis, were included in these registries. These phenotypes demonstrate different rates of progression and survival times.
- Only one study addressed cost benefits for multidisciplinary care in MND in a limited fashion.
- Caregivers and their needs, an important component in the management of MND, were not adequately addressed.
- Provision of palliative care was poorly addressed in general and the core staff of the multidisciplinary clinics in these ODs did not include a palliative care physician.
These five studies have only been able to contribute in a very limited way to the synthesis of best evidence for persons with MND. It was not possible to determine conclusively which type of programme is effective and in which setting, nor whether a greater intensity (time or expertise, or both) or “dose” of rehabilitation would lead to greater gains. Further studies are needed to suggest optimum number, duration and intensity of treatment sessions, and also to identify other factors that may affect outcome. It was also not possible to conclude more decisively regarding which specific outcomes are influenced (survival, dependency, social integration, mood, quality of life) by multidisciplinary care.

4.7.3 Agreements and disagreements with other studies or reviews

Gaps in evidence
The three pillars of evidence-based practice in rehabilitation for MND should include (a) integration of best available scientific evidence, (b) clinical expertise, judgement, and agreement and (c) the incorporation of the values and beliefs of patients. There is currently a gap between the available evidence, clinical practice and agreement between clinicians and incorporation of patient values in rehabilitation [266].

Previously there have been concerns about the method of application of evidence-based practice, especially of RCTs in rehabilitation settings [267, 268]. Randomised controlled trials are appropriate for studying effects of a simple intervention on a discrete outcome, but are much less well suited for studying complex interventions and outcomes that characterise most aspects of MND rehabilitation. This is due to a combination of logistical and ethical reasons. Motor neuron disease is a fatal disease associated with rapidly progressive disability. It is also relatively rare and heterogeneous in clinical presentation and manifestations. People with ALS often prefer to participate in disease-modifying pharmaceutical trials that might slow disease progression over other trials [170]. Attrition is particularly common, especially in trials requiring longer follow up, as participants may have difficulty attending clinic for follow up due to respiratory and mobility issues, rapid disease deterioration resulting in mechanical ventilation or death, long distances to travel to the clinic for follow up and fatigue [258].

An alternative to RCTs in MND care may be the use of an observational approach - the Practice Clinical Trial or Clinical Practice Improvement (CPI) method that acquires prospective or retrospective data without disrupting the natural milieu of treatment [269]. Data collected systematically in the course of routine clinical practice has the potential to provide additional information that will assist in understanding the nature of services provided as well as the outcomes and service implications for the MND or ALS population. This “practice-based evidence” can in future be used to address critical questions such as which patients have the most to gain, and what models and intensity of rehabilitation input are likely to be most effective [267]. The CPI method can assess effectiveness of rehabilitation care by focusing on effects of
treatment from the competitive effects of other factors (such as patient demographic, clinical, environmental and competing treatment effects). Another advantage of this practical approach is that it can produce generalisable results, examine heterogeneous groups of patients and the care management processes, and collect treatment and outcome data [270].

There are also concerns that the clinical decision-making process (especially in rehabilitation settings) can be “subjective” and potentially biased [271]. Judgements about a patient’s functional status that rely on established standardised instruments can be susceptible to bias [272]. Further, the comparison and agreement of clinical findings in MND in different rehabilitation settings can be difficult due to clinical heterogeneity and inconsistent use of appropriate measures. This can be overcome using a comprehensive, structured framework and defined classification system (such as the ICF), which is reproducible and provides a common language for clinicians across settings and patient types. It can facilitate comparison and agreement of findings, and assist with development of standardised outcome measures. Lastly, clinicians and patients have differing perspectives of what is important to their rehabilitation. Therefore practice based on best available systematic evidence alone is unlikely to succeed unless the values and beliefs of patients are incorporated into rehabilitation research [272].

Another significant issue relating to clinical trials lies within the choice of outcome measures. The outcome measures used may not capture the entire spectrum of issues in MND, nor reflect change adequately. Whilst survival is clinically important and easy to measure, there are several reasons to consider use of other outcomes [113]. Survival can be influenced by many interventions that do not clearly alter disease progression, such as enteral feeding [114]. The use of survival as an endpoint also mandates large trials that treat patients for long periods of time, thus very few patients will experience the event being measured [113]. Further, even when survival benefits are shown, these benefits have not been shown to last more than a few months. More importantly, when investigating the effectiveness of multidisciplinary care, it is important to note that the aim of such care is not to alter the underlying pathology of disease but to reduce symptoms and limitations at the level of activity and participation, and to improve quality of life through holistic interventions, which include personal and environmental factors.

The quality of life in MND care (both patients and caregivers) is a broad concept, and not easily incorporated in a single outcome measurement. Most outcome measures are generic (for example, SF-36) and may not be sensitive to changes specific to a rapidly progressive condition such as MND. Although measures specific for ALS or MND, such as the ALSAQ-40 [111], have since been developed for use, they have yet to be widely taken up. Some are heavily weighted towards physical function (e.g. ALSAQ-40) and do not include an existential element (perception of purpose, meaning of life, capacity for personal growth) relevant for persons with
ALS or MND [107]. Other measures in this population include the direct-weight version of the Schedule of the Evaluation of Individual Quality of Life (SEIQoL-DW) [108], which can be used for both patients and their caregivers, but this scale is time intensive [109]. More recently, a modified version of the McGill questionnaire was validated as an ALS-specific quality of life questionnaire (the ALSSQOL) [112], and a shortened version is currently undergoing validation in a multi-centre study.

Finally, there is enormous variability in availability of rehabilitation services for persons with MND. A recent survey highlighted a general shortfall in service provision for both rehabilitation and palliative care for people with long-term neurological conditions including MND [134].

**Interface between neurology, rehabilitation and palliative care**

Motor neurone disease is a fatal disease with a challenging progressive course that results in a broad and ever-changing spectrum of care needs. These persons have complex and diverse disabilities and need support to the end of their lives. Services need to work together to provide co-ordinated care rather than duplicating care provision or competing for resources [15]. The recent guidelines for persons with long-term neurological conditions (including MND) recommend the interface between neurology, rehabilitation and palliative care to address the diagnostic, restorative and palliative phases of illness [130]. Neurologists assess, diagnose and manage disease. Involvement of palliative care physicians at an earlier stage of disease is important for management of distressing symptoms (such as nausea, vomiting and breathlessness). While rehabilitation physicians can contribute to care by assisting with disability management and adaptive equipment provision (such as strategies and aids for communication, mobility and ability to perform activities of daily living; procedures for spasticity (phenol or botulinum toxin) or pain control; and behaviour management), they can struggle as disease advances with changing goal posts, while palliative care teams may struggle at stages where disease is not advancing. These issues may be addressed by cross-referral and closer collaboration between different services.

A proposed model for service interaction in caring for persons with MND shows involvement of neurologists and palliative care teams in the acute and terminal phases of care, with a relatively smaller role for rehabilitation physicians. However rehabilitation plays a major role in long-term care and support (over years) in the more slowly progressive phase. As patients deteriorate the rehabilitation and palliative care approaches can overlap, i.e. “neuropalliative rehabilitation”. Key skills in neuropalliative rehabilitation include: understanding disease progression, symptom control, managing expectations, issues relating to communication, addressing end of life issues, legal issues (mental capacity, wills), specialist interventions (ventilation), equipment needs, counselling and support, and welfare advice [130]. The gaps and deficiencies in MND care and services need to be addressed by collaborative work practice - clinicians need to respect others
with expertise in related areas; co-ordination should occur between services; communication between specialties and between specialist and local services needs to improve [133, 134].

In addition, the following should be considered.

- Education and support of treating physicians and other disciplines in the care of persons with ALS or MND.
- Education, support and needs of patients and their caregivers.
- Consolidated and integrated services across the spectrum of care, from rehabilitation and restorative phases to the palliative phases.

4.7.4 Conclusions
Implications for practice
In the absence of randomised controlled trials or controlled clinical trials, the “best” evidence to date, based on five observational studies, supports the current European Federation of Neurological Societies (EFNS) [10] and the British Society of Rehabilitation Medicine (BSRM) guidelines and standards [130] for multidisciplinary care in MND or ALS.

The absence of proof that multidisciplinary care is effective must not be interpreted as proof that this approach is ineffective. There are multiple, well-defined interventions, such as nutritional support and respiratory support, and interventions by physical, occupational and speech therapists which have individually had significant impact on disease course. The gap in available trial data showing efficacy when offered simultaneously in a multidisciplinary setting should not at all implicate therapeutic nihilism in the treatment of ALS/MND.

Implications for research
This review has highlighted a significant gap in the current literature. There is a need for the following.
1. Appropriate study designs and longitudinal data which address the changing needs of patients and their caregivers associated with MND disease progression and mortality. Future research in multidisciplinary care in MND should focus on observational study designs such as Clinical Practice Improvement (CPI) studies, to assess care and outcomes in “real-life” settings.

2. Studies to assess:
   - benefits of multidisciplinary care, particularly in relation to quality of life and to caregiver burden;
   - the effectiveness of specific rehabilitation interventions (and components);
   - the appropriate type, intensity and settings of therapy;
   - the cost-effectiveness of multidisciplinary care rehabilitation programmes;
• the impact of therapy on patients and their families;
• other factors that affect outcomes (support, adaptive aids and equipment, end of life issues).

3. The development of appropriate outcome measures including:
• reliable and valid outcome measures that are ALS-specific which reflect domains of the ICF and end of life care, such as quality of life and survival;
• a consensus on a core set of measurement of outcomes in MND/ALS trials using the ICF.

4. Research into different phases of MND, hence covering the spectrum of care required for this patient population. The interface between neurological, rehabilitative and palliative components of care, and caregiver needs should be explored and developed to provide long-term support for this population.

The next chapter describes the disability profile and health-care needs for persons with MND in an Australian sample from the perspective of the patients and caregivers to identify current gaps in knowledge and service provision.
Chapter 5 - Motor Neurone Disease: Disability profile and service needs in an Australian cohort.

Motor neurone disease places considerable burden upon patients and caregivers. This is the first study describing the disability profile and health-care needs for persons with MND in an Australian sample from the perspective of the patients and caregivers to identify current gaps in knowledge and service provision.

5.1 Introduction

The burden of disease and economic impact of MND upon patients, their caregivers (often family members) and on society is substantial. It often begins long before the actual diagnosis is made, and increases with increasing disability and the need for medical equipment and assisted care [6]. In the absence of a cure or indeed any medical intervention, which might stop the progression of MND, the focus is on symptomatic therapy.

A good understanding of the major disability issues and priorities in the care of persons with MND from the perspective of these persons themselves and their caregivers is important. It has been recognised that doctors do not always accurately estimate factors affecting health-related issues in their patients [273]. Patients themselves may underestimate their own care needs. In addition, there may also be disparities in perceptions of disability and care needs between patients and caregivers [274]. Within the Australian healthcare system, provision of care in people with terminal illness largely falls onto informal, unpaid caregivers, usually family and/or friends [26]. Therefore, both patient and caregiver views are necessary for a more complete picture of disability priorities and service needs in persons with MND.

This preliminary study provides the disability profile and health-care needs for persons with MND in an Australian sample and identifies current gaps in knowledge and in service provision to enable recommendations for future development of health care services for identified priorities.
5.2 Methods

5.2.1 Participants and setting
Participants and setting have been previously described (see sections 3.3 and 3.4).

All participants (n=59) who met the criteria were contacted by mail and invited to participate in the study. Forty-four consented to being interviewed together with their 37 caregivers.

5.2.2 Questionnaires
Interviews commenced with an open-ended self-report questionnaire, as described in section 3.5.1. Participants were asked, "What are the main problems you face in your everyday life? If possible, can you list and prioritise up to 10 issues that you feel are the most pressing problems you face in everyday life?" Caregivers were then asked the same question.

From the participant responses (available from authors), listed problems were categorised thematically under major disability headings, which included: impairments in body structure or function, activity limitations and participation restrictions (see section 3.5.1). Issues unrelated to either disability or health-care needs have not been included in this chapter as they are not the primary focus.

Self-administered (patient) questionnaires (described in detail in section 3.5.1) followed the open-ended questionnaire:
a) Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS-R)
b) sociodemographic and medical status questionnaire
c) items from the needs and provision complexity scale (NPCS) for long term neurological conditions.

5.2.3 Statistical analysis
Results were described by mean and standard deviation (SD) for continuous non-skewed data and as frequency (%) for categorical data.
5.3 Results

a) Participant sociodemographics
The mean age was 61 years (SD 9.8) and male: female ratio was 3:2. The mean time since diagnosis was 3.6 years. Severity of disease was classified using ALSFRS-R and half (n=18, 41%) of the participants had severe disease (level 1 and 2). (see Table 5.1) Participants appeared grossly cognitively intact based on simple observation during the interviews.

Of the 22 persons with MND who reported pain, 14 (64%) reported being on analgesia, which varied from paracetamol on an as required basis to regular opiates, and of the 32 (73%) who reported issues with spasticity, cramps or spasms, 15 (41%) reported being on medication for these symptoms. 21 (48%) reported “emotional disturbance” (included emotional lability, anxiety, depression and frustration”); 14 (67%) were on antidepressants and 1 (5%) received counselling.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Average/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong> (mean ± SD (range))</td>
<td>60.9 ± 9.8 (43 – 80)</td>
</tr>
<tr>
<td><strong>Sex</strong> [n(%)]</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>29 (65.9)</td>
</tr>
<tr>
<td>Female</td>
<td>15 (34.1)</td>
</tr>
<tr>
<td><strong>Marital status</strong> (n, %)</td>
<td></td>
</tr>
<tr>
<td>Married/Partner</td>
<td>34 (77.3)</td>
</tr>
<tr>
<td>Divorced/Separated/Single</td>
<td>10 (22.7)</td>
</tr>
<tr>
<td><strong>Living</strong> [n(%)]</td>
<td></td>
</tr>
<tr>
<td>Alone</td>
<td>8 (18.2)</td>
</tr>
<tr>
<td>Family</td>
<td>36 (82.8)</td>
</tr>
<tr>
<td><strong>Geographical area</strong></td>
<td></td>
</tr>
<tr>
<td>Metropolitan[n(%)]</td>
<td>27 (61.4)</td>
</tr>
<tr>
<td>Rural [n(%)]</td>
<td>17 (38.6)</td>
</tr>
<tr>
<td><strong>Diagnosis of ALS (El Escorial criteria) [n(%)]</strong></td>
<td></td>
</tr>
<tr>
<td>Clinically Definite ALS</td>
<td>14 (31.8)</td>
</tr>
<tr>
<td>Clinical Probable ALS</td>
<td>17 (38.6)</td>
</tr>
<tr>
<td>Probable ALS (Lab Supported)</td>
<td>5 (11.3)</td>
</tr>
<tr>
<td>Possible ALS</td>
<td>4 (9.1)</td>
</tr>
<tr>
<td>Suspected ALS</td>
<td>4 (9.1)</td>
</tr>
<tr>
<td><strong>Amyotrophic Lateral Sclerosis Functional Rating Scale – Revised (ALSFRS-R [n(%)])</strong></td>
<td></td>
</tr>
<tr>
<td>0-12 (level 1)</td>
<td>3 (6.8)</td>
</tr>
<tr>
<td>13-24 (level 2)</td>
<td>15 (34.1)</td>
</tr>
<tr>
<td>25-36 (level 3)</td>
<td>12 (27.3)</td>
</tr>
<tr>
<td>37-48 (level 4)</td>
<td>14 (31.8)</td>
</tr>
<tr>
<td><strong>Medications</strong> [n(%)]</td>
<td></td>
</tr>
<tr>
<td>Riluzole</td>
<td>36 (81.8)</td>
</tr>
<tr>
<td>Quinine</td>
<td>1 (2.3)</td>
</tr>
<tr>
<td>Carbamazepine</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Phenytoin</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Diazepam</td>
<td>2 (4.5)</td>
</tr>
<tr>
<td>Baclofen</td>
<td>11 (25.0)</td>
</tr>
<tr>
<td>Analgesia</td>
<td>14 (31.8)</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>14 (31.8)</td>
</tr>
<tr>
<td><strong>Co-morbidities</strong> (n, %)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>28 (63.6)</td>
</tr>
<tr>
<td>None</td>
<td>16 (36.4)</td>
</tr>
<tr>
<td>≥ 2 comorbidities</td>
<td>14 (50.0)</td>
</tr>
<tr>
<td><strong>Clinical symptoms and features</strong> (n, %)</td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td>34 (77.3)</td>
</tr>
<tr>
<td>Pain</td>
<td>22 (50.0)</td>
</tr>
<tr>
<td>Spasticity/cramps/spasms</td>
<td>32 (72.7)</td>
</tr>
<tr>
<td>Emotional lability</td>
<td>21 (47.7)</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>8 (18.2)</td>
</tr>
<tr>
<td>Use of PEG* tube</td>
<td>7 (16.0)</td>
</tr>
<tr>
<td>Unintelligible speech</td>
<td>9 (20.5)</td>
</tr>
<tr>
<td>Wheelchair-bound (Inability to walk)</td>
<td>31 (70.4)</td>
</tr>
<tr>
<td>Use of NIV**</td>
<td>10 (22.7)</td>
</tr>
</tbody>
</table>

*PEG percutaneous endoscopic gastrostomy
**NIV non-invasive ventilation
b) Caregiver Sociodemographics
All MND caregivers were immediate family members, the majority of who were spouses or de-facto partners (n=33, 89%) with a mean age of 57. (see Table 5.2)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Average/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean ± SD (range))</td>
<td>57 ± 6.6 (10-86)</td>
</tr>
<tr>
<td>Sex [n(%)]</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>10 (27.0)</td>
</tr>
<tr>
<td>Female</td>
<td>27 (72.9)</td>
</tr>
<tr>
<td>Carer type (n, %) (n=37)</td>
<td></td>
</tr>
<tr>
<td>Partner/Spouse</td>
<td>33 (89.1)</td>
</tr>
<tr>
<td>Child</td>
<td>4 (10.8)</td>
</tr>
</tbody>
</table>
c) Issues identified by persons with MND

Table 5.3 (see Table 5.3) lists issues reported by persons with MND classified by disease severity (ALSFRS-R).

Although participants with more severe disease reported more disability in terms of self-care and ambulation, they did not necessarily report more pain or fatigue or psychosocial issues.

**Table 5.3 Main issues reported by participants with Motor Neurone Disease classified by disease severity**

<table>
<thead>
<tr>
<th>Impairments (body structure and function)</th>
<th>Level 1 ALSFRS* 0-12 n = 3 (6.8%)</th>
<th>Level 2 ALSFRS* 13-24 n = 15 (34.1%)</th>
<th>Level 3 ALSFRS* 25-36 n = 12 (27.3%)</th>
<th>Level 4 ALSFRS* 37-48 n = 14 (31.8%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue</td>
<td>3</td>
<td>12</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Spasticity/cramps/spasms</td>
<td>2</td>
<td>10</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Emotional disturbance</td>
<td>2</td>
<td>7</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Dry mouth</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Poor sleep</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Pressure sores</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Weight gain/loss</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Blocked nose</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Loss of appetite</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Forgetfulness</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Body overheating</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Too much saliva</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Weakness</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Loss of bladder and bowel function</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Swallow</td>
<td>2</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Activity limitation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-care</td>
<td>3</td>
<td>13</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Mobility</td>
<td>3</td>
<td>12</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Communication</td>
<td>1</td>
<td>7</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Domestic activities (eg. cooking)</td>
<td>1</td>
<td>5</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Community Activities of Daily Living eg. banking</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>1</td>
<td>8</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Participation restrictions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Social life</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Avocational activities/hobbies</td>
<td>2</td>
<td>8</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Driving (the action of driving)</td>
<td></td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Loss of role in family</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

* Amyotrophic Lateral Sclerosis Functional Rating Scale – Revised (ALSFRS-R)*
d) Comparison of the perceptions of participants with MND and their caregivers (Table 5.4)

Whilst both groups reported similar levels of disability in terms of mobility, persons with MND focused more on symptoms (pain, fatigue, spasms) and participation restrictions in the community (socialising and employment) whilst caregivers focused more on psychological issues.

Table 5.4 Main issues reported by participants with Motor Neurone Disease and caregivers

<table>
<thead>
<tr>
<th>Issues</th>
<th>Participants with MND (n=44) (%)</th>
<th>Caregivers (n=37) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impairments (body structure and function)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td>34 (77.3)</td>
<td>8 (21.6)</td>
</tr>
<tr>
<td>Spasticity/cramps/spasms</td>
<td>32 (72.7)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Emotional disturbance</td>
<td>21 (47.7)</td>
<td>21 (56.8)</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>8 (18.2)</td>
<td>5 (13.5)</td>
</tr>
<tr>
<td>Weakness</td>
<td>14 (31.8)</td>
<td>8 (21.6)</td>
</tr>
<tr>
<td>Loss of bladder and bowel function</td>
<td>3 (6.8)</td>
<td>1 (2.7)</td>
</tr>
<tr>
<td>Swallow</td>
<td>7 (15.9)</td>
<td>11 (29.7)</td>
</tr>
<tr>
<td><strong>Activity limitation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-care</td>
<td>33 (75.0)</td>
<td>31 (83.8)</td>
</tr>
<tr>
<td>Mobility</td>
<td>32 (72.7)</td>
<td>25 (67.6)</td>
</tr>
<tr>
<td>Communication</td>
<td>16 (36.4)</td>
<td>10 (27.0)</td>
</tr>
<tr>
<td>Domestic activities (cooking, cleaning)</td>
<td>21 (47.7)</td>
<td>12 (32.4)</td>
</tr>
<tr>
<td>Community activities (shopping, banking)</td>
<td>3 (6.8)</td>
<td>4 (10.8)</td>
</tr>
<tr>
<td>Pain</td>
<td>22 (50.0)</td>
<td>4 (10.8)</td>
</tr>
<tr>
<td><strong>Participation restrictions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>11 (25.0)</td>
<td>4 (10.8)</td>
</tr>
<tr>
<td>Social life</td>
<td>18 (40.9)</td>
<td>8 (21.6)</td>
</tr>
<tr>
<td>Avocational activities/hobbies</td>
<td>20 (45.5)</td>
<td>15 (40.5)</td>
</tr>
<tr>
<td>Driving (the action of driving)</td>
<td>12 (27.3)</td>
<td>13 (35.1)</td>
</tr>
</tbody>
</table>
e) Access to health services (see Table 5.5)
This cohort of persons with MND was well serviced with close to 100% receiving multidisciplinary care, as defined by any intervention delivered by two or more disciplines, directed by a physician (neurologist, in this cohort), which is patient-centred, flexible and responsive to the evolving nature of the condition [123], and aimed to maximise activity and participation. Allied disciplines included nursing, physiotherapy, occupational therapy, speech pathology, dietetics/nutrition, social work, psychology, neuropsychology and spiritual counselling (chaplains). Given the wide geographical spread of the cohort, participants’ care services were delivered primarily in the local community setting through referrals by the tertiary MND clinic where they were seen three-monthly.

The overall level of disability was high as reflected by the assistance required with self-care -- 13 (30%) required help 2-3 times a day and 13 (30%) required the presence of someone most of the time. Of these, 16 (36%) received formal paid personal care assistance and 23 (52%) relied on assistance from family with 11 (25%) solely receiving assistance from family.

Twenty-five (57%) persons with MND reported that all their needs were currently met with services. Nineteen (43%) reported gaps in service provision (3 reported multiple gaps) in the areas of:
- therapy needs (n=10, 23%) [massage (n=5); vocational advice (n=4); social work or case manager (n=3); counselling (n=2); more occupational therapy and physiotherapy (n=2)]
- respite care (n=5, 11%).
Conversely, 1 reported receiving physiotherapy but not needing it. All persons with MND who perceived a gap in therapy service were already receiving therapy. However, many reported not fully understanding the role of allied health providers nor what could be provided and hence on one hand did not see always see the need for current therapy they were receiving and on the other hand, felt they needed services which were not commonly or frequently provided by their therapists – such as massage.

There was a significant discrepancy between reports of needs from persons with MND and their caregivers.

A much larger proportion of caregivers (n=19) reported a gap in service provision (9 reported multiple gaps). In addition to gaps that persons with MND had also reported in therapy needs (n=12) and respite care (n=8), caregivers reported discrepancies in:
- formal paid care for personal assistance (n=5)
- additional carer support (housework/gardening/meals/skills training (preparation of modified diet) and emotional counselling for themselves) (n=7)

Perceived gaps in needs appeared to be spread across the severity of disease although there was a trend towards a greater gap with more severe disease. Also, perceived gaps in needs did not appear to be related to the area of residence (rural/regional areas as opposed to metropolitan areas).

**Table 5.5 Domains from the Needs and provision complexity scale [234].**

<table>
<thead>
<tr>
<th>Domain</th>
<th>Need identified by persons with MND (n=44) (%)</th>
<th>Service fully provided from perspective of persons with MND (n=44) (%)</th>
<th>Need identified by caregiver (n=37) (%)</th>
<th>Service fully provided from perspective of caregiver (n=37) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medical:</strong> Specialist medical care (neurology +/- respiratory)</td>
<td>44 (100.0)</td>
<td>44 (100.0)</td>
<td>35 (94.6)</td>
<td>35 (94.6)</td>
</tr>
<tr>
<td><strong>Nursing:</strong> Skilled nursing (eg. palliative care nurse)</td>
<td>16 (36.4)</td>
<td>14 (31.8)</td>
<td>19 (51.4)</td>
<td>17 (44.9)</td>
</tr>
<tr>
<td><strong>Therapy:</strong> (eg. physiotherapy, occupational therapy, psychology, social work)</td>
<td>36 (81.8)</td>
<td>30 (68.2)</td>
<td>32 (86.5)</td>
<td>25 (67.6)</td>
</tr>
<tr>
<td><strong>Vocational support</strong> (including support to withdraw from work)</td>
<td>6 (13.6)</td>
<td>2 (4.5)</td>
<td>5 (13.5)</td>
<td>1 (2.7)</td>
</tr>
<tr>
<td><strong>Support for the caregiver</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal care assistance informal unpaid care only (family)</td>
<td>27 (61.4)</td>
<td>27 (61.4)</td>
<td>29 (78.4)</td>
<td>29 (78.4)</td>
</tr>
<tr>
<td>formal paid care only both formal and informal care</td>
<td>11 (25.0)</td>
<td>11 (25.0)</td>
<td>11 (29.7)</td>
<td>11 (29.7)</td>
</tr>
<tr>
<td>Respite (at home or in a residential facility)</td>
<td>4 (9.1)</td>
<td>4 (9.1)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Other assistance (eg. assistance with housework, emotional support)</td>
<td>12 (27.3)</td>
<td>12 (27.3)</td>
<td>18 (48.6)</td>
<td>13 (35.1)</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Home adaptation</strong> (eg. single level house, modifications to bathroom)</td>
<td>37 (84.1)</td>
<td>35 (79.5)</td>
<td>34 (91.9)</td>
<td>29 (78.4)</td>
</tr>
</tbody>
</table>
5.4 Discussion

This is the first study that we can identify in Australia providing a disability profile and description of health-care needs for persons with MND. The mean participant age, gender, time since diagnosis, distribution of type and severity of disease (based on ALSFRS-R) was similar to those reported by others [275, 276]. The participants represented a broad range of disability and disease severity, with demographic and diagnostic characteristics typical of MND.

Riluzole use (81.8%) was comparable to rates reported by other MND multidisciplinary clinics: 66% -98.8% [13, 263]. Interestingly, quinine, carbamazepine and phenytoin were rarely used for cramps in this cohort. In contrast, in the US, quinine (35%), baclofen (19%), phenytoin (10%), and gabapentin (7%) were the preferred agents [166]; in Europe, choices were quinine (58%), benzodiazepines (40%), magnesium (25%) and carbamazepine (23%) [196]. The list of potentially useful drugs for cramps is extensive, implying efficacy of individual agents is low and variable and the evidence base weak. As for treatment of spasticity, baclofen appears commonly used both in Australia (25% in this cohort) and in the US (40%).

Consistent with other reports [277, 278], symptoms of pain, emotional disturbances and spasticity/cramps/spasms are common throughout the spectrum of disease severity in MND. These symptoms are similarly common in other chronic neurological disorders such as multiple sclerosis [279, 280] and Guillain-Barré Syndrome [281]. The discrepancy between patient reports of pain, low mood and spasticity/cramps/spasms and the frequency of treatment of these symptoms however, suggest that doctors may underestimate the issues of pain and spasticity/cramps/spasms. It is possible that many patients do not volunteer this information, and that its inclusion in routine enquiries might help to encourage reporting and thus the facilitation of appropriate treatment. In addition, given the high prevalence of emotional disturbance, psychosocial support is an area of need that should be further explored.

Interestingly, despite their guarded prognosis, a number of persons with MND reported maintaining employment as a priority. Healthcare providers often assume otherwise and may therefore under treat this issue.

Caregivers were much more likely than persons with MND to underestimate symptoms of pain and fatigue but more likely to report self-care and psychosocial issues. The overestimation by caregivers of the psychosocial impact of the disease on persons with MND has previously been reported in MND [274] and in other chronic neurological conditions such as multiple sclerosis [279].

The Needs and Service Provision complexity scale highlighted that despite the high level of disability in the MND population, 25% solely relied on their families for all assistance. It is
therefore not surprising that caregivers were more likely to report gaps in service, namely additional paid caregivers, respite, and emotional support for themselves -- a reflection of carer strain. It has been reported previously that burden and depression of caregivers of persons with MND increase significantly with time and with worsening of their care recipient’s disability [282]. The situation is similar in other neurological conditions such as Multiple Sclerosis [283].

Carer strain in MND is likely multifactorial and may be associated with increased caregiving time, cognitive impairments in persons with MND, emotional labour and socio-economic considerations [28, 219, 223]. Caregiver time in MND is comparable with caregiver time in Alzheimer’s disease [284] and much higher than in stroke [285], with the most time-consuming duties being housekeeping, feeding, toileting -- activities that can be amenable to support from paid caregivers [28]. Cognitive impairment is also increasingly recognised in MND -- 50% have frontal executive deficits [205]. Although the participants appeared grossly cognitively intact based on simple observation during the interviews, subtle frontal cognitive deficits could be a significant contributor to caregiver stress. This is however, beyond the scope of this preliminary study. In addition, the emotional cost on family and social relationships is often profound and lastly, socio-economic considerations are common with loss of employment and need for specialised aids and equipment. Determining service needs from the caregivers’ perspective are necessary for interventions for psychosocial support (such as the provision of paid caregivers for personal care or housekeeping, respite and counselling) to reduce poor outcomes among caregivers and care recipients with MND.

MND is a progressive fatal disease with a challenging and diverse disability profile that results in a broad and ever-changing spectrum of care needs. Persons with MND have complex disabilities and need support to the end of their lives. Current evidence indicates that multidisciplinary rehabilitation is effective in the management of these needs and improves quality of life, reduces hospitalisation and improves disability [124]. Rehabilitation does not reverse the disease condition, but improves self-performance and independence by easing the burden of symptoms, and by improving participation in social activities and general well-being [286]. Thus, rehabilitation has much to offer, including the use of assistive technology to facilitate function and decrease reliance on carers, improve family dynamics and improve patients’ self-esteem [182]; and the use of specialised providers in addressing issues in employment (eg. the commonwealth rehabilitation service in Australia) and driving (eg. trained occupational therapy driving assessors).

Healthcare in Australia is universal (through Medicare) with good and cost-free access to specialised multidisciplinary MND clinics – the recommended standard of care [10], which may account for overall high level of service within both rural/regional and metropolitan areas. These findings are therefore likely generalisable to other regions in Australia serviced by tertiary
multidisciplinary MND clinics but not necessarily to areas that are not. This level of service is comparable to the Netherlands [11] and Italy [12] and superior to Ireland [287] and Scotland [14]. Despite the high level of service however, there remains significant discrepancy in service needs and provision. This most likely relates to the variations in service by local community providers compounded by the absence of care by rehabilitation or palliative care physicians, lack of consensus about what issues should be addressed in multidisciplinary care programs for persons with MND that incorporates the patients’, caregivers’, and treating clinicians’ perspective and poor understanding of allied health roles.

How then, “can we do better?”

The findings in this study confirm a complex and diverse disability profile. The neuropalliative rehabilitation model of care has previously been discussed [124], and incorporates the seamless interaction between neurology, rehabilitation and palliative care to address the diagnostic, restorative and palliative phases of illness [130] (see Box 5.1). Rehabilitation physicians can contribute to care by assisting with disability management and adaptive equipment provision. Stronger collaboration and integration through respect of others with expertise in related areas such as cross referral to rehabilitation and palliative care physicians can reduce gaps in MND care in Australia.

Box 5.1: Key skills in neuropalliative rehabilitation [130]

| • understanding disease progression |
| • symptom control |
| • managing expectations |
| • issues relating to communication |
| • addressing end of life issues |
| • legal issues (mental capacity, wills) |
| • specialist interventions (ventilation) |
| • equipment needs |
| • counselling and supports |
| • welfare advice |

As previously mentioned, to facilitate and optimise clinical care, the World Health Organisation has recommended the use of ICF categories, which describe the impact of a disease at different levels [5]. Within the ICF classification, MND-related impairments (muscle weakness) can limit “activity” (reduced mobility and self care) and “participation” (work, family, social reintegration). The World Health Organisation has also endorsed the development of “core sets” -- ICF
categories selected by experts (patients, caregivers, clinicians) that list issues in impairment, disability, participation environmental factors that need to be addressed in multidisciplinary care settings. This has been done in other neurological conditions such as stroke [126], multiple sclerosis [127] and Guillain-Barré syndrome [128]. A set of relevant ICF categories have not been identified in MND and would be particularly useful in both clinical and research settings given the rare incidence of MND and diverse and challenging nature of the symptoms. It has also been highlighted that current outcome measures do not capture the entire spectrum of issues in MND [124]; use of the ICF could contribute towards development of appropriate outcome measures for MND.

The limitations in this study include: cross-sectional survey (no longitudinal information); highly selective cohort (all already receiving specialised multidisciplinary care; willing research participants). Interviews were challenging given the fragile emotional and physical status of the participants. Self-reported information was used and validated as best with caregiver and medical records. The cohort covers a wide geographical population in Victoria and is representative of the wider sample of persons with MND.

MND is a devastating illness for patients and families. The “neuropalliative rehabilitation” model needs further exploration for service development. Rehabilitation has much to offer this population. For improved consensus of care and communication amongst treating clinicians, the framework of ICF should be explored in this population.

The next chapter builds on the findings in this chapter by linking patient-reported disability and environmental barriers in MND to ICF categories. In addition, these findings are compared to similar data collected for two other long-term neurological conditions (Guillain-Barré syndrome and multiple sclerosis).
Chapter 6 - Use of the International Classification of Functioning, Disability and Health to describe patient-reported disability: A comparison of Motor Neurone Disease, Guillain-Barré Syndrome and Multiple Sclerosis in an Australian cohort.

This chapter presents Study 3, which links the MND-related problems of 44 persons with MND (as reported in Chapter 5, Study 2) to the ICF framework. This allows the facilitation of comparison and agreement with other studies as it provides a standardised language and framework across different settings both locally and internationally. In addition, this study compares patient-reported disability across three long-term neurological conditions (MND, Guillain-Barré syndrome and multiple sclerosis) to determine if a set of common categories, which may be applicable across neurological conditions in a community setting, can be identified.

6.1 Introduction

As discussed in the previous chapters, MND results in a complex disability profile and presents a challenge for patients and their caregivers. The symptoms are varied and include motor deficits, respiratory compromise, speech and swallowing difficulties and psychosocial issues.

Guillain-Barré syndrome (GBS) (acute inflammatory demyelinating polyradiculopathy) is an immunological-based disease that commonly presents with symmetrical ascending paralysis. GBS has a worldwide annual incidence of 1-2 per 100,000 and is common between ages 30 and 50 years, with male preponderance [288]. It is a significant cause of new long-term disability affecting almost 1000 persons in the United States of America and 1500 in the UK annually [289]. Unlike MND, of the 90% of patients who survive the acute phase of GBS, majority (75%) have a good outcome (the ability to walk independently) [290]. However, a recent study (n=76) showed that the impact of GBS on ability to participate in work, family, and social activities remains significant after a median time post diagnosis of 6 years (range 1-14 years) [281]. Multiple sclerosis (MS) is a chronic progressive demyelinating disease of the central nervous system, affecting approximately 2.5 million worldwide. It affects more women than men (3:1 radio) and is the third leading cause of disability in adults aged between 20 and 50 [291]. The impact of MS on disability, quality of life and vocational and economic issues is considerable [249, 279, 292, 293].

The ICF [5] aims to develop a common language for describing the impact of a disease at different levels. The ICF framework should be applicable across different (neurological)
conditions and incorporate the major issues in the care of these persons. The use of ICF has previously been described in the MS [294] and a recent study demonstrated similarities in patient-reported disability and relevant environmental factors in GBS and MS [233]. A set of relevant ICF categories have not been identified in MND and would be particularly useful in both clinical and research settings given the rare incidence of MND and diverse and challenging nature of the symptoms. It has been highlighted that current outcome measures do not capture the entire spectrum of issues in MND [124]; use of the ICF could contribute towards development of appropriate outcome measures for MND. Within the ICF classification, MND-related impairments (muscle weakness) can limit “activity” (reduced mobility and self care) and “participation” (work, family, social reintegration).

As briefly discussed in Chapter 1, under the U.K. Department of Health’s National Service Framework for Long-term Neurological Conditions (LTNC) [15], MND and MS are “progressive conditions” although MND has a rapid deteriorating course compared to MS, which can be “intermittent”, “progressive” or “stable” in nature, whilst GBS is a “sudden onset condition”. This framework aims to provide guidance of care to anyone living with a neurological condition and highlights the need for integrated care and joined-up services. It acknowledges that MND, for example, has significant palliative care needs compared to other less rapidly fatal conditions such as MS and GBS.

The objectives of this study are to determine if the concepts of ICF lend themselves well to patient-reported disability in MND, a condition with significant palliative care needs; to compare patient-reported disability across the diversity of 3 LTNC (MND, GBS, MS); and to identify a set of common categories which may be applicable across neurological conditions in a community setting.
6.2 Methods

6.2.1 Participants and setting
A community-based MND group (n=44) was recruited through a tertiary MND multidisciplinary clinic. Details of participants and setting have previously been described in section 3.3 and 3.4.

6.2.2 Data collection
Details of data collection have been previously described in section 3.5. Each participant was interviewed using a structured format and asked to nominate a list of problems affecting their everyday life due to MND (open questionnaire available from authors, see section 3.5.1). Socio-demographic and clinical features were collected with a standard data form. Self-administered Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS-R) was used to determine severity of MND.

Each problem reported was linked with the standardised ICF checklist containing 128 categories ([232] with 45 added categories (available from authors) that linked with MS participant answers [294], as used for persons with MS and GBS in previous reports [233].

Authors trained in ICF used the linking rules to match each problem reported by the participant with an appropriate code from the ICF categories (second level).

6.2.3 Statistical analysis
Descriptive analysis was used to describe the study population (see section 3.5.3). Categories in which at least one third (33%) of participants reported a problem were considered relevant for describing the disability profile of MND. The frequency of participant-reported problems in the components body function, body structure, activities and participation and environmental factors due to MND were compared with categories linked for persons with GBS and for persons with MS [233].
6.3 Results
The socio-demographic and disease characteristics of participants with MND (n=44), GBS (n=77) and MS (n=101) are shown in Table 6.1. Further details of MND participants have previously been described in Table 5.1 There was 100% agreement between reviewers for linkage of participant-reported problems with the ICF categories. There were no problems identified by participants that could not be linked to the standardised ICF checklist with the 45 added categories, other than those that related to “personal factors”.

Table 6.1 Characteristics of Motor Neurone Disease/Amyotrophic Lateral Sclerosis (ALS), Guillain-Barré syndrome (GBS) and multiple sclerosis (MS) participants - demographics and disease features

<table>
<thead>
<tr>
<th>Variable</th>
<th>Average/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MND</td>
</tr>
<tr>
<td>Age (mean ± SD (range))</td>
<td>60.9 ± 9.8 (43–80)</td>
</tr>
<tr>
<td>Sex [n(%)]</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>29 (65.9)</td>
</tr>
<tr>
<td>Female</td>
<td>15 (34.1)</td>
</tr>
<tr>
<td>Living [n(%)]</td>
<td></td>
</tr>
<tr>
<td>Alone</td>
<td>8 (18.2)</td>
</tr>
<tr>
<td>Family</td>
<td>36 (82.8)</td>
</tr>
<tr>
<td>Other</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Geographical area</td>
<td></td>
</tr>
<tr>
<td>Metropolitan [n(%)]</td>
<td>27 (61.4)</td>
</tr>
<tr>
<td>Rural [n(%)]</td>
<td>17 (38.6)</td>
</tr>
<tr>
<td>Duration of disease (mean)</td>
<td>3.6</td>
</tr>
</tbody>
</table>
Tables 6.2-6.5 show the frequency of limitation in categories reported by at least one-third of the MND participants in the four ICF components (body function, body structure, activities and participation and environmental factors). The comparative frequency of each category for persons with GBS and MS reported by at least one-third of participants is also presented. A total of 70 ICF categories in MND were identified, compared to 41 in GBS and 63 in MS. Within body function, 15 categories were identified (compared to 7 in GBS and 18 in MS) whilst 5 categories were identified in the body structure component (3 in GBS, 5 in MS). Forty categories were identified in activities and participation (25 in GBS, 30 in MS) and 10 in environmental factors (6 in GBS, 10 in MS).

Additional categories identified by MND participants, not reported in GBS or MS included:

- Voice (b310), respiration (b440), ingestion (b510) and involuntary movements (b765) in the body function component
- Spinal cord and peripheral nerves (s120) in the body structure component
- Writing (d170), undertaking a single task (d210), speaking (d330), conversation (d350), changing basic body position (d410), toileting (d530), dressing (d540), eating (d550), drinking (d560), relating with strangers (d730), formal relationships (d740) and religion and spirituality (d930) in the activities and participation component, and
- For personal use in daily living (e115), design construction and building products and technology of buildings for private use (e155) and personal care providers and personal assistants (e340) in environmental factors.

All chapters, except functions of the skin and related structures, of body function (7 chapters) were relevant to MND participants, in at least one category. In the body structure component, two (structures of the nervous system and structures related to movement) out of eight chapters were identified. In the activities and participation component, all nine chapters were considered relevant by MND participants, with a particular emphasis in terms of frequency and number of categories in mobility (9 categories, mean frequency 83.7%) and self care (7 categories, chapters, mean frequency 86.1%). Other major areas identified included general tasks and demands (4 categories, mean frequency 74.2%), domestic life (5 categories, mean frequency 85.9%), interpersonal interactions and relationships (6 categories, mean frequency 63.7%), major life areas (3 categories, mean frequency 47.0%) and community, social and civic life (3 categories, mean frequency 68.9%). In the environmental factors component, four out of five chapters (products and technology; natural environment and human-made changes to environment; support and relationships; services; systems and policies) were identified.

There was more commonality between categories identified between MND and MS participants than with GBS participants. In the body function component, 11 out of 22 (50%) categories were
common between MND and MS and covered 6 chapters excluding voice and speech functions and functions of the skin and related structures. Of these, 5 categories (22.7%) in 4 chapters were common between all three neurological cohorts. In the body structure component, 3 out of 6 (50%) categories were common across all groups, with brain and lower extremity most frequently reported (brain 97.7% MND, 81.8% GBS, 99.0% MS; lower extremity 84.1% MND, 79.2% GBS, 96.0% MS). In contrast, 82.1% of MS participants reported problems with structure of the urinary system (s610), which was not identified by the MND and GBS participants. Within activities and participation, 28 out of 44 categories (63.6%) were common between MND and MS whilst 21 categories (47.7%) were common between all three groups (see Table 6). In most of these 21 categories, frequencies reported by MND and MS participants were significantly higher than in GBS participants, particularly in the categories of undertaking multiple tasks (d220), handling stress and other psychological demands (d240), walking (d450), moving around (d455), using transportation (d470), looking after one’s health (d570), preparation of meals (d630), doing housework (d640), assisting others (d660), intimate relationships (d770) and community life (d910). Seven of the 14 categories (50%) in environmental factors were common to MND and MS with four categories (28.6%), covering three chapters (products and technology, support and relationships and services, systems and policies) common to all three cohorts. In total, 33 categories (38.4%) out of an identified 86 categories were common to all three neurological groups.
Table 6.2 International Classification of Functioning, Disability and Health (ICF) - Frequency of limitation in the linked categories for the component body function reported by at least one-third (33%) of the motor neurone disease (MND) participants compared with Guillain-Barré syndrome (GBS) and with persons with multiple sclerosis (MS)²

<table>
<thead>
<tr>
<th>ICF Code</th>
<th>ICF Code Description</th>
<th>MND (n=44)</th>
<th>GBS (n=77)</th>
<th>MS (n=101)</th>
</tr>
</thead>
<tbody>
<tr>
<td>b130</td>
<td>Energy &amp; drive functions</td>
<td>38 (86.4)</td>
<td>51 (66.2)</td>
<td>98 (97.0)</td>
</tr>
<tr>
<td>b134</td>
<td>Sleep</td>
<td>22 (50.0)</td>
<td></td>
<td>84 (83.1)</td>
</tr>
<tr>
<td>b140</td>
<td>Attention</td>
<td></td>
<td></td>
<td>66 (65.3)</td>
</tr>
<tr>
<td>b144</td>
<td>Memory</td>
<td></td>
<td></td>
<td>62 (61.4)</td>
</tr>
<tr>
<td>b152</td>
<td>Emotional functions</td>
<td>25 (56.8)</td>
<td></td>
<td>97 (96.0)</td>
</tr>
<tr>
<td>b210</td>
<td>Seeing</td>
<td></td>
<td></td>
<td>47 (46.5)</td>
</tr>
<tr>
<td>b235</td>
<td>Vestibular</td>
<td>39 (50.6)</td>
<td></td>
<td>71 (70.3)</td>
</tr>
<tr>
<td>b265</td>
<td>Touch³</td>
<td></td>
<td></td>
<td>34 (33.7)</td>
</tr>
<tr>
<td>b280</td>
<td>Pain</td>
<td>24 (54.5)</td>
<td>34 (44.2)</td>
<td>76 (75.2)</td>
</tr>
<tr>
<td>b310</td>
<td>Voice</td>
<td>19 (43.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b440</td>
<td>Respiration</td>
<td>20 (45.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b455</td>
<td>Exercise and tolerance functions³</td>
<td>34 (77.3)</td>
<td>67 (87.0)</td>
<td>97 (96.0)</td>
</tr>
<tr>
<td>b510</td>
<td>Ingestion³</td>
<td>32 (72.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b525</td>
<td>Defecation</td>
<td>15 (34.1)</td>
<td></td>
<td>89 (88.1)</td>
</tr>
<tr>
<td>b620</td>
<td>Urination functions</td>
<td>15 (34.1)</td>
<td></td>
<td>94 (93.1)</td>
</tr>
<tr>
<td>b640</td>
<td>Sexual functions</td>
<td>15 (34.1)</td>
<td></td>
<td>57 (56.4)</td>
</tr>
<tr>
<td>b730</td>
<td>Muscle power</td>
<td>42 (95.5)</td>
<td>62 (80.5)</td>
<td>96 (95.1)</td>
</tr>
<tr>
<td>ICF Code</td>
<td>ICF Code Description</td>
<td>MND (n=44)</td>
<td>GBS (n=77)</td>
<td>MS (n=101)</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------------------</td>
<td>------------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>s110</td>
<td>Brain</td>
<td>43 (97.7)</td>
<td>63 (81.8)</td>
<td>100 (99.0)</td>
</tr>
<tr>
<td>s120</td>
<td>Spinal cord and peripheral nerves</td>
<td>43 (97.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>s610</td>
<td>Urinary system</td>
<td></td>
<td></td>
<td>93 (92.1)</td>
</tr>
<tr>
<td>s730</td>
<td>Upper extremity</td>
<td>41 (93.1)</td>
<td>31 (40.3)</td>
<td>44 (43.6)</td>
</tr>
<tr>
<td>s750</td>
<td>Lower extremity</td>
<td>37 (84.1)</td>
<td>61 (79.2)</td>
<td>97 (96.0)</td>
</tr>
<tr>
<td>s760</td>
<td>Trunk</td>
<td>18 (40.9)</td>
<td>85 (84.2)</td>
<td></td>
</tr>
</tbody>
</table>

GBS and MS data source [233]
3 categories added to the ICF (checklist version 2.1a) [232] after linkage of participant responses

Table 6.3 International Classification of Functioning, Disability and Health (ICF) - Frequency of limitation in the linked categories for the component body structure reported by at least one-third (33%) of the motor neurone disease (MND) participants compared with Guillain-Barré syndrome (GBS) and with persons with multiple sclerosis (MS)²
Table 6.4 International Classification of Functioning, Disability and Health (ICF) - Frequency of limitation in the linked categories for the component *activities and participation* reported by at least one-third (33%) of the motor neurone disease (MND) participants compared with Guillain-Barré syndrome (GBS) and with persons with multiple sclerosis (MS).²

<table>
<thead>
<tr>
<th>ICF Code</th>
<th>ICF Code Description</th>
<th>MND (n=44)</th>
<th>GBS (n=77)</th>
<th>MS (n=101)</th>
</tr>
</thead>
<tbody>
<tr>
<td>d160</td>
<td>Focusing attention</td>
<td>26 (33.8)</td>
<td>70 (69.3)</td>
<td></td>
</tr>
<tr>
<td>d170</td>
<td>Writing</td>
<td>34 (77.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d175</td>
<td>Solving problems</td>
<td></td>
<td>34 (33.6)</td>
<td></td>
</tr>
<tr>
<td>d177</td>
<td>Making decisions</td>
<td>26 (33.8)</td>
<td>59 (58.4)</td>
<td></td>
</tr>
<tr>
<td>d210</td>
<td>Undertaking a single task</td>
<td>25 (56.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d220</td>
<td>Undertaking multiple tasks</td>
<td>40 (90.1)</td>
<td>40 (51.9)</td>
<td>88 (87.1)</td>
</tr>
<tr>
<td>d230</td>
<td>Carrying out daily routine</td>
<td>35 (79.5)</td>
<td>48 (62.3)</td>
<td>80 (79.2)</td>
</tr>
<tr>
<td>d240</td>
<td>Handling stress and other psychological demands²</td>
<td>31 (70.5)</td>
<td>36 (46.8)</td>
<td>101 (100.0)</td>
</tr>
<tr>
<td>d330</td>
<td>Speaking</td>
<td>26 (59.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d350</td>
<td>Conversation</td>
<td>18 (40.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d410</td>
<td>Changing basic body position³</td>
<td>30 (68.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d430</td>
<td>Lifting and carrying objects</td>
<td>37 (84.1)</td>
<td>37 (48.1)</td>
<td>53 (52.5)</td>
</tr>
<tr>
<td>d440</td>
<td>Fine hand use</td>
<td>39 (88.6)</td>
<td>41 (53.2)</td>
<td>51 (50.5)</td>
</tr>
<tr>
<td>d445</td>
<td>Hand and arm use³</td>
<td>28 (63.6)</td>
<td>31 (40.3)</td>
<td>37 (36.6)</td>
</tr>
<tr>
<td>d450</td>
<td>Walking</td>
<td>40 (90.1)</td>
<td>47 (61.0)</td>
<td>101 (100.0)</td>
</tr>
<tr>
<td>d455</td>
<td>Moving around³</td>
<td>41 (93.2)</td>
<td>53 (68.8)</td>
<td>99 (98.0)</td>
</tr>
<tr>
<td>d465</td>
<td>Moving around using equipment</td>
<td>38 (86.4)</td>
<td></td>
<td>98 (97.0)</td>
</tr>
<tr>
<td>d470</td>
<td>Using transportation</td>
<td>40 (90.1)</td>
<td>58 (75.3)</td>
<td>100 (99.0)</td>
</tr>
<tr>
<td>d475</td>
<td>Driving (riding bicycle, motorbike)</td>
<td>39 (88.6)</td>
<td>56 (72.7)</td>
<td>99 (98.0)</td>
</tr>
<tr>
<td>d510</td>
<td>Washing oneself</td>
<td>39 (88.6)</td>
<td>41 (40.6)</td>
<td></td>
</tr>
<tr>
<td>d520</td>
<td>Caring for body parts</td>
<td>37 (84.1)</td>
<td>40 (39.6)</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Activity</td>
<td>Value 1</td>
<td>Value 2</td>
<td>Value 3</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>d530</td>
<td>Toileting</td>
<td>39 (88.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d540</td>
<td>Dressing</td>
<td>40 (90.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d550</td>
<td>Eating</td>
<td>40 (90.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d560</td>
<td>Drinking</td>
<td>37 (84.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d570</td>
<td>Looking after one’s health</td>
<td>34 (77.3)</td>
<td>31 (40.3)</td>
<td>88 (87.1)</td>
</tr>
<tr>
<td>d620</td>
<td>Acquisition of goods and services</td>
<td>39 (88.6)</td>
<td>92 (91.1)</td>
<td></td>
</tr>
<tr>
<td>d630</td>
<td>Preparation of meals</td>
<td>39 (88.6)</td>
<td>32 (41.6)</td>
<td>89 (88.1)</td>
</tr>
<tr>
<td>d640</td>
<td>Doing housework</td>
<td>39 (88.6)</td>
<td>51 (66.2)</td>
<td>94 (93.1)</td>
</tr>
<tr>
<td>d650</td>
<td>Caring for household objects$^3$</td>
<td>38 (86.4)</td>
<td>84 (83.2)</td>
<td></td>
</tr>
<tr>
<td>d660</td>
<td>Assisting others</td>
<td>34 (77.3)</td>
<td>27 (35.1)</td>
<td>87 (86.1)</td>
</tr>
<tr>
<td>d670</td>
<td>Complex interpersonal interactions</td>
<td>22 (50.0)</td>
<td>40 (51.9)</td>
<td></td>
</tr>
<tr>
<td>d680</td>
<td>Formal relationships</td>
<td>29 (65.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d690</td>
<td>Informal social relationships</td>
<td>20 (45.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d700</td>
<td>Family relationships</td>
<td>27 (61.4)</td>
<td>35 (34.6)</td>
<td></td>
</tr>
<tr>
<td>d710</td>
<td>Intimate relationships</td>
<td>37 (84.1)</td>
<td>56 (72.7)</td>
<td>73 (72.2)</td>
</tr>
<tr>
<td>d720</td>
<td>Economic self sufficiency</td>
<td>33 (75.0)</td>
<td>31 (40.3)</td>
<td>61 (60.4)</td>
</tr>
<tr>
<td>d730</td>
<td>Acquiring, keeping and terminating a job$^3$</td>
<td>15 (34.1)</td>
<td>40 (51.9)</td>
<td>73 (72.2)</td>
</tr>
<tr>
<td>d740</td>
<td>Remunerative employment</td>
<td>25 (56.8)</td>
<td>38 (49.4)</td>
<td>90 (89.1)</td>
</tr>
<tr>
<td>d750</td>
<td>Complex economic transaction$^3$</td>
<td>28 (36.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d760</td>
<td>Economic self sufficiency</td>
<td>22 (50.0)</td>
<td>55 (71.4)</td>
<td>84 (83.2)</td>
</tr>
<tr>
<td>d770</td>
<td>Community life</td>
<td>33 (75.0)</td>
<td>39 (50.6)</td>
<td>79 (78.2)</td>
</tr>
<tr>
<td>d780</td>
<td>Recreation and leisure</td>
<td>37 (84.1)</td>
<td>71 (92.2)</td>
<td>97 (96.0)</td>
</tr>
<tr>
<td>d790</td>
<td>Religion and spirituality</td>
<td>21 (47.7)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^2$ GBS and MS data source [233]

$^3$ categories added to the ICF (checklist version 2.1a) [232] after linkage of participant responses
Table 6.5 International Classification of Functioning, Disability and Health (ICF) - Frequency of limitation in the linked categories for the component *Environmental Factors* reported by at least one-third (33%) of the motor neurone disease (MND) participants compared with Guillain-Barré syndrome (GBS) and with persons with multiple sclerosis (MS).²

<table>
<thead>
<tr>
<th>ICF Code</th>
<th>ICF Code Description</th>
<th>Total number of participants linked responses, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>e110</td>
<td>For personal consumption</td>
<td>MND (n=44) GBS (n=77) MS (n=101)</td>
</tr>
<tr>
<td>e115</td>
<td>For personal use in daily living</td>
<td>43 (97.7) 101 (100.0)</td>
</tr>
<tr>
<td>e120</td>
<td>For personal indoor and outdoor mobility and transportation</td>
<td>31 (70.5)</td>
</tr>
<tr>
<td>e150</td>
<td>Design construction and building products and technology of building for public use</td>
<td>39 (88.6) 66 (85.7) 91 (90.1)</td>
</tr>
<tr>
<td>e155</td>
<td>Design construction and building products and technology of buildings for private use</td>
<td>37 (84.1) 70 (69.3)</td>
</tr>
<tr>
<td>e210</td>
<td>Physical geography³</td>
<td>e310 Immediate family</td>
</tr>
<tr>
<td>e225</td>
<td>Climate</td>
<td>e315 Extended family³</td>
</tr>
<tr>
<td>e340</td>
<td>Personal care providers and personal assistants</td>
<td>16 (36.4)</td>
</tr>
<tr>
<td>e415</td>
<td>Individual attitudes of extended family³</td>
<td>28 (36.4)</td>
</tr>
<tr>
<td>e460</td>
<td>Societal attitudes</td>
<td>e540 Transportation services, systems and policies</td>
</tr>
<tr>
<td>e580</td>
<td>Health services, systems and policies</td>
<td>40 (90.9) 64 (83.1) 79 (78.2)</td>
</tr>
</tbody>
</table>

² GBS and MS data source [233]
³ categories added to the ICF (checklist version 2.1a) [232] after linkage of participant responses
6.4 Discussion

This is the first study that we know of, to link problems reported by persons with MND with ICF categories in the components of body function, body structure, activities and participation and environmental factors. The identification of an extensive set of categories with the addition of a number of categories to the ICF checklist reflects the complexity of MND and is generally consistent with the well-known and described clinical picture [21]. The mean participant age, gender, time since diagnosis, distribution of type and severity of disease (based on ALSFRS-R) was also similar to those reported by others [276]. The identified list of ICF categories can facilitate communication and be useful in improving the care of a rare but challenging condition such as MND. Clinicians may use the categories to assist in the identification of issues and management of individual patients. The set of categories may also be useful in the development of a disability scale for MND patients that incorporates the perspective of MND patients themselves and also environmental factors that may impact upon their experience of disability.

The linkage of problems in MND participants in all components are largely consistent with previous reports of disability profile and care needs from the perspective of persons with MND and their caregivers [27]. In body function, pain (b280), fatigue (b130), spasticity/cramps/spasms (b735, b765) have been previously reported [19, 27, 277]. In contrast, bladder, bowel, and sexual dysfunction (b525, b620, b640) were much more commonly reported than in our previous report [27]. These areas are in general poorly studied in MND. Other reports have suggested a prevalence of 62% (n=62) in issues with sexuality [190] and 30% with bladder (n=38) [189]. The wide variation in reported prevalence suggests that patients may not volunteer this information and this requires further investigation. Inclusion of these issues in routine enquiries would be important to encourage reporting and thus the facilitation of appropriate treatment. Motor Neurone Disease affects all aspects of life; therefore activities and participation is well represented. Environmental factors linked, such as health services, systems and policies (e580) have also previously been reported [27].

The ICF framework has enabled comparison between three LTNC. As expected from their known clinical pictures, there was considerable overlap in ICF categories between MND, GBS and MS, especially in the components of activities and participation and environmental factors. There was more commonality between categories for MND and MS which is consistent with the more disabling nature of these conditions, being “progressive” LTNC as opposed to “sudden onset” LTNC (such as GBS) where the degree of recovery is expected to be much greater. Limitations in the domain of activities and participation common across all three groups included mobility, self care, domestic life, interpersonal interactions and relationships, major life areas (work and employment and economic life) and community, social and civic life. Interestingly, religion and spirituality (d930) was relevant to half the MND cohort but not to MS or GBS participants. This is consistent with previous reports that religion is one of the most important
coping mechanisms in a fatal disease such as MND [295]. Four environmental factors were common to MND, MS and GBS: personal indoor and outdoor mobility and transportation (e120), immediate family (e310), transportation services systems and policies (e540) and health services, systems and policies (e580).

Previous studies have reported on comparisons between different neurological conditions (migraine, myasthenia gravis and Parkinson’s disease [296]; GBS and MS [233]; “post-acute neurological conditions” [297]) and suggested that such comparisons provide a useful indication on what domains of functioning, not explored in previous studies in these neurological conditions could be of interest (eg. mobility in migraine and genitourinary or sexuality issues in GBS). These comparisons have shown that the ICF framework is applicable across different neurological conditions and there is common ground shared amongst these conditions. Identification of these common issues using the ICF potentially allows further development of an ICF Core Set for LTNC, which allows clinicians to provide targeted intervention to facilitate communication, assessment and management of persons across neurological conditions. Core sets are lists, selected by experts, of ICF categories [5], which need to be addressed in multidisciplinary care settings. This has been done in a number of neurological conditions such as stroke [126], MS [127], GBS [128] and early post-acute neurological conditions [297].

The comparison of three LTNC has shown that there is similarity with other neurological conditions (migraine, myasthenia gravis and Parkinson’s disease [296]; “post-acute neurological conditions [297]). The common limitations in MND, GBS and MS in activities and participation, for example are similar to those reported in migraine, myasthenia gravis and Parkinson’s disease [296]. All four common categories in MND, GBS and MS environmental factors have also been identified in other neurological conditions [281, 294, 296, 297]. However, previous comparisons of neurological conditions [296, 297] do not cover the degree of disability that would be found in the spectrum of LTNC. For example, the set of early post-acute neurological conditions reported by Stier-Jarmer in 2005 [297] included sudden onset conditions such as cerebrovascular diseases, head injuries, neoplasms (it was unclear if GBS or exacerbations of MS was included). In the Core Set for these conditions, domestic life and major life areas (work and employment and economic life), which featured strongly in MND, GBS and MS patients was not considered relevant for early post-acute neurological conditions, which is understandable as these are often not priorities in the post-acute environment (unlike in our community-based cohorts). Within the comparison of migraine, myasthenia gravis and Parkinson’s disease where two of the conditions (migraine, myasthenia gravis) generally do not report high levels of disability, 27 categories in activities and participation were relevant compared to the 44 categories identified in our groups. Hence from a clinical perspective, the comparison of MND,
GBS and MS provides guidance for continuum of care in long-term disability management across the spectrum of complex LTNC. Whilst many think of rehabilitation as a short term intervention following a single incident illness or injury, long-term disability management is in fact a core element of many rehabilitation services, which work in the community to support people to the end of their lives [130]. The ICF Core Set that covers the spectrum of LTNC can assist with practical guidelines and outline indications for specialist referral, hence facilitating the recommendations made within the 11 QRs highlighted by the National Service Framework for LTNC [15] in relation to how the interaction between specialist neurology, rehabilitation and palliative care service can best work together to provide long-term support for people with LTNC and the family members who care for them.

The limitations in this study include: cross-sectional survey (no longitudinal information); selective cohort (MND participants already receiving specialised multidisciplinary care; willing research participants). Interviews were challenging given the fragile emotional and physical status of the participants. Self-reported information was used and validated as best with caregiver and medical records. The cohort covers a wide geographical population in Victoria, and is representative of the wider sample of persons with MND.

Only patient-reported problems were linked to the ICF categories. The ICF checklist in this study was previously used in an MS cohort and a GBS cohort and we considered it comprehensive enough for use in the MND population. We did not use the World Health Organisation qualifiers scale (0-4) nor report concurrent co-morbidities, which may contribute to problems in function.

MND is a challenging disease with a diverse disability profile that results in a broad and ever-changing spectrum of care needs and is best cared for in a multidisciplinary program [124]. It is also rare, posing an even bigger challenge to health professionals who have little experience in caring for this condition. The use of the ICF framework provides an opportunity to establish a consensus about what issues should be addressed in multidisciplinary care programs for persons with MND that incorporates the patients’, caregivers’, and treating clinicians’ perspective. This is the first study to use ICF to lay a foundation from the Australian perspective to develop an ICF Core set for MND. It is also the first study to compare and demonstrate validity and generalisability of the ICF as a framework across the spectrum of LTNC and in doing so move towards development of an ICF Core set for LTNC. These core sets can then be used to facilitate clinical care and agreement, and in the future may assist in outcome development through the use of ICF item banking and scale development techniques [299, 300]. The next chapter focuses on the comparison of the MND-related ICF categories identified by patients (as reported in this chapter) to those identified by their caregivers; and further expands on the impact of MND on caregivers.
Chapter 7 - Use of the International Classification of Functioning, Disability and Health to compare patient- and caregiver-reported disability in motor neurone disease

Informal and unpaid caregivers (usually family and/or friends) provide much of the care for people with MND. Despite this, information about caregivers is limited. Building on from the previous chapter, this chapter (Study 3) links caregiver-reported disability in MND and compares this to patient-reported disability. In addition, it provides information on caregiver burden and caregiver psychological coping (anxiety, depression, stress, coping mechanisms, quality of life).

7.1 Introduction
Given its rapid progression, as manifested by upper and lower motor neuron signs and symptoms affecting bulbar, limb, and respiratory muscles and disability, MND creates a huge burden of disease and economic impact of MND upon patients, their caregivers (often family members) and society is substantial. It often begins long before the actual diagnosis is made and increases with increasing disability and the need for medical equipment and assisted care [6]. Within Australia, provision of care for people with terminal illness largely falls onto informal, unpaid caregivers, usually family and/or friends [301]. In Italy, it has been estimated that primary caregivers spend a mean of 9.5 hours a day caring for patients even where there is paid assistance [28]. This is comparable to caregiver time in Alzheimer’s Disease [284] and is much higher than for stroke [285]. Despite this, the disability profile from the perspective of caregivers of MND has not been well studied and the gap between the provision of health care and the needs of the caregiver can be significant [27]. Understanding the impact of MND on caregivers and how to optimise their well-being is limited in current literature. There is conflicting evidence regarding associations with caregiver burden and the patient’s functional impairment [222, 302]; caregiver distress has been linked to the psychosocial impact of MND, extent of patient’s emotional lability, number of dependents and degree of social support [222], and neurobehavioural symptoms [303]. Caregiver problem solving skills have been linked positively [304] to caregiver well-being (quality of life and psychological morbidity) but other coping mechanisms have not been well studied. Within Australia, qualitative studies have demonstrated 4 aspects of caring (receiving support, self-care, caregiver satisfaction, stress on family or community relationships) - stress on relationships (particularly with family and friends) was the single best predictor of carer well-being [223]. However the measures that were used predominantly focused on assessing caregivers’ perceptions of their social networks and were not designed to investigate other perceptions or aspects of caregiving [223].

Generalisation of previously reported information about caregiver strain in MND is difficult due to the significant variations in methodology, MND populations (often not across the whole
spectrum of severity), use of outcome measures, reported aspects of caregiver strain and
differences in local services. For example, studies that focus only on severe MND, where
patients are eligible for hospice and likely to require mechanical ventilation or to die within six
months [221] may not demonstrate correlation with level of disability and caregiver strain;
studies selecting those with mild to moderate disability [305] may focus more on existential
concerns. Further, no studies have looked at caregiver perspectives of the disability problems in
their care recipients.

The ICF [5] aims to develop a common language for describing the impact of a disease at
different levels. The ICF framework should be applicable across different perspectives and
incorporate the major issues in the care of these persons. The use of ICF has previously been
described in other neurological conditions such as multiple sclerosis and Guillain-Barré
Syndrome [233]. Comparison of the caregiver and patient perspective through an identified set
of relevant ICF categories in MND would be particularly useful in both clinical and research
settings given the rare incidence of MND and diverse and challenging nature of the symptoms
and the heavy reliance on caregivers for care. Incorporation of caregiver perspectives can help
ensure that their needs are also met. It has been highlighted that current outcome measures do
not capture the entire spectrum of issues in MND [124]; use of the ICF could contribute towards
development of appropriate outcome measures for persons with MND and their caregivers.
Within the ICF classification, MND-related impairments (muscle weakness) can limit “activity”
(reduced mobility and self care) and “participation” (work, family, social reintegration). In
addition, the ICF acknowledges that environmental factors (physical, social and attitudinal
environment in which people live and conduct their lives) and personal factors (intrinsic
influences such as self-efficacy and positive adaptation) interact with all the other constructs
within the ICF to affect a person’s overall experience of the disease.

The objectives of this study are to determine if the categories of ICF adequately address both
patient- and caregiver-reported disability in MND, and to assess caregiver burden and
psychological coping (anxiety, depression, stress, coping mechanisms, quality of life).
7.2 Methods

7.2.1 Participants and setting
This has previously been described in sections 3.3 and 3.4.

7.2.2 Data collection
As described in section 3.5, 44 MND participants and their 37 caregivers were interviewed separately using a structured format.

In addition, the following questionnaires were completed (see section 3.5 for more detailed description of each scale):

By the MND participants,
1) Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS) to determine severity of MND.
2) Needs and Provision Complexity Scale (NPCS) personal care domain [234] to determine the amount of assistance for personal care required for the care recipients. Two parts of the domain were asked: a) number of carers required (none, 1 or ≥2) and who the carers were (informal family care, formal paid carers, others) b) frequency of care required (no help, occasional need, once daily help, 2-3 times a day, frequent or unpredictable care needs, constant supervision).

By the caregivers:
1) Depression, Anxiety Stress Scale (DASS) [235]
2) Self-rated burden (SRB) [238]
3) Caregiver strain index (CSI) [239]
4) McGill Quality of life questionnaire (MQOL) [236]
5) Brief COPE [237]

7.2.3 Statistical analysis
This has previously been described in section 3.5.3. Each problem reported by the patients and the caregivers was linked to an appropriate code from the ICF categories (second level). Categories in which at least one third (33%) of patients or caregivers reported a problem were considered relevant for describing the disability profile of MND.
All other analyses were performed using SPSS version 14.0 (SPSS Inc, Chicago, IL). Participant demographics, ALSFRS and the personal care domain from the NPCS were described by mean and standard deviation (SD) for continuous non-skewed data and as frequency (%) for categorical data. The other outcomes, DASS, MQOL, Brief COPE, CSI and SRB were reported by median and interquartile range (IQR).
7.3 Results
7.3.1 Patient and caregiver characteristics
The socio-demographic and disease characteristics of persons with MND (n=44) and their caregivers (n=37) have previously been shown in Tables 5.1 and 5.2. Participants appeared grossly cognitively and behaviourally intact based on simple observation during the interviews. The overall level of disability was high as reflected by the assistance required with self-care (NPCS) -- 13 (30%) required help 2-3 times a day and 13 (30%) required the presence of someone most of the time. Of these, 16 (36%) received formal paid personal care assistance and 23 (52%) relied on assistance from family with 11 (25%) solely receiving assistance from family.

7.3.2 Comparison of limitation in ICF categories reported by patients and caregivers
There was 100% agreement between reviewers for linkage of participant-reported problems due to MND with the ICF categories. A total of 70 ICF categories for all 4 ICF components (body function, body structure, activities and participation and environmental factors) in MND were identified by MND patients, compared to 8 by caregivers. The categories where limitations were reported by at least one-third of MND patients (but by none of the caregivers) in the ICF components of body function (15 categories) and body structure (5 categories) have previously been reported in Tables 6.2 and 6.3. Table 7.1 shows the comparative frequency of limitation in categories reported by at least one-third of the MND patients and their caregivers in the ICF components of activities and participation and environmental factors. Forty categories were identified in activities and participation (6 by caregivers) and 10 in environmental factors (2 by caregivers). Caregivers did not identify any additional categories compared to MND participants. A significant proportion of MND participants identified the category “religion” (47.7%), but not their caregivers.

The common areas linked in activities and participation were general tasks and demands, mobility, self care and community, social and civic life; environmental factors included support and relationships, services, systems and policies.
Table 7.1 International Classification of Functioning, Disability and Health (ICF) - Frequency of limitation in the linked categories for the component *activities and participation* (codes with “d”) and *Environmental Factors* (codes with “e”) reported by at least one-third (33%) of the motor neurone disease (MND) participants compared with their caregivers [27].

<table>
<thead>
<tr>
<th>ICF Code</th>
<th>ICF Code Description</th>
<th>Total number of participants linked responses, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>d170</td>
<td>Writing*</td>
<td>MND (n=44) 34 (77.3) MND caregivers (n=37)</td>
</tr>
<tr>
<td>d210</td>
<td>Undertaking a single task</td>
<td>25 (56.8)</td>
</tr>
<tr>
<td>d220</td>
<td>Undertaking multiple tasks</td>
<td>40 (90.1)</td>
</tr>
<tr>
<td>d230</td>
<td>Carrying out daily routine*</td>
<td>35 (79.5)</td>
</tr>
<tr>
<td>d240</td>
<td>Handling stress and other psychological demands*</td>
<td>31 (70.5) 17 (45.9)</td>
</tr>
<tr>
<td>d330</td>
<td>Speaking</td>
<td>26 (59.1)</td>
</tr>
<tr>
<td>d350</td>
<td>Conversation</td>
<td>18 (40.1)</td>
</tr>
<tr>
<td>d410</td>
<td>Changing basic body position*</td>
<td>30 (68.2)</td>
</tr>
<tr>
<td>d430</td>
<td>Lifting and carrying objects</td>
<td>37 (84.1)</td>
</tr>
<tr>
<td>d440</td>
<td>Fine hand use</td>
<td>39 (88.6)</td>
</tr>
<tr>
<td>d445</td>
<td>Hand and arm use*</td>
<td>28 (63.6)</td>
</tr>
<tr>
<td>d450</td>
<td>Walking</td>
<td>40 (90.1)</td>
</tr>
<tr>
<td>d455</td>
<td>Moving around*</td>
<td>41 (93.2)</td>
</tr>
<tr>
<td>d465</td>
<td>Moving around using equipment</td>
<td>38 (86.4)</td>
</tr>
<tr>
<td>d470</td>
<td>Using transportation</td>
<td>40 (90.1)</td>
</tr>
<tr>
<td>d475</td>
<td>Driving (riding bicycle, motorbike)</td>
<td>39 (88.6)</td>
</tr>
<tr>
<td>d510</td>
<td>Washing oneself</td>
<td>39 (88.6)</td>
</tr>
<tr>
<td>d520</td>
<td>Caring for body parts</td>
<td>37 (84.1)</td>
</tr>
<tr>
<td>d530</td>
<td>Toileting</td>
<td>39 (88.6)</td>
</tr>
<tr>
<td>d540</td>
<td>Dressing</td>
<td>40 (90.1)</td>
</tr>
<tr>
<td>d550</td>
<td>Eating</td>
<td>40 (90.1)</td>
</tr>
<tr>
<td>d560</td>
<td>Drinking</td>
<td>37 (84.1)</td>
</tr>
<tr>
<td>d570</td>
<td>Looking after one’s health</td>
<td>34 (77.3)</td>
</tr>
<tr>
<td>d620</td>
<td>Acquisition of goods and services</td>
<td>39 (88.6)</td>
</tr>
<tr>
<td>d630</td>
<td>Preparation of meals</td>
<td>39 (88.6)</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Percentage</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>d640</td>
<td>Doing housework</td>
<td>39 (88.6)</td>
</tr>
<tr>
<td>d650</td>
<td>Caring for household objects*</td>
<td>38 (86.4)</td>
</tr>
<tr>
<td>d660</td>
<td>Assisting others</td>
<td>34 (77.3)</td>
</tr>
<tr>
<td>d720</td>
<td>Complex interpersonal interactions</td>
<td>22 (50.0)</td>
</tr>
<tr>
<td>d730</td>
<td>Relating with strangers</td>
<td>29 (65.9)</td>
</tr>
<tr>
<td>d740</td>
<td>Formal relationships</td>
<td>20 (45.5)</td>
</tr>
<tr>
<td>d750</td>
<td>Informal social relationships</td>
<td>27 (61.4)</td>
</tr>
<tr>
<td>d760</td>
<td>Family relationships</td>
<td>37 (84.1)</td>
</tr>
<tr>
<td>d770</td>
<td>Intimate relationships</td>
<td>33 (75.0)</td>
</tr>
<tr>
<td>d845</td>
<td>Acquiring, keeping and terminating a job*</td>
<td>15 (34.1)</td>
</tr>
<tr>
<td>d850</td>
<td>Remunerative employment</td>
<td>25 (56.8)</td>
</tr>
<tr>
<td>d870</td>
<td>Economic self sufficiency</td>
<td>22 (50.0)</td>
</tr>
<tr>
<td>d910</td>
<td>Community life</td>
<td>33 (75.0)</td>
</tr>
<tr>
<td>d920</td>
<td>Recreation and leisure</td>
<td>37 (84.1)</td>
</tr>
<tr>
<td>d930</td>
<td>Religion and spirituality</td>
<td>21 (47.7)</td>
</tr>
<tr>
<td>e110</td>
<td>For personal consumption</td>
<td>43 (97.7)</td>
</tr>
<tr>
<td>e115</td>
<td>For personal use in daily living</td>
<td>31 (70.5)</td>
</tr>
<tr>
<td>e120</td>
<td>For personal indoor and outdoor mobility and transportation</td>
<td>39 (88.6)</td>
</tr>
<tr>
<td>e150</td>
<td>Design construction and building products and technology of building for public use</td>
<td>37 (84.1)</td>
</tr>
<tr>
<td>e155</td>
<td>Design construction and building products and technology of buildings for private use</td>
<td>36 (81.2)</td>
</tr>
<tr>
<td>e210</td>
<td>Physical geography *</td>
<td>14 (31.8)</td>
</tr>
<tr>
<td>e310</td>
<td>Immediate family</td>
<td>43 (97.7)</td>
</tr>
<tr>
<td>e340</td>
<td>Personal care providers and personal assistants</td>
<td>16 (36.4)</td>
</tr>
<tr>
<td>e540</td>
<td>Transportation services, systems and policies</td>
<td>34 (77.3)</td>
</tr>
<tr>
<td>e580</td>
<td>Health services, systems and policies</td>
<td>40 (90.9)</td>
</tr>
<tr>
<td>e110</td>
<td>For personal consumption</td>
<td>43 (97.7)</td>
</tr>
</tbody>
</table>

* categories added to the ICF (checklist version 2.1a) (reference) after linkage of participant responses
7.3.3 Caregiver burden and psychological coping (Table 7.2)

Based on DASS scores, a significant proportion of caregivers were depressed (27%, 10.8% mild depression, 16.2% major depression), anxious (18.9%, 5.4% mild anxiety, 13.5% moderate or severe anxiety) and/or stressed (37.8%, 5.4% mild stress, 32.4% moderate or severe stress). Caregiver burden was high (SRB median 50, CSI mean 8.3). Twenty-four (64.9%) caregivers had CSI scores ≥ 7, indicating caregivers strain and of the 13 CSI items in total, more than half of the caregivers indicated strain for 10 items. The CSI items showing most caregivers strain (>75%) included: changes in caregivers’ personal plans (83.8%), family adjustment (81.1%), changes in former self (78.4%), and confining (78.4%). Despite this, quality of life was good (MQOL-SIS median 7 ± 1.820). Problem-focused coping strategies were more commonly used than emotion-focused coping strategies (brief COPE). Active coping, planning and acceptance were the most commonly used strategies.
Table 7.2 Results of Motor Neurone Disease caregiver questionnaires

<table>
<thead>
<tr>
<th>Measurement Scales</th>
<th>Median (IQR)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression Anxiety Stress Score-21</td>
<td>6.0 (2-10)</td>
<td>0-32</td>
</tr>
<tr>
<td>Depression (0-42)</td>
<td>2.0 (0-5)</td>
<td>0-26</td>
</tr>
<tr>
<td>Anxiety (0-42)</td>
<td>10.0 (2-20)</td>
<td>0-30</td>
</tr>
<tr>
<td>Self-rated burden</td>
<td>50.0 (35 – 72.5)</td>
<td>0-99</td>
</tr>
<tr>
<td>How burdensome (0-100)</td>
<td>25 (67.7)</td>
<td>12 (32.4)</td>
</tr>
<tr>
<td>Caregiver Strain Index</td>
<td>17 (45.9)</td>
<td>20 (54.1)</td>
</tr>
<tr>
<td>Sleep is disturbed</td>
<td>21 (56.8)</td>
<td>16 (43.2)</td>
</tr>
<tr>
<td>It is inconvenient</td>
<td>29 (78.4)</td>
<td>8 (21.6)</td>
</tr>
<tr>
<td>It is a physical strain</td>
<td>30 (81.1)</td>
<td>7 (18.9)</td>
</tr>
<tr>
<td>It is confining</td>
<td>31 (83.8)</td>
<td>6 (16.2)</td>
</tr>
<tr>
<td>There have been family adjustments</td>
<td>20 (54.1)</td>
<td>17 (45.9)</td>
</tr>
<tr>
<td>There have been other demands on my time</td>
<td>29 (78.4)</td>
<td>8 (21.6)</td>
</tr>
<tr>
<td>There have been emotional adjustments</td>
<td>19 (51.4)</td>
<td>18 (48.6)</td>
</tr>
<tr>
<td>Some behaviour is upsetting</td>
<td>25 (67.7)</td>
<td>12 (32.4)</td>
</tr>
<tr>
<td>It is upsetting to find that xx (care recipient) has changed so much from his/her former self</td>
<td>21 (56.8)</td>
<td>16 (43.2)</td>
</tr>
<tr>
<td>There have been work adjustments</td>
<td>29 (78.4)</td>
<td>8 (21.6)</td>
</tr>
<tr>
<td>There have been other demands on my time</td>
<td>20 (54.1)</td>
<td>17 (45.9)</td>
</tr>
<tr>
<td>There have been emotional adjustments</td>
<td>29 (78.4)</td>
<td>8 (21.6)</td>
</tr>
<tr>
<td>Some behaviour is upsetting</td>
<td>19 (51.4)</td>
<td>18 (48.6)</td>
</tr>
<tr>
<td>It is upsetting to find that xx (care recipient) has changed so much from his/her former self</td>
<td>29 (78.4)</td>
<td>8 (21.6)</td>
</tr>
<tr>
<td>Caregiver Strain Index</td>
<td>18 (48.6)</td>
<td>19 (51.4)</td>
</tr>
<tr>
<td>Sum score mean (SD)</td>
<td>16 (43.2)</td>
<td>21 (26.8)</td>
</tr>
<tr>
<td>McGill Quality of Life</td>
<td>24 (64.9)</td>
<td>13 (35.1)</td>
</tr>
<tr>
<td>Total (0-130)</td>
<td>111.0 (90.5-126)</td>
<td>56-151</td>
</tr>
<tr>
<td>Single item scale (SIS) (0-10)</td>
<td>7.0 (5-8)</td>
<td>0-10</td>
</tr>
<tr>
<td>Physical symptoms (0-30)</td>
<td>21.0 (15.5-30)</td>
<td>4-30</td>
</tr>
<tr>
<td>Physical well being (0-10)</td>
<td>6.0 (5-8)</td>
<td>0-10</td>
</tr>
<tr>
<td>Psychological symptoms (0-40)</td>
<td>25.0 (17-31)</td>
<td>2-40</td>
</tr>
<tr>
<td>Existential wellbeing (0-60)</td>
<td>44.0 (36-50.5)</td>
<td>17-58</td>
</tr>
<tr>
<td>Support (0-20)</td>
<td>15.0 (12-16)</td>
<td>9-20</td>
</tr>
<tr>
<td>Brief COPE</td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td>Problem focused coping strategies</td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td>Active coping (2-8)</td>
<td>6.5 (1.7)</td>
<td>2 – 8</td>
</tr>
<tr>
<td>Planning (2-8)</td>
<td>6.2 (1.8)</td>
<td>2 – 8</td>
</tr>
<tr>
<td>Positive reframing (2-8)</td>
<td>5.3 (1.8)</td>
<td>2 – 8</td>
</tr>
<tr>
<td>Acceptance (2-8)</td>
<td>7.1 (1.2)</td>
<td>4 – 8</td>
</tr>
<tr>
<td>Humour (2-8)</td>
<td>4.0 (2.0)</td>
<td>2 – 8</td>
</tr>
<tr>
<td>Religion (2-8)</td>
<td>4.0 (2.2)</td>
<td>2 – 8</td>
</tr>
<tr>
<td>Using emotional support (2-8)</td>
<td>5.9 (1.6)</td>
<td>3 – 8</td>
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<td>Using instrumental support (2-8)</td>
<td>5.6 (1.8)</td>
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<tr>
<td>Emotion-focused coping strategies</td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>-----------</td>
<td>-------</td>
</tr>
<tr>
<td>Self-distraction (2-8)</td>
<td>5.2 (1.8)</td>
<td>2 – 8</td>
</tr>
<tr>
<td>Denial (2-8)</td>
<td>3.2 (1.3)</td>
<td>2 – 6</td>
</tr>
<tr>
<td>Venting (2-8)</td>
<td>3.7 (1.4)</td>
<td>2 – 6</td>
</tr>
<tr>
<td>Substance use (2-8)</td>
<td>2.6 (1.2)</td>
<td>2 – 6</td>
</tr>
<tr>
<td>Behavioural disengagement(2-8)</td>
<td>2.4 (0.8)</td>
<td>2 – 5</td>
</tr>
<tr>
<td>Self-blame (2-8)</td>
<td>3.0 (1.1)</td>
<td>2 – 6</td>
</tr>
</tbody>
</table>
7.4 Discussion

This is the first study that we can identify, to compare problems reported by persons with MND with caregiver reports through linkage with ICF categories in the components of body function, body structure, activities and participation and environmental factors, and to relate the comparison to caregiver burden and psychological coping. The patient participants represented a broad range of disability and disease severity, with demographic and diagnostic characteristics typical of MND. The caregiver cohort had similar socio-demographic characteristics to other reports in MND [302]. Compared to caregivers in other chronic neurological diseases, they were slightly older with a higher male ratio than multiple sclerosis caregivers [283] and slightly younger with similar male: female ratios to stroke [285] and Alzheimer’s [284] as would be expected from differences in disease characteristics of their care recipients. Similar to other chronic neurological diseases, the majority of the caregivers were family members (mostly spouses) and resided with the patient. The ICF appears adequately comprehensive to incorporate both the perspectives of patients and their caregivers in MND. Caregivers linked a small number of categories in the components of *activities and participation* and *environmental factors*. However, caregiver psychological coping (depression, anxiety, stress) and carer burden were found to be significant. Despite this, caregiver self-reported Quality of life was good and may be related to the coping strategies (active coping, planning and acceptance) that they used. The mean patient participant age, gender, time since diagnosis, distribution of type and severity of disease (based on ALSFRS-R) was similar to those reported by others [276].

Caregiver-reported ICF categories in neurological conditions have been less studied (than patient-reported ICF categories) and are generally incorporated into “patient perspectives” when reported, not separately presented [127]. Hence comparison of MND caregiver perspectives with those of other neurological conditions is challenging. The focus of caregivers on psychosocial aspects of MND has been previously described [27]. As expected, caregivers linked categories only in the components of *activities and participation* and *environmental factors*. Interestingly, caregivers did not link themselves, the “immediate family members” (e310), which may indicate a reluctance to shift the focus away from the patients and onto themselves. It was also significant that the number of linked categories were relatively small especially in light of the significant reported levels of depression, anxiety, stress, and caregiver burden. This highlights the importance of “personal factors” (which have not yet been mapped in ICF) on the psychosocial burden of MND. Nevertheless, the identified list of ICF categories can facilitate communication and be useful in improving the care of a rare but challenging condition such as MND. Clinicians may use the categories to assist in the identification of issues and management of individual patients whilst importantly incorporating the perspectives of their caregivers on whom these patients heavily rely. The set of categories may also be useful in the development of a disability scale for MND patients that incorporates the
perspective of MND patients, their caregivers and also environmental factors that may impact upon their experience of disability. Finally, there is a need for a standardised and disease-specific questionnaire to measure the impact on the caregiver [306]. Whilst one is currently being developed [307], the ICF would be useful in providing a common language internationally and a more comprehensive incorporation of caregiver perspectives.

The level of reported anxiety and depression in caregivers was high, which is consistent with other reports in MND [221] and other neurological disorders such as multiple sclerosis, Huntington’s disease, Parkinson’s disease [308] and stroke [309]. Anxiety in MND caregivers is in general poorly studied and much higher prevalence has been reported by other studies: 40% - 80% [310] [311]. This may reflect differences in use of outcome measures, which has been the case with measurement of depression [277]. Also of significant note were the high levels of stress (DASS) and carer burden reported (SRB and CSI). The levels of caregiver strain and burden are much higher than reported in caregivers of multiple sclerosis [283] and stroke [312]. This emphasises the need for psychosocial support for the caregivers as previously highlighted [27]. MND is a devastating condition, which takes its toll on the patient and family especially as the disease progresses, and loss of independence occurs. Caregiver strain is often significant as a result of increased caregiving time, cognitive impairments in persons with MND, emotional labour and socio-economic considerations [28, 222, 223]. Hence, referrals to support groups and counselling and education of patients and their families (often their caregivers) are essential. Frank discussions facilitate understanding of the disease and improve coping skills. Carer support (both physical and emotional) and respite care should be discussed [306] [27]. Referrals to the local MND associations are also recommended as these provide patients and families with ongoing support, resources and equipment needs. Psychotherapy should also be considered to assist with coping strategies. Training in relaxation and breathing techniques are also often useful in management of anxiety.

Caregiver quality of life appeared to be relatively good in this cohort despite their psychological stresses and care-giving burden. Other studies have reported conflicting results with regards to quality of life in MND caregivers [302, 313]. Similarly, it has been reported that MND caregivers have a poorer quality of life when compared with caregivers in Huntington’s disease, Parkinson’s disease, and multiple sclerosis. The relatively good quality of life in this cohort may be related to the patients’ religiosity [305] and relative lack of neurobehavioural symptoms [303]. In addition, good problem-solving skills [304] and positivity [306] on the part of the caregivers, and the support they were receiving through the multidisciplinary MND clinic are likely also to have contributed to their quality of life. This is supported by findings in caregivers of other neurological disorders – in stroke caregivers active coping skills were positively linked with psychosocial functioning [312]; quality of life in MS caregivers is negatively impacted by care recipient cognitive and psychiatric symptoms but not by patient physical impairment [314].
The limitations in this study include: cross-sectional survey (no longitudinal information), selective cohort (already receiving specialised multidisciplinary care, willing research participants). Interviews were challenging given the fragile emotional and physical status of the patients. Patient self-reported information was used and validated as best with caregiver and medical records. The cohort covers a wide geographical population in Victoria and is representative of the wider sample of persons with MND.

Only patient- and caregiver-reported problems were linked to the ICF categories. The ICF checklist in this study was previously used in an MS cohort and a GBS cohort and we considered it comprehensive enough for use in the MND population. We did not use the World Health Organisation qualifiers scale (0-4) nor report concurrent co-morbidities, which may contribute to problems in function.

MND is a challenging disease with a diverse disability profile that results in a broad and ever-changing spectrum of care needs and heavy reliance on caregivers. It is best cared for in a multidisciplinary program [124]. Caregivers are an important but often “silent” and hence frequently neglected partner in the experience of disease – it is vital for their needs to be specifically identified and targeted to optimise care in MND. The use of the ICF framework provides an opportunity to establish a consensus about what issues should be addressed in multidisciplinary care programs for persons with MND that incorporates the patients’, caregivers’, and treating clinicians’ perspective. This is the first study to use ICF to lay a foundation from both patient and caregiver perspective to develop an ICF “Core set” for MND. These are ICF categories selected by experts (patients, caregivers, clinicians) that list issues in impairment, disability, participation environmental factors that need to be addressed in multidisciplinary care settings. These core sets can then be used to facilitate clinical care and agreement, and in the future may assist in outcome development through the use of ICF item banking and scale development techniques [299].

The next chapter presents a preliminary study that aims to identify the personal factors that are relevant in persons with MND from their perspective, in an Australian cohort.
Chapter 8 - Identification of personal factors in motor neurone disease: a pilot study

Whilst the ICF acknowledges that “contextual factors”, such as environmental (extrinsic) and personal factors (intrinsic) interact with all the other constructs to shape the impact of MND on patients and their families, personal factors are not classified in the current version of the ICF, thus representing a significant gap in the overall biopsychosocial view of the condition. This chapter presents Study 5, a preliminary study, which identifies personal factors from the perspective of patients with MND, as a potential next step in the development of personal factors within the ICF classification.

8.1 Introduction

The burden of disease and economic impact of MND upon patients, their caregivers (often family members) and on society is substantial. With no cure currently available, the challenge in MND is to prolong independence, prevent complications and optimise quality of life. This is best met by a multidisciplinary team with a focus on symptomatic, rehabilitative and palliative care [9, 10], through holistic interventions (incorporate personal and environmental factors) that span the spectrum of the disease. A significant part of the palliative rehabilitation process is the self-empowerment of patients and their families and helping them adapt as the disease progresses. Personal factors, which are defined as the particular background of a person’s life and living which are not part of a health condition [5], can be important barriers and/or facilitators to this process and rehabilitation often aims to enhance facilitating factors whilst underplaying the negative factors to achieve the most optimal functional and social reintegration outcomes. For example, education (for patients and families) is an integral part of MND management but information provided must be appropriate to the patient’s educational level; timing of end of life issues depend on a number of factors including coping skills, depression and anxiety, cultural issues and functional status [226]; and technological aids (which can vary considerably in cost) need to suit the patient’s socio-economic status, which impacts on their ability to fund these aids.

As discussed in previous chapters, the ICF [5] aims to develop a common language for describing the impact of a disease at different levels. Within the ICF classification, MND-related impairments (muscle weakness) can limit “activity” (reduced mobility and self care) and “participation” (work, family, social reintegration). The ICF also acknowledges that environmental factors (physical, social and attitudinal environment in which people live and conduct their lives) and personal factors (intrinsic influences such as race, gender, coping styles) interact with all the other constructs within the ICF to affect the person’s overall experience of living with their condition. A set of relevant ICF categories in MND would be
useful in both clinical and research settings given the rare incidence of MND and diverse and challenging nature of the symptoms. It has been also been highlighted that current outcome measures do not capture the entire spectrum of issues in MND [124]; use of the ICF categories could contribute towards development of appropriate outcome measures for MND. However, at present, personal factors are not classified in the current version of ICF, which represents a significant gap in the overall biopsychosocial view of the condition.

This preliminary study aims to identify the personal factors that are relevant in persons with MND from their perspective, in an Australian cohort.
8.2 Methods

8.2.1 Participants and setting
Participants and setting have previously been described in sections 3.3 and 3.4.

8.2.2 Questionnaires
As described in section 3.5, interviews commenced with an open-ended self-report questionnaire. Participants were asked, “What are the main problems you face in your everyday life? If possible, can you list and prioritise up to 10 issues that you feel are the most pressing problems you face in everyday life?” Participants were asked to include intrinsic factors that impacted on their experience of these problems, such as their ability to cope.

From the participant responses (from the open-ended questionnaire), all problems relating to personal factors (currently not coded within the ICF) were grouped under “personal factors” and categorised thematically under major headings, which included: demographic factors (gender, race, age, educational status), emotional states (depression, stress, anxiety, fear), coping strategies and styles (problem-based coping, denial), personality, beliefs (includes self-efficacy, religious beliefs and values, personal and cultural), attitudes (of the patient) and “other” (perceived social support). Reports unrelated to personal factors have not been included in this chapter as they are not the primary focus.

Self-administered (patient) questionnaires followed the open-ended questionnaire (details described in section 3.5):
- a) sociodemographic and medical status questionnaire
- b) Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS) [97], to determine severity of MND.
- c) Depression, Anxiety, Stress Scale (DASS) [235]
- d) Brief COPE [237]

8.2.3 Statistical analysis
As described in section 3.5.3, results were described by mean and standard deviation (SD) for continuous non-skewed data and as frequency (%) for categorical data. Each identified personal factor was listed once regardless of the frequency of identification either by a single or multiple participant(s) for simplicity.
8.3 Results
Mean age of participants was 61 years (SD 9.8) and male: female ratio was 3:2. Mean time since diagnosis was 3.6 years. Half (n=18, 41%) of the participants had severe disease as classified by ALSFRS (ALSFRS 0-24). (previously shown in Table 5.1) Participants appeared grossly cognitively intact based on simple observation during the interviews. Personal factors identified that were relevant in persons with MND to the experience of their condition are listed in Table 8.1. Some factors crossed over two categories. For example, “self-esteem” encompassed both a belief (that the patient was worthy) and an emotion (of pride) and is therefore listed under both categories. A significant proportion of the participants were depressed (n=19, 43%), anxious (18, 41%) and/or stressed (11, 25%) and problem focused coping strategies were used much more commonly than emotion-focused coping strategies. (see Table 8.2)
Table 8.1 Personal factors reported by participants with motor neurone disease (MND) which affected their experience of living with MND

<table>
<thead>
<tr>
<th>Personal factors - category</th>
<th>Personal factors - examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic factors</td>
<td>gender, race, age, educational status, socioeconomic status</td>
</tr>
<tr>
<td>Emotional states</td>
<td>frustration, depression, stress, anxiety, fear, worry, degrading, grumpy, loss of confidence, anger, self-esteem, embarrassment, hope (both hopeful and hopeless), guilt, grief, loss, gratitude</td>
</tr>
<tr>
<td>Coping strategies and styles</td>
<td>Problem-solving, Search for information, Planning, Positivity, Acceptance, Humour, Religion, Using support, Denial, Avoidance</td>
</tr>
<tr>
<td>Personality</td>
<td>Stubborn, Easy-going</td>
</tr>
<tr>
<td>Beliefs</td>
<td>Religious beliefs, Self-esteem</td>
</tr>
<tr>
<td>Attitudes (of the patient)</td>
<td>Grateful attitude (towards family and health professionals), Fighting attitude, Attitude towards assisted suicide, Being organised</td>
</tr>
<tr>
<td>“Other”</td>
<td>Perceived support</td>
</tr>
</tbody>
</table>
Table 8.2 Results of Depression, Anxiety and Stress Scale (DASS) and Brief COPE

<table>
<thead>
<tr>
<th>DASS</th>
<th>[n, (%)]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DASS Depression</strong></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>25 (56.8)</td>
</tr>
<tr>
<td>Mild</td>
<td>9 (20.5)</td>
</tr>
<tr>
<td>Moderate</td>
<td>4 (9.1)</td>
</tr>
<tr>
<td>Severe</td>
<td>3 (6.8)</td>
</tr>
<tr>
<td>Extreme</td>
<td>3 (6.8)</td>
</tr>
<tr>
<td><strong>DASS Anxiety</strong></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>26 (59.1)</td>
</tr>
<tr>
<td>Mild</td>
<td>6 (13.6)</td>
</tr>
<tr>
<td>Moderate</td>
<td>4 (9.1)</td>
</tr>
<tr>
<td>Severe</td>
<td>4 (9.1)</td>
</tr>
<tr>
<td>Extreme</td>
<td>4 (9.1)</td>
</tr>
<tr>
<td><strong>DASS Stress</strong></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>33 (75.0)</td>
</tr>
<tr>
<td>Mild</td>
<td>6 (13.6)</td>
</tr>
<tr>
<td>Moderate</td>
<td>2 (4.5)</td>
</tr>
<tr>
<td>Severe</td>
<td>3 (6.8)</td>
</tr>
<tr>
<td>Extreme</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brief COPE variables</th>
<th>Mean (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem focused coping strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active coping (2-8)</td>
<td>6.3 (1.6)</td>
<td>2 – 8</td>
</tr>
<tr>
<td>Planning (2-8)</td>
<td>6.2 (1.7)</td>
<td>2 – 8</td>
</tr>
<tr>
<td>Positive reframing (2-8)</td>
<td>6.0 (1.8)</td>
<td>2 – 8</td>
</tr>
<tr>
<td>Acceptance (2-8)</td>
<td>7.4 (1.1)</td>
<td>2 – 8</td>
</tr>
<tr>
<td>Humour (2-8)</td>
<td>5.0 (2.4)</td>
<td>2 – 8</td>
</tr>
<tr>
<td>Religion (2-8)</td>
<td>4.0 (2.3)</td>
<td>2 – 8</td>
</tr>
<tr>
<td>Using emotional support (2-8)</td>
<td>6.3 (1.5)</td>
<td>3 – 8</td>
</tr>
<tr>
<td>Using instrumental support (2-8)</td>
<td>5.7 (1.7)</td>
<td>2 – 8</td>
</tr>
</tbody>
</table>

| Emotion-focused coping strategies | | |
| Self-distraction (2-8) | 5.7 (2.0) | 2 – 8 |
| Denial (2-8)           | 2.9 (1.4) | 2 – 8 |
| Venting (2-8)          | 3.6 (1.6) | 2 – 8 |
| Substance use (2-8)    | 2.7 (1.5) | 2 – 8 |
| Behavioural disengagement(2-8) | 2.8 (1.4) | 2 – 7 |
| Self-blame (2-8)       | 2.7 (1.0) | 2 – 6 |
8.4 Discussion
This is the first study that we know of, that has identified personal factors that shape a person with MND’s experience of their condition. These factors include demographic factors (gender, race, age, educational status, socioeconomic status), emotional states (depression, stress, anxiety, fear), coping strategies and styles (problem-based coping, denial), personality, beliefs (includes self-efficacy, religious beliefs, personal values), attitudes (of the patient) and “other” (perceived social support). Rates of depression and anxiety were high and a broad range of coping strategies were used although problem-focused coping strategies were preferred. The mean participant age, gender, time since diagnosis, distribution of type and severity of disease (based on ALSFRS-R) was similar to those reported by others [276]. The participants represented a broad range of disability and disease severity, with demographic and diagnostic characteristics typical of MND.

These findings (of depression, anxiety and a range of coping strategies) and the identified personal factors are consistent with other reports in MND literature. Rates of depression and anxiety are reported to be 0-44% and 0-30% respectively in persons with MND [217]. This is not surprising given the progressive and fatal nature of their disease. However, it is also generally thought that despite disease progression, most MND patients adjust effectively to their illness and in fact are often perceived to be particularly positive people [224]. The impact of personal factors on the lived experience and quality of life of MND should not be underestimated. It has been previously reported that quality of life appears to be more dependent on “psychological and existential issues, social support and spirituality” rather than physical factors [220]. These findings were supported by Chio et al [315] who found that the main determinants of quality of life in MND were social support, depression, religiosity, and socioeconomic status. More recently, Roach et al concurred that it was likely that characteristics such as personality, social relationships and spirituality could be more important for quality of life [316] than progression of the disease per se. The importance of coping strategies in the experience of MND is further supported by Gallagher et al. [317] who surmised that MND is not a static disease but a progressive disorder that required different coping strategies at different stages of the disease. Matuz et al. [224] also found that the best predictors for the severity of depressive symptoms in MND were perceived social support (especially a supportive marital relationship) and coping potential (information seeking and strategies of emotional avoidance behaviour). For example, a combination of confronting and avoiding coping strategies might be useful for MND patients because search of information and support may help them to initiate actions that ensure optimal future care [224]. On the other hand, emotional avoidance behaviour (eg. choosing isolation or denial) could protect them from psychological distress and despair [318]. However, as the disease progresses, avoidance is no longer an adaptive strategy as it prevents patients from taking appropriate measure to cope further with the illness [224].
Personality appears to be another personal factor that plays a significant role in the experience of MND. It has been found that MND patients (n=31) who scored higher on the agreeableness personality dimension had higher quality of life initially but the reduction of quality of life over 12 months was significantly steeper than in patients who scored lower on agreeableness, suggesting that being less agreeable might serve as a protective factor with respect to quality of life [319]. Nelson et al. [320] reported that personality traits such as optimism, flexibility, and humour were important in coping. As for beliefs, it has been reported that the belief that fate controls one’s health and a person’s belief in “powerful others” such as doctors changes with disease progression in MND [321]. Interestingly, no cultural beliefs were mentioned in this cohort, possibly because of the homogeneity in race (100% Caucasian) in this cohort but religious beliefs were frequently mentioned, consistent with the high proportion (64%) of Christianity practiced in Australia [322] and with previous reports that religion is one of the most important coping mechanisms in a fatal disease such as MND [295]. Finally, other studies have reported that the most important personal values in MND patients were benevolence, self-direction and universalism [323]. These values were not specifically explored in this cohort.

Under the U.K. Department of Health’s National Service Framework for Long-term Neurological Conditions [15], MND is a “progressive condition” with a rapid deteriorating course. Multiple sclerosis is another long-term progressive neurological condition but with a more “intermittent”, slowly “progressive” or “stable” nature. Comparison of relevant personal factors in MND with other “long-term neurological conditions” is challenging as it differs from other conditions in that there is constant deterioration and therefore ongoing “change and adaptation” [324]. It is also unique in that given the limited life span, changes in personal factors can be studied through the entire spectrum of the disease, as described above. There are few other reports relating to personal factors in other long-term neurological conditions. In identifying the ICF core set for multiple sclerosis, Khan et al [127] suggested ten categories which included socioeconomic status, coping ability, attitudes and patient beliefs, self-efficacy, dependence on others, mood and affect, heat intolerance, fatigue, personality and temperament and patient attitude towards the biopsychosocial impact of multiple sclerosis. Many of these are comparable with this MND cohort. Other reports have shown that in both MND and multiple sclerosis, psychological adaptation to deteriorating function is an important factor in perceived quality of life and emotional well being [325]. The impact of personal factors on participation in the rehabilitative process in other neurological conditions has also been emphasised -- a recent study showed that rehabilitation professionals attempting to engage people with multiple sclerosis in a physical activity programme needed to consider adopting an individualised approach to barrier management which takes into account personal beliefs and perceptions regarding physical activity engagement [326]. Hence, despite some of the unique features of MND, many of the findings in this study are likely to be relevant to other neurological conditions.
MND takes its toll on the patient and family especially as the disease progresses and loss of independence occurs. Understanding the personal factors involved helps with the palliative rehabilitation process. As part of this process, advice with regards to adequate coping strategies and provision of an adequate amount of disease- and support-related information at any one time and encouraging patients to seek social support [224] is crucial. Hence, referrals to support groups and counselling and education of patients and their families (often their caregivers) are important. Subgroups of patients who are more likely to adapt poorly to a new diagnosis of MND can also be identified early with explorative interviews that specifically target coping, depression, anxiety, social withdrawal and quality of life [327]. Targeted earlier intervention can be provided for this subgroup. Frank discussions facilitate understanding of the disease and improve coping skills. Referrals to the local MND associations are also recommended as these provide patients and families with ongoing support, resources and equipment needs. Psychotherapy should also be considered to assist with coping strategies [224] and antidepressants may be used. Anxiety is difficult to measure due to physical confounding symptoms such as shortness of breath, muscle cramps and restlessness. Anxiety can be treated with psychotherapy and training in relaxation and breathing techniques, as well as participation in support groups. With good support, mental health and quality of life can remain stable despite deteriorating physical health [225]. In addition, an often-neglected part of rehabilitation in MND is support for continuation of work [27]. Understanding personal factors can help target the subgroup of MND patients who wish to continue work – it has been found that intrinsic reasons (motivation resulting from a person’s interest in and enjoyment of the work), followed by age, disability severity and accessibility of travel [328] are the strongest predictors for this group.

The limitations in this study include: cross-sectional survey (no longitudinal information); highly selective cohort (all already receiving tertiary multidisciplinary care; willing research participants). Interviews were challenging given the fragile emotional and physical status of the participants. Self-reported information was used and validated as best with caregiver and medical records. The cohort covers a wide geographical population in Victoria and is representative of the wider sample of persons with MND.

MND is a devastating illness for patients and families. Palliative care and rehabilitation has much to offer this population. For improved consensus of care and communication amongst treating clinicians, the framework of ICF should be explored in this population and further expanded to take into consideration individual personal factors which impact significantly upon the experience of illness and the rehabilitation process. This preliminary study identifies intrinsic factors reported by patients with MND and may be the first step in the development of personal factors within the ICF classification.
The next chapter (Study 6) reports on a pre-post study of the 7 MND participants who underwent a peer-support intervention to determine the effectiveness of such an intervention on neuropsychological sequelae and the role of peer-support intervention in the rehabilitative care of MND.
Chapter 9 - Neuropsychological sequelae in Motor Neurone Disease: outcomes of a peer support program

This chapter presents Study 6, a pre-post study of the 7 MND participants who underwent a peer-support intervention to determine the effectiveness of such an intervention on neuropsychological sequelae. The difficulties and limitations of conducting studies in peer support in an MND cohort have previously been discussed in Chapter 3. The implications of findings are discussed, as is the role of peer-support intervention in the rehabilitative care of MND.

9.1 Introduction

The burden of disease of MND upon patients and their caregivers (often family members) is substantial. Being diagnosed with a chronic illness, especially one that is fatal and incurable with a rapidly progressive and disabling course is a profound and life-altering event that can result in loss of control over life circumstances and subsequent emotional strain [329]. Rates of depression and anxiety are reported to be 0-44% and 0-30% respectively in persons with MND [217]. This in turn affects quality of life, which is more dependent on psychological and existential factors than on physical factors [315]. Management, best delivered through a coordinated multidisciplinary “neuropalliative rehabilitation” approach [124], focuses on symptomatic therapy to achieve the best quality of life for persons with MND and their families. Provision of additional social support, however, is thought to augment this process.

The self-perceived quality of social supports is a major contributor to quality of life in persons with MND [315]. Forms of social support can be broadly divided into psychotherapeutic programs (therapy by trained therapist), educational programs (expert knowledge by health professional), and peer support programs [330]. Peer support programs may include aspects of psychotherapeutic programs (discussing emotions) and educational programs (sharing of information about the disease), but they differ in that no therapy is conducted and the focus is not on providing education. The core attributes of peer support are emotional, informational and appraisal support [331]. Peer support programs commonly involve informal but regular meetings with a diagnostically homogenous group of patients. There are diverse models of peer support (one-on-one, face-to-face, one-on-on telephone, group face-to-face, group telephone, and group Internet). These programs are not facilitated by health care professionals as the value is felt to lie within the opportunity to share experiences with others in a similar situation without the professional guidance or presence of a health professional [332]. Hence, facilitators (when present) are generally non-professional peers. As peer support groups are believed to be
effective, and do not tend to cost much to run, they are an increasingly popular method of providing support.

Peer support has been proposed as an effective means for coping with stressful life experiences and for gaining information and support from others who share a common factor, such as a chronic illness [333]. Mutual identification, shared experiences and sense of belonging that develops through peer support are thought to impact on psychological outcomes positively [331]. The principal focus of peer support programs is on reducing symptoms (eg. pain and psychological distress) and on modifying “personal factors” such as self-efficacy and coping style. These changes are hypothesised to lead directly to changes in health status, which in turn influences health care utilisation [334].

Despite the popularity of peer support programs in chronic disease, there is limited published data on their effectiveness. Available data demonstrate mixed efficacy and often, weak study designs. For example, peer mentoring for people with spinal cord injury in a pre-post study (n=37) appeared to enhance self-efficacy beliefs and prevent medical complications [335]. In contrast, an eight-week peer support program in multiple sclerosis (n=44) did not appear to provide consistent improvement in quality of life or depression and it was further suggested that patients who had better mental health functioning could be at risk for deterioration in support groups [336]. A systematic review (43 papers, 5 models of peer support) of peer support programs for people with cancer concluded that whilst level of satisfaction was high, evidence of psychosocial benefit was mixed [330].

There are currently no intervention studies addressing the impact of peer support groups in MND. Results from other studies that assess the effectiveness of peer support cannot be generalised to the MND population as the clinical presentation and prognosis are vastly different to other chronic diseases. This preliminary study evaluates the effectiveness of a six-week group face-to-face peer support program in persons with MND in an Australian community cohort using a pre-post design. The aim of this study is to evaluate the impact of such a program on improving psychological coping (reducing anxiety, depression, stress), quality of life and caregiver burden.
9.2 Methods

9.2.1 Participants and setting
As previously described in sections 3.3-3.5, seven persons with MND and their five caregivers (2 had no caregivers) consented to participation in a peer support intervention.

9.2.2 Assessment
Assessments were completed at baseline, and at 6-weeks (T1) and 12-months (T2) post-program using a structured format (see section 3.5 for details):

a) sociodemographic and medical status questionnaire
b) Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS) to determine severity of MND
c) Depression, Anxiety, Stress Scale (DASS) [235] (primary outcome)
d) McGill Quality of Life questionnaire (MQOL) [236]
e) Brief COPE (Carver 1997)
f) Satisfaction with program. Participants were asked a single question at T1 and T2 on “how satisfied were you with the program” (“0” indicating not satisfied at all to “10” indicating very satisfied).

f) Caregivers completed the SRB [238] separately.

9.2.3 Intervention
This has been described in section 3.5.2. All participants were in a single group that received a 6-week group face-to-face community-based peer support program called “LifeMoves” (Jan-Feb 2010).

9.2.4 Statistical analysis
All analyses were performed using SPSS version 14.0 (SPSS Inc, Chicago, IL). Descriptive analyses were presented for participant demographics, patient satisfaction with the program, and ALSFRS by mean and standard deviation (SD) for continuous non-skewed data and as frequency (%) for categorical data. The other outcomes, DASS, MQOL, Brief COPE and SRB were reported by median and interquartile range (IQR).
9.3 Results

Of the 59 eligible participants, 7 participants consented and attended a minimum of four sessions, travelling a mean distance of 36.4km (range 8-106km) each way to attend the program. The remaining 52 declined to participate for a variety of reasons (eg. practical access, severity of disease, communication difficulties). Of the 7 participants, 1 was deceased at T1 and 2 more were deceased at T2 (and of the 4 remaining participants, only 2 had caregivers). The mean age of the patients was 62 years (SD 12) and male: female ratio was 5:2. The mean time since diagnosis was 3.6 years (range 1-6). More than half (n=4, 57%) of the participants had severe disease (ALSFRS 0-24). (see Table 9.1) No adverse effects of the peer support program were reported by the participants or facilitators.

Results are summarised in Table 9.2. There was a trend towards improvement in psychological coping (DASS 21) especially in the domains of anxiety and stress at T1. However, by 12 months, psychological coping had worsened again. Quality of life (MQOL) and coping strategies (brief COPE) remained unchanged at T1 and T2. Although caregiver burden (SRB) also remained unchanged at face value at T1 and T2, only one out of two eligible caregivers completed the questionnaire at T2 as the remaining 3 (5 original caregivers) were caregivers of participants who were deceased by 12 months. The single caregiver who did respond to the 12 month questionnaire had a care recipient who already required a very high level of care at the baseline assessment, and had remained functionally stable throughout the 12 months. The other caregiver who was eligible but did not complete the caregiver burden scale dropped out due to stress (she was already highly stressed at baseline and coping very badly).
Table 9.1 Characteristics of motor neurone disease (MND) participants and their caregivers - demographics and disease features

<table>
<thead>
<tr>
<th>Variable</th>
<th>MND Participant (n=7)</th>
<th>Caregiver (n=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years) mean ± SD (range)</strong></td>
<td>62 ± 12 (45 – 79)</td>
<td>66 ± 20 (35 – 86)</td>
</tr>
<tr>
<td><strong>Sex n(%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>5 (71.4)</td>
<td>2 (40%)</td>
</tr>
<tr>
<td>Female</td>
<td>2 (28.6)</td>
<td>3 (60%)</td>
</tr>
<tr>
<td><strong>Marital status n(%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/Partner</td>
<td>5 (71.4)</td>
<td></td>
</tr>
<tr>
<td>Divorced/Separated/Single</td>
<td>2 (28.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Living n(%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family</td>
<td>5 (71.4)</td>
<td></td>
</tr>
<tr>
<td>Alone</td>
<td>2 (28.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Geographical area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metropolitan n(%)</td>
<td>6 (85.7)</td>
<td></td>
</tr>
<tr>
<td>Rural n(%)</td>
<td>1 (14.3)</td>
<td></td>
</tr>
<tr>
<td><strong>Diagnosis of MND/Amyotrophic Lateral Sclerosis (ALS) (El Escorial criteria) n(%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinically Definite ALS</td>
<td>6 (85.7)</td>
<td></td>
</tr>
<tr>
<td>Clinically possible ALS</td>
<td>1 (24.3)</td>
<td></td>
</tr>
<tr>
<td><strong>Amyotrophic Lateral Sclerosis Functional Rating Scale – Revised n(%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-12</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>13-24</td>
<td>4 (57.1)</td>
<td></td>
</tr>
<tr>
<td>25-36</td>
<td>1 (14.3)</td>
<td></td>
</tr>
<tr>
<td>37-48</td>
<td>2 (28.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Medications n(%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riluzole</td>
<td>4 (57.1)</td>
<td></td>
</tr>
<tr>
<td>Baclofen</td>
<td>3 (42.9)</td>
<td></td>
</tr>
<tr>
<td>Analgesia</td>
<td>3 (42.9)</td>
<td></td>
</tr>
<tr>
<td>Antidepressants</td>
<td>1 (14.3)</td>
<td></td>
</tr>
<tr>
<td><strong>Co-morbidities n(%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2 (28.6)</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>5 (71.4)</td>
<td></td>
</tr>
<tr>
<td>≥ 2 comorbidities</td>
<td>2 (28.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Clinical symptoms n (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td>6 (85.7)</td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>6 (85.7)</td>
<td></td>
</tr>
<tr>
<td>Spasticity/cramps/spasms</td>
<td>4 (57.1)</td>
<td></td>
</tr>
<tr>
<td>Emotional liability</td>
<td>5 (71.4)</td>
<td></td>
</tr>
</tbody>
</table>
Table 9.2 Results of peer support (Lifemoves) intervention in motor neurone disease - pre and post treatment values at 6 weeks and 12 months

<table>
<thead>
<tr>
<th>Measurement Scales</th>
<th>Baseline (pre-treatment)</th>
<th>T₁ (6 weeks post)</th>
<th>T₂ (12 months post)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Depression Anxiety Stress Score - 21 Median (IQR)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (0-126)</td>
<td>26 (19-31)</td>
<td>21 (12-27)</td>
<td>32 (25.5-35)</td>
</tr>
<tr>
<td>Depression (0-42)</td>
<td>4 (4-13)</td>
<td>7 (4.5-10)</td>
<td>9 (6.5-11)</td>
</tr>
<tr>
<td>Anxiety (0-42)</td>
<td>6 (4-8)</td>
<td>2 (2-4)</td>
<td>3 (2-5)</td>
</tr>
<tr>
<td>Stress (0-42)</td>
<td>14 (9-18)</td>
<td>13 (3-17)</td>
<td>17 (12-21)</td>
</tr>
<tr>
<td><strong>McGill Quality of Life Median (IQR)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (0-130)</td>
<td>93 (88.5-105)</td>
<td>85 (80-89.3)</td>
<td>92.5 (82.8-99)</td>
</tr>
<tr>
<td>Single item scale (SIS) (0-10)</td>
<td>5 (4-6)</td>
<td>6 (5.3-6.8)</td>
<td>5 (4.8-5.5)</td>
</tr>
<tr>
<td>Physical symptoms (0-30)</td>
<td>19 (11-21.5)</td>
<td>7 (5.5-10)</td>
<td>12.5 (9.8-13.3)</td>
</tr>
<tr>
<td>Physical well being (0-10)</td>
<td>5 (4.5-7.5)</td>
<td>6.5 (4.5-7.8)</td>
<td>6.5 (5.8-7.5)</td>
</tr>
<tr>
<td>Psychological symptoms (0-40)</td>
<td>31 (23.5-32.5)</td>
<td>20.5 (19.3-24.8)</td>
<td>27.5 (19.8-32)</td>
</tr>
<tr>
<td>Existential wellbeing (0-60)</td>
<td>37 (25.5-41)</td>
<td>42 (33-48.8)</td>
<td>39 (37.8-39.8)</td>
</tr>
<tr>
<td>Support (0-20)</td>
<td>15 (12-17)</td>
<td>16 (14.3-18.5)</td>
<td>16 (14.8-17.3)</td>
</tr>
<tr>
<td><strong>Brief COPE Median (IQR)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (28-112)</td>
<td>69 (62-79)</td>
<td>71 (67-73)</td>
<td>71.5 (70.8-72.5)</td>
</tr>
<tr>
<td><strong>Problem focused coping strategies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active coping (2-8)</td>
<td>6 (5-7)</td>
<td>7.5 (6-8)</td>
<td>5.5 (5-6.3)</td>
</tr>
<tr>
<td>Planning (2-8)</td>
<td>6 (5-8)</td>
<td>6.5 (5-8)</td>
<td>5.5 (3.5-7.3)</td>
</tr>
<tr>
<td>Positive reframing (2-8)</td>
<td>7 (6-8)</td>
<td>6.5 (5-7)</td>
<td>5.5 (5-6.5)</td>
</tr>
<tr>
<td>Acceptance (2-8)</td>
<td>8 (7-8)</td>
<td>7 (5-7)</td>
<td>7 (5.8-8)</td>
</tr>
<tr>
<td>Humour (2-8)</td>
<td>6 (3-8)</td>
<td>5.5 (4-6)</td>
<td>6 (4.3-7.3)</td>
</tr>
<tr>
<td>Religion (2-8)</td>
<td>2 (2-6)</td>
<td>4 (4-6.3)</td>
<td>3.5 (3.4-8)</td>
</tr>
<tr>
<td>Using emotional support (2-8)</td>
<td>7 (5-8)</td>
<td>6.5 (6-7.8)</td>
<td>7 (6.8-7.3)</td>
</tr>
<tr>
<td>Using instrumental support (2-8)</td>
<td>5 (4.5-7)</td>
<td>6.5 (6-7)</td>
<td>7 (6.3-7.3)</td>
</tr>
<tr>
<td><strong>Emotion-focused coping strategies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-distraction (2-8)</td>
<td>8 (6-8)</td>
<td>6 (6-6)</td>
<td>6.5 (5.8-7.3)</td>
</tr>
<tr>
<td>Denial (2-8)</td>
<td>2 (2-2)</td>
<td>2 (2.2-8)</td>
<td>4 (2.8-5.3)</td>
</tr>
<tr>
<td>Venting (2-8)</td>
<td>4 (4-5)</td>
<td>4 (4-4)</td>
<td>4 (4-4.5)</td>
</tr>
<tr>
<td>Substance use (2-8)</td>
<td>2 (2-2)</td>
<td>2 (2-2)</td>
<td>3 (2-4)</td>
</tr>
<tr>
<td>Behavioural disengagement(2-8)</td>
<td>2 (2-5)</td>
<td>2 (2.3-5)</td>
<td>2 (2-3.5)</td>
</tr>
<tr>
<td>Self-blame (2-8)</td>
<td>3 (3-4)</td>
<td>3.5 (3-4)</td>
<td>3 (2.8-3.5)</td>
</tr>
<tr>
<td><strong>Satisfaction with the program</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How satisfied (1-10)</td>
<td></td>
<td>9 ± 1.3 (7-10)</td>
<td>7.5 ± 0.6 (7-8)</td>
</tr>
<tr>
<td><strong>Self-rated burden (Caregivers)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How burdensome (0-100)</td>
<td></td>
<td>50 (30-75)</td>
<td>47.5 (21.3-70)</td>
</tr>
</tbody>
</table>

Satisfaction with the program Mean ± SD (range)  
How satisfied (1-10)  
9 ± 1.3 (7-10)  
7.5 ± 0.6 (7-8)  
Self-rated burden (Caregivers) Median (IQR)  
How burdensome (0-100)  
(n = 5)  
50 (30-75)  
(n = 4)  
47.5 (21.3-70)  
(n = 1)  
50 (50)
9.4 Discussion

This is the first interventional study that we know of, on peer support in persons with MND. Although it was not possible to make conclusive findings given the small sample size, it appears to support the hypothesis that peer support programs in MND improve psychological coping (particularly anxiety and stress) in the short term but not in the long term, as the effects wear off over time. Quality of life, coping strategies and caregiver burden on the other hand, do not appear to be affected by peer support programs. The mean participant age, gender, time since diagnosis, distribution of type and severity of disease (based on ALSFRS-R) was similar to those reported by others [276]. The participants represented a broad range of disability and disease severity, with demographic and diagnostic characteristics typical of MND.

The findings are consistent with other MND literature that suggests peer support can have beneficial effects on participants who value camaraderie and comparison [318]. An important advantage is getting advice on practical aspects on managing MND (disability management, home adaptations). Many also enjoy the sense of camaraderie from just being with other people who understand. Seeing others coping well with the condition can provide hope, while downward comparison with those worse off can also make people feel better about their own situation. However, most people are also shocked and saddened by seeing others with the condition [318]. Levels of involvement may change over time as people struggle with their changing needs and fears [318]. The effects of a peer support program also appear not to last in the longer-term. Hence, it might be important for peer support to be offered at regular intervals, although this needs to be explored. Also consistent, were the findings that quality of life (MQOL-SIS) is relatively good and remains stable in MND [282]. In contrast to other literature [282], depression appeared to worsen with time. This may have been related to the findings that this particular cohort had higher levels of fatigue, pain and emotional lability than is usually described.

Similar to findings in other peer support studies (not MND), satisfaction with the programs was high but psychosocial benefits were unclear [330]. This may, at least in part, be related to the choice of outcome measures. This is a significant issue in MND clinical trials [124]. Most outcome measures are generic and may not be sensitive to changes specific to a rapidly progressive condition such as MND. Quality of life in particular is a broad concept, and not easily incorporated in a single outcome measurement. Within the generic measurement tools, some measure health-related status (for example, SF-36) whilst others are more specific for measurement of quality of life [eg. McGill Quality of Life Questionnaire, direct-weight version of the Schedule of the Evaluation of Individual Quality of Life (SEIQoLDW)] [107]. The SEIQoLDW [108] is time intensive and does not necessarily reflect aggregate quality of life in persons with MND [110]. Measures specific for MND are heavily weighted towards physical function (e.g. ALSAQ-40 [111]) and do not include an existential element relevant for persons with MND [107]. Recently, a modified version of the McGill questionnaire was validated
as an MND-specific quality of life questionnaire (the ALSSQOL) [112], and a shortened version is currently undergoing validation.

There were two non-verbal participants with bulbar-onset MND. However, they were both still able to participate actively in the group, albeit with some assistance from the facilitators (hence the relatively big number of facilitators) who read out from their notepads or assisted with the use of communication devices. It is common for both health professionals and patients to exclude those with severe communication difficulties from participation in interactive groups where others do not have similar communication difficulties. However, this population is often already very isolated and this study highlights the importance of providing assistance to enable such patients to receive the benefits of peer support.

This study also highlights the difficulties involved in conducting trials in MND both in terms of recruitment and attrition. The logistical and ethical considerations are significant. MND is fatal and rapidly progressive. It is also rare. People with MND often prefer to participate in disease-modifying pharmaceutical trials that might slow disease progression to other trials. Even if a greater number of participants had been recruited, having a “control” and not offering the intervention to strengthen the study design would have been difficult to justify ethically. Accessibility of face-to-face peer support is a major issue due to fatigue, respiratory and mobility difficulties. This was further compounded by the geographically spread-out nature of the population in Victoria, resulting in participants having to travel a greater distance. Attrition is particularly common, especially in trials requiring longer follow up, as illustrated by the deaths of almost 50% of participants by 12 months in this study.

Of the eligible participants only 12% (7 out of 59) were interested in attending a peer support intervention. Patients who decide not to attend support groups have been less studied. A recent study of people who left a cancer support group (n=87) and those who never attended (n=26) reported the most common reasons were practical (eg. timing or location of meetings) but others included “not needing support”, finding groups “boring and depressing” and “feeling unable to talk about one’s own distress” [337]. In this MND cohort, the poor uptake was due to a combination of difficulties with practical access and also with coping strategies. Whilst some cope well with their disease, many choose isolation as a deliberate defensive strategy to protect them from witnessing their possible future [318]. Hence, peer support is not appropriate for all persons with MND. In selected persons however, it can be very helpful. In such cases, different models to mobilise peer support should be considered to complement or extend or even replace, in some circumstances, the face-to-face programs. There is some evidence that online peer support programs are effective in individuals with depression [338]. Further, it has been suggested that using a face-to-face combined with an online model provides enhanced peer support [339]. There are current online forums in the U.K. and U.S.A
(BUILD, PatientsLikeMe, alsforums.com). Other models include telephone support and peer mentors (one-on-one meetings with those who are successfully coping with the same condition).

Other limitations in this study include: highly selective cohort (all recruited from a single tertiary multidisciplinary MND centre; willing research participants) and use of self-reported information. Interviews were challenging given the fragile emotional and physical status of the participants. Information was validated as best with caregiver and medical records.

9.5 Conclusion
MND is a devastating illness for patients and families. Peer support intervention appears to have some short-term benefits for psychological coping but more studies with larger sample sizes are needed to confirm and expand upon the findings of this study to enable optimal care for persons with MND.

The next (final) chapter of the thesis summarises the findings of the studies and discusses the implications of these findings on clinical practice and future research.
Chapter 10 Discussion and Conclusions

This final chapter discusses the research findings of the linked Studies 1-6 (Chapters 4-9), limitations of methodology, and outlines the implications for clinical practice and for future research.

10.1 Overview of thesis
A combination of qualitative and quantitative methods was used in the 6 studies to address a number of areas in MND. The overall aim was to determine if issues relevant to multidisciplinary rehabilitation care from the perspective of the patient and caregiver could be identified and addressed utilising the ICF framework; and in doing so, identify gaps in evidence and service provision to enable recommendations that would optimise clinical care in both clinical and research settings.

10.2 Key issues addressed and summary of findings
Through the series of studies, a number of key related issues were addressed. The issues can be broadly divided into a) those that address integration of evidence into practice, b) those that give patients and caregivers a “voice” by highlighting their perspective and c) those that relate to clinical judgment and agreement. Section 10.2 summarises the findings of each study and outlines how each study addresses the previously identified key issues.

10.2.1 Integration of evidence into practice
Key issue 1: Despite the recommendation for multidisciplinary rehabilitation and palliative care, the evidence base for rehabilitation in MND is unclear. This includes whether organised multidisciplinary care does indeed achieve better outcomes than the absence of such services in persons with MND; which types of programmes are effective and in which setting; whether a greater intensity (time or expertise or both) of rehabilitation leads to greater gains; which specific outcomes are influenced (survival, dependency, social integration, mood, quality of life); and whether there is demonstrable cost benefit for multidisciplinary care in MND.

Study 1 (Chapter 4) determined the current evidence-base for multidisciplinary rehabilitation and care for MND. No randomised controlled trials or controlled clinical trials were identified. In the absence of randomised controlled trials or controlled clinical trials, the “best” evidence to date is based on three “low” and two “very low quality” observational studies. These suggest “very low quality evidence” for an advantage for mental health domains (only) of quality of life without increasing healthcare costs, and “low level quality” evidence for reduced hospitalisation for multidisciplinary care in low-intensity outpatient settings; and “very low quality” evidence for
improved disability in high-intensity settings. The evidence for survival is conflicting. These conclusions are tentative and the gap in current research should not be interpreted as proof that multidisciplinary care is ineffective.

**Key issue 2:**
The effectiveness of specific interventions that complement rehabilitation, such as peer support programs, is unclear. Peer support has been proposed as an effective means of coping with a stressful life experience.

Study 6 (Chapter 9) aimed to determine the effectiveness of a peer-support intervention in MND on the management of neuropsychological sequelae to enable recommendations relating to the role of such interventions in the care of MND. It showed high participant satisfaction and a trend towards improved psychological coping (especially anxiety and stress) six-weeks post program. However, depression, anxiety, stress had worsened again at 12 months whilst quality of life, coping strategies and caregiver burden remained unchanged. Although participant numbers were too small to be conclusive, it did show that group face-to-face peer support was a feasible form of support in MND and should be considered even in patients who are severely disabled and/or have severe verbal communication (dysarthria).

**10.2.2 Highlighting the perspective of patients and their caregivers**

**Key issue 3:**
MND is a rare condition; hence many health practitioners are not experienced in its care. This is compounded by the patchiness of guidelines for the care of MND, which often focus in certain areas only such a respiratory management instead of comprehensive multidisciplinary rehabilitation and palliative care. Clinicians also tend to have a “top down” approach with the assumption that health care providers are in the position of the expert and therefore capable of making accurate judgments about the needs of their patients [340]. This is not always the case [341]. To ensure comprehensive person-centred care, the experience of disability from the perspective of the MND patients and their caregivers needs to be elucidated.

Study 2 (Chapter 5) described the disability profile and health-care needs for persons with MND in an Australian sample from the perspective of the patients and caregivers. Despite the high level of disability, 25% of the cohort solely relied on their families for all assistance. Patients tended to report more pain, emotional disturbance and spasticity/cramps/spasms whilst caregivers focused more on psychosocial issues. Forty-three percent of patients reported gaps in service in rehabilitation therapy and respite despite already receiving multidisciplinary MND care and proportionally even more caregivers (51%) reported gaps, particularly in the area of psychosocial support.
Key issue 4:
There is limited understanding of the impact of MND on caregivers.

Study 4 (Chapter 7) described the impact of MND on caregiver burden through a series of standardised questionnaires. Impact of MND on caregivers (caregiver psychological coping and burden) was significant. However, caregiver self-reported quality of life remained good, which was possibly related to their use of problem-focused coping strategies. This study highlighted the need to specifically identify and target the needs of caregivers to optimise outcomes for both MND caregivers and patients.

10.2.3 Clinical judgment and agreement
Key issue 5:
There is no common language for the management of disability in MND within the multidisciplinary setting or international setting, nor consensus of what issues should be addressed in multidisciplinary care programs for patients with MND that incorporates the patients’, caregivers’ and treating clinicians’ perspective.

Study 3 (Chapter 6) used the ICF World Health Organisation framework to describe patient-reported disability in MND and to identify relevant environmental factors that impacted upon their experience of MND and compared this to other conditions (GBS and MS) to determine a set of ICF categories that may be common to long-term neurological conditions. Seventy ICF categories in MND were identified (GBS 41, MS 63): body function 15 (GBS 7; MS 18); body structure 5 (GBS 3, MS 5); activities and participation 40 (GBS 25, MS 30); environmental factors 10 (GBS 6, MS 10). The main areas linked in activities and participation were mobility, self care, general tasks and demands, domestic life, interpersonal interactions and relationships, major life areas and community, social and civic life; environmental factors included products and technology, natural environment, support and relationships, services, systems and policies. This study demonstrated that the ICF was adequately comprehensive to compare three long-term neurological conditions, which could assist not only with development of a “core set” of categories in MND but also, potentially with a “core set” in “long-term neurological conditions” as a group. This would enable optimisation of consensus of care and communication amongst treating clinicians in these conditions.

Study 4 (Chapter 7) used the ICF framework to compare disability in MND from the patient and the caregiver perspective. Motor Neurone Disease patients identified 70 ICF categories and caregivers 8: body function 15 (caregivers 0); body structure 5 (caregivers 0); activities and participation 40 (caregivers 6); environmental factors 10 (caregivers 2). Main activities and types of participation linked were general tasks and demands, mobility, self-care, community, social and civic life. Environmental factors included support and relationships, services, systems
and policies. This study demonstrated that ICF adequately incorporated perspectives of MND patients and caregivers, which, like the previous study (Study 3), could assist with development of a “core set” in MND.

Study 5 (Chapter 8) was a preliminary study that identified intrinsic factors reported by patients with MND, as a first step towards bridging the significant gap that currently exists within the ICF classification – the fact that personal factors are currently not classified. Personal factors identified included demographic factors (socioeconomic status), emotional states (depression, anxiety, fear), coping strategies (problem-based coping, denial), personality, beliefs (religious and personal values), attitudes (of the patient) and others (eg. perceived support). An understanding of personal factors by treating clinicians is essential in the provision of optimal care in MND. This study could assist in the development of personal factors within the ICF, which would assist, with improved consensus of care and communication amongst treating clinicians.

10.3 Limitations with methodology

The individual limitations of each study are discussed in the text of each chapter. Whilst some limitations were potentially preventable, they were practically difficult to avoid.

As was highlighted in Chapter 3, qualitative approaches and the priority-sequence model (which combines qualitative and quantitative approaches) was the primary chosen methodological model for this thesis. The limitations of these methods were comprehensively discussed in Chapter 3. As mentioned, one of the most significant limitations to qualitative methodology is that whilst qualitative models are ideal for exploration and identification of issues, they do not usually “answer questions”; hence the evidence base does not move past the hypothetical phase. For the purposes of this thesis however, it was nevertheless the most useful method for capturing issues relevant to multidisciplinary rehabilitation care from the perspective of the patient and caregiver, i.e. understand their lived experience, and to identify gaps in evidence and service provision.

Another limitation that was discussed in Chapter 3 is that ICF qualifiers were not reported. As previously mentioned, qualifier are numeric codes 0-4 (0 no problem, 1 mild problem, 2 moderate problem, 3 severe problem, 4 complete problem) that specify the extent of functioning or disability in that category or the extent to which an environmental factor is a facilitator or barrier. The use of qualifiers is time-intensive (which can make the already challenging interview in these fragile patients even more difficult) and for the purposes of identifying issues relevant to multidisciplinary rehabilitation care from the perspective of the patient and caregiver, qualifiers were a lesser priority. In general, issues identified were negative (eg. disability, environmental
barriers) aspects as this was more relevant within the rehabilitation setting. The lack of qualifiers however, does mean that the data collected will be less useful in the future development of an ICF-based scale of disability in MND patients.

Other limitations include the cross-sectional nature of the studies; hence no longitudinal information was available. The exception to this was Study 6 (Chapter 9) where a small cohort (n=7) of patients was followed up at 6 weeks post peer-support program and again at 12 months. As demonstrated even by this small cohort, longitudinal follow up is very difficult in MND – a high proportion die (as illustrated by the deaths of almost 50% of participants by 12 months in the peer-support study) or become too disabled to be interviewed again. It was evident even at baseline interviews that many participants were fragile and would likely die within the year. Attrition is therefore particularly common, especially in trials requiring longer follow up. Whilst longitudinal data would have been helpful to examine changes in issues with disease progression, information obtained would have been limited by the likely significantly reduced number of participants at the later time point. The cross-sectional selected cohort, however, included patients well spread across the spectrum of disease, which would have captured, to a degree, issues related to the different stages of disease progression. A related issue is that of caregiver participant attrition. With only the responses from a single caregiver left at 12 months in the peer support intervention, it was not possible to draw any conclusions regarding caregiver burden. This was largely due to a combination of patient death (and therefore their caregivers dropping out) and caregiver stress.

The generalisability of findings and their wide extrapolation is potentially limited by the highly selected nature of the cohort. All were recruited from a single tertiary MND clinic and already receiving specialised multidisciplinary care. Although the cohort covered a wide geographical population (included participants who lived in rural and metropolitan areas), only a single state (Victoria) within one country (Australia) was represented. Also, the inclusion criteria were clinically based and did not include persons with significant cognitive deficits. Perceptions of these persons with MND and their caregivers were therefore not included. Further studies would be needed to establish the generalisability and validity of the results. A next step would be to show the draft lists to people with MND and their caregivers (such as in a focus group), and to other health professionals (for example, nurses, therapists, social workers, doctors) to determine if the lists had face validity and if they formed the basis of a useful common framework.

A significant limitation of the studies was the small participant numbers. It would have been useful to explore the perceptions of the 25% (15/59) who declined to participate in any interviews. However, this would not have been ethically possible. The limitations of such small
participant numbers was a particular issue for the peer-support program where the size of the cohort resulted in difficulties in making conclusive findings. Recruitment is a significant issue in MND research as the condition is fatal, rapidly progressive and also rare. It was common for the participants to be involved in multiple studies, which could have further biased results. Accessibility of face-to-face peer support was also a major issue in recruitment due to fatigue, respiratory and mobility difficulties. This was further compounded by the geographically spread-out nature of the population in Victoria, resulting in participants having to travel a greater distance. Even though the peer support programme was designed for neurologically disabled people, and wherever possible care was taken to ensure that such participants were able to take part (such as ensuring the venue is “disabled friendly” with wheelchair access, and having a number of facilitators so that communication in those with have speech difficulties can be facilitated), there were still a number of barriers preventing many participants from attending such programmes. For example, participants still needed to get to the venue and have caregivers who supported their attendance at such programmes. Many required caregivers to accompany them which meant caregivers had to be willing to sacrifice an afternoon when many were already time-poor given the high care needs of their care recipients. Travelling was also effortful – wheelchair-friendly taxis for example were often unreliable and travel itself resulted in significant fatigue. Finally, many potential participants reported that they simply did not feel they needed peer support. Another challenge in peer support as an intervention was the recruitment of peer facilitators – persons with MND have complex physical and emotional needs making them a challenging group to facilitate, hence suitable peer facilitators (who by definition are not health professional facilitators) can be challenging to find and groups cannot be delayed (by the time required to find such facilitators) as the participants are rapidly deteriorating.

The nature of the interviews themselves was a potential limitation. Interviews were challenging given the fragile emotional and physical status of the participants. All efforts were made to ensure comprehensiveness of reporting – rest breaks were provided as frequently as required by the patients, some interviews were divided into sections and completed on different days and the interviewers provided physical assistance (but not prompts) if required.

Another limitation was that it was not possible to tape the interviews given resource limitations, which could have affected consensus discussions and resolution of any disagreements. However, every interview was recorded verbatim, as accurately as possible. In general, it was rare to have disagreements and any disagreements were resolved at the time of the interviews between the patient and the caregiver. As for the linkage of ICF categories, again disagreements were rare and it was not necessary to have any disagreements resolved by a third health professional.
A further limitation is that only patient- (and caregiver-) reported problems were linked to the ICF categories. Whilst this is a positive in many ways as it acknowledges that patients have the right and often wish to be involved in their care and decision-making, it does also have its limitations. For example, a diagnosis of depression may reduce a patient's ability to self-identify as depressed and seek help. Also, patients may be unaware of the availability of effective rehabilitation interventions or lack the understanding of allied health roles resulting in them not always being to understand the aims of their therapy or having expectations of services which were not commonly or frequently provided by their therapists. Finally, there was no measurement of cognition used and it is therefore not possible to determine the effect of mild cognitive impairment on the participant responses.

Choice of outcome measures was difficult and potentially limited findings. This is a significant issue in MND clinical trials. Most outcome measures are generic and may not be sensitive to changes specific to a rapidly progressive condition such as MND. Quality of life in particular is a broad concept, and not easily incorporated in a single outcome measurement. Within the generic measurement tools, some measure health-related status (for example, SF-36) whilst others are more specific for measurement of quality of life (eg. McGill Quality of Life Questionnaire). The latter was chosen for the studies in this thesis, as it is not heavily weighted towards physical function, it includes an existential element relevant for persons with MND and it is not too time-intensive. Another issue with the currently available scales is that scales commonly used such as the ALSFRS does not cover domains such as cognition. It is heavily weighted towards the physical aspects of MND.

Finally, from a health services perspective, a significant limitation was the structure of the MND clinic, which limits generalisability of the results. Bethlehem Hospital is a stand-alone unit located in metropolitan Melbourne. Patients are generally seen on a three-monthly basis and “therapy” is predominantly of an assessment nature. The bulk of care services are delivered primarily in the local community setting through referrals from Bethlehem Hospital. There will therefore be significant variability in the type of services provided at a local level, making it more difficult to target specific recommendations.

10.4 General discussion

As discussed in Chapter 1, under the U.K. Department of Health’s National Service Framework (NSF) for Long-term Neurological Conditions (LTNC) [15], MND is a “progressive condition” with a rapid deteriorating course. The LTNC can be broadly categorised as follows [15]:

- Sudden-onset condition (for example acquired brain injury or spinal cord injury)
- Intermittent and unpredictable conditions (for example epilepsy or early multiple sclerosis with relapses and remissions)
• Progressive conditions (for example MND or later stages of multiple sclerosis)
• Stable neurological conditions, but with changing needs due to development or ageing
  (for example cerebral palsy or post-polio syndrome)

The NSF aims to bring about a structured and systematic approach to delivering treatment and care for people with LTNC and covers models for clinical care networks and service delivery. It does not address individual neurological conditions separately as there are so many elements of service provision common to different conditions, as illustrated in Chapter 6 (Study 3). There are however some significant differences in the needs of persons with MND when compared with other less rapidly progressive neurological conditions, such as the need for services to respond quickly. Because of its fatal nature, MND care also has a significant palliative/end-of-life component, which is not found in most other LTNC. Finally, MND causes high levels of disability, often much higher than found in other LTNC and has a high proportion of family caregivers which has implications on caregiver burden. The following sections (10.4.1-10.4.3) compare the findings of this thesis to those reported in current literature that relate to other LTNC, highlighting similarities and differences.

10.4.1 Integration of evidence into practice

Study 1 (Chapter 4) determined the current evidence-base for multidisciplinary rehabilitation and care for MND. Although the evidence-base for multidisciplinary rehabilitation in MND was limited by the lack of randomised controlled trials or controlled clinical trials and hence much weaker than systematic reviews in other LTNC such as multiple sclerosis [249], acquired brain injury [250] and stroke [251, 252], findings were not dissimilar to these other systematic reviews. In these reviews, strong evidence was found for intensive rehabilitation at the levels of activity (disability) and participation, and moderate or limited evidence was found for less intensive outpatient rehabilitation in multiple sclerosis, acquired brain injury and stroke; in MND, there was “low” to “very low” quality evidence activity (disability) and quality of life in both low- and high-intensity multidisciplinary rehabilitation settings. A significant difference was the focus on survival (conflicting evidence), which was not found in other LTNC. All reviews [249] [250, 342] however, highlighted the need for further studies to suggest the optimum number, duration and intensity of rehabilitation treatment and difficulties relating to outcome measurements which generally cross over the concepts of impairment, activity limitation and participation as described in the ICF framework.

As for effectiveness of peer support programs, evidence of psychosocial benefit remains unclear due to a combination of findings of mixed efficacy and often, weak study designs [330, 335, 336]. For reasons discussed in Chapters 3, 9 and in the previous section (10.3), the design of Study 6 was too weak to make conclusive findings. It is therefore difficult to comment on similarities and differences with other conditions other than participants in peer support
programs appear to report a high level of satisfaction and that peer support in MND is feasible despite the high levels of disability and potential severe communication (dysarthria) which might traditionally exclude participants from group-based face-to-face peer support programs.

10.4.2 Highlighting the perspective of patients and their caregivers
To improve health outcomes and reduce caregiver distress, it is imperative for the perspectives of patients and their caregivers to be incorporated and to involve them in decision-making about their own health care and wellbeing. The gap in health-care needs and provision was highlighted in Study 2 (Chapter 5) where despite receiving multidisciplinary care, patients and their caregivers reported a significant gap in service provision. There have been similar findings in other LTNC such as in multiple sclerosis [279, 283] and Guillain-Barré Syndrome [281]. Discrepancies in patient reports of symptoms and treatment suggest that doctors may underestimate these issues; hence its inclusion in routine enquiries might help to encourage reporting and thus the facilitation of appropriate treatment.

Caregiver burden was found to be high in Study 4 (Chapter 7), as was their levels of anxiety, depression and stress. This was not unexpected given the high level of care-recipient disability and gaps in service identified by the caregivers in Study 2 (Chapter 5) where more than 50% of caregivers reported needing formal paid care for personal assistance of their care recipients, additional carer support (housework/gardening/meals/skills training) and emotional counselling for themselves. The levels of caregiver strain and burden are much higher than reported in caregivers of multiple sclerosis [283], stroke [312] and acquired brain injury [343]. Similar to other studies relating to other LTNC, these findings suggest that caregiver stress should be screened for and specifically targeted. More research into identifying risk factors and effectiveness of various interventions for optimising mental and psychological well being in caregivers is required as is a better understanding of the role of coping strategies in well being and quality of life in caregivers.

10.4.3 Clinical judgment and agreement
Use of the ICF provides a common language and a standardised framework for describing health and functioning in LTNC. As discussed in Chapter 2, the ICF can be used to further facilitate and optimise clinical care through the development of “core sets”. These are ICF categories selected by experts (patients, caregivers, clinicians) that list issues in impairment, disability, participation environmental factors that need to be addressed in multidisciplinary care settings. This has been done in other neurological conditions such as stroke [126], multiple sclerosis [127], Guillain-Barré syndrome [128] and early post-acute neurological conditions [297]. The stroke and multiple sclerosis core sets are currently being validated internationally. The acquired brain injury core set has not yet been determined. However, the process for the development of this core set has commenced [344]. In MND, Study 3 (Chapter 6) is the first
study to identify a set of relevant ICF categories, which could contribute towards a core set for MND. Study 4 (Chapter 7) adds to this by including the caregiver perspective. Study 5 (Chapter 8) contributes a different dimension – that of “personal factors”. Once this domain has been developed by the World Health Organisation and incorporated into the current ICF framework, it would ensure that the ICF is much more comprehensive in addressing the biopsychosocial nature of health and functioning. In addition, by comparing three LTNC, Study 3 highlighted a number of common ICF categories across these LTNC (MND, MS, GBS), which could contribute towards a core set for LTNC.

10.5 Recommendations for optimal rehabilitation care

The findings of this thesis support the recommendations of the UK NSF LTNC framework. The eleven quality requirements (QR) are all relevant to care for patients with MND and their caregivers:

- Provision of information and co-ordinated person-centred care (QR1)
- Improvement of access to neurological services for diagnosis and treatment (QR2)
- Improvement of care of people experiencing a neurological or neurosurgical emergency (QR3)
- Improvement of access to rehabilitation so that disability can be targeted with the aim of achieving and maintaining the greatest possible level of independence and social inclusion (QR 4-6).
- Provision of flexible services and packages of care to help people lives as independently as possible according to their own choices (QR 7-8)
- Improvement of palliative care services for people in the later stages of their illness (QR9)
- Support families and caregivers (QR10)
- Provision of appropriate neurological; care in hospital and other health and social care settings (QR11)

In particular, coordinated and integrated care for persons with MND and their caregivers through provision of a seamless continuous care process, i.e. access and availability to specialist neurological, rehabilitation and palliative services all of whom maintain a high level of communication and coordination and education (to patients, families and health professionals) by publishing guidelines and information about the care of persons with MND are needed. The resources required for this is likely to be challenging. Significant investment as well as reorganisation of current health care models is required and close collaboration between neurology, rehabilitation, and palliative care services to plan, develop and link these services to meet the complex needs of persons with MND and their caregivers is needed. Involvement of persons with MND, their caregivers and consumer groups in this process of development and evaluation is vital.
A number of gaps and challenges to achieving these quality requirements have also been highlighted through the findings of this thesis.

- There is limited evidence at present to guide the provision of multidisciplinary care. It is not clear for example, which types of programmes are effective and in which setting; whether a greater intensity (time or expertise or both) of rehabilitation leads to greater gains; which specific outcomes are influenced (survival, dependency, social integration, mood, quality of life); and whether there are demonstrable cost benefits for multidisciplinary care in MND.

- The effectiveness of specific interventions that complement rehabilitation, such as peer support programs, also remains unclear.

- The understanding of the role of rehabilitation in MND by patients, caregivers and indeed by other health care professionals was limited. Lack of incorporation of active rehabilitation often stems from confusion and lack of understanding about the application of its principles [345]. A common misconception is the belief that the desired result of rehabilitation should be a measurable improvement or restoration of function [346]. The concept of rehabilitation is also more generally associated with disability resulting from chronic benign disease [347]. This belief, coupled with poor knowledge of rehabilitation and inadequate detection of rehabilitation problems [348] can lead to appropriate rehabilitative service not being available to those who are sometimes in greatest need of them [345].

- There is a lack of awareness of the needs of persons with MND and their caregivers from the part of health care professionals. In addition, there is lack of understanding on the part of persons with MND and their caregivers on the roles of health care professionals and the services that could be provided.

- Studies that assess the effectiveness of health service interventions need designs that consider challenges inherent in health service research. Research techniques need also to be developed to incorporate the challenges of research in the MND population.

These gaps are consistent with reports from MND Australia and more broadly from the National Health and Hospitals Reform Commission (NHHRC). As highlighted through the Motor Neurone Disease Palliative Care Pathway Project, there was no existing framework that could be implemented to integrate the palliative care of people with MND into the overall care received [8]. Palliative care workers did not feel confident in their level of knowledge regarding MND and people with MND had a distorted understanding of the service that palliative care offered [8]. Both palliative care workers and patients with MND reported that the rarity and the progression of the disease made coordinating care between numerous agencies difficult [8]. Inpatient palliative care services reported patients with MND had high resource needs and caregivers highlighted the lack of appropriate and timely respite, which caused considerable emotional,
psychological and physical demands [8]. Although these findings related more specifically to palliative care services, they are also relevant to rehabilitation services.

Specific suggestions from MND Australia to bridge these gaps have included the provision of education (to patients, families and health professionals regarding care of MND), access to a key worker model for coordination and communication, timely and appropriate referrals (eg. for palliative care), funding for high-needs patients and access to respite care and after hours support [8].

Further recommendations as a result of findings from this thesis would include:

- Targeting intervention at the patient and caregiver level – determining the needs of each individual from their perspective through routine enquiries to encourage reporting and thus the facilitation of appropriate treatment.
- Targeting intervention at the health professional level – comprehensive education and support programs, which include treatment guidelines and protocols.
- Targeting intervention at the government level – special consideration to the needs of people with MND and their families in policy decisions.
- Targeting intervention at the population level – health promotion campaigns.

The role of consumer organisations should also be highlighted, as it is not just the government who has responsibility for the care of persons with MND. In Australia, the MND associations play an important role in the advocacy and care for those with MND and their role should be facilitated by the government and by the community. For example, the Motor Neurone Disease Palliative Care Pathway Project, though commissioned by the government (Department of Human Services) was undertaken by MND Victoria [8]. Motor Neurone Disease Australia [349] should be supported in their ongoing role in:

- Linking people living with MND into local support services
- Provision of information, support and education about motor neurone disease for people living with MND, their families, friends and carers through information (telephone) lines, “regional advisors”, support groups, carer support resources, education and information sessions and provision of information resources
- Equipment loan
- Fundraising
- Advocacy and lobbying for funding from the government
- Provision of information, education and support for health professions eg. websites to assist with state specific referral pathways to assist health professionals in identifying services that can meet the identified needs of patients with MND, running of education programs, workshops and conferences
• Coordination of MND Special Interest Groups, informal networks of health and community care professionals interested in the care of people with MND to facilitate communication and information sharing
• Facilitating research through fundraising and assisting patients with participating in and understanding research through information provision

From a more global/international health services perspective, much still needs to be done. The preliminary work in this thesis is by no means expansive or comprehensive and was designed as a stepping-stone to further development of evidence-based clinical practice and optimisation of health services for people with MND. The following “where to from here” recommendations apply not just to Australia but also to an international audience.

1) Given the broad, complex and challenging spectrum of needs, current “gold-standard” management is “multidisciplinary care” which includes neurological, rehabilitative and palliative care. As consistent with the guidelines from the American Academy of Neurology [9] and the World Federation of Neurology [10], multidisciplinary care should be available to all persons with MND.

2) Where multidisciplinary care is currently available, it should be delivered with a high level of coordination and integration, with evidence-based intervention to ensure holistic and seamless care for persons with MND and their caregivers.

3) Much more work needs to be done in the area of evidence-based interventions. At present, much of the evidence has been concentrated in areas such as respiratory and nutritional management. There is paucity of information on effective rehabilitation interventions and very little is understood with regards to the “black box of rehabilitation”. For example, as highlighted in Chapter 2, evidence to guide exercise prescription (such as strengthening, stretching, aerobic/endurance exercises) is much needed. The use and development of assistive technology is another area that warrants much more attention, as is a better understanding of bowel, bladder and sexuality issues.

4) Whilst establishment of a number of MND population-based databases or registers worldwide (mainly in Europe and Australia) has enabled a clearer understanding of MND epidemiology, these databases have tended to be established by neurologists who aim predominantly to collect information on MND diagnosis and treatment, with little focus on disability [350, 351]. Access to the information collected in these databases is also limited. The potential of these databases in contributing to MND knowledge and care is endless and should be further explored.

5) There are current disability/rehabilitation based databases that exist. For example, the Australasian Rehabilitation Outcomes Centre (AROC) is a joint initiative of the Australian rehabilitation sector (providers, funders, regulators and consumers) which collects clinical and management information reports based on functional outcomes,
impairment groupings and other relevant variables from public and private rehabilitation clinical centres across Australia [352]. It allows national benchmarking to improve clinical rehabilitation outcomes in both the public and private sectors. It does not however, collect data on MND and there is no collaboration or communication with existing MND databases such as the Australian Motor Neurone Disease Registry. Such databases are time and cost intensive and should be further expanded and linked to other relevant data management organisations in order to measure and understand the role of rehabilitation within the broader health and community care systems.

6) The ICF model of disability advocates that the day-to-day experiences of people, and the social restrictions they face, are not caused by their health condition but are outcomes of an interaction with physical, social, and attitudinal factors in their world. Hence the factors drawn from an Australian population may map to other parts of the world but this would need further research.

7) Finally, national and international guidelines incorporating evidence-based practice in rehabilitation should be further developed to enable optimisation of clinical care and practice.

10.6 Implications for clinical practice
This thesis provides an improved understanding of the needs of MND patients and their caregivers. Clinicians should actively screen for and identify common MND related issues and timely referrals should be made to other specialists (such as rehabilitation or palliative care specialists) for optimal management of specific issues that lie in their area of expertise.
Motivation, teamwork, support from specialists in various areas, and knowledge of the patient’s fears, concerns and desires can bring worthwhile, even if sometimes subtle, benefits for the patient in terms of reducing disability and increasing individual independence and control [345].
Caregivers should be specifically targeted with an assessment of the caregiver’s individual needs and that of the caregiving situation to optimise caregiver health and well-being, and to allow collaborative decision making. An assessment tool can be used, of which a number are available [353]. Use of a standardised framework such as the ICF can be helpful to improve communication and clinical decision-making across patient types, service settings and health professional disciplines.

10.7 Implications for future research
The healthcare needs of MND patients and their caregivers should be further explored and their perspectives incorporated into rehabilitation programs. The linkage of MND-related problems with the ICF framework needs to be done in other cohorts to confirm the findings of this thesis. This would include showing the draft lists to people with MND and their caregivers (such as in a focus group) and to other health professionals – for example, nurses, therapists, social workers,
doctors working in primary care to determine if the lists had face validity and if they formed the basis of a useful common framework. From this, a core set should be determined which incorporates the perspective of the patients and their caregivers and multidisciplinary care health professionals at both a national and international level, which in turn should assist with the development of outcome measures relevant to persons with MND. Environmental and personal factors relevant to persons with MND need further attention.

As highlighted in Chapter 4 (Study 1), there is a significant gap in the current literature. There is a need for appropriate study designs and longitudinal data which address the changing needs of patients and their caregivers associated with MND disease progression and mortality. Future research in multidisciplinary care in MND should focus on observational study designs such as Clinical Practice Improvement (CPI) studies, to assess care and outcomes in “real-life” settings. Research is also needed to assess the benefits of multidisciplinary care, particularly in relation to quality of life and to caregiver burden. The development of appropriate outcome measures that are appropriate, reliable and valid and that reflect domains of the ICF are needed. Finally, the interface between neurology, rehabilitation and palliative care should be explored to provide long-term support for MND.

10.8 Conclusions
The thesis confirms the main hypothesis of this research, that is, issues relevant to multidisciplinary rehabilitation care from the perspective of the patient and caregiver can be addressed utilising the ICF framework, and gaps in evidence and service provision can be identified to optimise clinical care in both clinical and research settings.

A number of gaps in knowledge of evidence-based practices in MND care have been addressed using predominantly qualitative research methodology. The studies contribute to existing MND literature and should assist with the further development of evidence to minimise gaps between evidence and clinical practice in MND.

MND is a complex and challenging condition, as confirmed by the studies in this thesis. This thesis provides a comprehensive review of the current literature on multidisciplinary care in MND and provides recommendations for clinical practice and future research. It also highlights the disability profile, needs, and gaps in service provision from the perspective of the patient and their caregiver and links these disabilities to a standardised framework, the ICF which can facilitate communication amongst treating clinicians and researchers. A preliminary set of personal factors was identified and the feasibility of a peer support program for persons with MND explored which have not previously been reported. These add to the current knowledge base in MND care.
The gaps in MND care identified should be prioritised for future service development using the “neuropalliative rehabilitation” model of care. For improved consensus of care and communication amongst treating clinicians, the framework of International Classification of Functioning, Disability and Health should be further explored in this population and a core set developed.
References


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Appendix

MND Rehabilitation Study 2009
(For all enquiries please contact Dr Louisa Ng or Dr Fary Khan on (03)83872000)

RESEARCHER NAME: ________________________ Date: ____________

PATIENT NAME: ____________________________ BRADMA

AGE: __________ years

GENDER: Male □ Female □

ADDRESS: ______________

CONTACT NUMBER: ______________

MND CLINIC ATTENDED (CIRCLE): BETHLEHEM OR BECC OR OTHER (STATE)

DATE OF DIAGNOSIS OF MND: ____________

DIAGNOSIS: (CIRCLE MOST APPROPRIATE)
Clinically Definite ALS
Clinically Probable ALS
Clinically Probable - Laboratory-supported ALS
Clinically Possible ALS
Progressive muscular atrophy
Primary lateral sclerosis (PLS)

CLINICAL PHENOTYPE (CIRCLE) REGION OF SYMPTOM ONSET (CIRCLE)

<table>
<thead>
<tr>
<th>Global</th>
<th>Bulbar</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Cervical</td>
</tr>
<tr>
<td></td>
<td>Lumbar</td>
</tr>
<tr>
<td>Flail</td>
<td>Arm</td>
</tr>
<tr>
<td></td>
<td>Leg</td>
</tr>
<tr>
<td>PLS</td>
<td>All regions</td>
</tr>
</tbody>
</table>

Riluzole yes no
Quinine (cramps) yes no
Carbamazepine (cramps) yes no
Phenytoin (cramps) yes no
Diazepam (cramps or spasticity) yes no
Baclofen (spasticity) yes no
Analgesia yes no
Antidepressants yes no
Please specify: _________________________________
PATIENT SECTION:
Participant Initial Assessment: Open Ended Questionnaire
What are the main problems you face in your everyday life?
The Needs and Provision Complexity Scale (NPCS) for LTNC

PART A – NEEDS: For each subscale, circle highest level applicable

1. MEDICAL CARE NEEDS – requiring intervention from a doctor for investigation, monitoring or treatment – Specialist Medical input may be from any medical specialty

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Specialties</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>GP occasional – no regular contact- self-initiated visits to GP as required</td>
<td>Types of medical care</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neurology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rehab medicine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neuropsychiatry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Palliative care</td>
</tr>
<tr>
<td></td>
<td></td>
<td>other</td>
</tr>
<tr>
<td>M1</td>
<td>GP active monitoring – regular monitoring / treatment by GP solely</td>
<td>Other medical specialties</td>
</tr>
<tr>
<td>M2</td>
<td>Low level specialist support eg. for large stable condition. On-going monitoring/treatment by GP with occasional specialist advice/review</td>
<td>Other medical specialties</td>
</tr>
<tr>
<td>M3</td>
<td>Active specialist medical intervention required eg. for changing/ unstable condition or for unresolved symptoms. Investigation or treatment requiring frequent contact with specialist medical team</td>
<td>Other medical specialties</td>
</tr>
</tbody>
</table>

2. SKILLED NURSING NEEDS – intervention required from trained and / or specialist nursing staff eg. district nursing or Specialist nurse (eg. wound care, bladder/bowel management/medication monitoring/ specialist advice/support/counselling)

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Specialties</th>
</tr>
</thead>
<tbody>
<tr>
<td>N0</td>
<td>No needs for skilled nursing</td>
<td>Types of nursing care</td>
</tr>
<tr>
<td>N1</td>
<td>Requires occasional intervention from a trained nurse or specialist nurse (eg. monthly or less)</td>
<td>District nurse</td>
</tr>
<tr>
<td>N2</td>
<td>Requires regular intervention from a trained nurse or specialist nurse (eg. every 1-2 weeks)</td>
<td>Specialist nurse</td>
</tr>
<tr>
<td>N3</td>
<td>Requires frequent intervention from a trained nurse or specialist nurse on a daily basis, or several times a week</td>
<td>Neurology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mental Health</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Palliative care</td>
</tr>
<tr>
<td></td>
<td></td>
<td>other</td>
</tr>
</tbody>
</table>

3. PERSONAL CARE – in and around the home

3a: Number of Carers: Required to help with basic self-care

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Who provides this help?</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN0</td>
<td>No carer required for basic care activities</td>
<td>Informal family care</td>
</tr>
<tr>
<td>CN1</td>
<td>Requires help from 1 person for most basic care activities</td>
<td>Formal paid carers</td>
</tr>
<tr>
<td>CN2</td>
<td>Requires help from ≥ 2 people for most basic care activities</td>
<td>Other</td>
</tr>
</tbody>
</table>

3b: Carer frequency: Frequency of care for help with basic self-care, including maintaining safety

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Who provides this help?</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF0</td>
<td>No need for help with self care</td>
<td></td>
</tr>
<tr>
<td>CF1</td>
<td>Occasional intervention – less than daily for help with self care, or extended activities of daily living</td>
<td></td>
</tr>
<tr>
<td>CF2</td>
<td>Requires regular help once daily</td>
<td></td>
</tr>
<tr>
<td>CF3</td>
<td>Requires regular help 2-3 times a day – could be met by an intermittent visiting care package. Able to be left safely for &gt;4 hours and does not require care/supervision at night</td>
<td></td>
</tr>
<tr>
<td>CF4</td>
<td>Frequent or unpredictable care needs, requiring the presence of someone most of</td>
<td></td>
</tr>
</tbody>
</table>
the time. Cannot be left safely for >4 hours or requires care/supervision at night (but not waking night care)

| CF5 | Requires constant supervision, unable to be left alone in the house, even for short periods AND/OR requires waking night care – needs >2 interventions at night |

3c: Personal assistant/enabler: Frequency of assistance for participation in day time community activities

| PA0 | No need for assistance with community activities |
| PA1 | Occasional need – 1-2 days per week |
| PA2 | Frequent need – 3-5 days per week |
| PA3 | Daily – 6-7 days per week |

4. THERAPY NEEDS – including outpatient, community-based and vocational rehabilitation

Number of Therapy Disciplines: Required to actively involved in treatment (i.e. at least 1 hr per month)

| TD0 | 0 | Tick therapy disciplines required: |
| TD1 | Single discipline only | Physio |
| TD2 | Individual disciplines, not co-ordinated | Psychology |
| TD3 | Co-ordinated interdisciplinary team | OT |
|     |                             | Counselling |
|     |                             | SLT |
|     |                             | Mental Health |
|     |                             | Dietetics |
|     |                             | Pastoral Care |
|     |                             | Orthotics/Prosthetics |
|     |                             | Other: |

Therapy Intensity: Overall intensity of trained therapy intervention required

| TI0 | No need for trained therapy intervention |
| TI1 | Requires occasional review or maintenance programme – OR requires group therapy solely eg. rehab needs met by family/care staff or self-exercise, supervised by therapist eg 1-2 hrs total/month |
| TI2 | Regular intervention for maintenance/treatment eg every 1-2 weeks: OP or domiciliary treatment |
| TI3 | Requires frequent intervention involving several sessions per week |

1. VOCATIONAL SUPPORT NEEDS

| VR0 | No need for vocational support |
| VR1 | Requires vocational assessment/ advice from Centrelink eg Disability employment advisor |
| VR2 | Requires ongoing vocational support eg Access to work scheme, or support to withdraw from work |
| VR3 | Requires formal vocational rehabilitation eg. work preparation, work re-training, supported placements |

2. SOCIAL WORK AND CASE MANAGEMENT

| S0 | No need for social work or case management |
| S1 | Requires occasional intervention or available for advice when needed eg. contact 2-3 x per year |
| S2 | Requires regular intervention or contact eg. every 1-2 months |
S3  Requires frequent intervention or contact eg. every 1-2 weeks

7. FAMILY / CARER SUPPORT / RESPITE NEEDS

7a: Family carer support

| FC0 | No needs for family / carer support |
| FC1 | Assessment required for family / carer support |
| FC2 | Time-limited family / carer support required – eg. for skills training |
| FC3 | Ongoing family/ carer support required – eg. for emotional support |

7b: Respite – residential and day care centre

<table>
<thead>
<tr>
<th>RESIDENTIAL RESPITE</th>
<th>Type of respite care</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR0</td>
<td>No need for residential respite care</td>
</tr>
<tr>
<td>RR1</td>
<td>Requires occasional residential respite - eg to cover holidays etc.</td>
</tr>
<tr>
<td>RR2</td>
<td>Requires regular planned residential respite - but not very frequent (eg. 1-2 weeks per 6 months)</td>
</tr>
<tr>
<td>RR3</td>
<td>Requires frequent planned residential care (eg every 4-6 weeks) AND/OR back-up support at times of crisis</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DAY CARE</th>
<th>Type of day care</th>
</tr>
</thead>
<tbody>
<tr>
<td>RD0</td>
<td>No need for day care</td>
</tr>
<tr>
<td>RD1</td>
<td>Occasional day care – 1-2 days per week</td>
</tr>
<tr>
<td>RD2</td>
<td>Frequent day care – 3-5 days/week</td>
</tr>
</tbody>
</table>

8. ADVOCACY NEEDS

| AD0 | No needs for advocacy |
| AD1 | Mental capacity assessment required |
| AD2 | Independent advocacy required |

9. SPECIALIST EQUIPMENT – Eg. Special seating, assistive technology, ventilation equipment

| E0 | No specialist equipment required |
| E1 | Basic equipment required – eg. from social services equipment store eg kitchen aids, commode, bed, hoist etc) |
| E2 | Specialist equipment required – equipment requiring professional assessment and provision (eg. seating, standing frames) |
| E3 | Highly specialist equipment required – bespoke equipment requiring professional prescription (eg. environmental control, communication aids, ventilatory support) |
| | Types of equipment |
| | Basic lifting handling equipment |
| | Seating/wheelchair |
| | Standing/postural support |
| | Electronic Assistive technology |
| | Communication aid |
| | Assisted ventilation |
| | Other |

10. ACCOMODATION NEEDS

| AC0 | No need for special accommodation |
| AC1 | Restricted accommodation options (eg. requires ground floor or life access accommodation) |
| AC2 | Requires partially adapted accommodation (eg. rails, ramps etc) |
| AC3 | Requires fully adapted accommodation (eg. fully wheelchair accessible) |

SHELTERED AND RESIDENTIAL CARE
<table>
<thead>
<tr>
<th>AC4</th>
<th>Requires sheltered living accommodation (eg. warden controlled)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC5</td>
<td>Requires supervised living arrangement eg. small group home</td>
</tr>
<tr>
<td>AC6</td>
<td>Requires residential care home setting</td>
</tr>
<tr>
<td>AC7</td>
<td>Requires nursing home care</td>
</tr>
<tr>
<td>AC8</td>
<td>Requires specialist nursing home</td>
</tr>
<tr>
<td>AC9</td>
<td>Requires Hospice care</td>
</tr>
</tbody>
</table>

PART B: The Inputs provided

Part B is intended to mirror Part A, except that it records what the person actually gets – and so identified UNMET NEED
PART B – The inputs Provided

For each subscale, circle highest level applicable

1. MEDICAL CARE NEEDS – requiring intervention from a doctor for investigation, monitoring or treatment – Specialist Medical input may be from any medical specialty

<table>
<thead>
<tr>
<th>M0</th>
<th>GP occasional – no regular contact- self-initiated visits to GP as required</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>GP active monitoring – regular monitoring / treatment by GP solely</td>
</tr>
<tr>
<td>M2</td>
<td>Low level specialist support eg. for large stable condition. On-going monitoring/treatment by GP with occasional specialist advice/review</td>
</tr>
<tr>
<td>M3</td>
<td>Active specialist medical intervention required eg. for changing/unstable condition or for unresolved symptoms. Investigation or treatment requiring frequent contact with specialist medical team</td>
</tr>
</tbody>
</table>

2. SKILLED NURSING NEEDS – intervention required from trained and / or specialist nursing staff eg. district nursing or Specialist nurse (eg. wound care, bladder/bowel management/medication monitoring/ specialist advice/support/counselling)

<table>
<thead>
<tr>
<th>N0</th>
<th>No needs for skilled nursing</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>Requires occasional intervention from a trained nurse or specialist nurse (eg. monthly or less)</td>
</tr>
<tr>
<td>N2</td>
<td>Requires regular intervention from a trained nurse or specialist nurse (eg. every 1-2 weeks)</td>
</tr>
<tr>
<td>N3</td>
<td>Requires frequent intervention from a trained nurse or specialist nurse on a daily basis, or several times a week</td>
</tr>
</tbody>
</table>

3. PERSONAL CARE – in and around the home

3a: Number of Carers: Required to help with basic self-care

<table>
<thead>
<tr>
<th>CN0</th>
<th>No carer required for basic care activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN1</td>
<td>Requires help from 1 person for most basic care activities</td>
</tr>
<tr>
<td>CN2</td>
<td>Requires help from &gt; 2 people for most basic care activities</td>
</tr>
</tbody>
</table>

Who provides this help?:
- Informal family care
- Formal paid carers
- Other

3b: Carer frequency: Frequency of care for help with basic self-care, including maintaining safety

<table>
<thead>
<tr>
<th>CF0</th>
<th>No need for help with self care</th>
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<tbody>
<tr>
<td>CF1</td>
<td>Occasional intervention – less than daily for help with self care, or extended activities of daily living</td>
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<td>CF2</td>
<td>Requires regular help once daily</td>
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<tr>
<td>CF3</td>
<td>Requires regular help 2-3 times a day – could be met by an intermittent visiting care package. Able to be left safely for &gt;4 hours and does not require care/supervision at night</td>
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<tr>
<td>CF4</td>
<td>Frequent or unpredictable care needs, requiring the presence of someone most of the time. Cannot be left safely for &gt;4 hours or requires care/supervision at night (but not waking night care)</td>
</tr>
<tr>
<td>CF5</td>
<td>Requires constant supervision, unable to be left alone in the house, even for short periods AND/OR requires waking night care – needs &gt;2 interventions at night</td>
</tr>
</tbody>
</table>
### 3c: Personal assistant/enabler: Frequency of assistance for participation in day time community activities

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA0</td>
<td>No need for assistance with community activities</td>
</tr>
<tr>
<td>PA1</td>
<td>Occasional need – 1-2 days per week</td>
</tr>
<tr>
<td>PA2</td>
<td>Frequent need – 3-5 days per week</td>
</tr>
<tr>
<td>PA3</td>
<td>Daily – 6-7 days per week</td>
</tr>
</tbody>
</table>

### 4. THERAPY NEEDS – including outpatient, community-based and vocational rehabilitation

#### Number of Therapy Disciplines: Required to actively involved in treatment (i.e. at least 1 hr per month)

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TD0</td>
<td>0 Single discipline only</td>
</tr>
<tr>
<td>TD1</td>
<td>Individual disciplines, not co-ordinated</td>
</tr>
<tr>
<td>TD2</td>
<td>Co-ordinated interdisciplinary team</td>
</tr>
<tr>
<td>TD3</td>
<td>All disciplines required</td>
</tr>
</tbody>
</table>

#### Tick therapy disciplines required:

- Physio
- Psychology
- OT
- Counselling
- SLT
- Mental Health
- Dietetics
- Pastoral Care
- Orthotics/Prosthetics
- Other:

#### Therapy Intensity: Overall intensity of trained therapy intervention required

<table>
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<tr>
<th>Level</th>
<th>Description</th>
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<tbody>
<tr>
<td>TI0</td>
<td>No need for trained therapy intervention</td>
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<td>Requires occasional review or maintenance programme – OR requires group therapy solely eg. rehab needs met by family/care staff or self-exercise, supervised by therapist eg 1-2 hrs total/month</td>
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<td>TI2</td>
<td>Requires regular intervention for maintenance/treatment eg every 1-2 weeks: OP or domiciliary treatment</td>
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<td>TI3</td>
<td>Requires frequent intervention involving several sessions per week</td>
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### 3. VOCATIONAL SUPPORT NEEDS

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
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### 4. SOCIAL WORK AND CASE MANAGEMENT

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<tbody>
<tr>
<td>S0</td>
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<td>S3</td>
<td>Requires frequent intervention or contact eg. every 1-2 weeks</td>
</tr>
</tbody>
</table>
### 7. FAMILY / CARER SUPPORT / RESPIE NEEDS

#### 7a: Family carer support

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC0</td>
<td>No needs for family / carer support</td>
</tr>
<tr>
<td>FC1</td>
<td>Assessment required for family / carer support</td>
</tr>
<tr>
<td>FC2</td>
<td>Time-limited family / carer support required – eg. for skills training</td>
</tr>
<tr>
<td>FC3</td>
<td>Ongoing family / carer support required – eg. for emotional support</td>
</tr>
</tbody>
</table>

#### 7b: Respite – residential and day care centre

**RESIDENTIAL RESPITE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR0</td>
<td>No need for residential respite care</td>
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<td>RR1</td>
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<td>RR3</td>
<td>Requires frequent planned residential care (eg every 4-6 weeks) AND/OR back-up support at times of crisis</td>
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</table>

**DAY CARE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RD0</td>
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</tr>
<tr>
<td>RD1</td>
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</tr>
<tr>
<td>RD2</td>
<td>Frequent day care – 3-5 days/week</td>
</tr>
</tbody>
</table>

**Type of respite care**

- Home-based temporary live-in care
- Residential home
- Nursing home
- Specialist nursing home
- Hospice
- Other

**Type of day care**

- Community day centre
- Specialist day centre
- Hospice

### 8. ADVOCACY NEEDS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD0</td>
<td>No needs for advocacy</td>
</tr>
<tr>
<td>AD1</td>
<td>Mental capacity assessment required</td>
</tr>
<tr>
<td>AD2</td>
<td>Independent advocacy required</td>
</tr>
</tbody>
</table>

### 9. SPECIALIST EQUIPMENT – Eg. Special seating, assistive technology, ventilation equipment

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E0</td>
<td>No specialist equipment required</td>
</tr>
<tr>
<td>E1</td>
<td>Basic equipment required – eg. from social services equipment store eg kitchen aids, commode, bed, hoist etc)</td>
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<tr>
<td>E2</td>
<td>Specialist equipment required – equipment requiring professional assessment and provision (eg. seating, standing frames)</td>
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<tr>
<td>E3</td>
<td>Highly specialist equipment required – bespoke equipment requiring professional prescription (eg. environmental control, communication aids, ventilatory support)</td>
</tr>
</tbody>
</table>

**Types of equipment**

- Basic lifting handling equipment
- Seating/wheelchair
- Standing/postural support
- Electronic Assistive technology
- Communication aid
- Assisted ventilation
- Other

### 10. ACCOMODATION NEEDS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>AC0</td>
<td>No need for special accommodation</td>
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**SHELTERED AND RESIDENTIAL CARE**

<table>
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</tr>
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<tbody>
<tr>
<td>AC4</td>
<td>Requires sheltered living accommodation (eg. warden controlled)</td>
</tr>
<tr>
<td>AC5</td>
<td>Requires supervised living arrangement eg. small group home</td>
</tr>
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<td>AC7</td>
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</tr>
<tr>
<td>AC8</td>
<td>Requires specialist nursing home</td>
</tr>
<tr>
<td>AC9</td>
<td>Requires Hospice care</td>
</tr>
</tbody>
</table>
**DASS**

Please read each statement and circle a number 0, 1, 2 or 3, which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:
- 0 Did not apply to me at all
- 1 Applied to me to some degree, or some of the time
- 2 Applied to me to a considerable degree, or a good part of the time
- 3 Applied to me very much, or most of the time

<table>
<thead>
<tr>
<th></th>
<th>Statement</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I found it hard to wind down</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>I was aware of dryness of my mouth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>I couldn’t seem to experience any positive feeling at all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>I experienced breathing difficulty (eg. excessively rapid breathing,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>breathlessness in the absence of physical exertion)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>I found it difficult to work up the initiative to do things</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>I tended to overreact to situations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>I experienced trembling (e.g. in the hands)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>I felt that I was using a lot of nervous energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>I was worried about situations in which I might panic and make a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>fool of myself</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>I felt that I had nothing to look forward to</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>I found myself getting agitated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>I found it difficult to relax</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>I felt down -hearted and blue</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>I was intolerant of anything that kept me from getting on with</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>what I was doing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>I felt I was close to panic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>I was unable to become enthusiastic about anything</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>I felt I wasn’t worth much as a person</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>I felt that I was rather touchy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>I was aware of the action of my heart in the absence of physical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>exertion (eg. sense of heart rate increase, heart missing a beat)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>I felt scared without any good reason</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>I felt that life was meaningless</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Amyotrophic Lateral Sclerosis Functional Rating Scale-revised (ALSFRS-R)

<table>
<thead>
<tr>
<th>SPEECH</th>
<th>TURNING IN BED</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] 4 Normal speech processes</td>
<td>[ ] 4 Normal</td>
</tr>
<tr>
<td>[ ] 3 Detectable speech disturbance</td>
<td>[ ] 3 Somewhat slow and clumsy, but no help needed</td>
</tr>
<tr>
<td>[ ] 2 Intelligible with repeating</td>
<td>[ ] 2 Can turn alone or adjust sheets, but with great difficulty</td>
</tr>
<tr>
<td>[ ] 1 Speech combined with non-vocal communication</td>
<td>[ ] 1 Can initiate, but not turn or adjust sheets alone</td>
</tr>
<tr>
<td>[ ] 0 Loss of useful speech</td>
<td>[ ] 0 Helpless</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SALIVATION</th>
<th>WALKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] 4 Normal</td>
<td>[ ] 4 Normal</td>
</tr>
<tr>
<td>[ ] 3 Slight but definite excess of saliva in mouth; may have night time drooling</td>
<td>[ ] 3 Early ambulation difficulties</td>
</tr>
<tr>
<td>[ ] 2 Moderately excessive saliva, minimal drooling</td>
<td>[ ] 2 Walks with assistance</td>
</tr>
<tr>
<td>[ ] 1 Marked excess of saliva with some drooling</td>
<td>[ ] 1 Non-ambulatory functional movement only</td>
</tr>
<tr>
<td>[ ] 0 Marked drooling; requires constant tissue or handkerchief</td>
<td>[ ] 0 No purposeful leg movement</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWALLOWING</th>
<th>CLIMBING STAIRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] 4 Normal eating habits</td>
<td>[ ] 4 Normal</td>
</tr>
<tr>
<td>[ ] 3 Early eating problems-occasional choking</td>
<td>[ ] 3 Slow</td>
</tr>
<tr>
<td>[ ] 2 Dietary consistency changes</td>
<td>[ ] 2 Mild unsteadiness or fatigue</td>
</tr>
<tr>
<td>[ ] 1 Needs supplemental tube feeding</td>
<td>[ ] 1 Needs assistance</td>
</tr>
<tr>
<td>[ ] 0 NPO (exclusively parenteral or enteral feeding)</td>
<td>[ ] 0 Cannot do</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HANDWRITING</th>
<th>DYSPNEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] 4 Normal</td>
<td>[ ] 4 None</td>
</tr>
<tr>
<td>[ ] 3 Slow or sloppy: all words are legible</td>
<td>[ ] 3 Occurs when walking</td>
</tr>
<tr>
<td>[ ] 2 Not all words are legible</td>
<td>[ ] 2 Occurs with one</td>
</tr>
<tr>
<td>[ ] 1 Able to grip pen but unable to write</td>
<td>[ ] 1 Occurs at rest, difficult breathing when either sitting, or lying</td>
</tr>
<tr>
<td>[ ] 0 Unable to grip pen</td>
<td>[ ] 0 Significant difficulty, considering using mechanical respiratory support</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CUTTING FOOD</th>
<th>ORTHOPNEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] 4 Normal</td>
<td>[ ] 4 None</td>
</tr>
<tr>
<td>[ ] 3 Somewhat slow and clumsy, but no help needed</td>
<td>[ ] 3 Some difficulty sleeping at night due to shortness of breath. Does not routinely use more than 2 pillows</td>
</tr>
<tr>
<td>[ ] 2 Can cut most foods, although clumsy and slow; some help needed</td>
<td>[ ] 2 Needs extra pillow in order to sleep (more than two)</td>
</tr>
<tr>
<td>[ ] 1 Food must be cut by someone, but still feed slowly</td>
<td>[ ] 1 Can only sleep sitting up</td>
</tr>
<tr>
<td>[ ] 0 Need to be fed</td>
<td>[ ] 0 Unable to sleep</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DRESSING &amp; HYGIENE</th>
<th>RESPIRATORY INSUFFICIENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] 4 Normal function</td>
<td>[ ] 4 None</td>
</tr>
<tr>
<td>[ ] 3 Independent and complete self-care with effort or decreased efficiency</td>
<td>[ ] 3 Intermittent use of BiPAP</td>
</tr>
<tr>
<td>[ ] 2 Intermittent assistance or substitute methods</td>
<td>[ ] 2 Continuous use of BiPAP</td>
</tr>
<tr>
<td>[ ] 1 Needs attendant for self-care</td>
<td>[ ] 1 Continuous use of BiPAP during night and</td>
</tr>
<tr>
<td>day</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>----------</td>
</tr>
<tr>
<td>0 Total Dependence</td>
<td>0 Invasive mechanical ventilation by intubation or tracheotomy</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
</tr>
</tbody>
</table>
McGill Quality of Life (MQOL)

The questions in this questionnaire begin with a statement followed by two opposite answers. Numbers extend from one extreme answer to its opposite.

Please circle the number between 0 and 10 which is most true for you. There are no right or wrong answers. Completely honest answers will be most helpful.

It is very important that you answer all questions for how you have been feeling just in the past week.

PART A

Considering all parts of my life – physical, emotional, social, spiritual, and financial – over the past week the quality of my life has been:

Very Bad 0 1 2 3 4 5 6 7 8 9 10 Excellent

PART B

1. For the questions in Part “B”, please list the PHYSICAL SYMPTOMS or PROBLEMS which have been the biggest problem for you over the past two (2) days. Some examples are: pain, tiredness, weakness, nausea, vomiting, constipation, diarrhoea, trouble sleeping, shortness of breath, lack of appetite, sweating, immobility. Feel free to refer to others if necessary.

2. Circle the number which best shows how big a problem each one has been for you OVER THE PAST WEEK.

3. If, over the past week, you have NO physical symptoms or problems, or only one or two, answer for each of the ones you have had and write "none" for the extra questions in Part B, then continue with Part C.

1. Over the past two (2) days, one troublesome symptom has been:

   (write symptom)

   No Problem 0 1 2 3 4 5 6 7 8 9 10 Tremendous problem

2. Over the past two (2) days, another troublesome symptom has been:

   (write symptom)

   No Problem 0 1 2 3 4 5 6 7 8 9 10 Tremendous problem

3. Over the past week, a third troublesome symptom has been:
(write symptom)

No Problem 0 1 2 3 4 5 6 7 8 9 10
Tremendous problem

4. Over the past week I have felt:
Physically Terrible 0 1 2 3 4 5 6 7 8 9 10
Physically well

PART C

Please choose the number which best describes your feelings and thoughts OVER THE PAST WEEK

5. Over the past week, I have been depressed:
Not at all 0 1 2 3 4 5 6 7 8 9 10
Extremely

6. Over the past week, I have been nervous or worried:
Not at all 0 1 2 3 4 5 6 7 8 9 10
Extremely

7. Over the past week, how much of the time did you feel sad?
Never 0 1 2 3 4 5 6 7 8 9 10 Always

8. Over the past week, when I thought of the future, I was?
Not afraid 0 1 2 3 4 5 6 7 8 9 10 Terrified

9. Over the past week, my life has been:
Without purpose 0 1 2 3 4 5 6 7 8 9 10
Very purposeful

10. Over the past week, when I thought about my whole life, I felt that in achieving life goals I have:
Made no progress 0 1 2 3 4 5 6 7 8 9 10
Progressed to fulfilment

11. Over the past week, when I thought about my life, I felt that my life to this point has been:
Completely worthless 0 1 2 3 4 5 6 7 8 9 10
Very worthwhile

12. Over the past week, I have felt that I have:
No control over life 0 1 2 3 4 5 6 7 8 9 10
Complete control
13. Over the past week, I felt good about myself as a person:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Completely agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

14. To me, the past week was:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>A burden</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>A gift</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

15. Over the past week, the world has been:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>An impersonal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>unfeeling place</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td>9</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caring /</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsive to my needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

16. Over the past week, I have felt supported:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Completely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td>9</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
BRIEF COPE

Instructions: We are interested in how people respond when they confront difficult or stressful events in their lives. There are lots of ways to try to deal with stress. This questionnaire asks you to indicate what you generally do and feel when you experience stressful events. Obviously, different events bring out somewhat different responses, but think about what you usually do when you are under a lot of stress.

Then respond to each of the following items by blackening one number on your answer sheet for each, using the response choices listed just below. Please try to respond to each item separately in your mind from each other item. Choose your answer thoughtfully, and make your answers as true FOR YOU as you can. Please answer every item. There are no “right” or “wrong” answers, so choose the most accurate answer for YOU – not what you think “most people” would say or do. Indicate what YOU usually do when YOU experience a stressful event.

<table>
<thead>
<tr>
<th></th>
<th>I usually don't do this at all</th>
<th>I usually do this a little bit</th>
<th>I usually do this a medium amount</th>
<th>I usually do this a lot</th>
</tr>
</thead>
</table>
1. | I’ve been concentrating my efforts on doing something about the situation I’m in | 1 | 2 | 3 | 4 |
2. | I’ve been trying to come up with a strategy about what to do | 1 | 2 | 3 | 4 |
3. | I’ve been trying to see it in a different light, to make it seem more positive | 1 | 2 | 3 | 4 |
4. | I’ve been accepting the reality of the fact that it has happened | 1 | 2 | 3 | 4 |
5. | I’ve been making jokes about it | 1 | 2 | 3 | 4 |
6. | I’ve been trying to find a comfort in my religion or spiritual beliefs | 1 | 2 | 3 | 4 |
7. | I’ve been getting emotional support from others | 1 | 2 | 3 | 4 |
8. | I’ve been trying to get advice or help from other people about what to do | 1 | 2 | 3 | 4 |
9. | I’ve been turning to work or other activities to take my mind off things | 1 | 2 | 3 | 4 |
10. | I’ve been saying to myself “this isn’t real” | 1 | 2 | 3 | 4 |
11. | I’ve been saying things to let my unpleasant feelings escape | 1 | 2 | 3 | 4 |
12. | I’ve been using alcohol or other drugs to make myself feel better | 1 | 2 | 3 | 4 |
13. | I’ve been giving up trying to deal with it | 1 | 2 | 3 | 4 |
14. | I’ve been criticizing myself | 1 | 2 | 3 | 4 |
15. | I’ve been learning to live with it | 1 | 2 | 3 | 4 |
16. | I’ve been taking action to try and make the situation better | 1 | 2 | 3 | 4 |
17. | I’ve been thinking hard about what steps to take | 1 | 2 | 3 | 4 |
18. | I’ve been looking for something good in what is happening | 1 | 2 | 3 | 4 |
19. | I’ve been making fun of the situation | 1 | 2 | 3 | 4 |
20. | I’ve been praying or meditating | 1 | 2 | 3 | 4 |
21. | I’ve been getting comfort and understanding from someone | 1 | 2 | 3 | 4 |
22. | I’ve been getting help and advice from other people | 1 | 2 | 3 | 4 |
23. | I’ve been doing something to think about it less, such as going to movies, watching TC, reading, daydreaming, sleeping or shopping | 1 | 2 | 3 | 4 |
24. | I’ve been refusing to believe that it has happened | 1 | 2 | 3 | 4 |
25. | I’ve been expressing my negative feelings | 1 | 2 | 3 | 4 |
26. | I’ve been using alcohol or other drugs to get through it | 1 | 2 | 3 | 4 |
27. | I’ve been giving up the attempt to cope | 1 | 2 | 3 | 4 |
28. | I’ve been blaming myself for things that happened | 1 | 2 | 3 | 4 |
CAREGIVER SECTION:

Carer Initial Assessment: Open Ended Questionnaire
What are the main problems your care recipient faces in his/her everyday life?
**Self-rated burden (SRB)**
On the scale below '0' means that you feel that caring for or accompanying …. At the moment if no hard at all; ‘100’ means that you feel that caring for or accompanying …. At the moment is much too hard. Please indicate with an ‘X’ on the scale how burdensome you feel caring for or accompanying your partner is at the moment.

<table>
<thead>
<tr>
<th>Not at all straining</th>
<th>Much too straining</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Caregiver Strain Index (CSI)

I am going to read a list of things which other people have found to be difficult in helping out after somebody comes home from the hospital. Would you tell me whether any of these apply to you?

- Sleep is disturbed (e.g. because ……is in and out of bed or wanders around at night)
- It is inconvenient (e.g. because helping takes so much time or it’s a long drive over to help.
- It is a physical stain (e.g. because of lifting in and out of a chair; effort or concentration is required).
- It is confining (e.g. because helping restricts free time or cannot go visiting).
- There have been family adjustments (e.g. because helping has disrupted routine; there has been no privacy.
- There have been changes in personal plans (e.g. because had to turn down a job; could not go on vacation).
- There have been other demands on my time (e.g. from other family members).
- There have been emotional adjustments (e.g. because of severe arguments).
- Some behaviour is upsetting (e.g. because of incontinence…has trouble remembering things; or ….. accuses people of taking things).
- It is upsetting to find that …..has changed so much from his/her former self (e.g. because he/she is a different person than he/she used to be).
- There have been work adjustments (e.g. because of having to take time off).
- It is a financial strain.
- Feeling completely overwhelmed (e.g. because of worry about …..concerns about how you will manage).

**Total Score (count yes responses) _____**
ICF CHECKLIST
Version 2.1a, Clinician Form
for International Classification of Functioning, Disability and Health
This is a checklist of major categories of the International Classification of Functioning, Disability and Health (ICF) of the World Health Organization. The ICF Checklist is a practical tool to elicit and record information on the functioning and disability of an individual.

PART 1a: IMPAIRMENTS of BODY FUNCTIONS
- Body functions are the physiological functions of body systems (including psychological functions).
- Impairments are problems in body function as a significant deviation or loss.

Short List of Body Functions

<table>
<thead>
<tr>
<th>Category</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>b1. MENTAL FUNCTIONS</td>
<td>b110 Consciousness</td>
</tr>
<tr>
<td></td>
<td>b114 Orientation (time, place, person)</td>
</tr>
<tr>
<td></td>
<td>b117 Intellectual (incl. Retardation, dementia)</td>
</tr>
<tr>
<td></td>
<td>b130 Energy and drive functions</td>
</tr>
<tr>
<td></td>
<td>b134 Sleep</td>
</tr>
<tr>
<td></td>
<td>b140 Attention</td>
</tr>
<tr>
<td></td>
<td>b144 Memory</td>
</tr>
<tr>
<td></td>
<td>b152 Emotional functions</td>
</tr>
<tr>
<td></td>
<td>b156 Perceptual functions</td>
</tr>
<tr>
<td></td>
<td>b164 Higher level cognitive functions</td>
</tr>
<tr>
<td></td>
<td>b167 Language</td>
</tr>
<tr>
<td>b2. SENSORY FUNCTIONS AND PAIN</td>
<td>b210 Seeing</td>
</tr>
<tr>
<td></td>
<td>b230 Hearing</td>
</tr>
<tr>
<td></td>
<td>b235 Vestibular (incl. Balance functions)</td>
</tr>
<tr>
<td></td>
<td>b280 Pain</td>
</tr>
<tr>
<td>b3. VOICE AND SPEECH FUNCTIONS</td>
<td>b310 Voice</td>
</tr>
<tr>
<td>b4. FUNCTIONS OF THE CARDIOVASCULAR, HAEMATOLOGICAL, IMMUNOLOGICAL AND RESPIRATORY SYSTEMS</td>
<td>b410 Heart</td>
</tr>
<tr>
<td></td>
<td>b420 Blood pressure</td>
</tr>
<tr>
<td></td>
<td>b430 Haematological (blood)</td>
</tr>
<tr>
<td></td>
<td>b435 Immunological (allergies, hypersensitivity)</td>
</tr>
<tr>
<td></td>
<td>b440 Respiration (breathing)</td>
</tr>
<tr>
<td>b5. FUNCTIONS OF THE DIGESTIVE, METABOLIC AND ENDOCRINE SYSTEMS</td>
<td>b515 Digestive</td>
</tr>
<tr>
<td></td>
<td>b525 Defecation</td>
</tr>
<tr>
<td></td>
<td>b530 Weight maintenance</td>
</tr>
<tr>
<td></td>
<td>b555 Endocrine glands (hormonal changes)</td>
</tr>
<tr>
<td>b6. GENITOURINARY AND REPRODUCTIVE FUNCTIONS</td>
<td>b620 Urination functions</td>
</tr>
<tr>
<td></td>
<td>b640 Sexual functions</td>
</tr>
<tr>
<td>b7. NEUROMUSCULOSKELETAL AND MOVEMENT RELATED FUNCTIONS</td>
<td>b710 Mobility of joint</td>
</tr>
<tr>
<td></td>
<td>b730 Muscle power</td>
</tr>
<tr>
<td></td>
<td>b735 Muscle tone</td>
</tr>
<tr>
<td></td>
<td>b765 Involuntary movements</td>
</tr>
<tr>
<td>b8. FUNCTIONS OF THE SKIN AND RELATED STRUCTURES ANY OTHER BODY FUNCTIONS</td>
<td></td>
</tr>
</tbody>
</table>
Part 1 b: IMPAIRMENTS of BODY STRUCTURES

Body structures are anatomical parts of the body such as organs, limbs and their components.

Impairments are problems in structure as a significant deviation or loss.

s1. STRUCTURE OF THE NERVOUS SYSTEM
   - s110 Brain
   - s120 Spinal cord and peripheral nerves

s2. THE EYE, EAR AND RELATED STRUCTURES

s3. STRUCTURES INVOLVED IN VOICE AND SPEECH

s4. STRUCTURE OF THE CARDIOVASCULAR, IMMUNOLOGICAL AND RESPIRATORY SYSTEMS
   - s410 Cardiovascular system
   - s430 Respiratory system

s5. STRUCTURES RELATED TO THE DIGESTIVE, METABOLISM AND ENDOCRINE SYSTEMS

s6. STRUCTURE RELATED TO GENITOURINARY AND REPRODUCTIVE SYSTEM
   - s610 Urinary system
   - s630 Reproductive system

s7. STRUCTURE RELATED TO MOVEMENT
   - s710 Head and neck region
   - s720 Shoulder region
   - s730 Upper extremity (arm, hand)
   - s740 Pelvis
   - s750 Lower extremity (leg, foot)
   - s760 Trunk

s8. SKIN AND RELATED STRUCTURES ANY OTHER BODY STRUCTURES

PART 2: ACTIVITY LIMITATIONS & PARTICIPATION RESTRICTION

Activity is the execution of a task or action by an individual. Participation is involvement in a life situation.

Activity limitations are difficulties an individual may have in executing activities. Participation restrictions are problems an individual may have in involvement in life situations.

The Performance qualifier describes what an individual does in his or her current environment. Because the current environment brings in the societal context, performance can also be understood as “involvement in a life situation” or “the lived experience” of people in the actual context in which they live. This context includes the environmental factors – all aspects of the physical, social and attitudinal world that can be coded using the Environmental Factors.

The Capacity qualifier describes an individual’s ability to execute a task or an action. This construct indicates the highest probable level of functioning that a person may reach in a given domain at a given moment. To assess the full ability of the individual, one would need to have a “standardized” environment to neutralize the varying impact of different environments on the ability of the individual. As standardized environment may be: (a) an actual environment commonly used for capacity assessment in test settings; or (b) where this is not possible, a hypothetical environment a uniform impact.

Short List of A&P domains

d1. LEARNING AND APPLYING KNOWLEDGE
   - d110 Watching
   - d115 Listening
   - d140 Learning to read
   - d145 Learning to write
   - d150 Learning to calculate (arithmetic)
   - d175 Solving problems

d2. GENERAL TASKS AND DEMANDS
   - d210 Undertaking a single task
   - d220 Undertaking multiple tasks

d3. COMMUNICATION
   - d310 Communicating with -- receiving -- spoken messages
   - d315 Communicating with -- receiving -- non-verbal messages
d330 Speaking
d335 Producing non-verbal messages
d350 Conversation
d4. MOBILITY
d430 Lifting and carrying objects
d440 Fine hand use (picking up, grasping)
d450 Walking
d465 Moving around using equipment (wheelchair, skates, etc.)
d470 Using transportation (car, bus, train, plane, etc.)
d475 Driving (riding bicycle and motorbike, driving car, etc.)
d5. SELF CARE
d510 Washing oneself (bathing, drying, washing hands, etc)
d520 Caring for body parts (brushing teeth, shaving, grooming, etc.)
d530 Toileting
d540 Dressing
d550 Eating
d560 Drinking
d570 Looking after one’s health
d6. DOMESTIC LIFE
d620 Acquisition of goods and services (shopping, etc.)
d630 Preparation of meals (cooking etc.)
d640 Doing housework (cleaning house, washing dishes, laundry, ironing, etc.)
d660 Assisting others
d7. INTERPERSONAL INTERACTIONS AND RELATIONSHIPS
d710 Basic interpersonal interactions
d720 Complex interpersonal interactions
d730 Relating with strangers
d740 Formal relationships
d750 Informal social relationships
d760 Family relationships
d770 Intimate relationships
d8. MAJOR LIFE AREAS
d810 Informal education
d820 School education
d830 Higher education
d850 Remunerative employment
d860 Basic economic transactions
d870 Economic self-sufficiency
d9. COMMUNITY, SOCIAL AND CIVIC LIFE
d910 Community Life
d920 Recreation and leisure
d930 Religion and spirituality
d940 Human rights
d950 Political life and citizenship

ANY OTHER ACTIVITY AND PARTICIPATION

PART 3: ENVIRONMENTAL FACTORS

Environmental factors make up the physical, social and attitudinal environment in which people live and conduct their lives.

Short List of Environment

e1. PRODUCTS AND TECHNOLOGY
   e110 For personal consumption (food, medicines)
e115 For personal use in daily living
e120 For personal indoor and outdoor mobility and transportation
e125 Products for communication
e150 Design, construction and building products and technology of buildings for public use
e155 Design, construction and building products and technology of buildings for private use
e2. NATURAL ENVIRONMENT AND HUMAN MADE CHANGES TO ENVIRONMENT
   e225 Climate
e240 Light
e250 Sound

3. SUPPORT AND RELATIONSHIPS
   e310 Immediate family
   e320 Friends
   e325 Acquaintances, peers, colleagues, neighbours and community members
   e330 People in position of authority
   e340 Personal care providers and personal assistants
   e355 Health professionals
   e360 Health related professionals

4. ATTITUDES
   e410 Individual attitudes of immediate family members
   e420 Individual attitudes of friends
   e440 Individual attitudes of personal care providers and personal assistants
   e450 Individual attitudes of health professionals
   e455 Individual attitudes of health related professionals
   e460 Societal attitudes
   e465 Social norms, practices and ideologies

5. SERVICEx, SYSTEMxS AND POLICIES
   e525 Housing services, systems and policies
   e535 Communication services, systems and policies
   e540 Transportation services, systems and policies
   e550 Legal services, systems and policies
   e570 Social security, services, systems and policies
   e575 General social support services, systems and policies
   e580 Health services, systems and policies
   e585 Education and training services, systems and policies
   e590 Labour and employment services, systems and policies

ANY OTHER ENVIRONMENTAL FACTORS

Part 4: OTHER CONTEXTUAL INFORMATION
4.1 Give a thumbnail sketch of the individual and any other relevant information.
4.2 Include any Personal Factors as they impact on functioning (e.g. lifestyle, habits, social background, education, life events, race/ethnicity, sexual orientation and assets of the individual).
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