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Towards Earlier Discharge, Better Outcomes, Lower Costs: Stroke rehabilitation in Ireland

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Towards Earlier Discharge, Better Outcomes, Lower Cost: Stroke Rehabilitation in Ireland

September 2014

Report prepared for the **Irish Heart Foundation**
by the **Economic and Social Research Institute** (ESRI)
and the **Royal College of Surgeons in Ireland** (RCSI)

IRISH HEART FOUNDATION

RCSI

ESRI

Towards Earlier Discharge, Better Outcomes, Lower Cost: Stroke Rehabilitation in Ireland

Report prepared for the Irish Heart Foundation by the Economic and Social Research Institute (ESRI) and the Royal College of Surgeons in Ireland (RCSI)

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The ESRI

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Abbreviations

ADL	Activities of Daily Living
ASPIRE-S	The Action on Secondary Prevention Interventions and Rehabilitation in Stroke Study
AusTOMs	Australian Therapy Outcome Measures
BI	Barthel Index
CCA	Cost-Consequences Analysis
CD	Conventional Discharge
CEA	Cost-Effectiveness Analysis
CMA	Cost-Minimisation Analysis
CMG	Case-Mix Group Classification
COPM	Canadian Occupational Performance Measure
CoSS	HSE National Stroke Programme's Community Stroke Service Survey
CRT	Community Rehabilitation Team
CST	Community Stroke Team
CUA	Cost-Utility Analysis
DES	Discrete-Event Simulation
DST	Disability State Transition
ESD	Early Supported Discharge
FIM	Functional Independence Measure
HCP	Home Care Packages
HIPE	Hospital Inpatient Enquiry Database
HIQA	Health Information and Quality Authority
HLS	Hospital Leads' Survey
HRQoL	Health-Related Quality of Life
HSE	Health Service Executive
ICER	Incremental Cost-Effectiveness Ratio
IHF	Irish Heart Foundation
INASC	Irish National Audit of Stroke Care
ISA	Integrated Service Area
KCL	King's College London
LHO	Local Health Office
LOS	Length of Stay
LSAS	Long-Stay Activity Statistics
MMUH	Mater Misericordiae University Hospital
MRS	Modified Rankin Scale
MSW	Medical Social Worker
NDPSS	North Dublin Population Stroke Study
NDS	National Disability Survey
NICE	National Institute for Health and Clinical Excellence (UK)
NRH	National Rehabilitation Hospital
OT	Occupational Therapist
PSSRU	Personal Social Services Research Unit (UK)
PT	Physiotherapist
QALY	Quality-adjusted Life Year
QNHS	Quarterly National Household Survey
RCT	Randomised Controlled Trial
SAQOL39	Stroke and Aphasia Quality of Life Scale - 39
SD	Standard deviation
SLSR	South London Stroke Register
SLT	Speech and Language Therapist
SRI	Stroke Rehabilitation in Ireland study
SSS	Scandinavian Stroke Scale
SU	Stroke Unit
TILDA	The Irish Longitudinal Study on Ageing
WTE	Whole-time Equivalent

Foreword

Towards Earlier Discharge, Better Outcomes, Lower Cost is a new and valuable study which adds to our understanding of how to better patient outcomes within the budgetary realities of our current healthcare system. This study, undertaken by the ESRI and the RCSI with the support of the Irish Heart Foundation, provides a strong economic justification for policymakers to develop Ireland's community rehabilitation and care services, and equally, shows the potential benefits for patients that can come from healthcare research.

This study brought together a range of disciplines and expertise to build on the previous Irish Heart Foundation-supported study, *The Cost of Stroke in Ireland*, undertaken by researchers at the ESRI and RCSI. We would like to acknowledge the hard work and input of all those involved in the research for this study, especially the researchers in the ESRI, NUIG, RCSI, King's College London and the team in the IHF. We would also like to acknowledge the invaluable guidance of the steering group, many of whom are clinical professionals directly involved in delivering stroke care. We would like to thank the HSE for contributing funding to this research. It is hoped that more research of this nature, which provides an evidence base for the development of Irish healthcare, might be considered in the near future.

Dr Angie Brown
Medical Director, Irish Heart Foundation

Professor Frances Ruane
Director, ESRI

Executive Summary

Introduction

This report describes the analysis and findings of the Stroke Rehabilitation in Ireland (SRI) study. This study was undertaken with the overall aim of examining rehabilitation services for stroke patients in the Irish healthcare system, identifying patterns of use, and assessing implications (in terms of economic and health outcomes) of existing and new models of care.

The SRI study had four main objectives:

- to describe current rehabilitation provision for stroke patients in Ireland;
- to analyse best practice pathways of stroke rehabilitation;
- to compare costs, outcomes and cost-effectiveness implications of actual and best practice pathways of rehabilitation in Ireland;
- to recommend how best to deliver stroke rehabilitation after the inpatient phase.

Context

Stroke is a leading cause of death and disability worldwide and estimates for a number of countries suggest that cerebrovascular diseases account for up to five per cent of total healthcare. Total stroke costs in Ireland were most recently estimated to have been €489 to €805 million in the year 2007 with nursing home care needs and indirect costs accounting for the largest proportion of costs (Smith et al. 2010). Patients who survive an acute stroke episode are often left with some level of disability. Rehabilitation to reduce disability is therefore central to the post-acute care of stroke patients. Although the importance of rehabilitation for stroke has been acknowledged and addressed in national strategies, earlier studies of stroke services in the Irish healthcare system found large gaps in the provision of rehabilitation services and restrictions in access (Irish Heart Foundation 2008; Smith et al. 2010; Department of Health and Children 2011b).

Need for Rehabilitation After Stroke

This report analyses the need for rehabilitation among those who have had a stroke. In the region of 7,000 people are hospitalised following stroke each year in Ireland, of whom approximately 18 to 19 per cent die as inpatients. At seven

days after stroke, 44 per cent of patients, some 3,000 people, will have mild to moderate disability and require some level of rehabilitation. Such patients could potentially benefit from Early Supported Discharge (ESD) from hospital. ESD is an intensive approach to rehabilitation in the community which is used internationally but not generally available in Ireland and it is examined in detail in this study. A further 2,500 surviving patients have severe disability at seven days after stroke, of whom 1,000 to 1,200 patients have persistent severe disability for at least three months after stroke. Optimising the prospects for rehabilitation of patients with severe post-stroke disability and providing for their care is critical for these patients and their families. This means that the quality of rehabilitation services for stroke patients in Ireland will affect the quality of life of some 5,000 to 6,000 people annually, in addition to the lives of their families and carers.

Approach to Analysis

This report analyses need for rehabilitation services nationally and regionally in Ireland; assesses current stroke services in light of that need; and analyses pathways of care from hospital to rehabilitation settings, whether inpatient, outpatient, in the community or at home. The data sources for Ireland which have informed this study have encompassed: detailed, stroke-specific, patient-level studies; surveys of stroke survivors; surveys of providers of services; routinely collected administrative data; and Central Statistics Office datasets. Some of these datasets are based on a total population, such as all public hospital stroke discharges, which are recorded in the Hospital Inpatient Enquiry (HIPE). Others, such as The Irish Longitudinal Study on Ageing (TILDA), are based on a nationally representative sample. In addition, in order to inform this study's understanding of detailed local pathways of care for stroke survivors, the authors of this study undertook a survey of clinical leads in stroke care in Irish hospitals (consultants, clinical nurse specialists and physiotherapists). From this composite analysis, current resource use, costs and outcomes are estimated for stroke survivors who may benefit from ESD in Ireland. From detailed review of the international literature on stroke rehabilitation, the resource and cost implications of implementing ESD are analysed and estimated. Based on these analyses, the costs and outcomes of ESD and Conventional Discharge practices are compared, using cost and cost-effectiveness modelling techniques. The findings from this comparison enable an assessment of the implications for individuals, for national healthcare expenditure and for policy-makers, of moving to international best practice in stroke rehabilitation.

Key Findings

The detailed nature of this study has produced extensive new information across a range of areas. The detailed findings, reflecting the nature and breadth of the study, are summarised in Chapter 6. The study's key findings are:

1. There is an international consensus that:
    i. stroke survivors with mild or moderate disability are in general suited to Early Supported Discharge (ESD);
    ii. ESD is an intensive approach to rehabilitation in the community, which can improve disability outcomes, reduce the likelihood of long-term institutional care and reduce acute hospital length of stay;
    iii. the needs of survivors with more severe disability are better met by specialised inpatient rehabilitation;
2. There is currently poor resourcing of and wide regional variation in community and inpatient rehabilitation for stroke survivors in Ireland.
3. There is considerable regional and hospital variation in stroke survivors' length of stay in acute hospitals, which appears to reflect differing regional pathways of care and differing resourcing of care in alternative settings.
4. There are long waits for nursing home care and specialist inpatient rehabilitation for patients with severe stroke conditions.
5. On base case assumptions, implementing ESD in Ireland for stroke survivors with mild to moderate disability:
    i. could save nationally approximately €12 million from reduced hospital length of stay;
    ii. could free up over 24,000 hospital bed days, the equivalent of 67 hospital beds annually;
    iii. could cost nationally between €5 million and €10 million to resource the community therapy and other community services necessary, depending on the model of ESD adopted;
    iv. would require a substantial increase in the resourcing of community therapists and other community care from current levels in Ireland, even in areas where community rehabilitation is better-resourced;
    v. taking account of these costs and savings could result in a net saving nationally of between €2 million and €7 million in first-year care after stroke, depending on the model of ESD;

vi. could deliver a mean additional Quality-Adjusted Life Year (QALY) for a mean additional cost of €4,734 over ten years, which compares favourably to standard UK benchmarks for cost-effective healthcare interventions.

6. Sensitivity analysis, undertaken to test the robustness of the analysis, shows:

   i. that this first-year cost saving generally holds, provided ESD delivers an expected mean eight-day reduction in hospital length of stay at Irish average stroke bed-day costs;

   ii. In one scenario, a marginal first-year cost of ESD implementation arises, when high unit costs are applied to the most generously-resourced ESD model. Even in this scenario, the marginal cost of implementing ESD is one-third of the cost of an inpatient day;

   iii. the level of cost-effectiveness (cost per QALY gained) is sensitive to assumptions about the improvement in disability levels consequent on ESD and the costing methodology applied.

Policy Issues

The analysis in this report supports a move to international best practice in stroke rehabilitation in Ireland, with implementation of Early Supported Discharge (ESD) for patients with mild to moderate disability offering the potential for better outcomes for patients from better care in the community. This could be achieved at a net saving in national health expenditure by freeing up acute hospital beds. However, moving from this analysis to implementation of best practice in a context of constrained national healthcare expenditures and inadequately resourced community care requires a planned and integrated approach. Allocation of resources to community care should reflect regularly updated, area-level analysis of resourcing, such as that undertaken in this report, and should prioritise those areas which are relatively under-resourced. Although this is not a resource allocation study, this study does point to a need for transparent resource allocation criteria, with assessment of need potentially expanded beyond the factors analysed in this report.

Translating acute care savings into community care resourcing requires shifting the balance in the Irish healthcare system from over-reliance on the acute sector to greater delivery of care in the community. While it has been outside the scope of this study to analyse the reasons for this imbalance in Irish health care and the policy measures required to remedy it, other studies have pointed a way. The 2010 *Report of the Expert Group on Resource Allocation and Financing in the Health Sector* described ‘the poorly developed system of community health

services' as 'perhaps the greatest deficiency in the current provision of public health services in Ireland' (Ruane 2010: 48). The Expert Group recommended that the development of community health services should be clearly based on protocols for care and there should be a system of 'clearer and more logical entitlements to community health services' (Ruane 2010: 113).

The analysis in this report has, to the greatest degree possible, encompassed the needs of all stroke survivors, including those with severe disability post-stroke. Regrettably, limited international research on best practice in their rehabilitation has meant that this study could not undertake an economic analysis of implementing best practice for severe stroke patients. However, this study has analysed Irish services for this grouping to the degree that the data allow and is in a position to make some recommendations for their care. Further research is needed in relation to severe stroke. Further research is also needed in relation to stroke survivors with mild to moderate disability, who live in rural areas of dispersed population, for whom the potential benefits of ESD have not yet been adequately researched internationally.

Recommendations

The recommendations in this report have been developed from reflection and discussion on the findings of the analysis between the research team and the expert members of the Stroke Rehabilitation in Ireland project steering group, many of whom are clinical professionals directly involved in delivering stroke care. The recommendations are listed below under three headings: recommendations for patients with mild to moderate disability after stroke; recommendations for patients with severe disability after stroke; and general recommendations for stroke rehabilitation in Ireland.

Recommendations for Patients with Mild to Moderate Disability After Stroke

1. Early Supported Discharge should be the preferred rehabilitation option in Ireland for patients with mild to moderate disability after stroke;
2. Savings from reduced acute bed days achieved by ESD should be applied to resourcing community care staff: physiotherapists, occupational therapists, speech and language therapists, community nurses, social workers, home helps, psychologists and counsellors;
3. Further research is required to assess the feasibility of ESD in rural areas of dispersed population. If implementation of ESD is not found to be feasible in some such areas, inpatient or centre-based rehabilitation programmes should be maintained or developed and resourced.

Recommendations for Patients with Severe Disability After Stroke

4. Capacity and staffing should be expanded for specialist inpatient rehabilitation for patients with severe stroke;
5. Numbers of nursing home places suitable for support and care for stroke patients with significant disability should be increased, particularly in areas where there is evidence of long delays in discharge from hospital due to difficulties in accessing nursing home care;
6. Patients with severe stroke, who could potentially be discharged home following rehabilitation, should be identified early and offered specialised inpatient rehabilitation;
7. The rehabilitation needs of survivors of a severe or moderate stroke should be reassessed weekly for the first month, and then at intervals as indicated by their health status;
8. Given the relatively limited research on best practice in rehabilitation for patients with severe stroke, a randomised controlled trial (RCT) should be conducted in Ireland to assess the relative costs and outcomes of systematically providing specialised inpatient rehabilitation for severe stroke as compared to usual care;
9. Such an RCT should measure functional outcomes and include the costs of long-term care, whether delivered at home or in an institutional setting and by formal or informal carers.

General recommendations for stroke rehabilitation in Ireland

10. Services should be provided to stroke survivors on a needs basis, without regard to age or region and with standardised delivery of care, meeting international and national best practice guidelines;
11. Any stroke survivor with declining physical activity, ability to undertake everyday tasks or mobility at six months or later after stroke should be assessed for appropriate targeted rehabilitation;
12. Evidence from this and other studies of deficits in the availability of psychological services for stroke survivors in the acute setting, in the community and in nursing homes, combined with evidence of considerable emotional distress in stroke survivors, indicates a clear need for the development of psychological and counselling services;
13. Any stroke survivor with declining cognitive function or mood at six months or later after stroke should be assessed for appropriate targeted rehabilitation;

14. A national stroke register should be resourced to sustain the systematic recording of treatment, outcomes (including measures of disability) and care in hospital, the community and long-term care settings of patients with stroke.

CHAPTER 1

Background

1.1 Introduction

This report describes the analysis and findings of the Stroke Rehabilitation in Ireland (SRI) study. The study was commissioned by the Irish Heart Foundation (IHF) and funded by the IHF and the Health Service Executive (HSE).[1] The SRI study has four main objectives: to describe current rehabilitation for stroke patients in Ireland; to analyse best practice pathways of stroke rehabilitation; to compare costs, outcomes and cost-effectiveness implications of actual and best practice pathways of rehabilitation in Ireland; and to recommend how best to deliver stroke rehabilitation after the inpatient phase depending on age, severity of disability and type of stroke.

The standard definition of stroke is as a brain attack, caused by the blockage of a blood vessel or a haemorrhage that disrupts the flow of blood to the brain, causing a focal or global neurological deficit (affecting bodily functions or mental processes) lasting more than 24 hours or causing death within 24 hours (World Health Organization 2006). There is also a strong case for considering stroke as a chronic disease with acute events (O'Neill et al. 2008). Stroke is a leading cause of death and disability worldwide and it is estimated that cerebrovascular diseases account for up to five per cent of total healthcare expenditure in a number of countries (Evers et al. 2004; Rossnagel et al. 2005). Patients who survive an acute stroke episode are often left with some level of disability and may be dependent on others to carry out daily activities (Moon et al. 2003). The physical disability and morbidity resulting from stroke pose a significant burden both at individual and societal level (Hickey et al. 2012). Rehabilitation can have an important impact on the overall clinical and economic burden of stroke not just for the stroke survivor but also for the family/caregiver, the healthcare system (Department of Health and Children 2010) and the economy.

Langhorne et al. (2011) have observed that 'although impressive developments have been made in the medical management of stroke [...] most post-stroke care will continue to rely on rehabilitation interventions' (Langhorne et al. 2011: 1693). Although definitions of rehabilitation differ, the need for rehabilitation is

[1] The study commenced in December 2012 and concluded in August 2014.

broadly identified by some level of disability; and successful rehabilitation is an intervention that reduces disability. Wade (1992) defined rehabilitation as 'a problem-solving and educational process aimed at reducing the disability and handicap experienced by someone as a result of a disease' (Wade 1992: 11). Outpatient Service Trialists (2003) elaborate that outpatient stroke rehabilitation services can be considered as any intervention delivered by rehabilitation personnel which aims to meet these broad objectives. Korner-Bitensky (2013) has described the goals of early stroke rehabilitation as: preventing post-stroke complications; minimizing impairments; and maximizing function. Outpatient Service Trialists (2003) identified two groups of interventions designed to rehabilitate stroke survivors at home: therapy-based services provided by physiotherapy, occupational therapy, or multidisciplinary staff working with patients primarily to improve task-orientated behaviour (e.g. walking, dressing) and hence reduce disability; or

> *stroke liaison worker services: provided by nursing, social work or volunteer staff working with patients to provide information and improve social liaison with the primary intention of improving mood and alleviating the emotional impact of stroke*
>
> *(Outpatient Service Trialists 2003: 3).*

This first chapter of the report establishes the background to this study, discussing the Irish and international literature on stroke rehabilitation. Chapter Two describes the data analysed in this study and the methods of analysis employed. Chapter Three analyses current provision of rehabilitation for stroke patients in Ireland. Chapter Four draws on the international literature review to present best practice pathways of stroke rehabilitation. Chapter Five reports on the economic evaluation of current compared to best practice pathways of stroke rehabilitation. Chapter Six summarises and discusses the report's findings. Chapter Seven provides recommendations on stroke rehabilitation in Ireland.

1.2 Stroke Rehabilitation in Ireland

This study examines rehabilitation for stroke survivors in Ireland.[2] Analysis in this report has found that in the region of 7,000 people are hospitalised following stroke each year in Ireland, of whom approximately 18 to 19 per cent die as inpatients. At seven days after stroke, 44 per cent of patients, some 3,000 people, have mild to moderate disability and require some level of rehabilitation. Such patients could potentially benefit from Early Supported Discharge (ESD) from hospital. ESD is an intensive approach to rehabilitation in the community which is used internationally but not generally available in Ireland and it is examined in detail in this study. A further 2,500 surviving patients have severe disability at

[2] This study does not examine services for survivors of Transient Ischaemic Attacks (TIAs).

seven days after stroke, of whom 1,000 to 1,200 patients have persistent severe disability for at least three months after stroke. Optimising the prospects for rehabilitation of patients with severe post-stroke disability and providing for their care is critical for these patients and their families. This means that the quality of rehabilitation services for stroke patients in Ireland will affect the quality of life of some 5,000 to 6,000 people annually, in addition to the lives of their families and carers.

In 2007, total stroke costs in Ireland are estimated to have been €489 to €805 million, with nursing home care needs and indirect costs accounting for the largest proportion of costs (Smith et al. 2010). At €805 million, these costs equate to five per cent of total Irish health expenditure in that year (Department of Health and Children 2011b). The importance of rehabilitation for stroke has been acknowledged and addressed in national strategies: the National Cardiovascular Health Policy (Department of Health and Children 2010) and the National Policy and Strategy for the Provision of Neuro-Rehabilitation Services in Ireland 2011-2015 (Department of Health and Health Service Executive 2011). The literature on stroke services in the Irish healthcare system has found large gaps in the provision of rehabilitation services and restrictions in access (Irish Heart Foundation 2008; Smith et al. 2010; Department of Health and Children 2011b).

Neuro-rehabilitation services have been found to be underdeveloped and to have 'developed in an ad hoc manner, leading to fragmented services around the country'. Impacts from the 'disjointed' neuro-rehabilitation service delivery include 'increased pressures on the overall health system caused by delayed discharges of patients to appropriate settings, repeated re-admissions to hospitals and associated wastage of resources' (Department of Health and Children 2011b: 23). Hickey et al. (2012) note the absence of services such as early supported discharge and dedicated community stroke services, with ongoing unmet medical and rehabilitation needs for physiotherapy, occupational therapy and day care. Assessment of rehabilitation for stroke patients in Ireland has also been limited by the absence of systematically recorded, centrally pooled data (Smith et al. 2010; Hickey et al. 2012). Chapter Three of this report further analyses the evidence on current provision of stroke rehabilitation in Ireland.

1.3 Evidence on Best Practice in Stroke Rehabilitation

The international literature on stroke rehabilitation distinguishes between rehabilitation needs of stroke survivors based on their level of disability. Broadly, a consensus has emerged from international trials that survivors with mild or moderate disability are considered suited to Early Supported Discharge (ESD),

while the needs of survivors with more severe disability are better met by specialised inpatient rehabilitation. The following sections review the evidence on best practice in stroke rehabilitation for each of these survivor groupings in turn, while the final section of this chapter reviews analyses of the cost-effectiveness of alternative rehabilitation pathways.

1.3.1 Early Supported Discharge

ESD has been defined as any intervention that aims to accelerate discharge from hospital and provides support in a community setting (Fearon and Langhorne 2012). ESD has been variously described as: 'early supported discharge schemes', 'early home supported discharge services', 'accelerated discharge schemes' and 'post discharge support services' (Fearon and Langhorne 2012).

The rationale for the relative effectiveness of ESD is that since stroke patients prefer not to be in hospital, their compliance with rehabilitation may not be as high in the hospital setting as at home which may result in less effective rehabilitation (Teasell et al. 2003). Furthermore, since a goal of rehabilitation is to facilitate re-adaptation to the home environment, this environment is the best place to learn such skills (Teasell et al. 2003). To achieve successful outcomes, it is recommended that ESD should only be offered to patients who are able to transfer independently or with the assistance of one person, and should consist of the same intensity and skill-mix that is available in hospital, without delay in delivery (Intercollegiate Stroke Working Party 2012). Rehabilitation and support in the community setting should be provided from a well co-ordinated, multidisciplinary rehabilitation team (Brewer and Williams 2010).

Systematic reviews of the published results of ESD trials have found a significant reduction in the odds of requiring long-term institutional care for patients receiving ESD compared to conventional care (Langhorne et al. 2005; Larsen et al. 2006; Rousseaux et al. 2009; Fearon and Langhorne 2012). A meta-analysis of individual patient data from 14 trials with 1,957 participants found that patients who received these services returned home earlier and were more likely to remain at home in the long term and to regain independence in daily activities (Fearon and Langhorne 2012). The seminal ESD trials, which feature in this and most meta-analyses of ESD, were conducted in: Adelaide, Australia; Akershus, Trondheim and Oslo in Norway; Belfast, Northern Ireland; Stockholm, Sweden; Bangkok, Thailand; Montreal, Canada; London and Newcastle in England; and Copenhagen and Glostrup in Denmark. Fearon and Langhorne (2012) found that with ESD there was a significant reduction in the odds of patients dying or requiring long-term institutional care, which equated to an extra four patients

living at home for every 100 treated. There was also a significant reduction in the odds of the combined adverse outcome of death or dependency, which equated to an extra five patients regaining independence for every 100 receiving ESD services.

Hospital length of stay (LOS) has been found to reduce by between seven to 13 days with ESD (Anderson et al. 2002; Langhorne et al. 2005; Larsen et al. 2006; Rousseaux et al. 2009; Fearon and Langhorne 2012). Studies over longer periods have found better outcomes for ESD participants than for control groups who did not receive ESD, when measured at 26 weeks and at one year (Indredavik et al. 2000; Fjaertoft et al. 2003). While LOS reduces and disability rates and rates of institutionalisation reduce with ESD, mortality rates show no significant difference when compared to usual care (Fearon and Langhorne 2012). A review by Langhorne et al. (2005) found no significant difference in mortality (based on 11 trials) between ESD and the control population.

Although ESD is not a standardised system, a consensus document published by ESD Trialists developed recommendations regarding several aspects of ESD services (Fisher et al. 2011). Based on a 100 patient per year caseload, the consensus was that the team, expressed as whole-time equivalents (WTE), should include: physiotherapy (1.0), occupational therapy (1.0), speech and language therapy (0.4), social work (0-0.5), nursing (0-1.2), and medical (0.1) staff (Fisher et al. 2011). In a review of ESD trials (nine urban, four mixed and one rural), Fearon and Langhorne (2012) calculated that staffing levels for a 100 patient per year caseload were a median of approximately 3.0 WTE staff (range 2.5 to 4.6): medical 0.08 (0 - 0.12), nursing 0 (0 - 1.2), physiotherapy 1.1 (0.7 - 2), occupational therapy 1.0 (0.7 - 2), speech and language therapy 0.1 (0 - 0.5), and assistant 0.2 (0 - 1.5). Variable levels of social work (0 - 0.5 WTE) and secretarial support were also available. Duration of ESD, frequency of visits and intensity of therapy varies based on the individual patient's need and level of disability. Mas and Inzitari (2012) suggest that there is a need to define more precisely an adequate duration and intensity of ESD interventions, possibly modifying for different types of stroke patients.

There has been considerable variation in the percentage of hospitalised patients included in ESD trials, ranging from 7.4 to 68.4 per cent in a comparison of 11 trials (Rousseaux et al. 2009). Inclusion rates were highest in an influential Norwegian trial in Trondheim and lowest in a trial in Montreal in Canada. Inclusion rates ranged from 13 to 70 per cent (median 34 per cent) in a further comparison of 14 trials (Fearon and Langhorne 2012). Mas and Inzitari (2012) found that patients selected for inclusion in ESD trials tend to be older and in a

clinical state suited to home management, to have mild or moderate stroke severity/disability and to live in the area where the intervention is implemented. Cognitive impairment, severe disability and prior institutionalisation are frequent exclusion criteria. Conversely, Gaynor et al. (2014) suggested there was emerging evidence of ageism in the selection of patients for studies on rehabilitation after stroke, with a mean age of 64.3 of all patients in such studies in Cochrane reviews[3] of rehabilitation after stroke. This mean is almost a decade younger than that for those seen by stroke physicians in daily practice in global terms, and 11 to 12 years younger than encountered in hospital practice in the UK and Ireland. Almost half (46 per cent) of trials excluded patients with cognitive impairment, almost one-quarter (23 per cent) patients with dysphasia and one-eighth (13 per cent) excluded patients with multiple strokes. Mas and Inzitari (2012) suggest that assessment of 'sufficient cognitive function and ability to consent' needs to be defined more clearly and standardised to avoid patients with some degree of potentially reversible cognitive impairment being unnecessarily excluded from the benefits of ESD. In some cases, patients with cognitive impairment have been excluded because they were unable to consent to research rather than unable to benefit from treatment (Mas and Inzitari 2012).

Since the characteristics of ESD services vary between trials and health and social care systems differ across countries where the trials are conducted, there are limitations to the generalisability of their results. Most ESD studies are single-site based and implemented in countries with healthcare systems which differ from the Irish system, factors which must be taken into account in assessing their applicability to Ireland. The overall cost of care after discharge may depend on a country's healthcare system. Rousseaux et al. (2009) pointed out that studies of ESD performed in cities across Europe, Canada and Australia show disparities, which depend on the respective healthcare systems:

> *the Norwegian and Swedish systems involve both relatively intense community rehabilitation care (including physiotherapy, occupational therapy and speech therapy) and social care... This could help explain why some studies did not show any (or only minor) differences between ESD and standard care. In contrast, the systems in the UK, Canada and Australia often provide less support for rehabilitation at home and thus comparative studies could more easily favour ESD*
>
> *(Rousseaux et al. 2009: 228).*

In summary, the literature suggests that ESD is a feasible and effective model of care that is associated with reduced hospital length of stay and has comparable

[3] Cochrane Reviews are systematic reviews of primary research in human health care and health policy, which investigate the effects of interventions for prevention, treatment and rehabilitation. They are published online in the Cochrane Library (The Cochrane Collaboration 2014).

or better patient outcomes than conventional services. Importantly, the evidence suggests that ESD does not adversely impact patient survival, functional recovery or quality of life. Best results in functional recovery are seen in patients with mild to moderate disability who are under the care of a well organised and co-ordinated ESD team who meet on a regular basis (Fearon and Langhorne 2012). However, uncertainties remain about team composition, eligible patients, and duration and intensity of therapy/services. In the Irish context, an important caveat to note is that the feasibility of ESD is uncertain for patients living in dispersed rural locations (Fisher et al. 2011). The role of ESD in such communities has not been adequately addressed with few RCTs having been undertaken in rural areas so that there is insufficient evidence to draw conclusions on ESD services for these patients (Fearon and Langhorne 2012).

1.3.2 Rehabilitation Post-Severe Stroke

There is no standardised definition of severe stroke. A number of scales are used in the literature to define stroke severity (Pereira et al. 2013). Severity may be measured based on the amount of initial trauma or risk of mortality on admission (Appelros et al. 2002) or it may be based on functional outcome after rehabilitation or level of morbidity after discharge (Nolfe et al. 2003). Some commonly used scales for assessing the level of independence in activities of daily living (ADLs) include the Barthel Index (BI) and the Functional Independence Measure (FIM). (See Appendix 8.1 for greater detail on the scales discussed here). In both of these scales, higher scores indicate greater independence. The FIM, unlike the BI, measures cognitive function. Examples of other scales arising in the literature include the Scandinavian Stroke Scale (SSS) where a low score is a predictor of early neurological deterioration following stroke; the Orpington Prognostic score with possible scores ranging from 1.2 (best prognosis) to 6.8 (worst prognosis); and the Case-Mix group (CMG) classification which groups cases that are similar according to functional motor and cognitive scores and age (Gagnon et al. 2005). Measures used in the literature to define severe stroke include BI scores of up to 10 (Fagerberg et al. 2000) and FIM scores ranging from motor FIM 13-44 (Sandstrom et al. 1998), admission FIM of under 60 (Schmidt et al. 1999) and FIM 18-39 at discharge from acute care (Nolfe et al. 2003). Jorgensen et al. (2000) described individuals with severe stroke as those with lowered consciousness at admission, while Teasell et al. (2005) described such individuals as those who were non-ambulatory at admission.

Since many studies examining stroke rehabilitation exclude individuals with severe stroke or do not include a subgroup analysis according to stroke severity, there is less research relating to the rehabilitation of severe stroke patients than other stroke survivors. Patients with severe stroke are thought to be unsuitable

for inclusion in ESD programmes (Lindsay et al. 2010). Although there are also questions regarding the rehabilitation potential of individuals with severe stroke (Pereira et al. 2012), there is evidence suggesting that patients with severe disability post-stroke benefit from specialised inpatient rehabilitation (Pereira et al. 2013). While these patients may not achieve improvements in functional outcomes, which are comparable to those achieved by patients with less severe disability, inpatient rehabilitation may provide other benefits such as reduced mortality and greater likelihood of discharge home compared to rehabilitation in other settings. Mortality has been found to be significantly lower in patients with severe stroke admitted to a stroke unit for inpatient rehabilitation compared to a general medical ward in studies in the UK and Denmark (Kalra et al. 1993; Jorgensen et al. 1995; Kalra and Eade 1995; Jorgensen et al. 2000). In a Norwegian study, Ronning and Guldvog (1998) found that at seven months post stroke, combined death and dependency was significantly lower in stroke unit patients (32 per cent) compared to those who received rehabilitation at home (62 per cent).

Compared to conventional rehabilitation, rehabilitation in a stroke unit tended to include or emphasise family participation, stroke education for providers, and improved multidisciplinary planning, discharge planning and goal setting. Kalra et al. (1993) outline that while the average duration of therapy input on the stroke unit was less than that on general medical wards, treatment differed in that it was specifically matched to individual patient needs. The authors suggest that this individualised treatment combined with better multidisciplinary co-ordination with patients and carers, a positive attitude among nurses, and their involvement as informal therapists may have contributed significantly to differences in outcome between the two groups. The psychological impact of being on the stroke unit may have also contributed by improving patients' morale and motivation to achieve greater functional independence.

Shorter LOS has been reported for persons with severe stroke admitted to stroke units when compared to general medical wards in studies in the UK and Denmark (Kalra et al. 1993; Jorgensen et al. 1995). Results of a randomised controlled trial (RCT) in the UK showed that patients treated on a stroke unit had a higher rate of discharge home compared to patients treated on a general medical ward (47 per cent versus 19 per cent) (Kalra and Eade 1995). Teasell et al. (2005) reviewed non-ambulatory stroke patients admitted between 1996-2001 to a specialised inpatient rehabilitation unit in Canada, which was designed to accommodate the needs of patients with profound disabilities who were considered inappropriate for conventional inpatient rehabilitation programmes. This study found that 43.4 per cent of patients with severe stroke were discharged home, while the

remainder were admitted to nursing homes or hospitals closer to their homes. The most powerful predictor of successful discharge home was admission FIM score, followed by age, male sex and no history of previous stroke.

While this literature suggests that patients with severe stroke benefit from inpatient rehabilitation in relation to reduced mortality, reduced length of stay and increased likelihood of discharge home, the evidence is less clear regarding functional outcomes for patients with severe stroke. Teasell et al. (2013) in *The Stroke Rehabilitation Evidence-Based Review (SREBR) (16th edition)* conclude:

> *There is strong evidence that for the subset of more severe stroke patients, specialized stroke rehabilitation reduces mortality, but does not result in improved functional outcomes, nor does it reduce the need for institutionalization, compared to conventional care... There is moderate evidence that patients with severe or moderately severe stroke who receive treatment on a stroke rehabilitation unit have a lower risk of being dependent or of having a poor outcome (death or dependency) compared with patients who receive little or no rehabilitation.*
>
> *(Teasell et al. 2013: Executive Summary 5).*

Although a number of studies have come to similar conclusions (Kalra et al. 1993; Kalra and Eade 1995), other studies have found improved functional outcomes following inpatient rehabilitation in patients with severe stroke (Beech et al. 1996; Ronning and Guldvog 1998; Teasell et al. 2005). An Irish study examining the effect of multidisciplinary rehabilitation in stroke patients aged up to 65 years, including some patients with severe stroke, found that patients made significant gains in physical and cognitive ability (O'Connor et al. 2005). The authors recommend that all patients should be offered a comprehensive rehabilitation programme following stroke that includes acute and late multidisciplinary phases as required.

The treatment of patients with severe stroke raises ethical issues due to the uncertainty surrounding the type of rehabilitation, and the duration, frequency and intensity of therapy that should be provided to these patients. Since it is likely that patients with severe stroke will have a worse prognosis, require more resources, and cost more than patients with mild or moderate strokes (Gladman and Sackley 1998), there may a perception that there is little incentive to rehabilitate these patients. However, recovery from a severe stroke can be significant. Wyller (2000) notes that poor prognosis may incorrectly be seen as an indicator of poor rehabilitation potential. While younger, more severe stroke

patients may be accepted for rehabilitation, older severe stroke patients may be sent directly to long-term care, where they receive little rehabilitation (Teasell et al. 2009). Early identification of patients with severe stroke who have a realistic possibility of being discharged home following rehabilitation is recommended (Pereira et al. 2012). Kalra and Eade (1995) recommend the use of prognostic grouping of stroke patients undergoing rehabilitation.

Early initiation of rehabilitation has been found to be significantly associated with improvements in FIM scores at discharge in patients with both severe and moderate strokes (Maulden et al. 2005). The Canadian stroke clinical guidelines (Lindsay et al. 2010) recommend that the rehabilitation needs of survivors of a severe or moderate stroke should be reassessed weekly for the first month, and then at intervals as indicated by their health status. Although those with severe stroke initially may not be candidates for rehabilitation, they still require follow-up since up to 50 per cent may be able to return home following rehabilitation rather than requiring institutional care. Holloway et al. (2005) have generated guidelines to assist with decision-making for patients with severe stroke. These guidelines suggest a shared decision-making approach to care, customised to the needs of patients with severe stroke and their families. Family involvement is deemed important along with the use of time-limited trials to ensure timely discharge (Holloway et al. 2005).

1.3.3 Economic Evaluation

Health economic evaluation involves the systematic appraisal of alternative healthcare interventions from an economic perspective. A basic evaluation will identify, measure, value and compare the costs and consequences of the alternative programmes being considered (Drummond et al. 2005). The rationale for the conduct of economic evaluation is to assess the cost-effectiveness of healthcare interventions in order to inform the decision regarding their adoption in clinical practice. In addition to clinical effectiveness, any decision regarding the adoption of a healthcare intervention should depend upon its expected cost-effectiveness: that is, whether or not it improves health outcomes for patients at an acceptable cost to society. The technique of economic evaluation compares the relative cost-effectiveness of alternative treatment strategies by relating their mean differences in cost to their mean differences in effectiveness, and by quantifying the uncertainty surrounding these estimates. In Ireland, the Health Information and Quality Authority (HIQA) has issued guidelines for the conduct of evaluations of health technologies. The HIQA guidelines present details on, for example, the types of costs and health outcomes that should be included in the analysis, the time horizon over which the costs and health outcomes should be captured, the manner in which the comparative analysis of the alternative

treatment strategies should be conducted, and how the uncertainty in the analysis should be presented. The perspective of a health economic evaluation may be from the viewpoint of the public payer, individual, or society as a whole and, at its broadest, may include direct and indirect costs, including productivity costs and costs/savings for informal carers.

HIQA's preferred approach for evaluation is cost-utility analysis (CUA) in which the health outcomes of treatment are expressed in terms of quality-adjusted life years (QALYs) (Health Information and Quality Authority 2013). This is a composite measure of health outcome which includes impacts on both quality and quantity of life. The measurement of health-related quality of life (HRQoL), as distinct from more clinically focused measures of health, incorporates the impact of a particular condition on the patient's everyday life. The advantage of such generic outcomes is that they can be applied across a wide range of healthcare interventions for a wide variety of conditions. This wide-ranging scope of CUA provides its appeal to healthcare providers and others involved in service planning and healthcare resource allocation. HIQA also recommend the use of cost-effectiveness analysis (CEA), in which outcomes are expressed in terms of life years gained or other disease-specific outcome measures, as the reference case when CUA is an unsuitable choice (Health Information and Quality Authority 2013). CEA is an effective tool for providing information on alternative strategies which may be evaluated on the basis of the same unit of health outcome (Drummond et al. 2005); however it is limited to such comparisons.

The conduct of economic evaluation can take two interrelated and often complementary forms. The first form of economic evaluation is trial-based and conducted in conjunction with a randomised controlled trial (RCT); supplementary economic data are collected over the course of the trial. In trial-based evaluation, patient level data on resource use and effectiveness are collected over a pre-specified follow up period. These data are typically combined with external valuation data in the form of unit costs and/or utilities to facilitate the estimation of the mean cost and effectiveness per treatment arm and the undertaking of an incremental analysis. Uncertainty deriving from the random nature of the available data is typically examined in such analyses (Drummond et al. 2005).

The second form of economic evaluation is model-based and involves the construction of computer-based decision models, which combine data from a range of disparate sources to conduct the analysis of interest. Decision analytic modelling techniques, which have been developed in disciplines such as epidemiology, statistics, operations research and decision science, are

increasingly being used to conduct the economic evaluation of healthcare technologies. Decision analysis has been defined as a systematic approach to decision-making under uncertainty, and a model is an analytical framework, based on explicit structural assumptions, within which available evidence can be combined and brought to bear on a specified decision problem (Briggs et al. 2006). In the context of health economic evaluation, decision analytic models provide a framework to draw together evidence from a range of sources in order to assess the relative cost-effectiveness of alternative healthcare programmes. Specific forms of such modelling techniques include decision-tree analysis, state-transition / Markov models, and Discrete-Event Simulation (DES). Decision-Tree models are relatively simple and present policy-makers with transparent cost and resource consequences of alternative decisions about treatment pathways.

Whereas decision models are restricted to a finite time frame, such as the first year post-stroke, Markov models are designed to capture health risks that are ongoing over time. These models assume that a patient is always in one of a finite number of discrete health states, called Markov states. Discrete-Event Simulation models one or more phenomena of interest in a system that change value or state at discrete points in time. In all of the above modelling approaches, data are typically derived from a range of epidemiological, observational and trial literature. Uncertainty in such analyses is typically examined probabilistically, whereby multiple repetitions of the model are undertaken with key variables assigned values randomly from their known or assumed distribution of values.

McPake et al. (2002) have observed that 'the choice of type of evaluation to use is normally made on the basis of how difficult it is to obtain data that will allow benefits to be measured or valued' (McPake et al. 2002: 93). In the clinical context of stroke, a recent review of economic evaluations of stroke rehabilitation by Craig et al. (2013) critiqued the methodologies of a majority of 21 studies for their inability to 'identify, measure, and value all resources and benefits pertinent to the complexity of stroke rehabilitation'. Determining the clinical effectiveness of such a complex intervention was more complicated than that of pharmacological interventions, in these authors' view. They proposed

> *a move away from conventional economic evaluation and decision making, based purely on cost-effectiveness, toward multi-criteria decision analysis frameworks for complex interventions, where a broader range of criteria may be assessed by policy makers*
>
> *(Craig et al. 2013: 1).*

While such broad criteria should inform understanding of the findings from cost-effectiveness studies, cost-effectiveness analysis has a role to play in assessing

the costs and benefits of interventions such as ESD. Results for ESD in Ireland are presented in this study, with the economic evaluation adopting two of the modelling methodologies discussed above: decision-tree analysis and Discrete-Event Simulation modelling. The DES modelling exercise was conducted in collaboration between researchers at King's College London (KCL) and the research team at the ESRI and NUIG and applied Irish data to the KCL model. The UK application of the model is described in the next section and the methods and results of this collaboration are further discussed in Chapters 2 and 5 of this report.

1.3.4 Economic Evaluation of ESD

To inform the methodological approaches adopted for the economic evaluation of ESD in Ireland, a comprehensive review of the existing economic literature on ESD was conducted. The results of this review are presented in this section. Typically, analyses of the costs or cost-effectiveness of ESD are based on randomised controlled trials of ESD compared to usual care, which are of their nature country-specific and may be based on only one hospital site or span hospital sites. Cost-minimisation analyses (CMAs), which only compare costs of the two arms of the trials and do not evaluate costs in relation to outcomes, are the least ambitious of such analyses. Examples of CMA analyses are Anderson et al. (2000) based on an RCT at two hospitals in Australia between 1997 and 1998 and Beech et al. (1999) based on an RCT at two hospitals in London between 1993 and 1995 (Table 1). While Beech et al. (1999) included health and social service costs in the analysis, Anderson et al. (2000) further included indirect costs incurred by informal caregivers (costing their care at the rate of residential care in a hostel). The authors of the Beech et al. (1999) study reported that they had attempted analyses of caregiver and lost earnings effects but had not reported these because of data quality concerns. Anderson et al. (2000) followed the patients to six months post allocation to the trial, while Beech et al. (1999) followed patients to 12 months. Both studies found that the per capita cost of ESD was lower than the per capita cost of usual care (Table 1). Anderson et al. (2000) found that the 20 per cent cost difference was not statistically significant but generally the lower ESD cost remained in sensitivity analysis which varied some of the assumptions. Compared to patients with moderate disability, those with mild disability had lower costs. Beech et al. (1999) found that average costs per patient were eight per cent lower for ESD but, given the extent of fixed costs within hospitals, unless hospital staffing were to be reorganised to meet the increased community care demands, concluded that ESD should not be perceived as a means of generating financial savings but that its probable major benefit would be to release beds to increase capacity.

An earlier analysis by McNamee et al. (1998) of an RCT conducted at three hospitals in Newcastle-upon-Tyne in the UK between 1995 and 1996, which included health service and personal social service costs to follow up at six months, also reported lower mean costs for ESD (albeit with an insignificant difference), with inpatient bed-day savings in effect balancing the additional costs of ESD (Table 1). For both the intervention and standard care groups, costs were highest among the most dependent patients, followed by dependent patients, with lowest costs for independent patients. These authors acknowledged the limitations of six months follow-up, observing:

> *If early supported discharge leads to differences in admission to residential or nursing homes, or greater problems for carers in terms of psychological distress or lost work opportunities in the longer term, then costs are likely to have been underestimated*
>
> *(McNamee et al. 1998: 349).*

Although a number of studies of the costs of ESD have been associated with RCTs, which having found improved outcomes with ESD, could have applied this evidence in a cost-utility analysis (CUA), such additional analysis has not been undertaken. Two analyses of costs associated with RCTs in Sweden have reported lower costs and improved outcomes for ESD. Fjaertoft et al. (2005) analysed health service costs to 12 months for the seminal Trondheim RCT conducted in Sweden between 1995 and 1997, which had recorded significantly improved functional outcomes and quality of life from ESD (Indredavik et al. 2000; Fjaertoft et al. 2003; Fjaertoft et al. 2004). This RCT was unusual in including patients with severe disability post-stroke, with one-third of patients discharged to inpatient rehabilitation or to nursing homes, contributing to higher mean costs than reported in other studies (Table 1). While mean cost showed a non-significant reduction for ESD, when costs for 26 to 52 weeks were compared, there was a significantly lower cost for ESD, which the authors suggested could indicate that ESD might lead to long-term cost-effectiveness. In a cost analysis of an RCT conducted in Stockholm between 1993 and 1996, von Koch et al. (2001) analysed health care and informal care utilisation and reported better outcomes and lower mean healthcare costs for ESD. Informal care utilisation was not costed but no statistically significant differences were found between the two groups in use of home help or formal care in the first year after stroke. These authors concluded that ESD

> *proved no less beneficial than routine rehabilitation for stroke patients with moderate impairments 5-7 days after onset and, moreover, enabled five patients to receive care and rehabilitation over one year for the cost of four [patients] in routine rehabilitation*
>
> *(von Koch et al. 2001: 137).*

A study by Donnelly et al. (2004), which analysed costs and benefits from an RCT conducted in two hospitals in Belfast in 1999, could similarly have been extended to a cost-utility analysis. This study included health service and social service costs, and reported lower mean cost and better outcomes for patients receiving ESD at 12-month follow-up (Table 1).

Roderick et al. (2001) separately reported health and social service costs and outcomes for an RCT conducted in Dorset in the UK between 1995 and 1997. Not a trial of ESD per se, this RCT compared home (domiciliary) rehabilitation and rehabilitation in day hospitals for stroke patients aged 55 and over. Outcome measures were better for the domiciliary group while mean costs were not significantly different between the two groups (Table 1). Rehabilitation and health service costs were similar for the two groups but when social services costs were included, the intervention was more costly. These authors suggested that a 'mixed model' of post-discharge rehabilitation might be appropriate since day hospital care appeared beneficial for people with medical or nursing needs or for those with serious disability and for whose carers the day hospital provided respite.

Teng et al. (2003) analysed costs associated with an RCT of ESD compared to usual care conducted in five acute care hospitals in Montreal in Canada. Improved outcomes with ESD over a three-month period had been reported for this RCT (Mayo et al. 2000). The Teng et al. (2003) study had the secondary objective of estimating the effect of ESD on caregivers. The assessment of healthcare costs found a statistically significant 30 per cent lower mean cost for ESD, with readmission to hospital a large contributor to the higher costs for the usual care group. The effect on caregivers was assessed with caregivers in the ESD group scoring lower for burden than caregivers in the usual care group. The authors concluded that ESD was more cost-effective than usual care because it delivered better outcomes, reduced the caregiver burden and had lower costs. However, this was not a cost-effectiveness analysis per se because there was no economic quantification of the incremental costs associated with the incremental outcomes.

TABLE 1 Economic Evaluations of RCTs Comparing ESD to Standard Care

Author (Year)	Country study year	Study design	Intervention	Comparator	Outcomes/ Measures of benefit	Intervention Mean Costs	Comparator Mean Costs	Significance of difference
Anderson et al. (2000)	Adelaide, Australia 1997-1998	CMA, n = 86, six months Societal costs: health service, community, patient and informal caregiver	Early hospital discharge and home-based rehabilitation	Conventional in-hospital rehabilitation and community care	Health-related and economic outcomes	A$8,040 (€5,041)	A$10,054 (€6,304)	20% lower; P=0.14
Beech et al. (1999)	London, UK 1993-1995	CMA, n = 331, 12 months Health service and social service costs	ESD service	Conventional in-hospital rehabilitation and community care	Impairment, disability, general health, caregiver stress, patient and caregiver satisfaction	£6,800 (€9,844)	£7,432 (€10,759)	8.5% lower
Donnelly et al. (2004)	Belfast, UK 1999	CCA**, n = 113, 12 months Health service and social service costs	Community stroke team	Hospital inpatient rehabilitation stroke unit, day unit follow-up	Health-related quality of life, activities of daily living, patient, and carer satisfaction	£9,680 (€15,136)	£11,734 (€18,347)	17.5% lower; P=0.82
Fjaertoft et al. (2005)	Trondheim, Sweden 1995-1997	CMA, n=320, 12 months, Health service costs Incl. severe stroke and costs of inpatient rehabilitation /nursing home	Extended stroke unit service (ESUS)	Ordinary stroke unit service (OSUS)	Disability and quality of life	€18,937 26-52 weeks: €5,113	€21,824 26-52 weeks: €6,665	13% lower; NS 26-52 weeks: 23% lower; P=0.064
McNamee et al. (1998)	Newcastle, UK 1995-1996	n = 92, six months; Health service and social service costs	ESD service	Conventional care	Activities of daily living, depression, and general health	£7,155 (€8,533)	£7,480 (€8,920)	4% lower
Roderick et al. (2001)	Dorset, UK 1995-1997	CCA, n = 140, six months; Health service and social service costs	Community-based rehabilitation	Day hospitals	Functional gain, mobility, mental state, social activity and health-related quality of life	£1,170 (€1,573)[a] £1,965 (€2,642)[b] £3,070 (€4,128)[c]	£1,146 (€1,541)[a] £2,057 (€2,766)[b] £2,428 (€3,264)[c]	2% higher; NS[a] 4.5% lower; NS[b] 26% higher; NS[c]

TABLE 1 Economic Evaluations of ESD Compared to Standard Care (Continued)

Author (Year)	Country study year	Study design	Intervention	Comparator	Outcomes/ Measures of benefit	Intervention Mean Costs	Comparator Mean Costs	Significance of difference
Sritipsukho et al. (2010)	Thailand 2007-2008	CEA, n = 60, three months Health service costs	Home rehabilitation program	Conventional care	Disability	15,678 THB (€320) ICER: 14,212 THB (€290)	4,616 THB (€94) ICER: 24,364 THB (€498)	240% higher
Teng et al. (2003)	Montreal, Canada 1998	CCA, n = 114, three months; Health service costs	ESD service	Standard care	Health-related quality of life	C$7,784 (€4,273)	C$11,065 (€6,074)	30% lower, P<0.0001
von Koch et al. (2001)	Stockholm, Sweden 1993-1996	CMA, n= 83, 12 months Health service costs	ESD service	Standard care	Disability, health-related quality of life	71,958 SEK (€8,790)	91,453 SEK (€11,172)	21% lower

Note: * Euro exchange rate of study year; a Rehabilitation costs; b Health service costs; c Health and social services costs; NS Not significant.

** CCA is a Cost-consequences analysis, which is a form of economic evaluation that compares the proposed intervention with its main comparator(s) as an array of all costs and outcomes measured in their natural units rather than a single representative outcome as presented in a cost-effectiveness analysis (Health Information and Quality Authority 2013).

A cost-effectiveness analysis was undertaken by Sritipsukho et al. (2010) in a study of the costs and outcomes at three months of a home rehabilitation programme for survivors of ischemic stroke, which was the subject of an RCT at a hospital in Thailand between 2007 and 2008. This study calculated incremental cost-effectiveness ratios (ICERs) for the intervention expressing the incremental effect as the mean cost per case that achieved the treatment goal, which was mild or no disability (Table 1). The costs included hospital care and home rehabilitation and, unusually, the participants in the programme showed increased hospital care utilisation and costs, with the consequence that the intervention group had higher mean costs. This effect suggests that hospitals may play a greater role in providing medical care to discharged patients in Thailand than in the healthcare systems of other countries which have conducted such RCTs. The authors found that the ICERs of 14,212 THB (€290) and 24,364 THB (€498) for patients achieving respectively mild and no disability were cost-effective from the provider perspective of a hospital administrator. Hospitals in Thailand receive capitation payments for each registered person so that an intervention that reduces disability, reduces the cost to the hospital of further disability care. This study recorded that guidelines in Thailand indicated that from a societal perspective, a cost per QALY of 100,000 THB (€2,043) was considered cost-effective. This study did not, however, calculate the cost per QALY of this intervention.

The longer-term cost-utility of ESD has been modelled in two UK studies applying evidence from the RCT in London, which was analysed in Beech et al. (1999) and previously in Rudd et al. (1997). These studies employed respectively Markov and Discrete-Event Simulation (DES) techniques to model stroke rehabilitation (Saka et al. 2009; National Audit Office 2010; National Audit Office 2010b). Saka et al. (2009) modelled the cost-effectiveness of stroke unit care followed by ESD using a Markov health state transition model, which simulated the care pathways after stroke, starting from the diagnosis of acute stroke and admission to inpatient care, following disease progression and costs of care for ten years. Data on the service use and health outcomes of a group of patients with stroke registered in the South London Stroke Register (SLSR) between 2001 and 2006 were used to calculate the average length of hospital stay for patients with stroke in a stroke unit and general medical ward, the discharge location of patients and to identify the disability levels of patients at discharge. The SLSR is a population-based register in the London Boroughs of Lambeth and Southwark. The disability levels of the patients at the end of the first year and data on resource use and severity levels of ESD and non-ESD patients were obtained from the ESD trial reported by Beech et al. (1999) and Rudd et al. (1997) with one-year outcomes extrapolated for ten years. Costs were analysed from a societal perspective, including indirect cost estimates based on income loss due to mortality and/or morbidity.

Incremental cost-effectiveness ratios (ICERs) were calculated as cost per QALY gained to assess the cost-effectiveness of the different strategies. Saka et al. (2009) concluded that over ten years, stroke unit care followed by ESD was a cost-effective strategy with an incremental cost-effectiveness ratio of £10,661 (€15,489[4]) compared with care on a general medical ward without ESD and £17,721 (€25,746) compared with stroke unit care without ESD. This compared to a £30,000 (€43,586) per QALY threshold recommended by the UK's National Institute for Health and Clinical Excellence. The authors noted that limitations to their study included the limited approach to measuring outcomes in the Beech RCT: functional ability scores had to be converted to QALYs; and the results of the trial were extrapolated to ten years post-stroke.

Building on the approach of Saka et al. (2009) and using many of the same data sources, a Discrete-Event Simulation Model was developed at King's College London (KCL) and informed the UK's National Audit Office 2010 Report *Progress in Improving Stroke Care* (National Audit Office 2010; National Audit Office 2010b). The KCL model simulates the patient journey from stroke for ten years, including time to admission, inpatient stay, post-discharge rehabilitation and long-term follow-up. The model is designed to replicate the stroke unit from an existing hospital treating around 300 patients a year. Patients are created and given characteristic attributes which determine their care pathway: age, severity, type of stroke and whether ESD is available. Average disability levels of patients under different scenarios, measured as Barthel Index (BI) scores, are then converted to QALYs, using a methodology developed by Van Exel et al. (2004). The care pathway of each patient is assumed to affect their outcome, informed by evidence from the literature. Disability state transitions associated with ESD versus Conventional Discharge (CD) are again informed by the London RCT (Rudd et al. 1997; Beech et al. 1999). Post-discharge, patients are routed back through the model according to their probability of death and recurrence and continue in the same loop until the total period of ESD and long-term follow-up ends at ten years. The analysis adopts a healthcare perspective, including costs which are related to treatment but not including wider societal costs such as productivity loss. Multiple replications test that the results do not vary significantly with different random number streams. Application of this model to comparison of current stroke care with previous provision in the UK found an incremental cost-effectiveness ratio of £5,500 (€5,705)[5] per quality-adjusted life year gained, which compared to standard National Institute for Health and Clinical Excellence (NICE) benchmarks of £20,000 to £30,000 (€20,750 to €31,122) per QALY. Increasing Early Supported Discharge from 20 to 43 per cent of patients cost

4 Conversion at 2006 exchange rates, since amounts in 2006 prices.

5 Conversion at 2009 exchange rates, since amounts in 2009 prices.

about £5,800 (€6,016) per QALY gained over the ten-year period analysed. The incremental cost was judged to be outweighed by the effect.

In summary, the economic evaluation literature of rehabilitation for stroke is typically based on randomised controlled trials, which compare the costs and outcomes of rehabilitation interventions and conventional care. The existing evidence base indicates that ESD may improve health outcomes and reduce healthcare costs relative to usual care across a variety of settings. This analysis needs to be replicated, incorporating Irish data, to examine whether the clinical and economic benefits are generalisable to Ireland. In the absence of a trial, this is best achieved through a decision model framework.

1.3.5 Economic Evaluation of Severe Stroke Rehabilitation

As is apparent from the review of economic evaluations of ESD, economic evaluation of rehabilitation for stroke survivors requires evidence of resource use, costs and outcomes from differing pathways of care, with ideally adequate detail to facilitate generalisability of results. Such evidence is unfortunately inadequate in the case of severe stroke. In a synthesis of evidence on rehabilitation for people with severe stroke, Pereira et al. (2012) concluded that important questions remained unanswered about 'problems faced by individuals with severe stroke in accessing care, their course of recovery in rehabilitation, the factors that influence the outcome of rehabilitation, and their long-term needs' (Pereira et al. 2012: 130).

In a systematic review of integrated care for stroke patients, Tummers et al. (2012) recommended that:

> *Since stroke severity is such an important variable in the outcome and effectiveness of stroke interventions… future research should take stroke severity into account when researching cost-effectiveness and… cost-effectiveness studies for stroke interventions should focus on the patient groups with moderate and severe stroke*
>
> *(Tummers et al. 2012: 12).*

In effect, these authors recommend that severe stroke should be the focus of future RCTs and associated cost-effectiveness studies to develop a body of evidence comparable to the evidence on the effectiveness of ESD for patients with mild to moderate disability after stroke. A limited number of studies have examined costs of care for patients with severe stroke. Sandstrom et al. (1998) reviewed 292 cases of severe stroke admitted to a rehabilitation centre in Omaha

in the USA from the years 1993 to 1995, of whom 45 per cent were discharged home and 25 per cent to a long-term care facility. Charges for care in the rehabilitation centre varied little by discharge destination. This study was not an RCT and its focus on the costs of inpatient rehabilitation by discharge destination limits its generalisability. Deutsch et al. (2006) in an assessment of outcomes and reimbursement for stroke patients in alternative inpatient or sub-acute skilled nursing rehabilitation facilities (IRFs/SNFs) also in the USA found that rehabilitation in the more costly and intensive IRFs resulted in higher functional outcomes than rehabilitation in an SNF. This study linked clinical data to Medicare claims for 58,724 Medicare beneficiaries with a recent stroke who completed treatment in 1996 or 1997.This also was not an RCT and patients had differing characteristics in the rehabilitation facilities compared.

In a study in Taipei in Taiwan between 1995 and 1996, Chiu et al. (2001) compared costs and outcomes of 313 severe stroke patients treated in hospital, nursing homes or at home, with home nursing care or only family care. This study found that at three months post-discharge, caring for patients in their own homes was more expensive and less effective in improving scores for Activities of Daily Living (ADL) than caring for patients in nursing homes and in hospital chronic care units. The study included healthcare costs and informal care costs valued at the equivalent rate for health aides. All costs were calculated from family monthly bills because there is no government support for long-term care in Taiwan. While not an RCT, this study does demonstrate comparable mean levels of ADL disability in the four groups studied and a significant reduction in ADL score at three months only for the group cared for in hospital chronic care units. However, the specific features of the Taiwanese health and social care system limit the generalisability of this study to a European or Irish healthcare setting.

In summary, the studies of the costs and outcomes of rehabilitation for severe stroke cases reviewed here do not offer an evidential basis for economic evaluation of severe stroke rehabilitation, echoing the conclusion by Tummers et al. (2012) that there is need for a focus on severe stroke in cost-effectiveness studies.

1.4 Conclusion

This chapter has reviewed the Irish and international literature on stroke rehabilitation. The literature suggests that ESD is a feasible and effective model of care that is associated with reduced hospital length of stay and comparable or better patient outcomes than conventional services. The evidence suggests that

ESD does not adversely impact patient survival, functional recovery or quality of life. Best results in functional recovery are seen in patients with mild to moderate disability who are under the care of a well organised and co-ordinated ESD team which meets on a regular basis. However, the feasibility of ESD is uncertain for patients living in dispersed rural locations, since the role of ESD in such communities has not been adequately addressed with few RCTs having been undertaken in rural areas. In the case of stroke survivors with severe disability, the literature suggests that specialised inpatient rehabilitation achieves reduced mortality, reduced length of stay and increased likelihood of discharge home.

While there is inadequate evidence to conduct an economic evaluation of treatment options for severe stroke, this study undertakes an economic evaluation to compare the costs and outcomes of Early Supported Discharge relative to usual care for stroke rehabilitation in Ireland. The evidence base in relation to ESD derives from analyses based on randomised controlled trials, which compare the costs and outcomes of rehabilitation interventions and conventional care in a variety of settings. No such trials have been conducted in Ireland at the time of writing. For this reason, the economic evaluation in this study uses modelling techniques, reviewed above, which apply evidence from RCTs to assessing the cost-effectiveness of an intervention such as ESD to differing populations and over longer time periods. In this study, the evidence of an RCT in the UK is combined with Irish data to evaluate the cost-effectiveness of ESD in Ireland.

The next chapter describes the data and methods employed in this study. Chapter Three analyses the available Irish data on current provision of stroke rehabilitation. Chapter Four returns to the literature reviewed above to identify best practice pathways of stroke rehabilitation. Chapter Five describes the modelling of the costs and cost-effectiveness of ESD in Ireland. Chapter Six summarizes and concludes. Chapter Seven applies the analysis in this report to develop recommendations for stroke rehabilitation in Ireland.

CHAPTER 2

Data and Methods

2.1 Introduction

This chapter describes the data and methods applied in the analysis in this report. At the time of this analysis, no Irish RCT had been conducted to inform understanding of the resources, outcomes and costs pertaining to stroke survivors' rehabilitative care in Ireland. Although a national stroke register had begun data collection, it was still in development, so that there was no national, longitudinal data source on the epidemiology and utilisation of care of stroke patients in Ireland available to this study. However, the data sources for Ireland which have informed this study have encompassed: detailed stroke-specific patient-level studies with some longitudinal follow-up; surveys of stroke survivors; surveys of providers of services; routinely collected administrative data; and Central Statistics Office datasets. By analysis of data from these combined sources it has been possible in Chapter Three to meet the first objective of this study by describing current provision of rehabilitation for stroke patients in Ireland and to develop case studies of Irish conventional care to inform the economic evaluation in Chapter Five. The comparator case studies for best practice pathways of care are developed in Chapter Four from the international literature. Where Irish data are unavailable to inform the cost-effectiveness modelling, UK data sources applied to modelling for the UK are applied to the Irish modelling.

The methods applied to analyse current services and pathways of care in the cost and cost-effectiveness modelling of ESD and usual care are outlined in this chapter. Economic evaluation of the comparative resource use, costs and outcomes of ESD and usual care is undertaken by two methodologies, Discrete-Event Simulation modelling and decision-tree analysis, methods which are conceptually explained in this chapter. The next section describes in detail the data analysed in this report. Section 2.3 describes the methods applied in the analysis. Section 2.4 concludes.

2.2 Data

The datasets which inform this analysis can be characterised by type as individual-level data, provider surveys, administrative datasets and Central Statistics Office datasets and are described within these categories below.

2.2.1 Individual-Level Micro-Datasets

Individual-level micro-datasets, recording individual, anonymised patients' utilisation of health services and their individual characteristics, such as age, gender and place of residence, have contributed to this analysis. Some of these datasets are based on a total population, such as all public hospital stroke discharges, which are recorded in the Hospital Inpatient Enquiry. Others, such as The Irish Longitudinal Study on Ageing, are based on a nationally representative sample. These micro-datasets are:

The Hospital Inpatient Enquiry (HIPE)

HIPE collects clinical and administrative data on discharges from and deaths in acute hospitals. HIPE recorded comprehensive data on nearly 1.5 million discharges in 2011, the data year for this analysis (ESRI 2012). Variables include: principal diagnosis and up to 29 secondary diagnoses (ICD-10-AM diagnosis codes); patient demographic data (e.g. age, gender, marital status, area of residence); and hospital administrative data (e.g. length of stay, discharge source, discharge destination, hospital location). For this analysis, an initial extract was downloaded from the HIPE database covering all patients discharged in 2011. The HIPE extract was reduced to include only those inpatient discharges with a principal or secondary diagnosis of stroke. Diagnoses were coded using the 10th Revision of the International Classification of Diseases, Australian Modification, 4th Edition (ICD-10-AM) incorporating the Australian Classification for Health Interventions (ACHI)(National Centre for Classification in Health (NCCH) 2004). The HIPE codes for the extracted discharges were: subarachnoid haemorrhage (I60); intracerebral haemorrhage (I61); cerebral infarction (I63); or stroke, not specified as haemorrhage or infarction (I64). In HIPE, a principal diagnosis is defined as the 'diagnosis established after study to be chiefly responsible for occasioning the episode of admitted patient care'. A secondary diagnosis is defined as 'a condition or complaint either coexisting with the principal diagnosis or arising during the episode of admitted patient care. Interpreted as conditions that affect patient management.' (ESRI 2009: 45).

Since HIPE records discharges and researchers are not permitted access to identifying codes for individual patients, there is the possibility that duplicates may arise from multiple admissions/discharges for the same patient. To reduce

the risk of duplication, discharges from hospitals that specialise in rehabilitation were excluded (N=360) because they were more likely to concern cases already recorded as discharges from acute hospitals. The HIPE stroke discharges were further reviewed to exclude discharges with a secondary diagnosis of stroke and a principal diagnosis of rehabilitation (N=136)[6], which were also likely to duplicate cases recorded as discharges from acute hospitals. Day cases (N=88) and discharges that were followed by transfer to another hospital (N=70) or home after a stay of less than one day (N=60) were excluded for the same reason. The HIPE stroke discharges for this analysis are therefore restricted to patients with a principal or secondary diagnosis of stroke, who had an inpatient length of stay of at least one day or whose treatment was not as a day case or succeeded by transfer to another hospital or home. This amounts to 6,945 stroke discharges in 2011.

The Irish Longitudinal Study on Ageing (TILDA)

TILDA is a nationally representative, longitudinal study of 8,504 community-dwelling adults aged 50 and older in Ireland. This analysis employed first wave data from TILDA to investigate stroke survivors' hospital outpatient visiting rates and utilisation of care in the community by stroke survivors and older people in general.

The Irish National Audit of Stroke Care (INASC) clinical audit database

The Irish National Audit of Stroke Care (INASC) clinical audit was undertaken in 2005 and involved a review of clinical case notes for a selected sample of patients with stroke in 36 hospitals participating in HIPE. The clinical audit database defines stroke type by the results of a scan within the first 24 hours after stroke as: infarct; haemorrhage; haemorrhagic infarct; or 'no relevant abnormality' (Irish Heart Foundation 2008). The audit sample included consecutive discharged cases with a primary diagnosis of stroke (ICD 10 codes: I61, I63 and I64, including subcategories) during a six-month period: January, February and March; July, August and September 2005. The number of patients discharged over the six-month period was 2,570 (Irish Heart Foundation 2008). The INASC dataset is the sole national source of disability rates at discharge for stroke survivors.

The North Dublin Population Stroke Study (NDPSS)

The North Dublin Population Stroke Study identified 568 incident and recurrent stroke events in 2005/2006 in the North Dublin resident population using multiple overlapping hospital and community sources, including acute and non-

[6] The relevant discharge codes are Z48.8, which is assigned to patients with a diagnosis of 'postoperative convalescence', who transfer from one hospital to another and who are still receiving active treatment; Z50, which is assigned to patients who are admitted specifically for rehabilitation; and Z54, which is assigned to patients with a principal diagnosis of convalescence. Extracted from NCCH eBook (National Centre for Classification in Health (NCCH) 2004).

acute hospitals, general practitioners, nursing homes and review of death certificates and pathology or coroner's records. The NDPSS found that of patients with first ever stroke (FES) in North Dublin over the period December 2005 to November 2006, 90.5 per cent were admitted to hospital and 9.5 per cent were treated in the community (Kelly et al. 2012). The NDPSS followed patients for two years post-stroke. NDPSS data have informed this project's analysis of stroke incidence, disability transitions in stroke survivors and utilisation of care by stroke survivors in the community.

The Action on Secondary Prevention Interventions and Rehabilitation in Stroke (ASPIRE-S) study

The ASPIRE-S project is designed to evaluate the adequacy of secondary prevention and rehabilitation intervention six months post-stroke, provide information on the management of stroke patients at home and inform a future strategy on the management of stroke in the community. The project has followed a sample of 256 survivors of ischaemic stroke (first-ever and recurrent) who were treated in three hospitals in North Dublin and were alive at six months post-stroke. The participants were recruited from October 2011 to end-September 2012. ASPIRE-S data have contributed to analysis for this study of evidence of disability in stroke survivors.

The Irish Longitudinal Study on Ageing (TILDA)

TILDA is a nationally representative, longitudinal study of 8,504 community-dwelling adults aged 50 and older in Ireland. This analysis employed first wave data from TILDA to investigate stroke survivors' hospital outpatient visiting rates and utilisation of care in the community by stroke survivors and older people in general.

The Mater Misericordiae University Hospital (MMUH)/North Dublin ESD pilot study

A pilot ESD programme was introduced for stroke patients at the Mater Misericordiae University Hospital (MMUH) in Dublin under the auspices of the HSE National Stroke Programme in 2011-2012. During the period 1 October 2011 to 30 September 2012, 49 patients received intense therapy support at home following discharge. Subsequent to the conclusion of the pilot, the MMUH Stroke Programme implementation team together with HSE Dublin North colleagues continued to implement an ESD programme. Anonymised data relating to 80 programme participants (including the 49 pilot participants), who had participated in the programme up to 30 June 2013, have been analysed in this study to inform understanding of the costs, benefits and challenges of ESD implementation in Ireland. Ethical approval for the retrospective use of these anonymised data was sought from and given by the MMUH Ethics Committee.

2.2.2 Surveys Of Services Providers

Provider surveys record health and social care professionals' assessments of aspects of their service such as: the nature of the care they deliver, the resources available for care, the amount of care they deliver and the extent of patient need. Provider surveys, which have contributed to this analysis are:

The HSE National Stroke Programme's Community Stroke Service Survey (CoSS)

The HSE Stroke Programme's Community Stroke Services Survey (CoSS) of managers in Local Health Offices (LHOs) was undertaken in April/May 2011 and received responses from 149 managers of 161 surveyed. The HSE Stroke Programme provided unpublished CoSS survey data to this study disaggregated by therapy and LHO area on: numbers of community staff, numbers of total referrals and of stroke referrals to community staff; and the average number of weeks, weekly sessions and minutes per session of therapy given to stroke patients in differing settings.

The Hospital Leads' Survey (HLS)

The Hospital Leads' Survey (HLS) of National Stroke Programme hospital consultant and clinical nurse specialist leads and of hospital physiotherapy managers was conducted by the authors of this study in 2013. This was an online survey, carried out by the authors of this report (questionnaire in Appendix 8.5). The survey elicited 49 responses from 28 out of 29 hospitals surveyed (22 consultants stroke leads; 12 clinical nurse specialist stroke leads; and 15 physiotherapy stroke leads/managers). This survey was designed to identify Irish stroke survivors' rehabilitation pathways from acute hospitals.

2.2.3 Administrative Datasets

Administrative datasets employed in this analysis are:

The Health Service Executive (HSE) Personnel Census

The monthly HSE Personnel Census records public health and social care service personnel numbers by region, LHO area, employer, grade, group and care group. The December 2012 Personnel Census was analysed to ascertain numbers of physiotherapists, occupational therapists and speech and language therapists in Primary Care or Older Persons' Services, and numbers of psychologists in these services and in Mental Health Services.

Department of Health Long-Stay Activity Statistics (LSAS)

The Department of Health Long-Stay Activity Statistics (2011) which records availability of long-stay and intermediate stay beds from a survey of public,

voluntary and private facilities was analysed to estimate long-stay capacity relative to population by area of residence.

2.2.4 Central Statistics Office Datasets

Data from the following Central Statistics Office datasets have also contributed to this study:

The Census of Population, 2011

The base population year for this analysis has been 2011, the latest Census year.

The National Disability Survey (NDS) 2006

Analysis of utilisation of home help services by older people with disability in the National Disability Survey 2006 has contributed to estimation of home help utilisation by stroke survivors.

The Health Module of the Quarterly National Household Survey (QNHS) 2010

Data from the Health Module of the 2010 QNHS has informed analysis of utilisation of general practitioner and community nurse and public health nurse services by stroke survivors.

2.2.5 Cost Data

This study has adopted a public healthcare provider perspective to costing, including costs which are related to treatment but not including wider societal costs such as productivity loss or informal care demand and effect on informal carers. Unit cost data for Irish health and social care developed for a forthcoming study of Palliative Care in Ireland (Brick et al. forthcoming) have been applied to cost service use by stroke patients in the community. The methodology to calculate unit costs for community healthcare staffing has been an application of the Personal Social Services Research Unit (PSSRU) method (Curtis 2012), which includes wages, salary costs, overheads and capital overheads. In alternative modelling scenarios, the unit cost methodology applies either unit cost per hour, generated by applying costs to total hours worked, or unit cost per hour of client contact, generated by applying costs only to estimated patient contact hours. Where the costing methods in this study have differed from the methods in Brick et al. (forthcoming), this is stated and explained. Costs are expressed in Euros (€) in 2011 prices. Inpatient care is costed using Irish stroke inpatient average bed-day costs. The HSE National Casemix Programme Ready Reckoner for 2013 is the source for a weighted average bed-day cost for a stroke inpatient of €500 based on 2011 cost and utilisation data.

2.2.6 UK Data Applied In Modelling

In the Discrete-Event Simulation (DES) modelling in Chapter Five, where Irish data sources have not been available, UK data from the South London Stroke Register (SLSR) have been applied. The SLSR is a population-based register, which records stroke patients' characteristics, resource use and outcomes. SLSR data from 2006 to 2011 are applied in the Irish application of the model.

2.3 Methods

2.3.1 Approach to Estimating Rehabilitation Need

Rehabilitation need is estimated in a series of steps in Chapter Three. Regional incidence rates for stroke discharges by age cohort and gender are calculated from HIPE 2011 using area of residence to assign discharges to HSE Region. The relevant regional rates are applied to the sub-regional HSE Integrated Service Area (ISA) population by age cohort and gender derived from Census 2011 to generate estimated numbers of stroke discharges by ISA. Numbers of discharged survivors by ISA are estimated by applying HIPE 2011 regional stroke inpatient death rates by age cohort and gender to the estimated stroke discharges by ISA. Numbers of survivors by disability/dependence level are calculated by applying INASC 2005 disability rates at discharge by age cohort and gender to the estimated surviving stroke discharges by ISA. These numbers of survivors by disability/dependence level by age cohort and gender are increased by nine per cent to adjust for estimated strokes occurring outside hospitals and their estimated survival rate, derived from the North Dublin Population Stroke Study, by a methodology developed in Wren and Kelly (2013).

2.3.2 Approach to Estimating Supply of Community Therapists

Estimates of supply of community therapists (physiotherapists, occupational therapists and speech and language therapists) are developed in Chapter Three from the HSE Personnel Census. The supply of therapists is expressed as a ratio to population and to estimated stroke survivors in the community by ISA to enable comparison of the supply of therapy staff relative to estimated need by ISA. The level of filled community physiotherapy posts and of total referrals to physiotherapy by ISA is calculated from the Community Stroke Services Survey (CoSS) and the correlation coefficient (a statistical measure of association) between posts in an ISA and referrals as a percentage of ISA population is calculated. To enable comparison of managers' estimates of mean therapy hours delivered by therapy, setting and region, mean intensity in therapy delivered is calculated from CoSS data for each LHO for which all the data are available by the formula:

$$Intensity\ (hours) = \frac{(Av.weeks\ X\ Av.sessions\ per\ week\ X\ Av.session\ duration(mins))}{60}$$

National and regional mean intensities are calculated from the LHO intensities.

2.3.3 Approach To Analysis of Pathways of Care

Evidence of pathways of care is analysed in Chapter Three, primarily by generating cross-tabulations of HIPE and INASC data, to investigate the associations between such factors as stroke patients' discharge destinations, length of inpatient stay, region, hospital, age, gender, and level of disability at discharge. A correlation coefficient is calculated from INASC data for mean hospital length of stay and proportions of patients with severe disability at discharge. Long-stay bed capacity relative to population by ISA is estimated from the Department of Health's Long-Stay Activity Statistics (2011) and a correlation coefficient is calculated between long-stay bed capacity and numbers discharged to nursing homes in the area, calculated from HIPE 2011 discharges to nursing homes by patient area of residence. Responses to the Hospital Leads' Survey are analysed by hospital and region to identify referral patterns for stroke rehabilitation, the locations which undertake stroke rehabilitation, stroke leads' referral criteria and to record their assessment of the adequacy of community services.

2.3.4 Approach to Analysis of Outcomes From Conventional Care in Ireland

Evidence from the NDPSS of stroke survivors' transitions between disability states at intervals post-stroke is analysed In Chapter Three. This analysis calculates disability state transitions, in which disability state changes at a later time of measurement are expressed as a proportion of numbers in that disability state at the earlier time of measurement.

2.3.5 Approach to Development of Conventional Care Case Studies

Estimates of therapy and care utilisation by stroke survivors in the community are developed in Chapter Three by combining evidence from a number of sources. To capture regional variation in the delivery of community therapy, therapy utilisation is estimated for two case studies, based on CoSS data for managers' estimates of mean therapy delivered in Primary Care Services in North Dublin and in HSE Region South. Mean therapy received is then calculated by applying evidence from the NDPSS of the percentage of stroke survivors in receipt of therapy. Mean stroke survivor utilisation rates for GP visits, community/public health nurse visits, hospital outpatient visits, meals on wheels and home help services are estimated from data from the Quarterly National Household Survey, TILDA, the NDPSS and the 2006 National Disability Survey.

2.3.6 Approach to Development of Models of Best Practice Pathways of Care

Two models of ESD are derived in Chapter Four from detailed analysis of the literature. The first model, the 'Beech Model', is based primarily on recorded mean utilisation of services by ESD participants in an RCT in London in the 1990s (Beech et al. 1999). This is the approach to ESD applied in the Discrete-Event Simulation modelling in Chapter Five. The second model, the 'Fisher Model', has been derived by this study from the published, consensus view of international ESD Trialists in 2011 about optimal resourcing of ESD (Fisher et al. 2011), drawn from their experience of implementing the ESD trials, discussed in Chapter One (Fearon and Langhorne 2012). In Chapter Four, the Trialists' recommendations for ESD team staffing, expressed as whole-time equivalents (WTE) for a 100 patient per year caseload, are converted into mean estimated therapy/care received per ESD participant. The costs of this relatively better resourced ESD approach are compared to the alternative Beech model and Conventional Discharge care (CD) in the decision-tree analysis in Chapter Five.

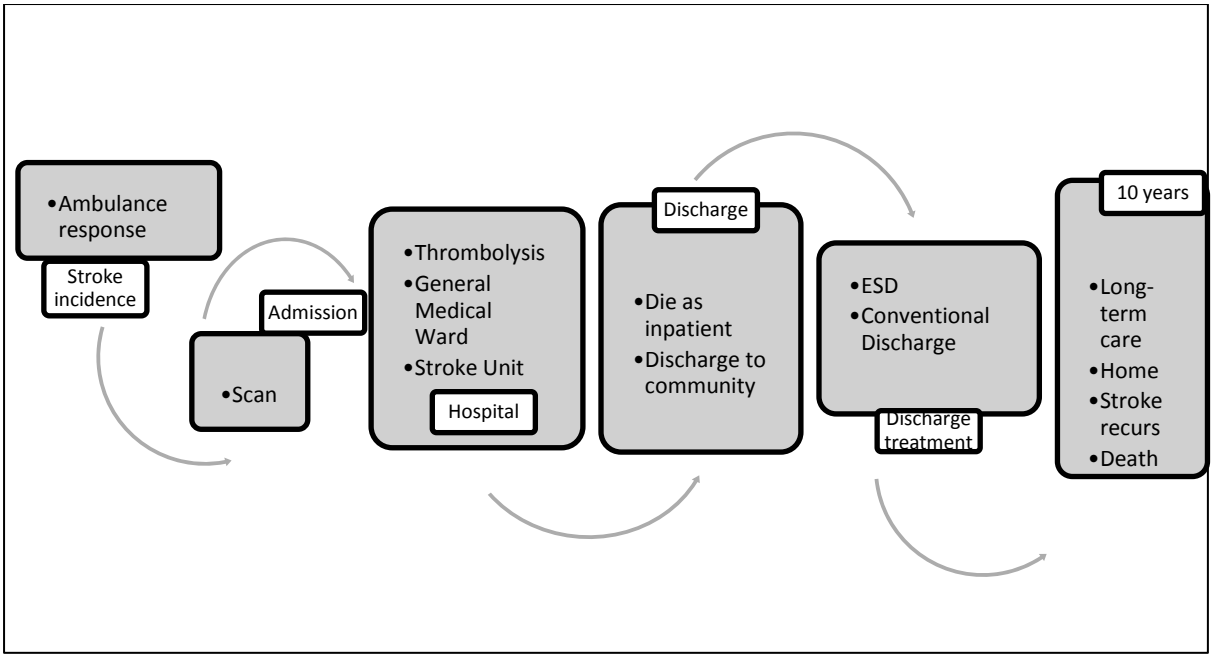
2.3.7 Approaches to Modelling

Two modelling methodologies are applied to analyse the costs and benefits of ESD compared to Conventional Discharge (CD) in Ireland: Discrete-Event Simulation (DES) modelling and decision-tree analysis. The DES modelling exercise constitutes a full economic evaluation in which the cost-effectiveness of ESD relative to CD is explicitly examined. The DES modelling exercise was conducted in collaboration between researchers at King's College London (KCL), the ESRI and NUIG and applies Irish data to the KCL model. The decision-tree analysis is a reduced form of economic evaluation in which only the costs of ESD and CD are compared. In technical terms, the central difference between these modelling approaches is that the decision-tree analysis is a Cost-Minimisation Analysis (CMA), in which ESD and CD are assumed to be equivalent in terms of effect and are compared only in terms of resource use and costs, whereas the DES modelling is a Cost Utility Analysis (CUA), in which resource use, costs and outcomes are analysed and the cost-effectiveness of ESD is expressed in terms of cost per Quality-Adjusted Life Year (QALY) gained. A further difference is that the DES model follows the simulated journey of stroke patients for ten years post-stroke, whereas the decision-tree analysis solely compares the costs of treatment in the first year after stroke. The modelling approaches are complementary in demonstrating costs and effects of alternative approaches to stroke rehabilitation.

2.3.8 Discrete-Event Simulation Model Methodology

The KCL DES model simulates the patient journey from stroke for ten years, including time to admission, inpatient stay, post-discharge rehabilitation and long-term follow-up (Figure 1; National Audit Office (2010) and (2010b)). The model is designed to replicate the stroke unit from an existing hospital treating around 300 patients a year. Patients are created and given characteristic attributes which determine their care pathway: age, severity, type of stroke, whether ESD is available. Average disability levels of patients under different scenarios are then converted to quality-adjusted life years (QALYs), using a methodology developed by Van Exel et al. (2004). The care pathway of each patient is assumed to affect their outcome, informed by evidence from the literature and the SLSR. Post-discharge, patients are routed back through the model according to their probability of death and recurrence (reflecting their individual characteristics including disability level, which in this analysis varies depending on whether or not the patient has undergone ESD). Patients' simulated journeys continue in the same loop until the total period of ESD and long-term follow-up ends at ten years. Multiple replications test that the results do not vary significantly with different random number streams. In the application of the model to Ireland in this study, several scenarios have been tested which vary the proportion of patients receiving ESD.

FIGURE 1 Discrete-Event Simulation Model



Source Adapted from National Audit Office (2010b)

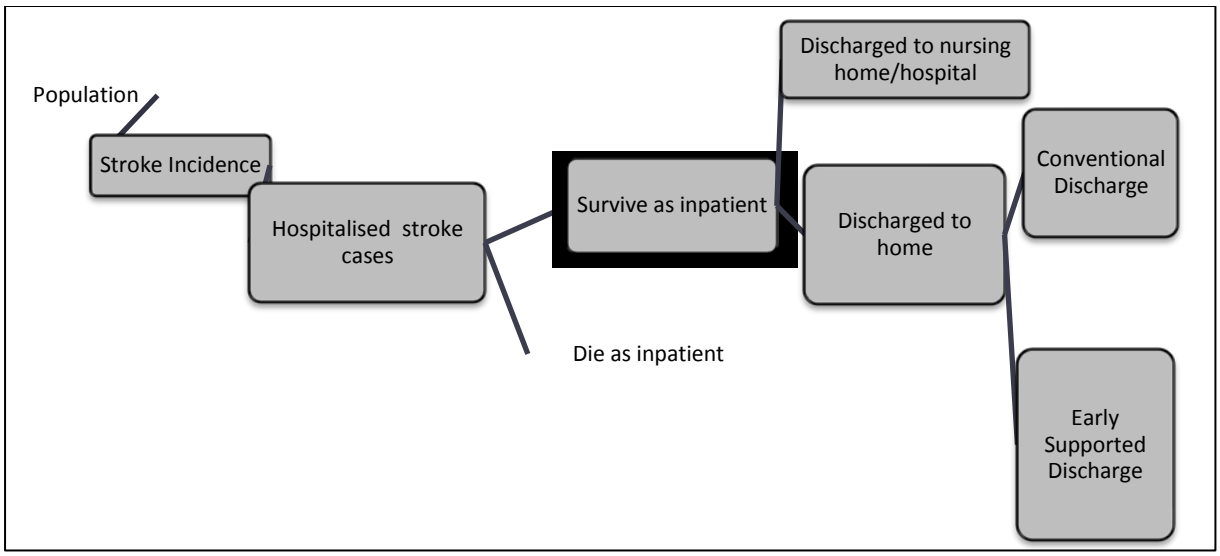
The objective of this application of the model is to compare the relative cost-effectiveness of ESD and CD by relating their mean differences in cost to their mean differences in effectiveness, and by quantifying the uncertainty

surrounding these incremental point estimates. Model outputs include estimates for expected mean costs and effectiveness, expressed as QALYs, for ESD and CD. This output is used to undertake an incremental cost-effectiveness analysis to compare the alternative treatment strategies in terms of costs and health outcomes. The incremental analysis provides information on the marginal costs and effects of ESD relative to CD through the calculation of incremental cost-effectiveness ratios (ICERs). Univariate, multi-variate and probabilistic sensitivity analyses are employed to address uncertainty in the study. The findings of this modelling are reported in Chapter Five.

2.3.9 Decision-Tree Analysis Methodology

The decision-tree model provides supplementary evidence to that from the DES modelling of cost-effectiveness of ESD. It may be viewed as both a form of budget impact analysis and a form of sensitivity analysis. The decision-tree model (Figure 2) compares the resource use and costs of ESD and CD in Ireland up to one year post-stroke. Since resource use and costs are calculated from a healthcare provider perspective, this analysis offers accessible and transparent information about the relative costs and resource requirements of the two treatment strategies. Patients' outcomes are not a factor in this model and their journeys after discharge are not followed beyond their receipt of ESD or CD in the community in the first year post-stroke. The output from this model can be expressed as the mean incremental cost of ESD and as the total incremental cost of ESD to the public healthcare system, which facilitates budget impact analysis of implementation of an ESD programme at local, regional or national level.

FIGURE 2 Decision-Tree Model



Source Developed by authors.

2.4 Conclusion

This chapter has described the multiple data sources employed in this study to analyse stroke rehabilitation in Ireland and to formulate models of best practice in stroke rehabilitation internationally. The methodologies adopted in this analysis and in modelling the relative costs and benefits of current versus preferred care have been outlined. The next three chapters describe the findings from this study in detail. Chapter Three describe the findings in relation to current stroke rehabilitation in Ireland. Chapter Four describes the findings in relation to best practice pathways of rehabilitation. Chapter Five describes the findings from the modelling of the costs and cost-effectiveness of current and preferred stroke rehabilitation.

CHAPTER 3

Stroke Rehabilitation in Ireland — Findings

3.1 Introduction

This chapter addresses the first two objectives of this study: to describe current rehabilitation for stroke patients in Ireland; and to analyse best practice pathways of stroke rehabilitation. This analysis builds from an evidence base in the recent literature on stroke services in Ireland (Smith et al. 2010; Horgan et al. 2011; Hickey et al. 2012). At national aggregate level, the volume and cost of rehabilitation for stroke survivors has been previously estimated employing survey evidence from professionals supplying care and from inpatient rehabilitation data (Smith et al. 2010). The particular challenge for this study has been to build on this national picture by developing disaggregated estimates of rehabilitation need, supply and access by such metrics as age, gender, area of residence/treatment and level of disability. The limitations of relying on nationally averaged data to estimate local needs/services are underlined by the findings of Hickey et al. (2012) of a lack of formal, structured community-based services for stroke with significant regional variation in availability of allied healthcare professionals; and considerable inequity in access to stroke services. Hickey et al. (2012) found that such services as existed were generic in nature (i.e. not specialised in stroke care) and were rarely multi-disciplinary.

This chapter therefore takes the approach of reporting findings on current stroke rehabilitation in Ireland at as disaggregated a level as the available data allow. The chapter presents findings on: area-level stroke incidence; area-level need for rehabilitative care at varying levels of disability; and area-level supply of professionals who deliver rehabilitative care. Findings on estimated intensity of delivery of therapy to stroke survivors are presented by region and service setting. Analysis presented on stroke hospital discharges examines: length of stay, discharge destination, age, gender and level of disability. The hospital discharge analysis is presented at regional and hospital level. Responses to this project's survey of stroke hospital leads are examined with a view to understanding how pathways of care differ across the country. Analysis of evidence on stroke survivors' outcomes post-discharge is presented. Finally, to reflect regional divergence, two case studies are presented, which estimate stroke survivors' utilisation of care based on evidence from North Dublin and HSE Region South.

The chapter presents the findings of the analysis under the headings: regional incidence and need for rehabilitation (Section 3.2); current rehabilitation services (Section 3.3); hospital discharges (Section 3.4); care pathways from hospitals (Section 3.5); progress post-discharge (Section 3.6); and care post-discharge (Section 3.7). Section 3.8 concludes.

3.2 Regional Incidence and Need for Rehabilitation

In Table 2, national stroke discharges by age cohort and gender are expressed per 1,000 population of that age cohort and gender to generate incidence rates, purely on this hospital discharge basis. The discharges in TABLE 2 exclude a small number of people with a stroke diagnosis who were not resident in the State because the purpose of this step in the analysis is to assign discharges to area of residence. In Table 3, the same exercise is repeated for each of the four HSE Regions: Dublin Mid-Leinster, Dublin North-East, South and West. HSE Region West has an overall incidence at 1.59 discharges per 1,000 population, compared to a national rate of 1.50 (inclusion of non-residents would bring the national rate to 1.51). This Region also has the oldest age profile (Figure 3). There is a relatively high proportion of older women in the West and this cohort has a relatively high stroke discharge rate (Figure 4 and Table 3).

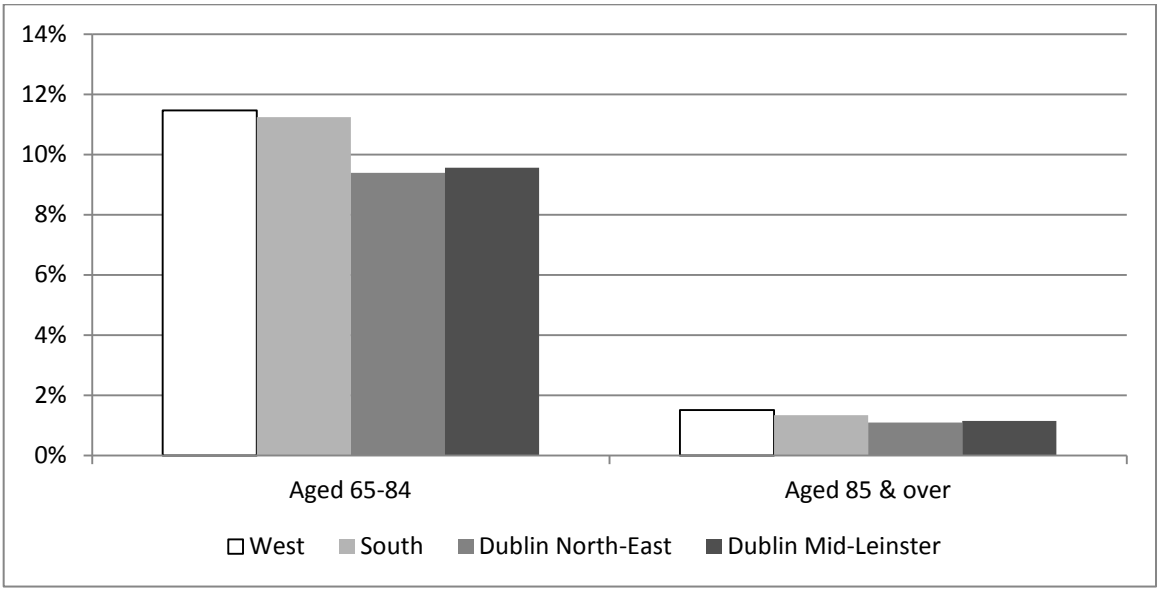
TABLE 2 Acute Stroke Discharges by Age and Gender, Residents of Republic of Ireland,[7] 2011

	Acute stroke discharges 2011			Population, 2011			Incidence (Hospital Basis)		
	Number			Number			Rates per 1,000 population		
Age Group	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-14	38	30	68	501,189	478,401	979,590	0.08	0.06	0.07
15-34	82	93	175	659,386	675,931	1,335,317	0.12	0.14	0.13
35-44	130	121	251	348,567	346,506	695,073	0.37	0.35	0.36
45-54	330	230	560	288,253	291,318	579,571	1.14	0.79	0.97
55-64	613	368	981	231,990	231,318	463,308	2.64	1.59	2.12
65-74	970	574	1,544	149,774	155,054	304,828	6.48	3.70	5.07
75-84	1,033	1,064	2,097	75,054	97,095	172,149	13.76	10.96	12.18
85+	386	828	1,214	18,486	39,930	58,416	20.88	20.74	20.78
Total	3,582	3,308	6,890	2,272,699	2,315,553	4,588,252	1.58	1.43	1.50

Source: HIPE 2011, Census 2011. Principal and secondary stroke discharges included by Wren and Kelly (2013) method: HIPE principal plus secondary diagnoses of stroke (excluding principal diagnosis of rehabilitation) in non-rehabilitation hospitals, all discharges (survivors and deaths). Excludes if day case or if length of stay is under one day and discharge home or to another hospital unless non-HIPE, non-acute, exclusions to avoid duplication.

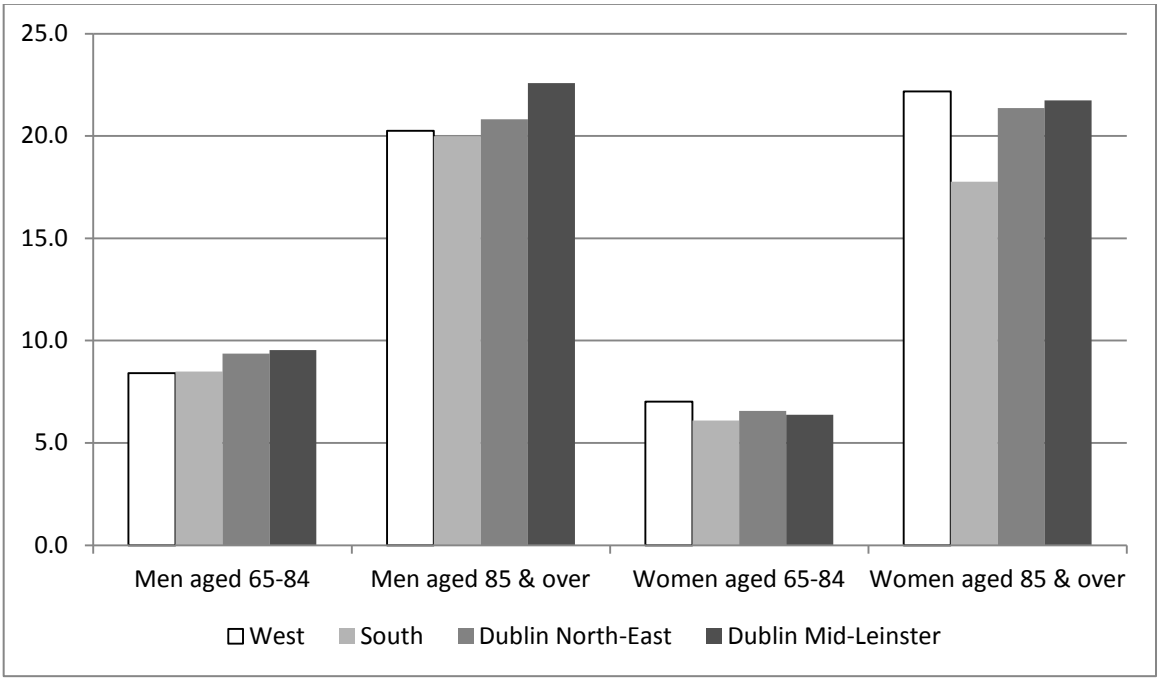
[7] Excluding 55 discharges in 2011 of patients with a principal or secondary diagnosis of stroke who were not resident in the Republic of Ireland.

FIGURE 3 Older Age Cohorts as Percentage of Population, 2011, HSE Regions



Source: Population; CSO Census 2011. Service Boundaries; HSE Health Atlas Ireland.

FIGURE 4 Stroke Discharge Rate per 1,000 Older Men and Women by HSE Region of Residence, 2011



Source: Discharges; HIPE 2011. Population; CSO Census 2011. Service Boundaries; HSE Health Atlas Ireland.

TABLE 3 Acute Stroke Discharges, Residents of HSE Regions, 2011

	Acute stroke discharges			Population			Incidence (Hospital Basis)		
	Number			Number			Rates per 1,000 population		
HSE Region Dublin Mid-Leinster									
	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-14	13	3	16	142,056	135,668	277,724	0.09	0.02	0.06
15-34	25	20	45	200,157	207,646	407,803	0.12	0.10	0.11
35-44	45	36	81	100,143	100,504	200,647	0.45	0.36	0.40
45-54	110	67	177	80,611	83,525	164,136	1.36	0.80	1.08
55-64	191	107	298	63,611	65,503	129,114	3.00	1.63	2.31
65-74	253	147	400	38,830	41,990	80,820	6.52	3.50	4.95
75-84	301	287	588	19,272	26,156	45,428	15.62	10.97	12.94
85+	106	230	336	4,694	10,579	15,273	22.58	21.74	22.00
Total	1,044	897	1,941	649,374	671,571	1,320,945	1.61	1.34	1.47
HSE Region Dublin North-East[8]									
0-14	6	14	20	113,796	108,454	222,250	0.05	0.13	0.09
15-34	18	26	44	154,301	159,873	314,174	0.12	0.16	0.14
35-44	28	32	60	81,078	80,763	161,841	0.35	0.40	0.37
45-54	92	48	140	61,192	62,251	123,443	1.50	0.77	1.13
55-64	158	86	244	45,627	46,548	92,175	3.46	1.85	2.65
65-74	205	119	324	29,633	31,875	61,508	6.92	3.73	5.27
75-84	208	220	428	14,499	19,818	34,317	14.35	11.10	12.47
85+	72	165	237	3,458	7,725	11,183	20.82	21.36	21.19
Total	787	710	1,497	503,584	517,307	1,020,891	1.56	1.37	1.47
HSE Region South									
0-14	10	7	17	127,264	121,469	248,733	0.08	0.06	0.07
15-34	18	21	39	157,247	160,782	318,029	0.11	0.13	0.12
35-44	25	36	61	87,683	86,181	173,864	0.29	0.42	0.35
45-54	70	53	123	76,298	75,857	152,155	0.92	0.70	0.81
55-64	144	109	253	62,332	60,810	123,142	2.31	1.79	2.05
65-74	261	152	413	41,368	42,196	83,564	6.31	3.60	4.94
75-84	266	265	531	20,740	26,301	47,041	12.83	10.08	11.29
85+	100	188	288	5,003	10,581	15,584	19.99	17.77	18.48
Total	894	831	1,725	577,935	584,177	1,162,112	1.55	1.42	1.48
HSE Region West									
0-14	9	6	15	118,073	112,810	230,883	0.08	0.05	0.06
15-34	21	26	47	147,681	147,630	295,311	0.14	0.18	0.16
35-44	32	17	49	79,663	79,058	158,721	0.40	0.22	0.31
45-54	58	62	120	70,152	69,685	139,837	0.83	0.89	0.86
55-64	120	66	186	60,420	58,457	118,877	1.99	1.13	1.56
65-74	251	156	407	39,943	38,993	78,936	6.28	4.00	5.16
75-84	258	292	550	20,543	24,820	45,363	12.56	11.76	12.12
85+	108	245	353	5,331	11,045	16,376	20.26	22.18	21.56
Total	857	870	1,727	541,806	542,498	1,084,304	1.58	1.60	1.59

Source: Discharges; HIPE 2011. Population; CSO Census 2011. Service Boundaries; HSE Health Atlas Ireland. Methodology as in footnote to Table 2.

8 Areas of residence recorded in HIPE do not exactly map to HSE Region boundaries. Whereas the county of Cavan is one area of residence, it is divided in the HSE Regions with West Cavan assigned to HSE West and the remainder of the county to HSE Dublin North-East. In this calculation of the areas of residence of patients with stroke and consequent incidence rates of stroke, Cavan is assigned to Dublin North-East, which may mean there is marginal understatement of stroke incidence in the West and over-statement in the North-East.

These regional rates of stroke hospital discharges are then converted into more disaggregated estimates of incidence at area level. The current HSE organisational structure for the delivery of services outside acute hospitals comprises 17 Integrated Service Areas (ISAs), which subsume the previous long-standing 32 Local Health Offices (LHOs).[9] There are 17 ISAs: HSE Regions Dublin Mid-Leinster, Dublin North-East and South are divided into four ISAs each; while HSE Region West is divided into five ISAs (Table 4). The ISAs vary greatly in population (Figure 5: Cork 520,000; Sligo/Leitrim/West Cavan 96,000) and also have differing age profiles (Figure 6).

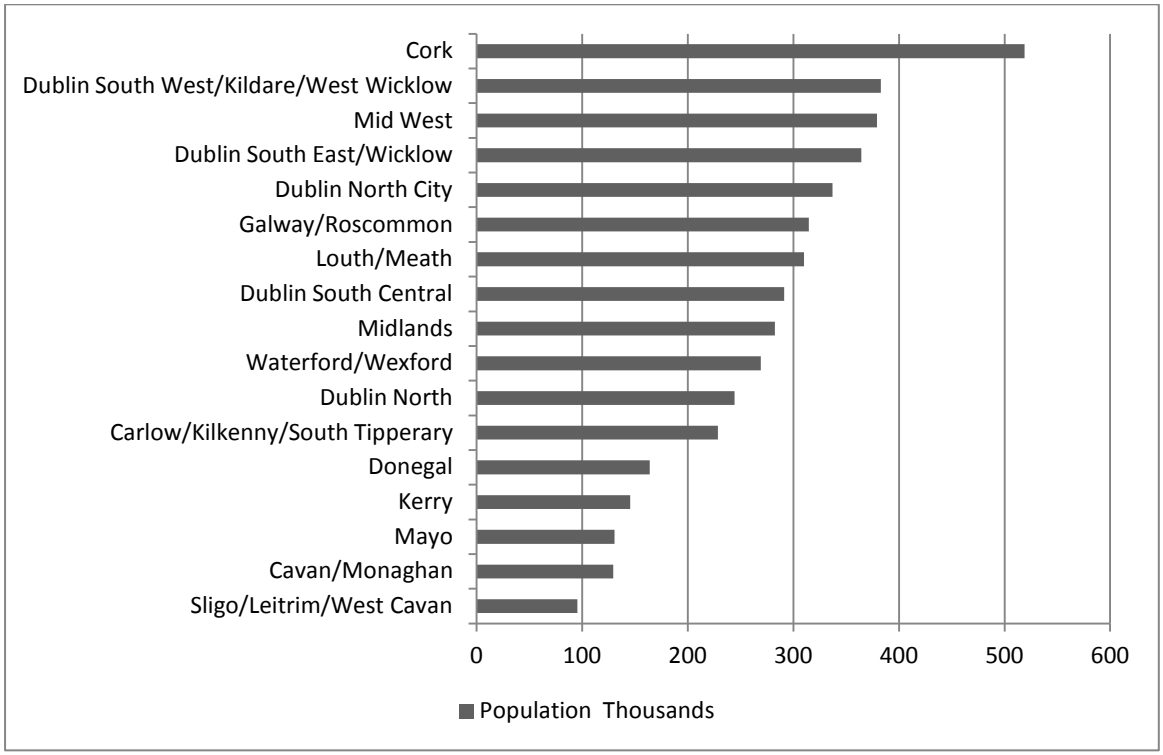
TABLE 4 HSE Regions and Integrated Service Areas

Regions	Integrated Service Areas
Dublin Mid-Leinster	Dublin South Central
	Dublin South East/ Wicklow
	Dublin South West/Kildare
	Midlands[1]
Dublin North-East	Cavan/Monaghan
	Dublin City North
	Dublin North
	Louth/ Meath
South	Carlow/ Kilkenny/ South Tipperary
	Cork
	Kerry
	Waterford/ Wexford
West	Donegal
	Galway/Roscommon
	Mayo
	Mid-West[2]
	Sligo-Leitrim/West Cavan

Midlands equates to Counties Laois, Offaly, Longford and Westmeath;
Mid-West equates to Counties Limerick, Clare and North Tipperary.

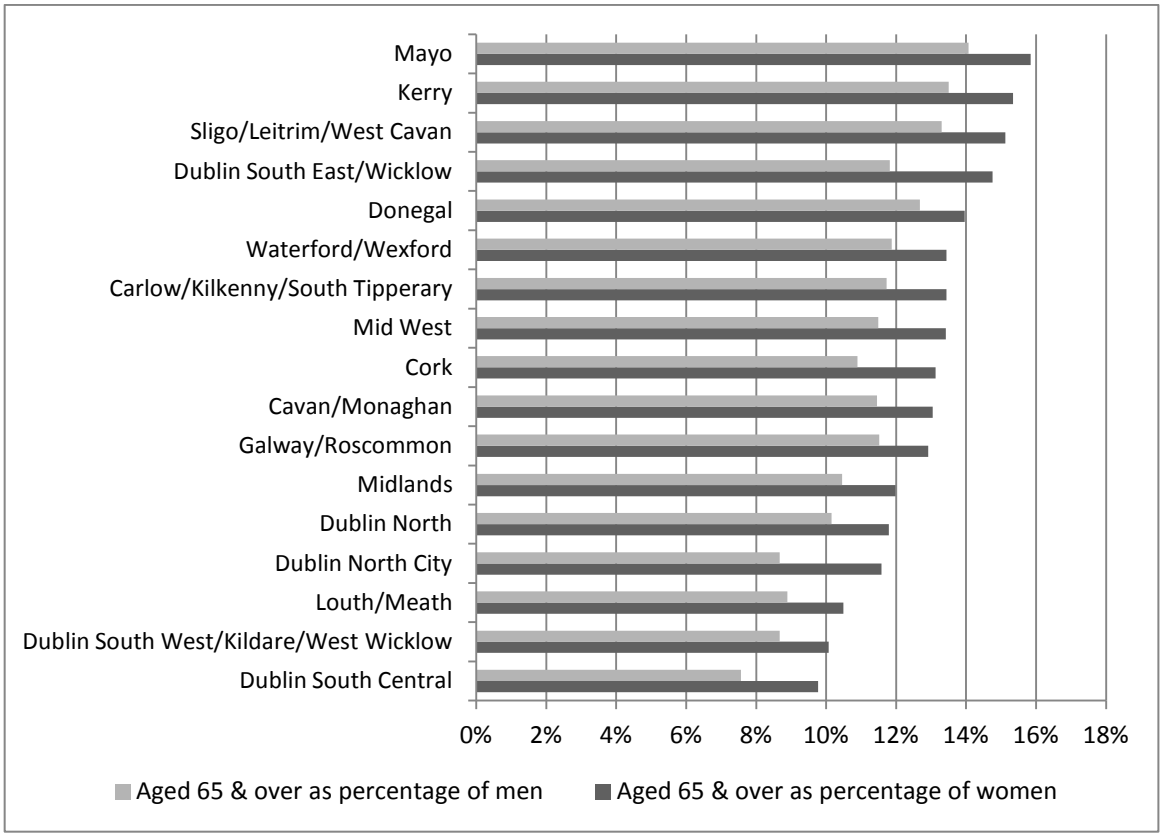
9 This administrative structure was under review at the time of writing.

FIGURE 5 Population by ISA, 2011



Source: Population; CSO Census 2011. Service Boundaries; HSE Health Atlas Ireland.

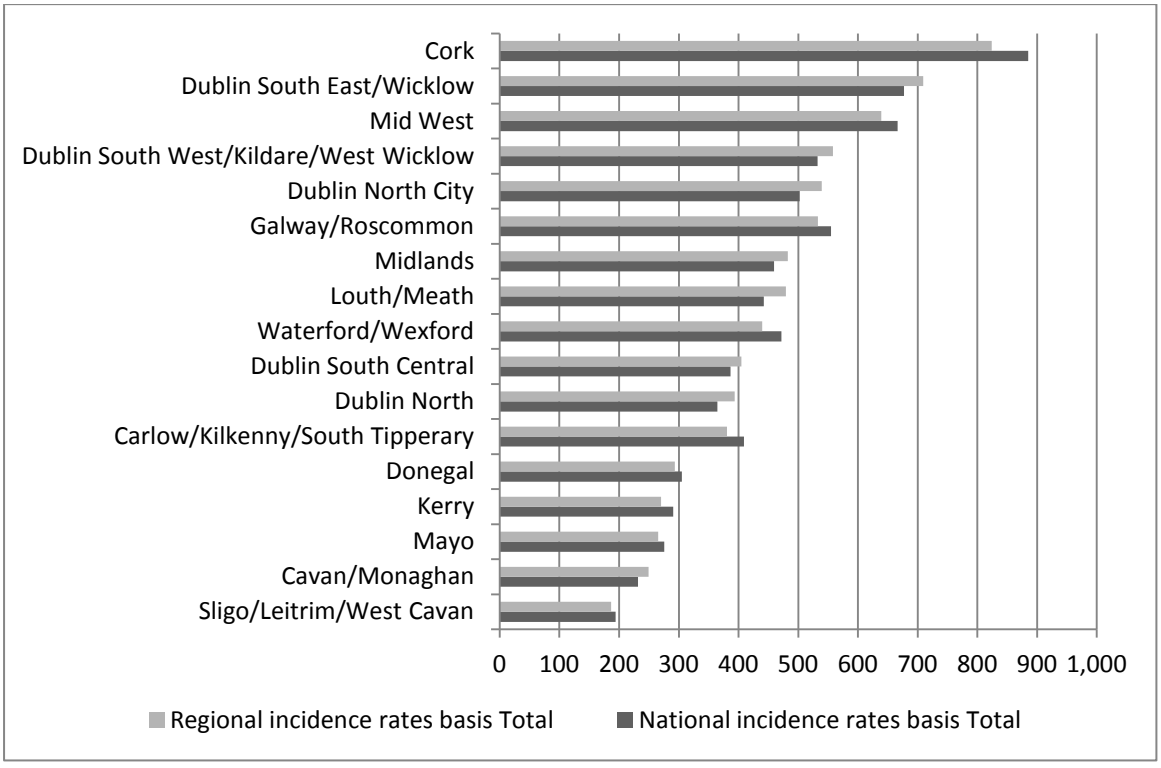
FIGURE 6 Proportions of Older Men and Women by ISA, 2011



Source: Population; CSO Census 2011. Service Boundaries; HSE Health Atlas Ireland.

Incidence of stroke at ISA level is estimated by two methods, illustrated in Figure 7. In one estimate, the national HIPE discharge incidence rates by age and gender from Table 2 are applied to ISA population by age and gender. This estimated incidence by ISA is then increased by 11 per cent to reflect an assumption that 11 per cent of cases are not hospitalised following the analysis of Wren and Kelly (2013). In the second set of estimates, regional incidence rates from Table 3 are applied to the ISA populations in that Region and this estimate is then also increased by 11 per cent. The greater numbers of incident stroke cases by ISA for 2011 reflect larger populations, as in the case of Cork, as well as the ISAs' demographic profiles and the regional incidence rates for HIPE discharges. Applying the regional rates by ISA can be seen to have the effect of changing the distribution of estimated stroke discharges.

FIGURE 7 Estimated Stroke Incidence (Numbers) by ISA, 2011



Source Calculated as described in text.

Rehabilitation need by ISA is estimated by applying evidence on stroke patients' survival from HIPE and on levels of severity of disability by gender among stroke survivors from INASC to these estimated incident cases. INASC recorded patient disability level using the Barthel Index (BI), which assesses levels of dependence or independence in undertaking everyday tasks and self-care (Appendix 8.1) and scores cumulatively for differing domains. This analysis follows Irish Heart Foundation (2008) in defining levels of disability according to the BI score as: independent (20); mild disability (15-19); moderate disability (10-14), severe

disability (5-9); and very severe disability (0-4) (Table 5).[10] Numbers of survivors by disability/dependence level are increased by nine per cent to adjust for estimated strokes occurring outside hospitals and their estimated survival rate, derived from the North Dublin Population Stroke Study, by a methodology developed in Wren and Kelly (2013). The adjustment for stroke survivors is lower than the 11 per cent adjustment applied to estimate all strokes because the survival rate from strokes that were recorded in the community in the NDPSS and did not lead to hospitalisation was lower than the survival rate for hospitalised strokes.

TABLE 5 Levels of Disability in Discharged Stroke Patients, INASC

	Barthel Index	N	Overall disability rate %	Male disability rate %	Female disability rate %
Very severe disability	0-4	256	16.0	15	18
Severe disability	5-9	224	14.0	14	14
Moderate disability	10-14	243	15.2	12	19
Mild disability	15-19	417	26.1	26	26
Independence	20	456	28.6	34	23
Total		1,596	100		

Source: INASC clinical audit, 2005.

Estimated ISA-level incident stroke numbers by level of disability are illustrated graphically for men (Figure 8), women (Figure 9) and total ISA population (Figure 10). It can be seen that across ISAs the proportions at differing levels of disability vary, due to the differing age and gender profiles of ISAs. A limitation in this analysis is that it is only possible to generate national disability rates from INASC since the region in which INASC hospitals were located is not available to researchers. Furthermore, as will be demonstrated in analysis of discharge rates and length of stay from INASC below, INASC disability rates at discharge are an understated measure of rehabilitation need because of the evidence of rehabilitation occurring in hospitals and may understate need for rehabilitation outside the acute hospital setting because of decrease in inpatient length of stay since 2005.

[10] Categorisation of disability levels differs in Chapter 5. See also Appendix 8.1.

FIGURE 8 Estimated Numbers of Stroke Survivors and Disability Level on Discharge by ISA, Male

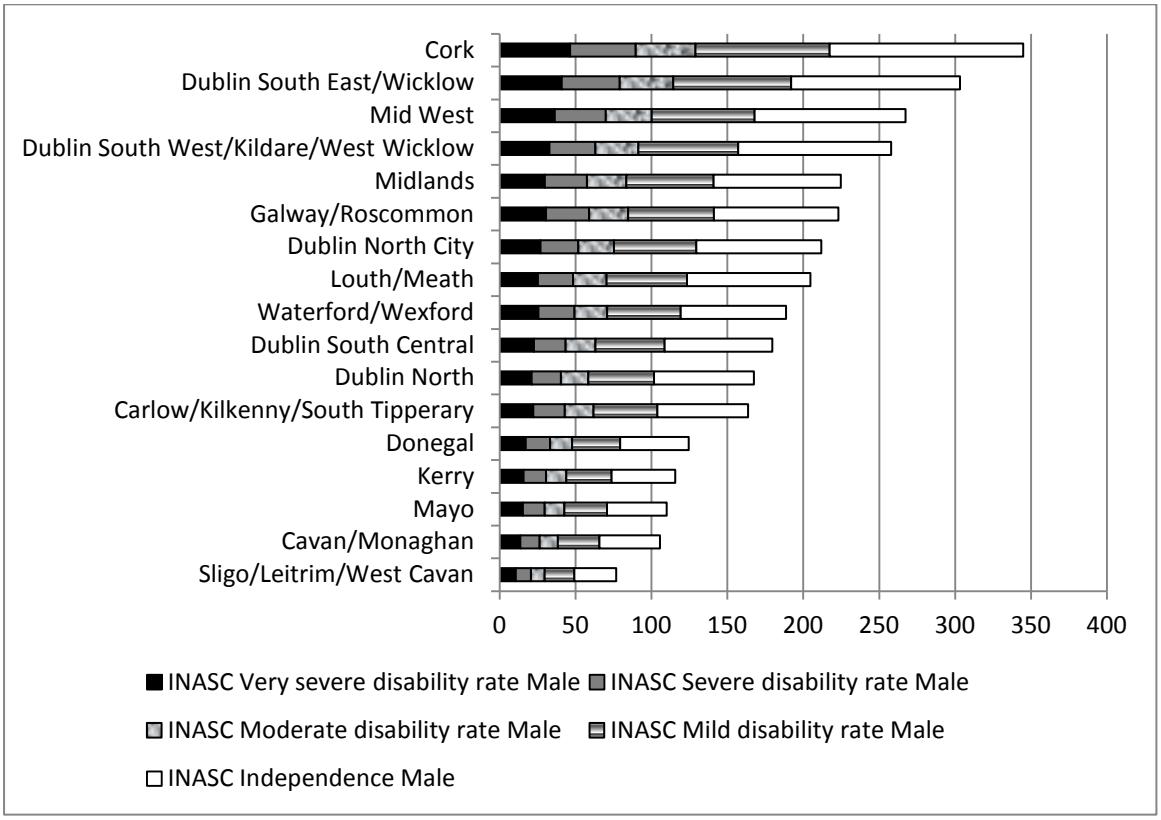
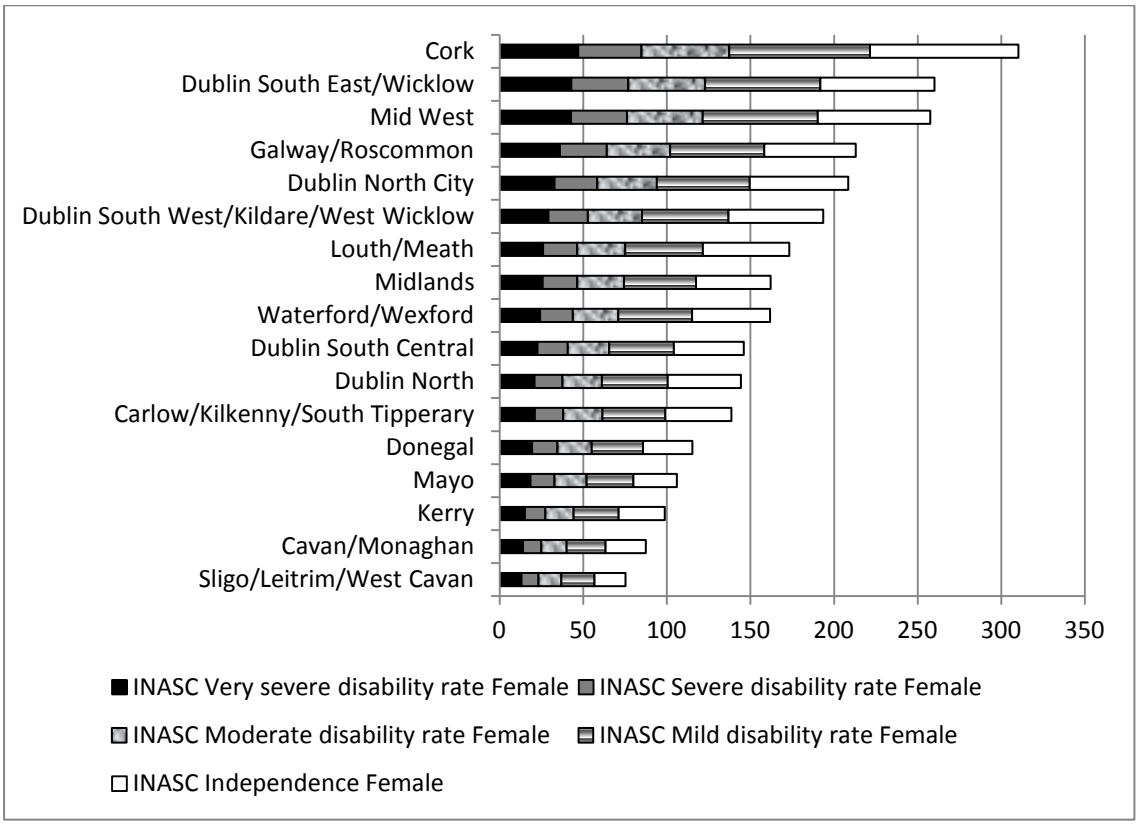
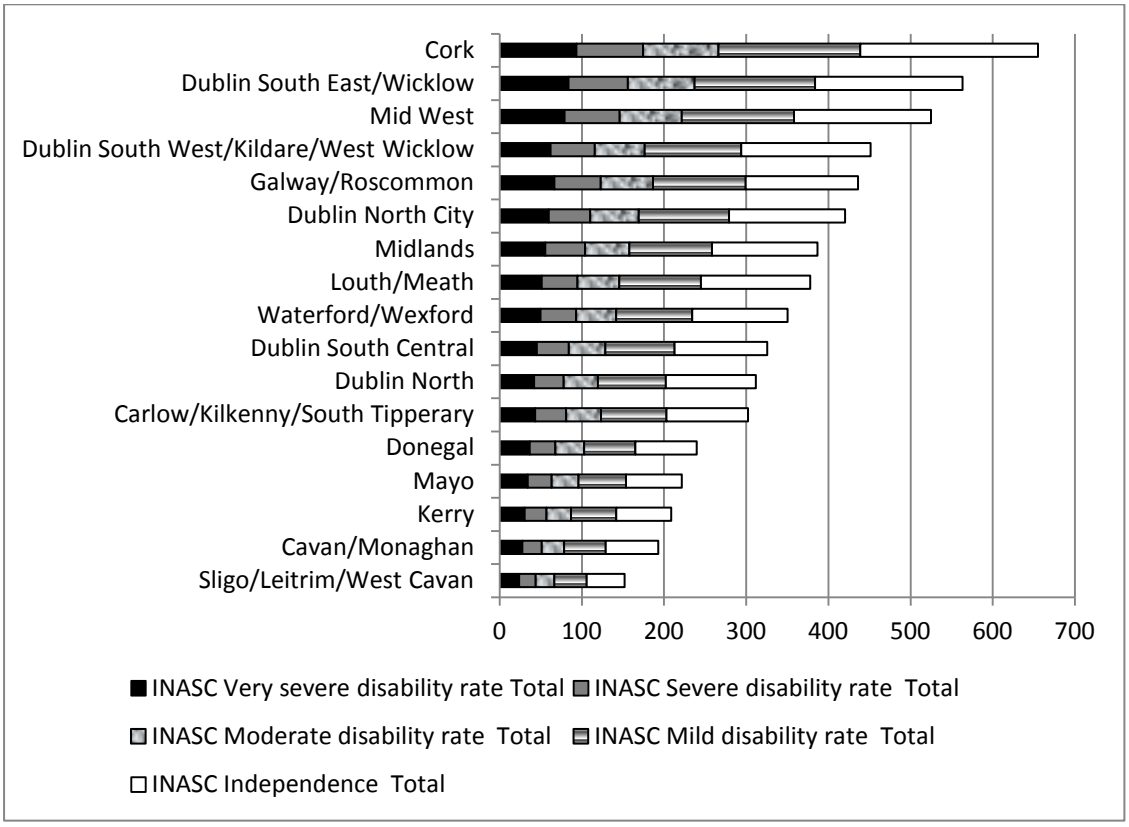


FIGURE 9 Estimated Numbers of Stroke Survivors and Disability Level on Discharge by ISA, Female



Source: Calculated as described in text.

FIGURE 10 Estimated Numbers of Stroke Survivors and Disability Level on Discharge by ISA, Total



Source: Calculated as described in text.

3.3 Current Rehabilitation Services

Since Hickey et al. (2012) found that the community stroke rehabilitation service is generic in nature (as opposed to specifically dedicated to stroke or more generally to neurological rehabilitation), assessing the supply of professionals who deliver rehabilitation services in the community is relevant to assessing the availability of such services to stroke survivors. The HSE Personnel Census data for December 2012 provides personnel numbers by region, grade, group and care group. Although the HIPE and Census of Population data that have informed this analysis pertain to 2011, it is considered appropriate to use more recent personnel data due to the high level of service retirements in early 2012. This analysis reviews numbers of physiotherapists (PT), occupational therapists (OT) and speech and language therapists (SLT) in Primary Care or Older Persons' Services, and numbers of psychologists in these services and in Mental Health Services. While the analysis provides a comparison of relative resourcing of community staffing by area across the country relative to numbers of stroke survivors with need for rehabilitative therapy, it is solely a comparative exercise and is not postulated to reflect the actual demands on these staff, who must meet all needs for rehabilitation in the community.

The assignment of staff and institutions to HSE Care Groups does not follow consistent definitions and reflects the historic development of services across former health board areas. Consequently, the Primary Care Personnel Census category includes some institutions; and staff, who are engaged in community care, are assigned across differing Groups. In the following tables and figures, Primary Care staffing excludes the National Rehabilitation Hospital in Dublin South-East/Wicklow, and the Incorporated Orthopaedic Hospital, Clontarf, which respectively have national and regional catchment areas (and are included in the HSE Census under the Primary Care heading). Arguably, staff at St Mary's Hospital, Phoenix Park, should also be excluded from Older Persons Services in Dublin City North, since this hospital has a regional catchment area. In the figures a distinction has been made between community and residential services for older people. However, staff based in community residential units may also offer services to community-dwelling older people. Relating supply of therapy professionals by ISA to total ISA populations and older ISA populations demonstrates a wide range (Table 6). The three ISAs with proportionately greatest numbers of physiotherapists and occupational therapists, when staffing is expressed as a ratio to 1,000 population aged 65 and over, are: Sligo-Leitrim/West Cavan, Donegal and the Midlands (Figure 11 and Figure 12). The four ISAs with proportionately the greatest number of SLTs are: Sligo-Leitrim/West Cavan, the Midlands, Mayo and Carlow/Kilkenny/South Tipperary (Figure 13). It is notable that the Dublin ISAs generally rank low in supply: Dublin City North can be seen to have a relatively high number of allied healthcare professionals in older persons' residential services, which would reduce if St Mary's, Phoenix Park, were excluded.

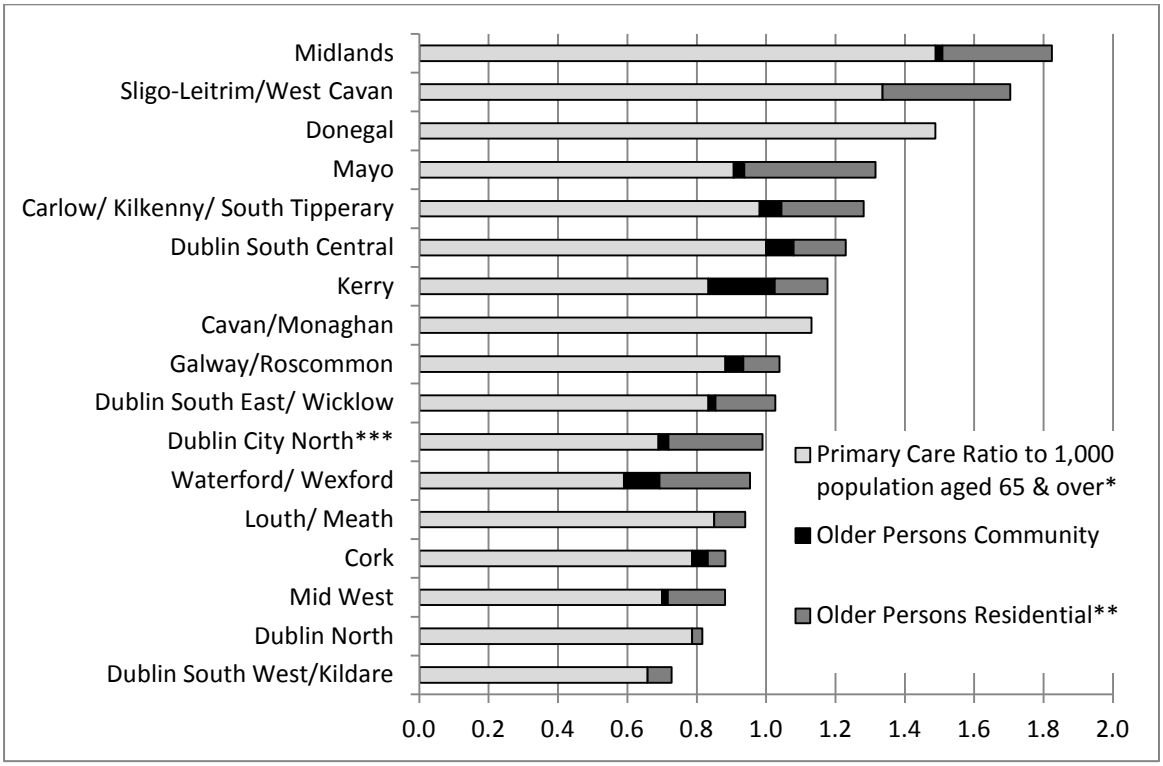
TABLE 6 Numbers of Therapists, Primary Care and Older Persons' Services, by ISA and Region, December 2012

	Primary Care Numbers (WTE)			Older Persons Numbers (WTE)		
	PT	OT	SLT	PT	OT	SLT
HSE Region Dublin Mid-Leinster						
Dublin South Central	25.3	26.7	14.8	5.8	2.8	1.0
Dublin South East/ Wicklow	40.5	40.0	32.5	9.4	6.4	1.8
Dublin South West/Kildare	23.6	30.8	23.5	2.5	0.5	0.0
Midlands	47.2	43.9	46.3	10.6	4.5	1.0
Total Dublin Mid-Leinster	136.6	141.4	104.5	28.3	14.2	3.8
HSE Region Dublin North-East						
Cavan/Monaghan	17.9	18.2	14.5	0.0	1.9	0.8
Dublin City North	23.6	32.1	20.7	10.3	9.0	3.8
Dublin North	21.1	21.3	19.5	0.8	0.0	0.0
Louth/ Meath	25.6	23.1	19.1	2.7	1.0	1.0
Total Dublin North-East	88.2	94.7	73.8	13.7	11.9	5.6
HSE Region South						
Carlow/ Kilkenny/ South Tipperary	28.2	8.3	29.0	8.6	21.5	2.7
Cork	49.1	12.1	41.7	6.0	31.8	1.4
Kerry	17.5	1.0	12.9	7.2	10.4	1.0
Waterford/ Wexford	20.1	4.0	26.4	12.4	24.1	1.0
Total South	114.9	25.4	110.0	34.1	87.8	6.1
HSE Region West						
Donegal	32.5	30.6	19.9	0.0	0.0	0.0
Galway/Roscommon	33.9	37.0	36.7	6.0	1.0	0.0
Mayo	17.7	14.0	20.5	8.0	4.8	0.6
Mid-West	33.1	24.7	29.1	8.6	10.3	1.0
Sligo-Leitrim/West Cavan	18.2	17.5	15.8	5.0	11.0	0.0
Total West	135.4	123.8	122.0	27.6	27.1	1.6
National						
National	475.1	385.3	410.2	103.9	141.0	17.1

TABLE 7 Ratio of Therapists to Population, Primary Care and Older Persons' Services, by ISA and Region, December 2012

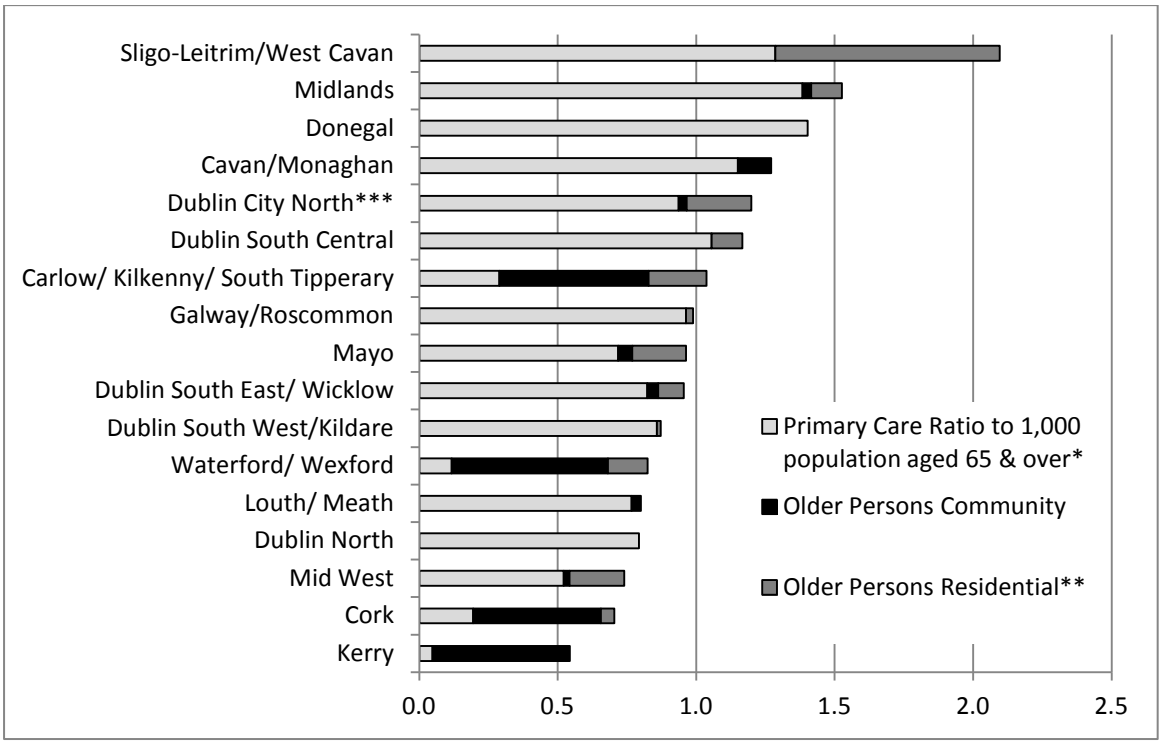
	Primary Care and Older Persons Ratio to 10,000 population			Primary Care and Older Persons Ratio to 1,000 population aged 65 and over		
	PT	OT	SLT	PT	OT	SLT
HSE Region Dublin Mid-Leinster						
Dublin South Central	1.07	1.0	0.5	1.23	1.2	0.6
Dublin South East/ Wicklow	1.37	1.3	0.9	1.03	1.0	0.7
Dublin South West/Kildare	0.68	0.8	0.6	0.73	0.9	0.7
Midlands	2.05	1.7	1.7	1.82	1.5	1.5
Dublin Mid-Leinster	**1.25**	**1.2**	**0.8**	**1.17**	**1.1**	**0.8**
HSE Region Dublin North-East						
Cavan/Monaghan	1.36	1.5	1.2	1.13	1.3	1.0
Dublin City North	1.01	1.2	0.7	0.99	1.2	0.7
Dublin North	0.90	0.9	0.8	0.82	0.8	0.7
Louth/ Meath	0.92	0.8	0.7	0.94	0.8	0.7
Dublin North-East	**1.00**	**1.0**	**0.8**	**0.95**	**1.0**	**0.7**
HSE Region South						
Carlow/ Kilkenny/ South Tipperary	1.61	1.3	1.4	1.28	1.0	1.1
Cork	1.06	0.8	0.8	0.88	0.7	0.7
Kerry	1.70	0.8	1.0	1.18	0.5	0.7
Waterford/ Wexford	1.21	1.0	1.0	0.95	0.8	0.8
South	**1.28**	**1.0**	**1.0**	**1.02**	**0.8**	**0.8**
HSE Region West						
Donegal	1.98	1.9	1.2	1.49	1.4	0.9
Galway/Roscommon	1.27	1.2	1.2	1.04	1.0	1.0
Mayo	1.97	1.4	1.6	1.32	1.0	1.1
Mid-West	1.10	0.9	0.8	0.88	0.7	0.6
Sligo-Leitrim/West Cavan	2.42	3.0	1.7	1.70	2.1	1.2
West	**1.50**	**1.4**	**1.1**	**1.16**	**1.1**	**0.9**
National						
National	**1.26**	**1.1**	**0.9**	**1.08**	**1.0**	**0.8**

FIGURE 11 Physiotherapists by ISA Population Aged 65 and Over



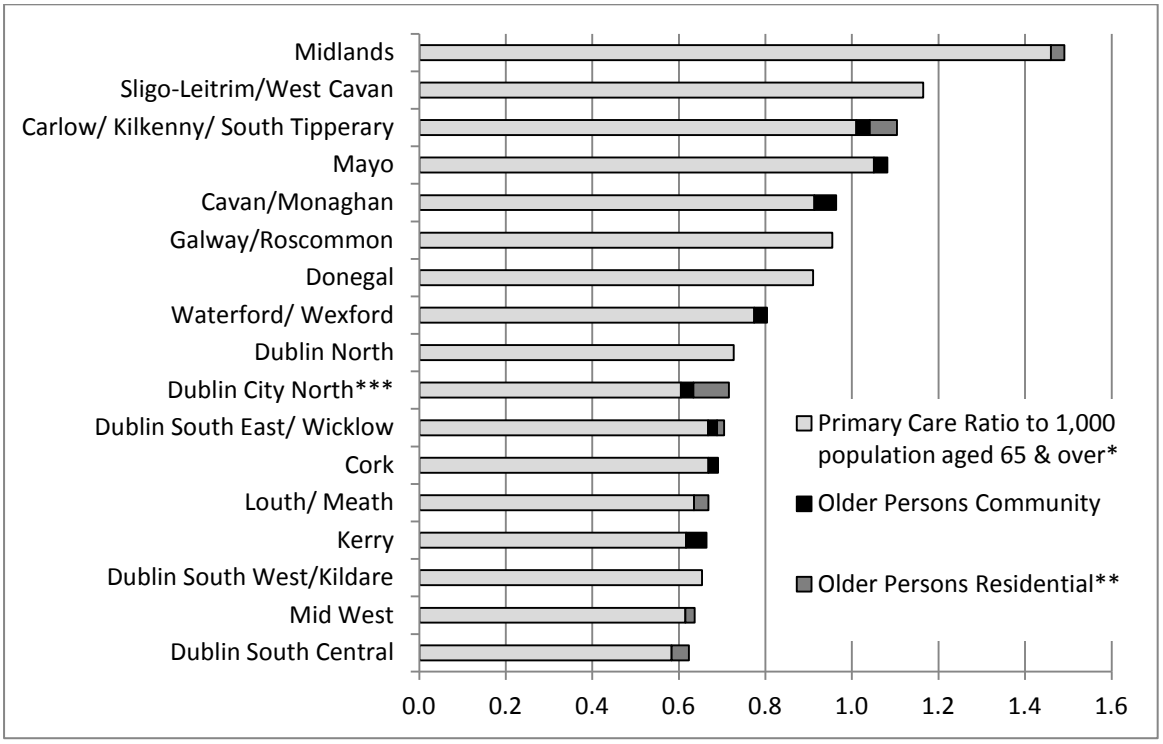
Source: Staffing; HSE Personnel Census, December 2012. Population; CSO Census 2011. Service Boundaries; HSE Health Atlas Ireland.
*Excluding National Rehabilitation Hospital in Dublin South-East/Wicklow and Incorporated Orthopaedic Hospital, Clontarf in Dublin City North.
** Physiotherapists based in community residential units may also offer services to community-dwelling older people.
***Older Persons Services in Dublin City North includes St Mary's Phoenix Park, regional catchment.

FIGURE 12 Occupational Therapists by ISA Population Aged 65 and Over



Source: As Figure 11.

FIGURE 13 Speech and Language Therapists by ISA population Aged 65 and Over



Source: As Figure 11.

Assessment of the supply of psychologists and counsellors finds fewer employed in Primary Care Services than the other therapies (175 compared to approximately 400 to 500 of the other therapies) and virtually none in Older Persons' Services (1.8 WTE compared to 17 SLTs, 104 PTs and 141 OTs). Determining the availability of psychologists and counsellors employed in Mental Health Services to community care is difficult because this Care Group includes institutional staff, who may or may not contribute to outpatient care. Comparison of psychology staffing across ISAs should therefore be approached with particular caution. While Sligo-Leitrim/West Cavan, Donegal and Mayo appear relatively better resourced, a more detailed investigation of the roles of staff in Mental Health Services would be necessary for a reliable comparison of the availability of psychologists and counsellors to community services (Table 8).

TABLE 8 Numbers of Psychologists and Counsellors in Primary Care, Older Persons Services and Community Mental Health Services (Estimated) and Ratios to Population By ISA and Region, December 2012

	Primary Care Numbers (WTE)	Older Persons Services Numbers (WTE)	Ratio of staffing to 1,000 people aged 65 and over (Primary Care, Older Persons Services)	Mental Health Services Numbers (WTEs)*	Ratio of staffing to 1,000 people aged 65 and over (incl. Community Mental Health)
HSE Region Dublin Mid-Leinster					
Dublin South Central	10.9	0.0	0.4	10.0	0.8
Dublin South East/ Wicklow	21.5	1.0	0.5	14.6	0.8
Dublin South West/Kildare	13.5	0.0	0.4	0.0	0.4
Midlands	6.6	0.0	0.2	6.0	0.4
Total Dublin Mid-Leinster	52.5	1.0	1.5	30.6	2.4
HSE Region Dublin North-East					
Cavan/Monaghan	5.0	0.0	0.3	1.0	0.4
Dublin City North	15.4	0.8	0.6	0.0	0.6
Dublin North	0.0	0.0	0.0	5.0	0.1
Louth/ Meath	14.6	0.0	0.5	14.3	1.0
Total Dublin North-East	35.1	0.8	1.4	20.3	2.1
HSE Region South					
Carlow/ Kilkenny/ South Tipperary	0.0	0.0	0.0	0.0	0.0
Cork	5.0	0.0	0.1	3.0	0.1
Kerry	0.0	0.0	0.0	0.0	0.0
Waterford/ Wexford	1.0	0.0	0.0	11.6	0.4
Total South	6.0	0.0	0.1	14.6	0.5
HSE Region West					
Donegal	20.6	0.0	0.9	3.8	1.1
Galway/Roscommon	18.6	0.0	0.5	4.5	0.6
Mayo	16.3	0.0	0.8	4.0	1.0
Mid-West	9.8	0.0	0.2	0.0	0.2
Sligo-Leitrim/West Cavan	15.8	0.0	1.2	5.2	1.5
Total West	80.9	0.0	3.6	17.5	4.5
National					
National	174.5	1.8	6.6	83.0	9.5

Source: Staffing; HSE Personnel Census, December 2012. Population; CSO Census 2011. Service Boundaries; HSE Health Atlas Ireland. *Mental Health Services exclude staff of hospitals and in child and adolescent and addiction services. Dublin City North includes staffing for the region, who may also service Dublin North.

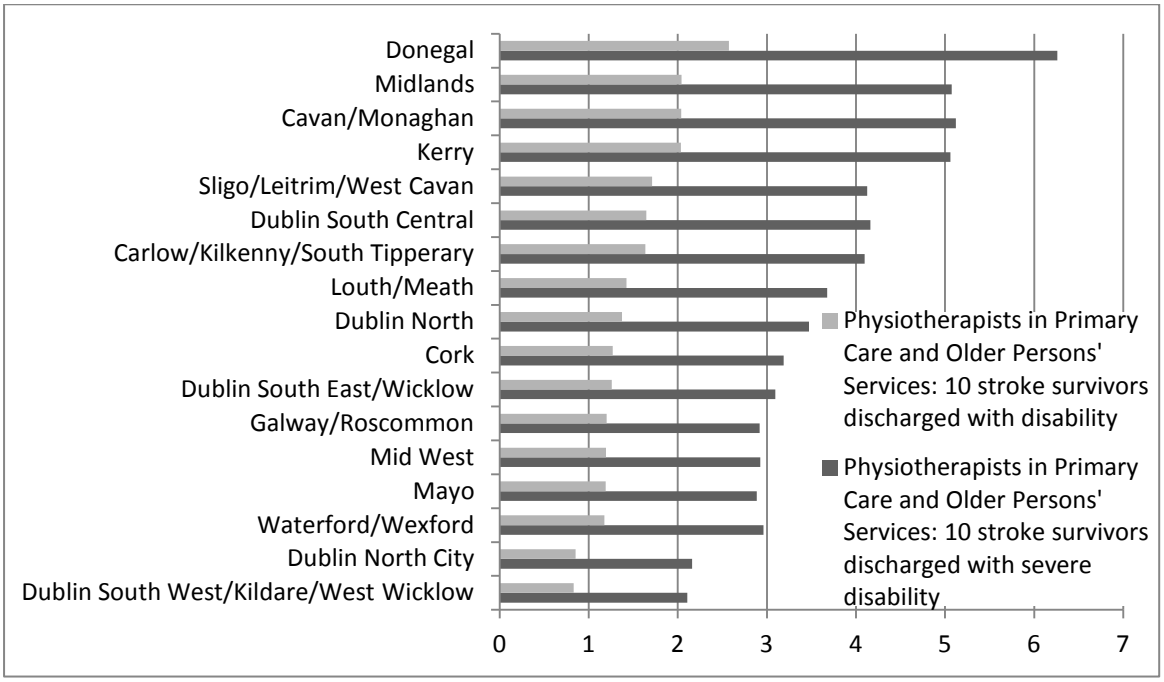
The Hospital Leads' Survey conducted by this project in 2013 and discussed in detail in Section 3.5 below confirms that the role of psychology in stroke services in Ireland is relatively under-developed. Respondents from only four out of 28 acute hospitals confirmed that the services of a psychologist were offered to patients undergoing inpatient rehabilitation after stroke while respondents from 23 hospitals said that psychology was not available. When asked at which offsite

rehabilitation locations availability of psychology would be a criterion in a decision to refer for rehabilitation, respondents identified only five locations, which were not acute hospitals: the National Rehabilitation Hospital in Dun Laoghaire, the Royal Hospital in Donnybrook, Acquired Brain Injury facilities in Counties Offaly and Sligo, and St John's Hospital in County Wexford. Other studies have confirmed significant deficits in the availability of psychological services for stroke survivors in the community and in nursing homes. A survey of 196 stroke survivors living in the community in 2013 found that 77 per cent had emotional difficulties and, of this grouping, only eleven per cent received psychological services (Horgan et al. 2014). A study of care for stroke patients in nursing homes in Ireland undertaken in 2007, which primarily interviewed nursing home managers, found that fewer than ten per cent reported high access to a psychologist, only three per cent reported high access to a counsellor, while in public nursing homes psychological and counselling services were 'almost non-existent' (The National Audit of Stroke Care Research Team 2007; Irish Heart Foundation 2008).

To estimate supply of therapy staffing in the community (including residential older persons' services) relative to stroke survivors with disability, this evidence of supply of generic community therapists is combined with the evidence of rehabilitation need developed in Section 3.2 above. In reviewing the effect of combining supply of community therapists and need for rehabilitation, the caveats which qualify estimated need by area should be born in mind. The relative supply of staff between ISAs offers insights into the degree to which community care can meet rehabilitation need across the country. However the ratios of staffing to estimated stroke survivors with disability (either severe or any disability) presented for physiotherapists (Figure 14), OTs (Figure 15) and SLTs (Figure 16) is not postulated to reflect the actual demands on these staff, who must meet all needs for rehabilitation in the community. When estimated supply of generic community rehabilitation staff and demand for community rehabilitation for stroke survivors are combined in this way, it appears that the ISAs which have more highly resourced community physiotherapy relative to stroke rehabilitation need are: Donegal, Midlands, Cavan-Monaghan and Kerry. The least well-resourced ISAs for community physiotherapy relative to stroke rehabilitation need appear to be: Dublin South-West/Kildare/West Wicklow; and Dublin North City (Figure 14). It appears that the ISAs which have more highly resourced community OT relative to stroke rehabilitation need are: Sligo-Leitrim/West Cavan; Dublin North; Midlands; and Donegal. The least well-resourced ISAs for community OT relative to stroke rehabilitation need appear to be: Dublin North City, Kerry and the Mid-West (Figure 15). The ISAs which appear to have more highly resourced community SLT relative to stroke rehabilitation need are: Midlands; Carlow-Kilkenny/South Tipperary; and Sligo-Leitrim/West

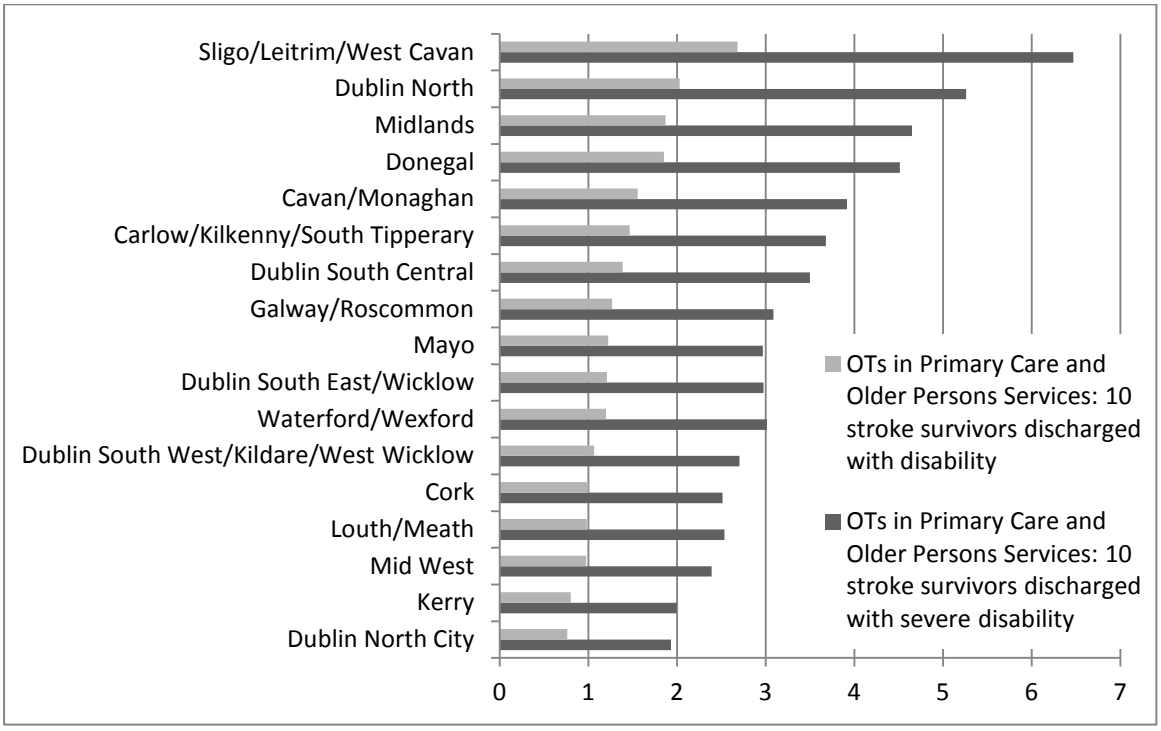
Cavan. The least well-resourced ISAs for community SLT relative to stroke rehabilitation need appear to be: Dublin South-West/Kildare/West Wicklow; Dublin North City; and Dublin South Central (Figure 16).

FIGURE 14 Ratio of Community Physiotherapists to Stroke Survivors with Disability by ISA



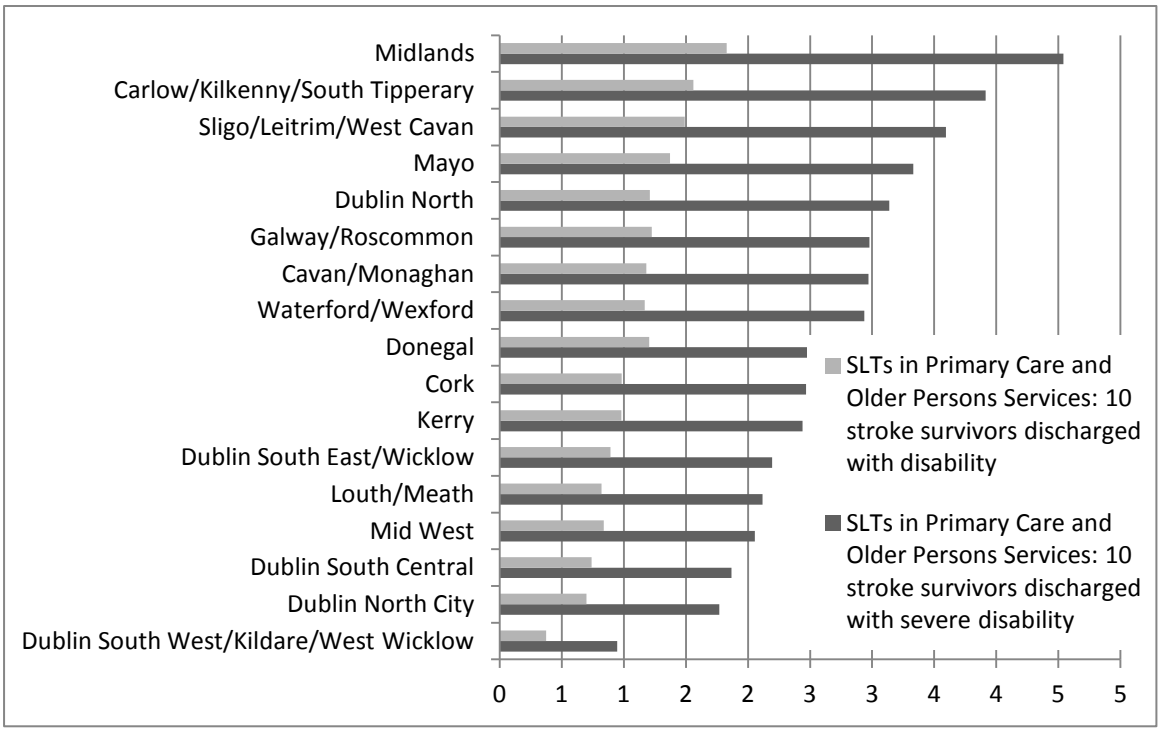
Source: HSE Personnel Census, as interpreted in text, estimated stroke survivors as in Section 3.2.

FIGURE 15 Ratio of Community Occupational Therapists to Stroke Survivors with Disability by ISA



Source: HSE Personnel Census, as interpreted in text, estimated stroke survivors as in Section 3.2.

FIGURE 16 Ratio of Community Speech and Language Therapists to Stroke Survivors with Disability by ISA

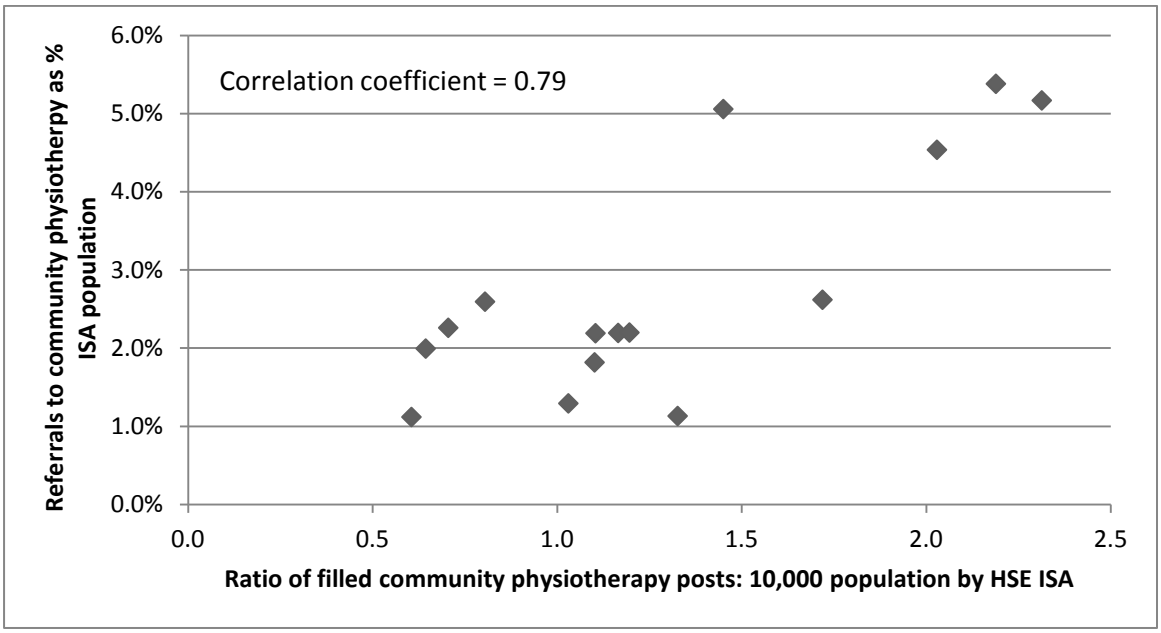


Source: HSE Personnel Census, as interpreted in text, estimated stroke survivors as in Section 3.2.

A complementary source of data about the supply of community services to stroke survivors is the HSE Stroke Programme Community Stroke Services Survey (CoSS) of managers in Local Health Offices (LHOs) undertaken in April/May 2011. The majority of respondents were employees of the HSE (90.8 per cent) with the remaining 9.2 per cent coming from the voluntary sector including the National Rehabilitation Hospital, Peamount Hospital and the Royal Hospital Donnybrook (HSE National Stroke Programme 2011). The CoSS survey found that therapy is most commonly delivered in the community to stroke survivors who are resident at home through Primary Care Services; but also in community day hospitals, through outpatient rehabilitation in non-acute hospitals, by community stroke teams (CST) and by generic community rehabilitation teams (CRT). Some stroke survivors receive therapy through disability services. Therapy is also delivered in residential settings in the community: as residential rehabilitation in non-acute hospitals, in nursing homes, in community hospitals or other long-stay residential settings. The survey found that only six per cent of stroke survivors had access to services from a Community Stroke Team. Referral criteria were inconsistent, stroke care was not prioritised, and data on referral numbers and waiting lists were frequently not collected (CoSS, unpublished reports supplied to this study in draft). The survey collected data on numbers of community staff and on numbers of total referrals and of stroke referrals to community staff. (Due to a small sample, CoSS does not augment the picture of psychology service availability in the community.) Notwithstanding some limitations,[11] there is a strong linear relationship between numbers of staff and the number of referrals to their service across ISAs.

11 The survey response rate for total referrals was 82 per cent. No referrals data were supplied for Mayo and Sligo-Leitrim/West Cavan and data were incomplete for some other ISAs. Data were unavailable for stroke referrals in many areas.

FIGURE 17 Relationship Between Referrals to Community Physiotherapy and Numbers of Therapists, CoSS 2011



Source: Derived from Census 2011; and HSE Stroke Programme Community Stroke Services Survey April/May 2011.

This relationship is demonstrated in Figure 17, in which total referrals are expressed as a percentage of ISA population on the vertical axis and numbers of community physiotherapists recorded by CoSS are expressed per 10,000 ISA population on the horizontal axis. There appears to be a strong association between the availability of community physiotherapy staffing and use of the service. ISAs with evidence of high referral rates as a percentage of population are: Kerry (5.1 per cent); Cavan-Monaghan (5.2 per cent); Midlands (4.5 per cent); and Donegal (5.4 per cent). ISAs with apparently low referral rates are: Dublin City North (1.1 per cent); Waterford-Wexford (1.1 per cent); Dublin South Central (1.3 per cent); and Dublin South-East/Wicklow (1.8 per cent). It should be noted in relation to Cavan-Monaghan that the CoSS returns for community referrals appear to include hospital physiotherapy services. The CoSS survey also provides valuable insights into the intensity with which therapy is delivered to stroke survivors in different services and regions of the country. CoSS asked therapy managers about the average number of weeks, weekly sessions and minutes per session of therapy given to stroke patients in differing settings. Therapy intensity in hours has been calculated by region from the responses, for which all three variables were supplied. Comparisons between regions, therapies and therapy settings must be approached with caution because of a variable response rate (Table 9 records the number of LHOs for which intensity data were available). Nonetheless, some patterns emerge, which are of assistance to this analysis.

Some of the most intense therapy interventions occur in residential rehabilitation: with a national mean intensity for physiotherapy (PT) of 62 hours; occupational therapy (OT) of 41 hours; and speech and language therapy (SLT) of 35 hours (Figure 18, Figure 19, Figure 20 and Table 9). In contrast, although this survey suggests that most stroke survivors in the community receive therapy through Primary Care Services, this is of relatively low intensity with national mean intensity for therapy delivered of: PT 5.4 hours, OT 13 hours and SLT eight hours. Community rehabilitation teams and community stroke teams deliver more intense care in home settings (PT 33 and 24 hours respectively; OT 30 and 54 hours respectively; and SLT (CST) 28 hours) but these appear to be available in few areas. Similarly, a single instance of very intense OT offered in a community day hospital is not representative of the therapy in these hospitals in general, which appears to be closer to the low intensity therapy offered by Primary Care Services. The intensity of therapy offered in nursing homes appears to be relatively low for OT and SLT in this survey but the response rate with regard to nursing homes was also low. However, intensity for PT at an average of ten hours in nursing homes was almost twice the average intensity of PT in Primary Care.

FIGURE 18 National Average Hours of Physiotherapy for Stroke Survivors in Differing Settings, CoSS 2011

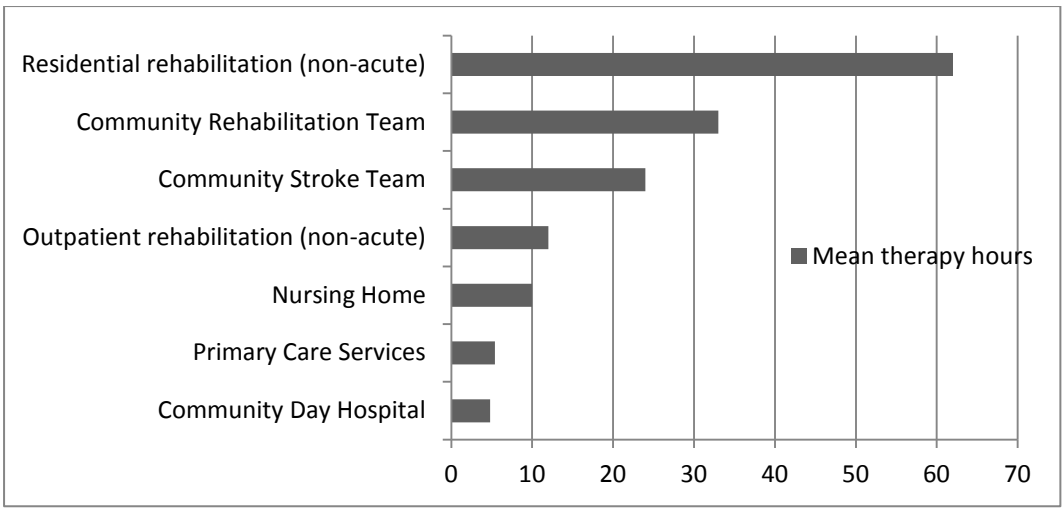


TABLE 9 National Average Therapy Intensity by Therapy and Setting

Therapy setting	Average number of weeks	Average number of sessions per week	Average length of session in minutes	Intensity: Average total hours of therapy	Number of LHOs for which intensity calculated
Physiotherapy					
Primary Care Services	7	1	49	5.4	22
Community Day Hospital	7	1	43	4.8	7
Residential rehabilitation (non-acute)	10	7	66	62	10
Outpatient rehabilitation (non-acute)	8	2	52	12	7
Nursing Home	8	2	41	10	4
Community Rehabilitation Team	13	3	49	33	4
Community Stroke Team	2	12	60	24	1
Occupational therapy					
Primary Care Services	11	2	46	13	12
Community Day Hospital	8	8	45	50	2
Residential rehabilitation (non-acute)	10	5	49	41	9
Outpatient rehabilitation (non-acute)	6	1	41	4	3
Nursing Home	2	1	45	2	1
Community Rehabilitation Team	14	3	53	30	2
Community Stroke Team	12	6	45	54	1
Speech and Language Therapy					
Primary Care Services	8	1	51	6.3	12
Community Day Hospital	8	1	48	7	3
Residential rehabilitation (non-acute)	15	3	53	35	8
Outpatient rehabilitation (non-acute)	14	1	56	15	6
Nursing Home	7	1	52	5	4
Community Rehabilitation Team	NA	NA	NA	NA	0
Community Stroke Team	22	1	60	28	2
Community hospitals/ long-stay residential	9	1	50	7	3

Source: Calculated from HSE National Stroke Programme's Community Stroke Service Survey (CoSS) 2011. Method note: Mean intensity (average total hours) in therapy delivered calculated from CoSS data for each LHO (LHO average weeks x sessions x session duration) and national and regional means are calculated from the LHO intensities. The mean intensities in this table do not equate to national weeks x sessions x session duration.

FIGURE 19 National Average Hours of Occupational Therapy for Stroke Survivors in Differing Settings, CoSS 2011

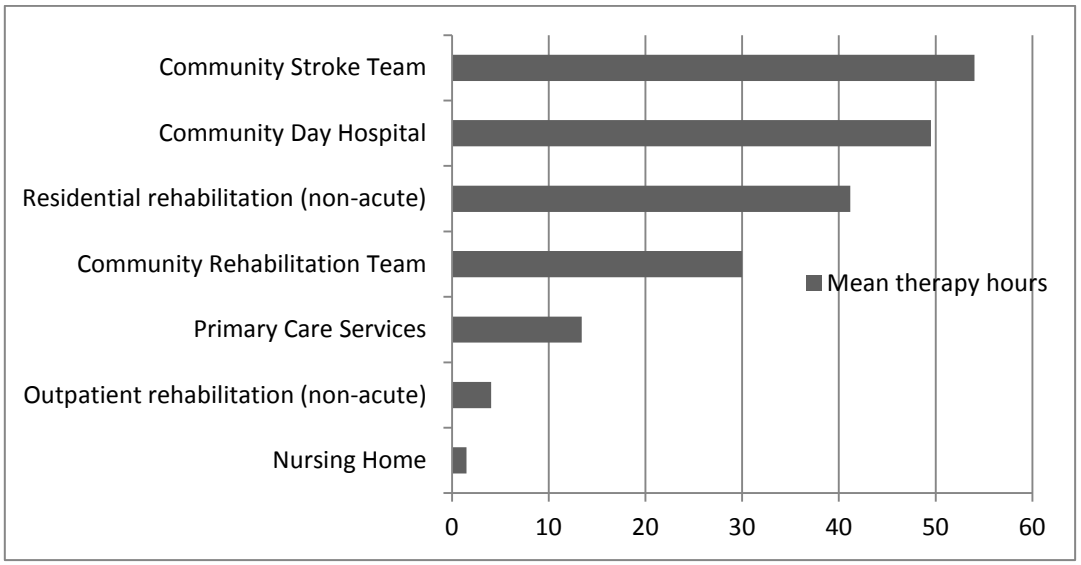
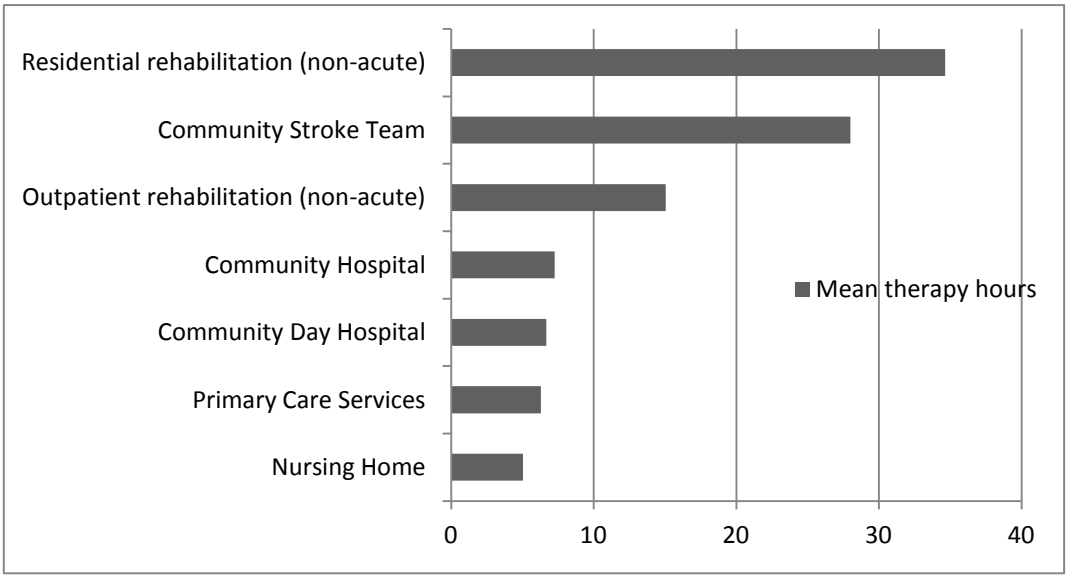


FIGURE 20 National Average Hours of Speech and Language Therapy for Stroke Survivors in Differing Settings, Coss 2011



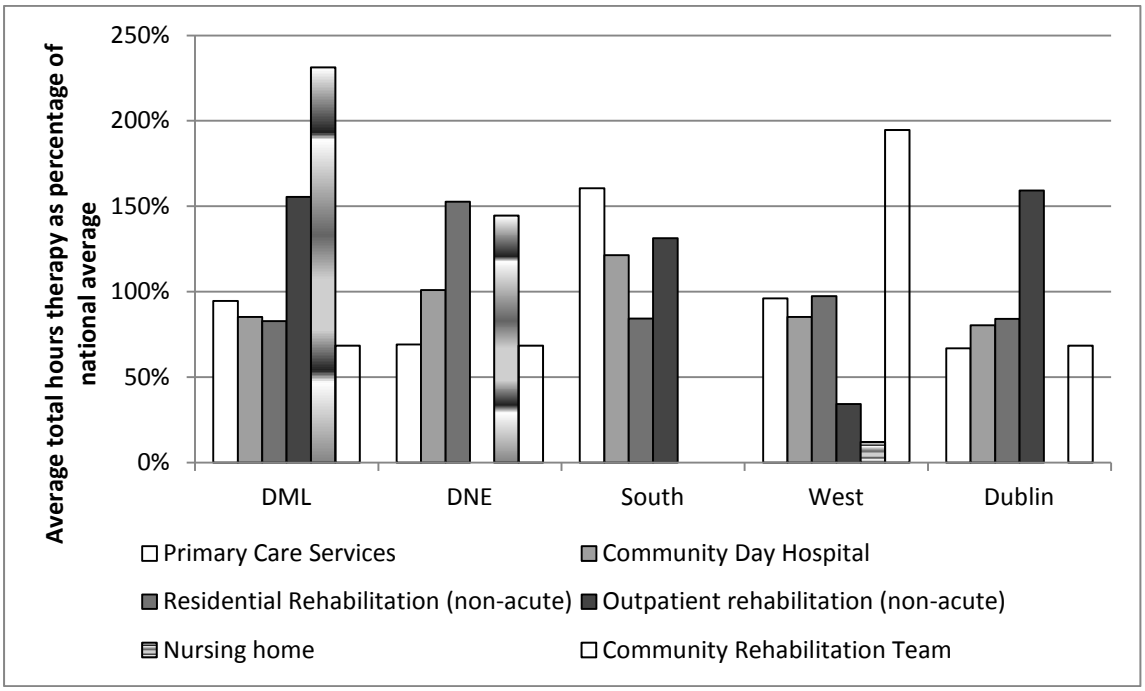
Source: Calculated from HSE National Stroke Programme's Community Stroke Service Survey (CoSS) 2011, as outlined in note to Table 9.

These national averages (Figure 18, Figure 19, Figure 20 and Table 9) mask considerable regional variation. As Figure 21 demonstrates, when physiotherapy intensity is expressed as a proportion of the national average for each of the HSE Regions and for Dublin, excluding the surrounding counties, differing regional and urban-rural patterns of care emerge. Dublin has an above average intensity in non-acute outpatient PT rehabilitation and below average intensity of PT in other settings. Dublin Mid-Leinster delivers some above average intensity nursing home

PT (which reflects care in one LHO outside Dublin) and Dublin North-East delivers some above average intensity residential and nursing home PT rehabilitation (also reflecting care in one LHO outside Dublin). HSE Region South is distinguished by above average intensity physiotherapy in Primary Care Services (based on a response from four LHO managers). Delivery of PT in HSE Region West is close to the national average intensity for PCS, community day hospitals and residential rehabilitation but is distinguished by intense therapy delivered by one community rehabilitation team. The absence of any response in relation to nursing home PT for Dublin and HSE Region South and the limited response elsewhere indicates the necessity to interpret these results with caution. Furthermore, these are measures of relative intensity of average care as estimated by managers, who themselves frequently expressed caveats about their estimates. Importantly, these estimates are means of therapy delivered and give no indication of the proportion of stroke survivors in receipt of therapy in an area.

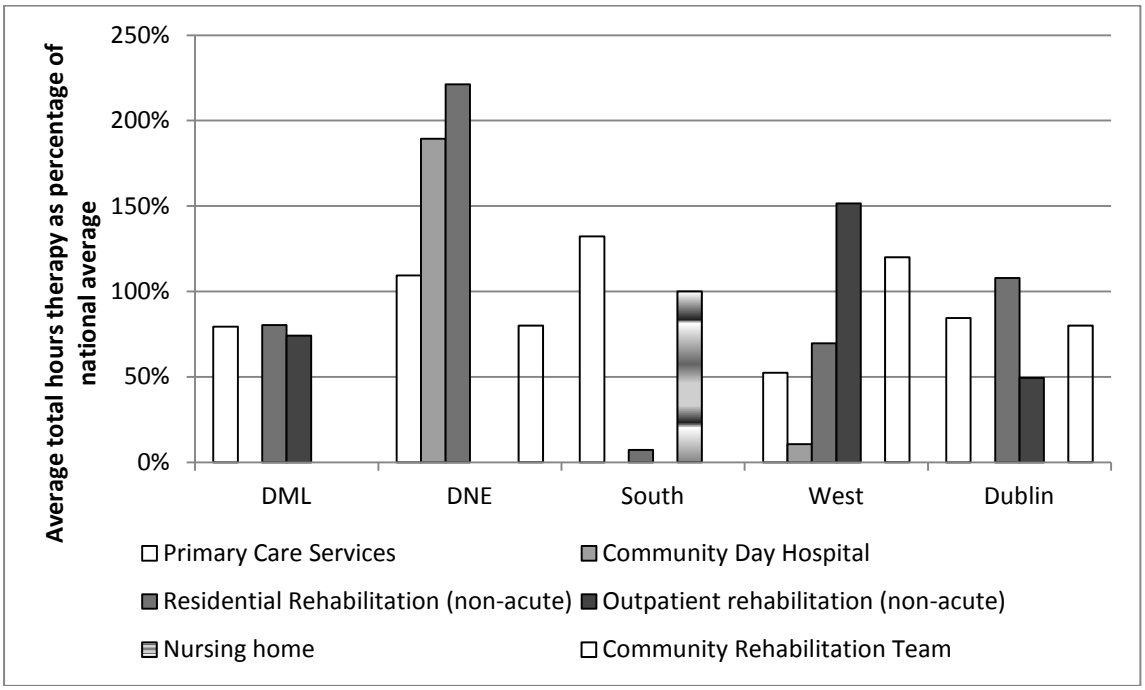
These findings from the CoSS survey are broadly consistent with the comparisons of supply of physiotherapists from the HSE Personnel Census, insofar as the Census showed relatively low ratios of PTs to population in Primary Care and Older Persons' Services in Dublin city ISAs (Table 7), which accords with the relatively low intensity of PT delivered to stroke survivors in Dublin city (Figure 21) at 67 per cent of the national average. When the same exercise is repeated for the other therapies, Dublin North-East delivers intense OT in non-acute residential rehabilitation; the South again offers more intense than average therapy in Primary Care; and in the West the community rehabilitation team and non-acute outpatient rehabilitation offer above average OT intensity (Figure 22). In the case of SLT, Dublin offers above average intensity therapy in residential, outpatient and nursing home settings; and Dublin North-East is distinguished by particularly intense SLT offered in a non-acute residential rehabilitation setting in a Dublin LHO area (Figure 23). SLT intensity in Primary Care Services appears to be more even across the regions than the other therapies. As is evident from Table 9, these comparisons for OT and SLT are based on fewer responses than for PT and should therefore be interpreted with even greater caution.

FIGURE 21 Physiotherapy Average Hours Therapy Delivered as Percentage of National Average by HSE Region, for Dublin and by Service



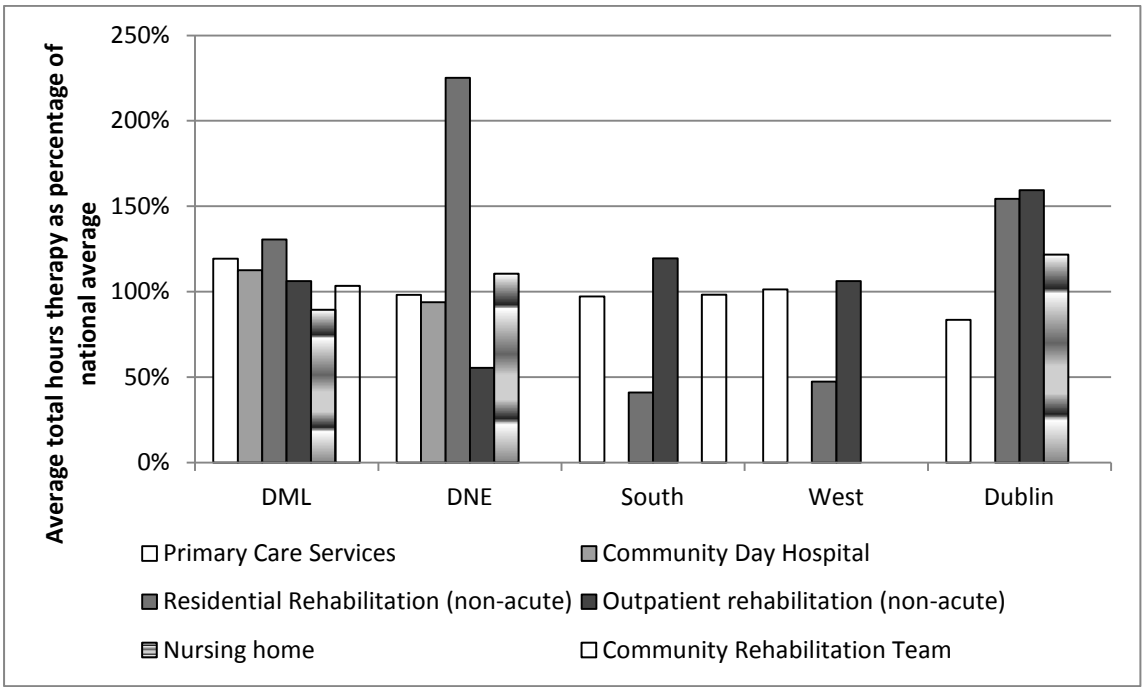
Source: Calculated from HSE National Stroke Programme's Community Stroke Service Survey (CoSS) 2011.

FIGURE 22 Occupational Therapy Average Hours Therapy Delivered As Percentage Of National Average By HSE Region, For Dublin And By Service



Source: Calculated from HSE National Stroke Programme's Community Stroke Service Survey (CoSS) 2011.

FIGURE 23 Speech and Language Therapy Average Hours per Stroke Patient as Percentage of National Average by HSE Region, for Dublin and by Service



Source: Calculated from HSE National Stroke Programme's Community Stroke Service Survey (CoSS) 2011.

3.4 Stroke Hospital Discharges

Evidence of pathways of care for patients experiencing stroke is derived from the HIPE database and the INASC clinical audit database. HIPE stroke discharges in 2011 are the basis for this analysis, while the INASC sample is a stroke-specific audit of medical records undertaken in 2005. The INASC sample differs from the HIPE data in: the year (2005 versus 2011); its shorter time period (six months compared to a year); its limitation to patients aged 17 and over; and in its measurement of disability levels. In this analysis, the size of the INASC sample available varies depending on the variables of interest since not all variables were available for all patients in INASC. The focus of this enquiry is to develop an understanding of pathways of care by examining in particular patterns of discharge and inpatient length of stay and the relationships between these and other variables such as age, gender, region/area of residence and hospital of discharge.

TABLE 10 Discharge Destinations and Length Of Stay, INASC and HIPE 2011 Compared

	INASC Clinical Audit 2005				HIPE 2011		
	Sample	Percentage full sample	Percentage known discharges	Length of stay in days	Sample	Percentage of total discharges	Length of stay in days
	N	%	%	Mean (Median; SD)	N	%	Mean (Median; SD)
Inpatient death	408	18.8	19.9	26 (10; 58)	1,275	18.4	20 (9; 36)
Discharge home	1,024	47.1	50.0	24 (11; 42)	3,492	50.3	17 (9: 32)
Discharge to nursing home	319	14.7	15.6	53 (27; 66)	1,039	15.0	50 (21; 82)
Discharge to hospital	203	9.3	9.9	29 (19; 34)	1,111	16.0	24 (11; 45)
Other discharge	96	4.4	4.7	23 (17; 28)	27	0.4	18 (11; 34)
Total known discharges	2,050		100	29 (13; 50)	6,944*	100.0	24 (10; 47)
Discharge unknown	123	5.7		26 (11; 28)			
Total discharges	2,173	100		29 (13; 50)			

Source: INASC clinical audit, 2005; HIPE 2011. Not all patients in INASC with known discharge destination have known length of stay. Samples for LOS in INASC are: inpatient death (396); home (976); nursing home (308); hospital (198); other (94); unknown (66).

* One outlier discharge with very long LOS has been excluded in this analysis.

Comparison of stroke patients' discharge destinations in the two datasets shows a fairly close correspondence in the proportions of discharges to home (HIPE 50 per cent; INASC 47 per cent) or a nursing home (HIPE 15 per cent; INASC 14.7 per cent) and the proportion of inpatient deaths (HIPE 18.4 per cent; INASC 18.8 per cent), when the INASC proportions are calculated across all discharges including those with unknown discharge destination (Table 10). INASC has a relatively high proportion with unknown discharge (5.7 per cent), which may account for the difference between the two databases in the proportions recorded as going to another hospital (INASC 9.3 per cent; HIPE 16 per cent). This divergence could also reflect the differing nature of the two databases: with potentially differing interpretations of such categories as hospital, nursing home and other. In Table 10, the HIPE discharge to nursing home category includes nursing home, convalescent or long-stay facilities, while the INASC category appears to encompass only residential or nursing home facilities.[12] The HIPE hospital

[12] The INASC clinical audit questionnaire asked about 'Living accommodation at discharge' with a series of options for answer: Home (yes/no/live alone/live with spouse or family); Residential/Nursing home; Hospital; Other. Separately, the audit recorded inpatient deaths. Statistical analysis of the dataset reveals contradictory overlaps between some categories of discharge e.g. 22 recorded inpatient deaths recorded as discharged home. In this analysis, a recorded inpatient death is regarded as more accurate than discharge home; and discharges to other destinations are similarly preferred over discharge home. INASC (2006) reports 56 per cent of the sample as discharged home which may reflect a differing statistical approach.

destination includes acute, non-acute, psychiatric and rehabilitation hospitals. Stroke discharges have a higher mean length of stay in INASC at 29 days compared to 24 days in HIPE 2011 (Table 10). This higher mean LOS in INASC can be seen to apply for all discharge destinations. It appears that there has been a reduction in stroke patients' mean length of stay in acute hospitals in the years 2005-2011. Mean age is lower in HIPE 2011 at 70 years compared to 75 years in INASC (Table 11 and Table 12). The exclusion of patients aged under 17 years in INASC is not significant in this difference, since the HIPE 2011 mean age increases only marginally from 70.2 to 70.9 years if younger patients are similarly excluded. Such younger patients comprise 1.1 per cent of the 2011 HIPE stroke discharges.

TABLE 11 Mean Age by Discharge Destination, INASC and HIPE 2011

Discharge destination	INASC clinical audit 2006		HIPE 2011	
	N (age known)[13]	Mean age in years	N	Mean age in years
Inpatient death	404	79	1,275	76
Discharge home	1,009	72	3,492	67
Discharge to nursing home	309	81	1,039	79
Discharge to hospital	198	71	1,111	66
Other discharge	95	77	27	64
Total known discharges	2,015	75	6,944	70
Discharge unknown	112	74		
Total discharges	2,127	75		

Source: INASC clinical audit, 2005; HIPE 2011.

TABLE 12 Age Distribution by Discharge Destination, INASC and HIPE 2011

Discharge Destination	INASC Clinical Audit 2006			HIPE 2011		
	N (age known)	Aged under 65 years % full sample	Aged 65 years and over % of full sample	N	Aged under 65 years %	Aged 65 years and over %
Inpatient death	404	12.4	20.5	1,275	11.5	21.2
Discharge home	1,009	62.4	44.0	3,492	62.3	45.2
Discharge to nursing home	309	3.8	17.0	1,039	4.8	19.2
Discharge to hospital	198	14.0	8.3	1,111	20.9	13.9
Other discharge	95	2.0	5.0	27	0.5	0.3
Total known discharges	2,015	94.7	94.7	6,944	100.0	100.0
Discharge unknown	112	5.3	5.3			
Total discharges	2,127	100	100			

Source: INASC clinical audit, 2005; HIPE 2011.

[13] 46 discharges in INASC have no data for age (age/age at admission/date of birth) which reduces N from 2,173 to 2,127.

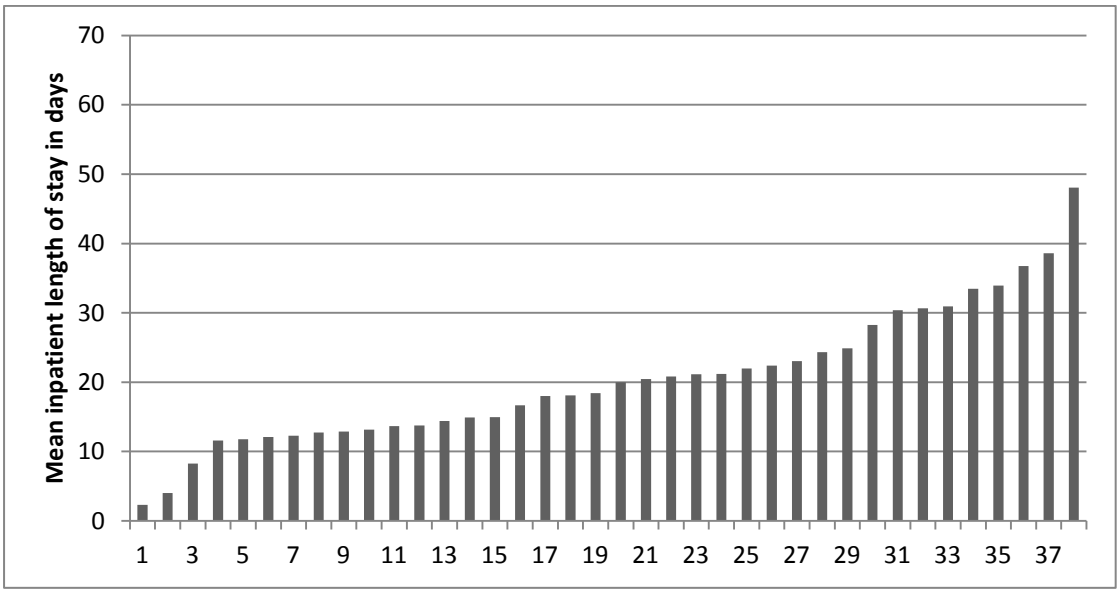
FIGURE 24 Mean Length of Stay in Days of Inpatients with Principal or Secondary Diagnosis of Stroke, Regional, HIPE 2011



Source: HIPE 2011.

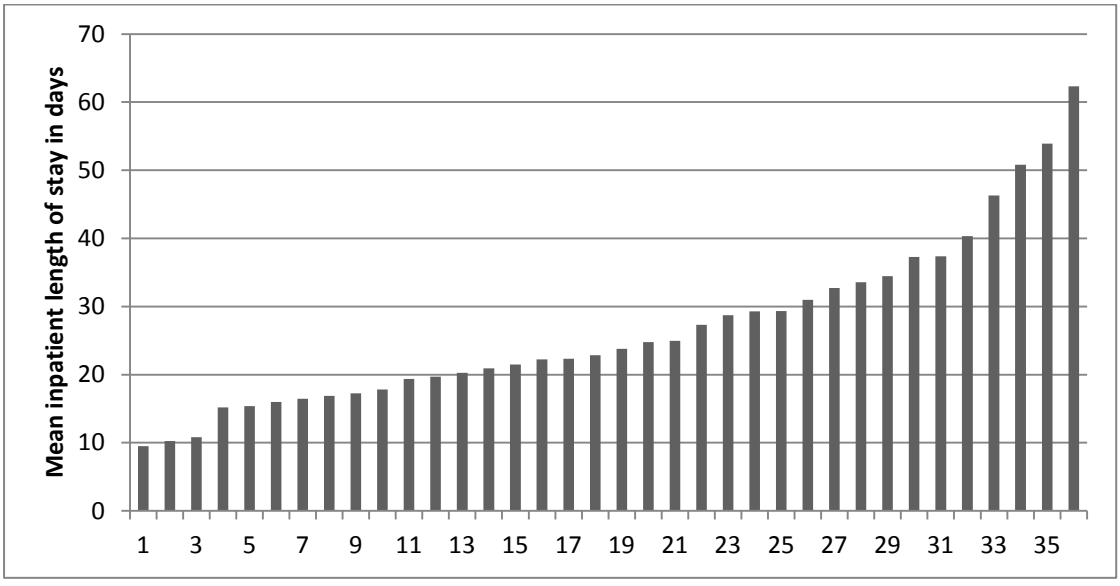
HIPE data show considerable variation in stroke discharges' length of stay between the HSE Regions, in which patients are treated (Figure 24), and between individual hospitals (Figure 25). Mean length of stay is longest in Dublin Mid-Leinster and Dublin North-East; and very much shorter in the South and West. Median (mid-range) LOS shows less variation across regions, indicating that mean LOS in the Dublin-based regions is influenced by some patients with particularly long stays (Table 13). At hospital level the mean length of stay for stroke patients in 2011 ranged from under ten to 48 days. Despite the intervening six years and the reduction in stroke discharges' inpatient length of stay between INASC in 2005 and HIPE in 2011, variability in length of stay across hospitals is evident in both databases (Figure 25 and Figure 26). The mean length of stay in the hospital at the top of the range had fallen by approximately one-quarter from 60 to 48 days between INASC and HIPE 2011. (Numbered hospitals in Figure 25 and Figure 26 are not necessarily the same. Since INASC hospital identities are not disclosed to researchers, they could not be matched to HIPE in this analysis.)

FIGURE 25 Mean Length of Stay of Inpatients with Principal or Secondary Diagnosis of Stroke, by Hospital, HIPE 2011



Source: HIPE 2011.

FIGURE 26 Mean Length of Stay of Inpatients with Principal or Secondary Diagnosis of Stroke, By Hospital, INASC



Source: INASC clinical audit, 2005.

Variability in LOS by HSE Region is evident for all discharge destinations and greatest for discharge to the HIPE category of nursing homes, convalescent and long-stay facilities (Table 13). Mean LOS for discharge to nursing homes is 79 days in Dublin North-East, 76 days in Dublin Mid-Leinster, 49 days in the South and 24 days in the West. Comparison of the median (mid-point) LOS by Region for this category of discharge again shows the influence of outlier, particularly long discharges in the two Dublin Regions. Although there is a higher mean LOS in the

two Dublin Regions, the median is lower or only marginally higher than in the South. In the case of patients who die in hospital, the West has a shorter mean LOS at 14 days compared to 27 days in Dublin Mid-Leinster, although the mean age of such inpatient deaths is highest in the West (Table 14). Again, the influence of outliers is evident, with comparable median LOS in this category across the two Dublin Regions and the West.

TABLE 13 Mean and Median Length of Stay in Days By HSE Region and Discharge Destination, Stroke Diagnoses, HIPE 2011

Discharge Destination	N	%	Dublin North-East	Dublin Mid-Leinster	South	West	Total
			Mean (Median)				
Inpatient death	1,275	18.4	23(10)	27(9)	15(6)	14(9)	20(9)
Discharge home[14]	3,492	50.3	19(10)	20(10)	12(7)	17(9)	17(9)
Discharge to nursing home[15]	1,039	15.0	79(25)	76(32)	49(31)	24(14)	50(21)
Discharge to hospital[16]	1,111	16.0	31(13)	30(13)	14(10)	13(6)	24(11)
Other discharge	27	0.4	70(21)	12(12)	13(5)	11(11)	18(11)
LOS all patients			28(11)	30(11)	18(8)	18(10)	24(10)
Total discharges	6,944	100.0	1,781	1,811	1,756	1,596	

Source: HIPE 2011.

TABLE 14 Mean Age in Years by HSE Region and Discharge Destination, Stroke Diagnoses, HIPE 2011

Discharge Destination	N	%	Dublin North-East	Dublin Mid-Leinster	South	West	Total
Inpatient death	1,275	18.4	73	77	77	78	76
Discharge home	3,492	50.3	63	67	67	70	67
Discharge to nursing home	1,039	15.0	79	79	78	78	79
Discharge to hospital	1,111	16.0	64	64	70	64	66
Other discharge	27	0.4	39	57	68	69	64
Mean age all patients			67	70	71	73	70
Total discharges	6,944	100.0	1,781	1,811	1,756	1,596	

Source: HIPE 2011.

14 Discharge home: includes self-discharge (HIPE Data Dictionary).

15 Discharge to nursing home includes: nursing home, convalescent or long-stay (HIPE Data Dictionary).

16 Discharge to hospital includes: acute, non-acute, psychiatric and rehabilitation hospitals (HIPE Data Dictionary).

Since differing types of rehabilitation and long-stay facilities may, depending on area, perform essentially the same rehabilitation/long-stay functions but come under the definition of nursing home or hospital, the analysis also combines the two categories to compare regional discharge patterns. On this basis, a similarly high proportion of patients by region is discharged to a nursing home or another hospital in Dublin North-East (34.2 per cent) and the West (33.9 per cent). The combination of variability in discharge destinations and LOS by Region and discharge destination suggests that differing pathways of stroke patient care, rehabilitation and long-stay institutionalisation pertain in different Regions and/or hospitals.

Discharge patterns among patients with disability in INASC show that 43 per cent of patients discharged home were independent with a further 35 per cent having mild disability (Table 16). Yet a further ten per cent of patients discharged home had either very severe or severe disability. In contrast, 44 per cent of patients discharged to nursing homes had very severe disability and a further 23 per cent had severe disability. Yet, four per cent were independent and ten per cent had mild disability (Table 16). Such complex discharge patterns suggest that factors other than level of disability influence discharge destination. These differing patterns can also be expressed in terms of the proportions of patients at each level of disability, who go to alternative discharge destinations (Figure 27). Nursing home is the dominant destination for persons with very severe disability. Those with severe disability are discharged home and to nursing home in almost equal proportions. In all other categories, moderate/mild disability or independence, the dominant destination is home.

TABLE 15 Discharge Destinations by HSE Region and by Age

Discharge destination	N	Total %	Dublin North-East %	Dublin Mid-Leinster %	South %	West %
Total discharges						
Inpatient death	1,275	18.4	19.4	17.9	19.0	17.0
Discharge home	3,492	50.3	46.3	56.5	49.9	48.1
Discharge to nursing home	1,039	15.0	9.2	13.1	12.3	26.4
Discharge to hospital	1,111	16.0	25.0	12.2	18.6	7.5
Discharge to nursing home/hospital	2,150	31.0	34.2	25.3	30.9	33.9
Other discharge	27	0.4	0.2	0.2	0.3	0.9
Total discharges	6,944	100.0	1,781	1,811	1,756	1,596
Discharges aged under 65 years						
Inpatient death	236	11.5	12.8	9.9	11.3	11.7
Discharge home	1,280	62.3	54.8	67.6	67.9	61.4
Discharge to nursing home	98	4.8	2.6	4.1	3.8	11.7
Discharge to hospital	429	20.9	29.5	18.0	16.9	13.7
Discharge to nursing home/hospital	527	25.7	32.1	22.1	20.6	25.4
Other discharge	10	0.5	0.3	0.4	0.2	1.5
Total discharges	2,053	100.0	688	543	480	342
Discharges aged 65 years and over						
Inpatient death	1,039	21.2	23.5	21.4	21.9	18.5
Discharge home	2,212	45.2	40.9	51.8	43.1	44.5
Discharge to nursing home	941	19.2	13.4	17.0	15.5	30.5
Discharge to hospital	682	13.9	22.1	9.7	19.2	5.7
Discharge to nursing home/hospital	1,623	33.2	35.5	26.7	34.7	36.2
Other discharge	17	0.3	0.1	0.2	0.3	0.8
Total discharges	4,891	100.0	1,093	1,268	1,276	1,254

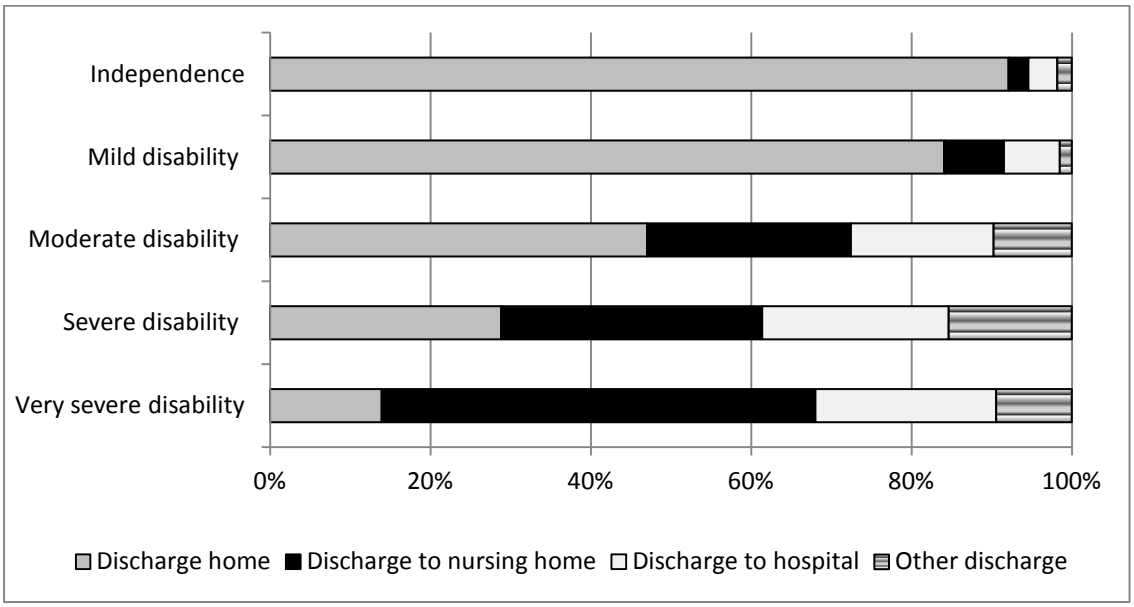
Source: HIPE 2011.

TABLE 16 Disability Level Proportions by Discharge Destination, INASC*

		Very severe disability %	Severe disability %	Moderate disability %	Mild disability %	Independence %
	N	0-4	5-9	10-14	15-19	20
Discharge home	954	3.6	6.5	11.6	35.4	42.9
Discharge to nursing home	303	43.6	23.1	19.8	9.9	3.6
Discharge to hospital	191	28.8	26.2	22.0	14.7	8.4
Other discharge	93	24.7	35.5	24.7	6.5	8.6
Total known discharges	1,541	17.2	13.9	15.1	25.6	28.2
Discharge unknown	55	21.8	16.4	12.7	27.3	21.8
Total discharges	1,596	17.3	14.0	15.0	25.7	28.0

Source: INASC clinical audit, 2005.*In the analysis of disability levels in INASC, independence is distinguished from mild disability. These categories are combined in the disability categories applied to modelling ESD in Chapters 4 and 5. (See Appendix 8.1).

FIGURE 27 Discharge Destinations of Persons at Differing Disability Levels, INASC



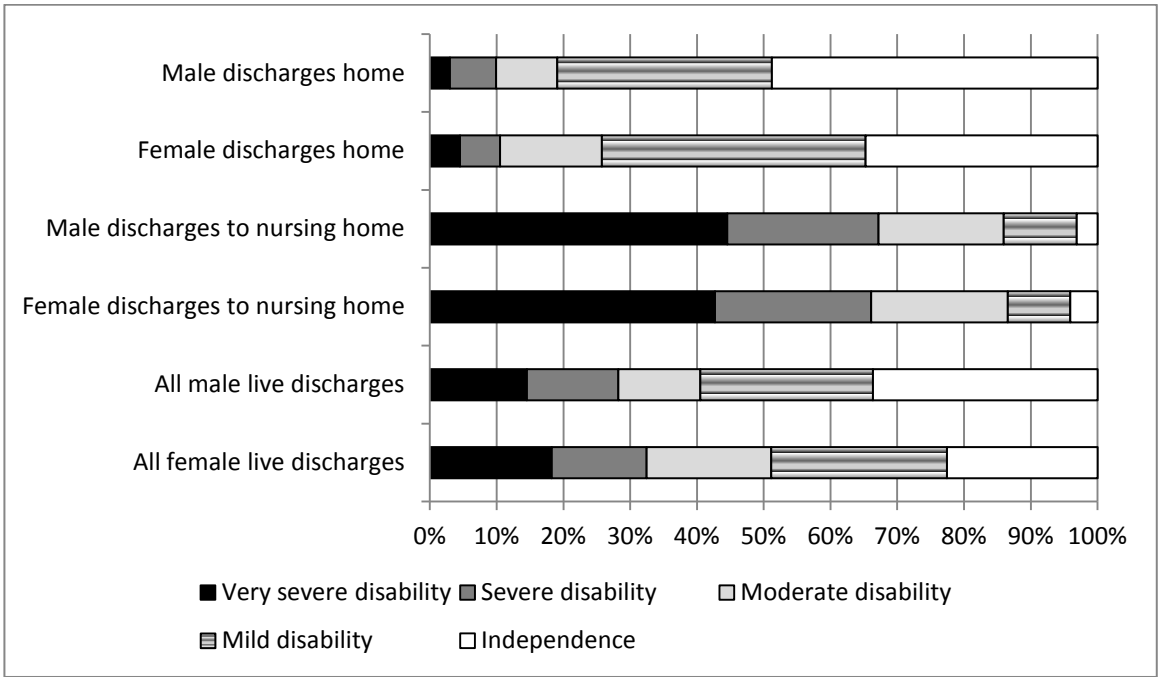
Source: INASC clinical audit, 2005.

It is widely recognised in the literature on predictors of nursing/residential home utilisation that gender plays a significant role. Women have been found to be more likely to be admitted to residential long-term care than men in the UK generally, in Northern Ireland and in the Republic of Ireland (Grundy and Jitlal 2007; Connolly and O'Reilly 2009; Wren 2009). This is also the case within the INASC sample. In general, this reflects women's longer life expectancy than their spouses/partners and, therefore, their greater likelihood of living alone in older age, which means there is no potential co-resident carer to assist in discharge from hospital and offer sufficient informal care and support to obviate need for nursing home admission. Women comprise 48 per cent of the INASC sample with known gender but account for 54 per cent of inpatient deaths. Men comprise 52

per cent of the sample and account for 46 per cent of inpatient deaths. The proportion of women who die as inpatients is 21 per cent compared to 17 per cent of men. The mean age of men in the sample is 72 years and of women is 78 years. Within the INASC sample, men are in general less disabled than women (Figure 28). A greater proportion of female discharges from hospital have more severe disability, while a greater proportion of male discharges are independent.

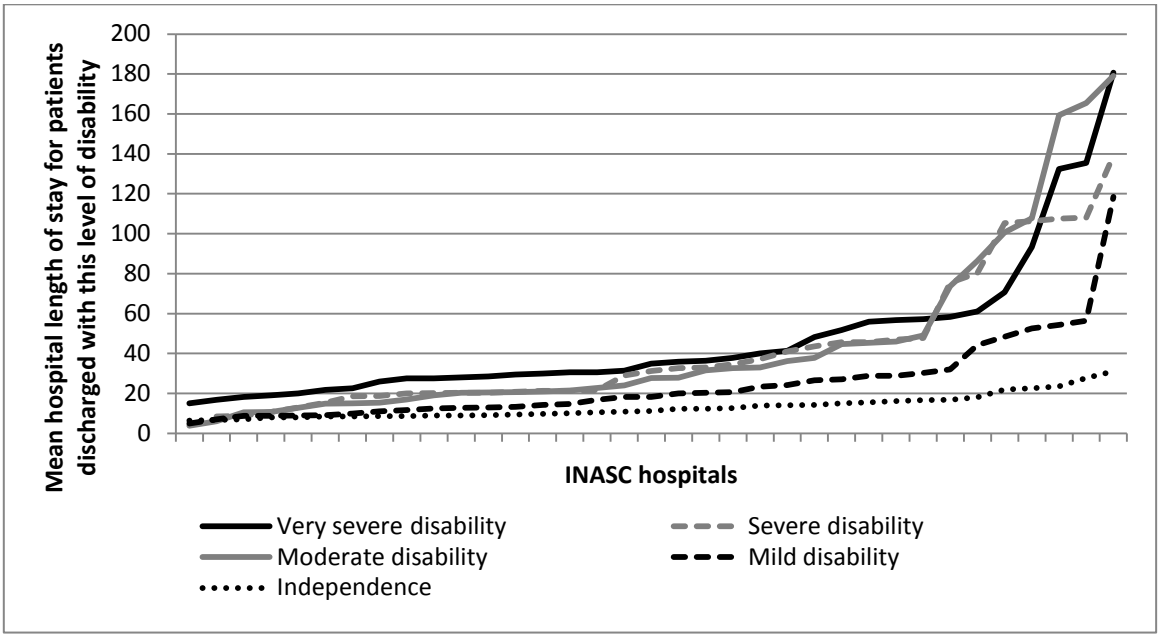
When discharges are examined at hospital level, the heterogeneity in stroke patients' discharge destination, even at the same level of disability, is mirrored in heterogeneous length of stay across hospitals for patients with the same level of disability (Figure 29). This evidence from INASC of such a spread of length of stay by disability level is further suggestive of significant differences in stroke care pathways and rehabilitation across hospitals.

FIGURE 28 Male and Female Discharges from Hospital, to Home and Nursing Home, Proportions by Disability Level, INASC



Source: INASC clinical audit, 2005.

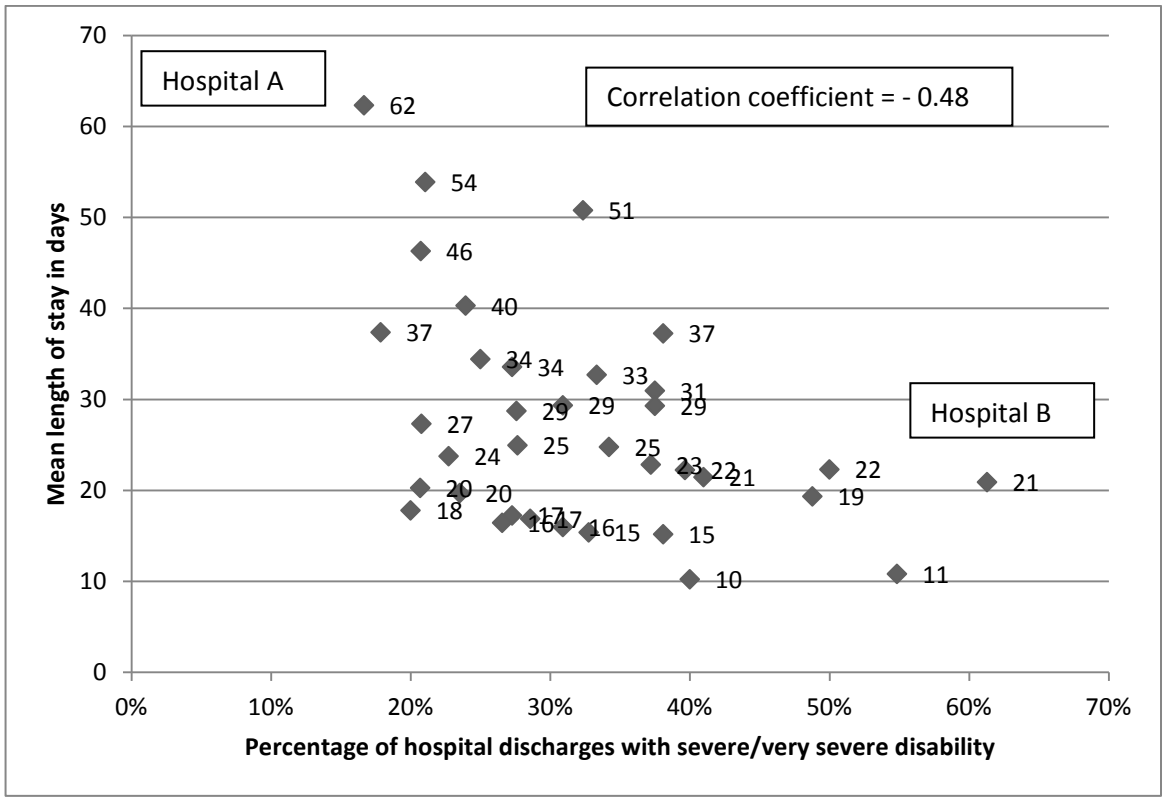
FIGURE 29 Hospital-Level Differences in Mean Length of Stay by Level of Disability, INASC



Source: INASC clinical audit, 2005.
Note: Ordering of hospitals differs by disability level i.e. the hospital with the highest or lowest mean length of stay for one level of disability is not necessarily at the same point in the range at another level of disability.

To investigate further the variability between mean lengths of stay by hospital, Figure 30 graphs individual INASC hospitals' mean length of stay for stroke patients against the percentage of their discharges that leave hospital with very severe or severe disability. There is an inverse association between these two variables with a negative correlation coefficient of 0.48. While this correlation does not demonstrate a causal relationship, the depiction of this inverse relationship offers insights into variability in patient care pathways. Those hospitals in the left upper quadrant of the graph have the longest length of stay but a relatively small proportion of their discharges have severe disability, which might suggest that these hospitals undertake relatively effective rehabilitation and may be better resourced to do so. It is, of course, also possible that they admit fewer patients with severe disability and, notwithstanding this, have relatively long LOS. Conversely, at the bottom right quadrant of the graph are hospitals with relatively low length of stay but with a relatively high proportion of their discharges with severe disability.

FIGURE 30 Hospital Mean Length of Stay and Percentage with Very Severe/Severe Disability on Discharge, INASC



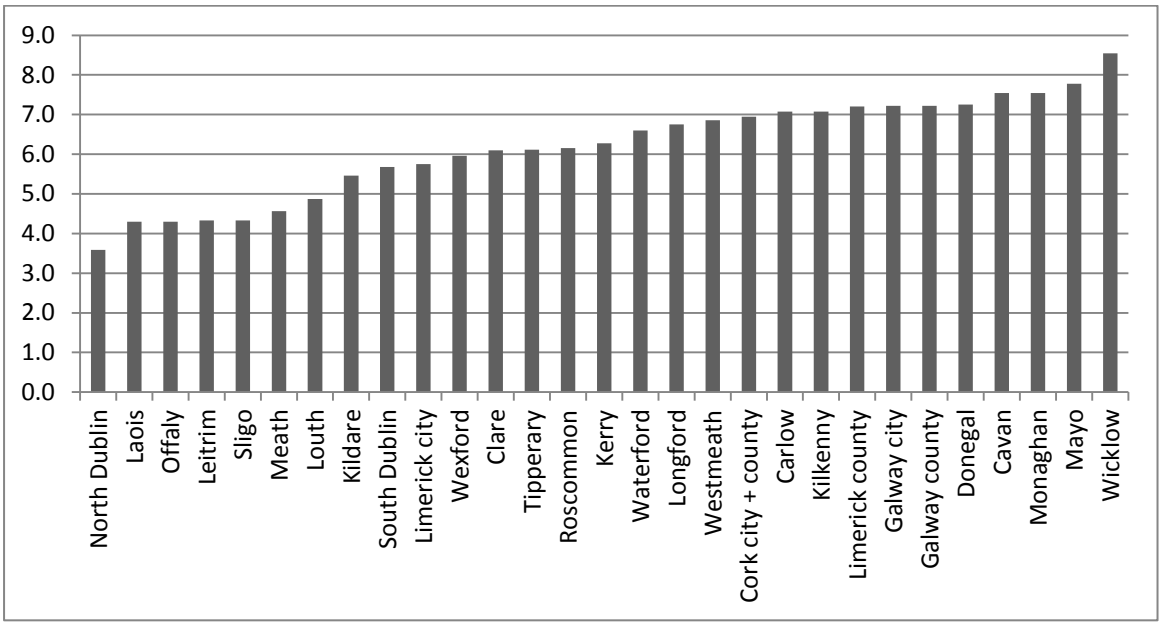
Source: Derived from INASC 2005.

At extreme positions on the graph are: Hospital A with a mean length of stay of 62 inpatient days but with only 11 per cent of discharges having very severe or severe disability; and Hospital B with a mean length of stay of 21 inpatient days, close to one-third of Hospital A's mean LOS, but with 50 per cent of discharges having very severe or severe disability. Although the clustering of hospitals in the middle of the graph with some hospitals with relatively short lengths of stay showing a relatively low proportion of discharges with severe disability would caution against drawing definitive conclusions from this association of two variables, there is nonetheless evidence to suggest that some hospitals with long lengths of stay may be engaging in significant inpatient rehabilitation whereas some hospitals with very short length of stay are discharging patients with severe disability to other facilities for rehabilitation.

The wide range across HSE Regions in mean length of stay for stroke patients discharged to nursing homes (Table 13) suggests that a factor in determining LOS may be regional/ local nursing home bed capacity. Studies of the determinants of acute care utilisation and expenditure in the UK have found that the availability of residential long-term care reduces acute care utilisation/expenditure utilisation (Carr-Hill et al. 1994; Martin and Smith 1996; Forder 2009). Analysis of

long-term care bed capacity and demand by region in Ireland in 2006 found that the West had over 30 per cent of national long-stay capacity compared to 26 per cent of population aged 65 and over, whereas Dublin Mid-Leinster and Dublin North-East had proportionately lower shares of long-stay beds than of population aged 65 and over. The need for additional long-term care places caused by population growth and ageing was projected to be substantially greater in Dublin North-East and Dublin Mid-Leinster than in the South or the West (Wren 2009). The Department of Health's Long-Stay Activity Statistics (2011) records availability of long-stay beds from a survey of facilities. Following adjustment for the response rate to the survey by Region,[17] the estimated long-stay capacity (including intermediate care beds) relative to population by area of residence ranges from under four beds per 1,000 population to over eight in 2011 (Figure 31).

FIGURE 31 Estimated Long-Term and Intermediate Care Beds Per 1,000 Population by Area of Residence, 2011

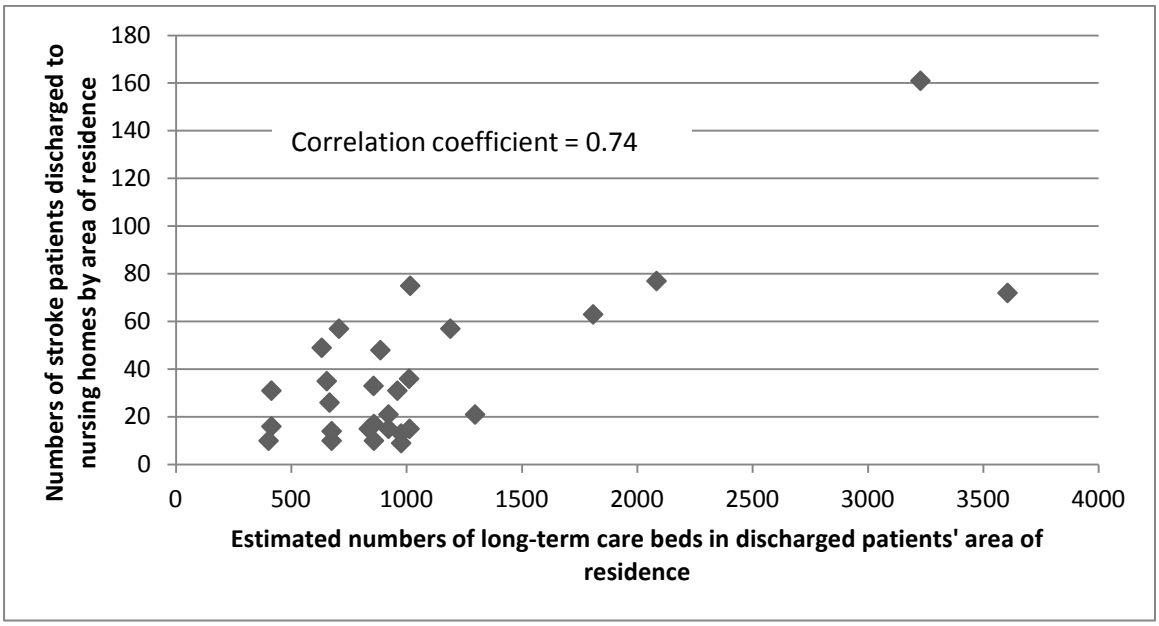


Source: Calculated from Long-Stay Activity Statistic (Department of Health and Children, 2011).

There is a positive correlation between numbers of long-term care beds and numbers of stroke discharges to nursing homes by area of residence from HIPE (Figure 32: correlation coefficient = 0.74). Although a correlation does not demonstrate a causal relationship, this strong association nonetheless suggest that long-term bed capacity should be included in any analysis of the determinants of length of stay and discharge destinations for stroke patients.

[17] LHO bed numbers are adjusted according to the survey response rate for the Region, adopting the assumption that the non-responding long-stay units in the Region have a proportionate number of beds to the responding units.

FIGURE 32 Estimated Numbers of Stroke Discharges to Nursing Homes and Long-Stay Beds by Area of Residence, 2011



Source: Derived from HIPE, 2011 and Long-Stay Activity Statistics, 2011.

HIPE demonstrates inter-regional flows of patients with a diagnosis of stroke (Table 17). Hospitals in the North-East had 1,811 stroke patient discharges in 2011, 81 per cent of whom (1,436) were resident in the HSE North-East Region. Conversely, 61 patients resident in the North-East were hospitalised in other HSE Regions. The other three HSE Regions had fewer patient inflows, with 93 per cent to 96 per cent of their discharges comprised of residents of the Region. The stroke patient inflow to Dublin North-East is likely to reflect to some degree the presence in the Region of the tertiary National Referral Centre for Neurosurgery and Neurology at Beaumont Hospital.

TABLE 17 Region of Treatment and Region of Residence, Stroke Discharges, HIPE 2011

		Patient Region of Residence					Percentage of Discharges Treated within Region by Region of Residence %				
Discharges		DNE	DML	South	West	NR	DNE	DML	South	West	NR
DNE	1,781	1,436	212	31	85	17	81	12	2	5	1
DML	1,811	49	1,683	35	30	14	3	93	2	2	1
South	1,756	3	13	1,649	78	13	0	1	94	4	1
West	1,596	9	33	10	1,533	11	1	2	1	96	1

Source: Calculated from HIPE 2011 DNE=Dublin North-East; DML= Dublin Mid-Leinster; NR= Non-resident.

3.5 Care Pathways from Hospital

This analysis from HIPE and INASC suggesting differing rehabilitation pathways from hospitals after stroke is supported by the returns from a survey of clinical stroke leads in acute hospitals, the Hospital Leads' Survey (HLS), conducted by this project in 2013 (questionnaire in Appendix 8.5). The survey elicited 49 responses from 28 out of 29 hospitals surveyed (22 consultants stroke leads; 12 clinical nurse specialist stroke leads; and 15 physiotherapy stroke leads/managers). In 26 of the 28 hospitals covered by the Hospital Leads Survey (HLS), respondents confirmed that their hospitals provided onsite inpatient rehabilitation, with a respondent from a further hospital identifying that onsite inpatient rehabilitation was provided sometimes. Professionals had contradictory answers in three hospitals, with some answering in the negative while others answered in the affirmative. One hospital had only one respondent, who answered in the negative. The major rehabilitation therapies (PT, OT and SLT) were confirmed as available in 27 out of 28 hospitals (with no response on this question from the respondent who had confirmed no onsite rehabilitation). A dietician was available in 24 hospitals and a psychologist in only four hospitals. A majority of hospitals (17 out of 28) also offered rehabilitation in the outpatient department or day hospital. The survey did not ask about the intensity or perceived adequacy of inpatient rehabilitation: respondents from one major regional hospital volunteered the supplementary information that due to a moratorium on recruitment, staffing was insufficient to meet national guidelines for stroke rehabilitation.

When respondents were asked to identify locations to which they refer stroke patients for inpatient rehabilitation, responses from hospitals in Dublin and the greater Dublin region showed a pattern of referrals to a few major institutions: the National Rehabilitation Hospital (NRH) in Dun Laoghaire; Peamount Healthcare in South County Dublin; St Mary's Hospital at the Phoenix Park in Dublin; the Royal Hospital Donnybrook; the Rehabilitation Unit at Cappagh National Orthopaedic Hospital in North Dublin; or another acute hospital, possibly a smaller hospital within the region. If referring for outpatient rehabilitation in the greater Dublin region, the same locations were identified with few additions, notably the Stroke Rehabilitation Unit and Team in Baggot Street Community Hospital. One respondent mentioned referral to county hospitals, where suitable to the patient, and another mentioned the local Primary Care Centre in the inner city. In Cork city and county, the dominant referral location for both inpatient and outpatient rehabilitation is St Finbarr's Hospital in Cork city. A respondent also referred to 'repatriation' of patients from larger hospitals in the region to rehabilitate in smaller hospitals closer to their home; while in West Cork, local continuing care units could provide therapist services (PT onsite and access to OT and SLT, if needed).

A pattern of dispersed referrals to small community hospitals is evident in the North-West of the country. Following inpatient rehabilitation in the acute hospital, some patients in County Donegal might continue rehabilitation in any one of ten community hospitals. Networks of community hospitals, day centres and other forms of stepdown facility were identified as locations to which patients were referred for rehabilitation in a number of areas of the country. Two respondents referred patients to a community rehabilitation team in County Laois in the Midlands for rehabilitation. While broadly there is a contrast between Dublin and Cork referral patterns to a few specialised rehabilitation institutions and the more dispersed patterns of referral to multiple small hospitals and day centres in areas of more dispersed population, there is also a generally discernible pattern across the country of referral from major acute hospitals to smaller, satellite acute hospitals, which, in this context, effectively operate as stepdown facilities playing a rehabilitation role. Throughout the country, some patients are referred to NRH in Dublin.

When respondents were asked to specify factors such as severity of disability or age which determined their choice of referral locations for off-site inpatient rehabilitation, respondents from seven hospitals identified severe disability as a determinant of their decision. In all seven hospitals, a patient with severe disability and aged under 65 would be referred for inpatient rehabilitation to the National Rehabilitation Hospital (NRH) in Dun Laoghaire. Respondents who said they would refer patients with severe disability aged under 65 to NRH responded from major acute hospitals in Dublin, Cork, Limerick, Galway and the Midlands. No respondent identified NRH as a referral location for patients with severe disability who were aged 65 and over. Furthermore, no respondent from acute hospitals outside the West of the country identified *any* referral locations for the rehabilitation of older patients with severe disability, which suggests that hospitals outside the West either undertake rehabilitation for such patients on-site, or they neither offer nor refer these patients for inpatient rehabilitation. In the West of the country, however, respondents from three hospitals identified smaller non-acute hospitals, a county hospital, a nursing home and a retirement village, as locations to which patients aged 65 and over with severe disability would be referred for rehabilitation.

When asked to identify referral locations for which moderate disability was a referral criterion, there were respondents from 21 hospitals, of whom respondents from 11 hospitals identified NRH as a referral location and in each instance a further referral criterion was that the patient should be aged under 65. Many more referral locations were identified for older patients with moderate disability than for those with severe disability. Specific non-acute hospitals

attracted referrals from a number of acute hospitals: hospitals in Cork referred older patients with moderate disability to the stroke rehabilitation unit in St Finnbarr's Hospital; hospitals to the West of Dublin referred patients to Peamount Hospital; hospitals in the West of the country referred patients (of all ages) to Merlin Park Hospital. In all, respondents identified 19 locations to which they referred patients with moderate disability for offsite inpatient rehabilitation, which compares to seven locations to which patients with severe disability were referred. Respondents from only two hospitals identified mild disability as a criterion for referral for off-site inpatient rehabilitation and in both cases an additional criterion was that the patient should be aged under 65. The identified locations for such inpatient rehabilitation for a younger person with mild disability were the Rehabilitation Unit in Cappagh Hospital in Dublin and the Acquired Brain Injury in Mountbolus in County Offaly.

A distinct picture emerges of differing care pathways by age, with NRH providing most inpatient rehabilitation for stroke survivors who are aged under 65 and with moderate to severe disability, while older stroke survivors' rehabilitation needs may be met through older persons' services. It is understood that the role of NRH in prioritising the treatment of younger people with disability post-stroke has evolved in response to the exclusion of younger people from access to some regional rehabilitation services, which have developed for older people. Rehabilitation of older people with stroke at NRH normally requires specific referral from a consultant geriatrician.

A clear majority view emerged that community rehabilitation services are not adequate to meet stroke patients needs post-discharge. While respondents from 27 out of 28 hospitals confirmed that they referred stroke patients for community rehabilitation when discharged to home, respondents from 24 hospitals also confirmed that, at least sometimes, they referred patients post-discharge for rehabilitation services in hospitals or other inpatient locations such as nursing homes, who could be treated at home by community services, if these were more readily available. Inadequate access to community rehabilitation has been separately confirmed by a survey of 196 survivors living in the community in 2013, of whom 36 per cent had paid privately for rehabilitation (Horgan et al. 2014). Respondents from six hospitals said that their hospital implemented an Early Supported Discharge (ESD) programme, which the question elaborated as 'rapid discharge to home for suitable patients to receive specialist community rehabilitation services'. Other hospitals said that their hospital implemented such a programme 'sometimes', which does not suggest an organised programme. Notably, two respondents from hospitals with large and remote catchment areas and dispersed populations, volunteered that ESD was not feasible in their areas.

One of these respondents referenced the inadequacy of the evidence for ESD in rural areas with dispersed population (Fearon and Langhorne 2012).

When asked the average waiting time for stroke patients from referral to transfer to offsite inpatient rehabilitation in hospitals or other inpatient locations such as nursing homes, respondents from six hospitals reported waits of longer than three months, with three of these referring hospitals in Dublin, two in neighbouring counties and one in Cork city. Average waits of from one month to three months were reported in a further eight hospitals spread throughout the country. Waits of less than one week were recorded in one hospital in Dublin and three in the South of the country, while waits of one to four weeks were recorded in one hospital in Dublin, three in the South and four in the West. This question, although designed to elicit average waits, evoked a numbers of responses which identified two average waits: one shorter and one longer. When their responses were queried in follow-up, a number of respondents elaborated that the longer wait was for transfer to NRH. There is clear evidence of insufficient capacity at NRH to treat the demand for rehabilitation for younger patients with severe stroke, with a number of respondents citing waits of over three months. Difficulty in discharging patients with poor prognoses to nursing homes was described by a respondent from a large Dublin hospital, who said that patients with severe disability, which did not improve with rehabilitation, and who could not return home, could remain up to six months in the acute hospital until a nursing home bed became available, an account which accords with the strong correlation between stroke discharges and long-stay bed capacity reviewed above.

3.6 Stroke Survivors' Progress Post-Discharge

Two studies have followed the progress of Irish stroke survivors after discharge from hospital. These are the North Dublin Population Stroke Study (NDPSS) of 2005/2006 which was contemporaneous to INASC (Kelly et al. 2012); and the Action on Secondary Prevention Interventions and Rehabilitation in Stroke (ASPIRE-S) study conducted in 2011/2012. Whereas the INASC dataset is the sole source of evidence of post-stroke disability that is national in scope, it measures disability rates solely at discharge. The NDPSS offers the best evidence of disability rate transitions, since it follows stroke patients in North Dublin for up to two years, measuring disability at six intervals post-stroke. Whereas these datasets both date from 2005/2006, the ASPIRE-S dataset offers more recent evidence of disability from 2011/2012 for a defined sub-set of stroke patients (ischaemic stroke only, recruited from three North Dublin hospitals, and alive and available to follow-up at six months post-stroke). Examination of longitudinal evidence of disability trends from the NDPSS and ASPIRE-S demonstrates that, despite differing timing of disability measurement in the two studies (90 days and

six months post-stroke) and the differing years of the studies (2005/2006 and 2011/2012), when the NDPSS sample is reduced to comparable cases of survivors of ischaemic stroke living at home at assessment who were treated in the same three North Dublin hospitals studied by ASPIRE-S, there is no statistically significant difference in the disability profiles of the samples.

The NDPSS provides the only Irish evidence of changes in stroke survivors' disability levels, recorded for up to two years post-stroke using the Modified Rankin Scale (MRS, Appendix 8.1). Table 18 demonstrates how survivors' disability state transitions can be calculated from the NDPSS data: comparing disability levels at seven days post-stroke to levels at 90 days; and comparing disability levels at 90 days to levels at one year. (In this table, the definition of mild disability includes patients who are independent.) From this examination of disability state transitions in patients discharged to the community (home or long-term care settings) in North Dublin, it can be seen that patients' disability status may improve, disimprove or remain the same. Of patients with mild disability at seven days post-stroke, 98 per cent remained at this level at 90 days but two per cent had become more disabled. Between 90 days and one year post-stroke, seven per cent of those with mild disability had become more disabled. Of patients with severe disability at seven days post-stroke, 56 per cent had become less disabled at 90 days. However, for those with severe disability at 90 days, only six per cent had become less disabled at one year. Patients with moderate disability appear to transition most from this disability level. Of patients with moderate disability at seven days, 58 per cent had transitioned to mild disability at 90 days. Of those with moderate disability at 90 days, 16 per cent had become less disabled at one year, while 19 per cent had become more disabled.

TABLE 18 Disability State Transitions, Patients Discharged to Home or Long-Term Care At 90 Days, NDPSS 2005/2006

7 day severity		90-day severity		
	N	Mild %	Moderate %	Severe %
Mild	130	98	1	1
Moderate	45	58	40	2
Severe	91	30	26	44
90 day severity		One-year severity		
	N	Mild %	Moderate %	Severe %
Mild	169	93	3	4
Moderate	37	16	65	19
Severe	31	0	6	94

Sources and methods: Derived from North Dublin Population Stroke Study, proportions at differing disability states at 90 days post-stroke compared to seven days post-stroke and at one year post-stroke compared to 90 days post-stroke sample of patients discharged from hospital to community by 90 days (including those in long-term care settings). Disability categories derived from Modified Rankin Scale: Mild (0-2), Moderate (3) and Severe (4-5).

3.7 Stroke Survivors' Care Post-Discharge

Identifying from Irish data the pathway of care post-hospital for patients with severe disability is particularly challenging. INASC records that 44 per cent of stroke discharges with severe or very severe disability at discharge were discharged to nursing homes and a further 23 per cent were discharged to other hospitals in 2005 (Table 19). These other hospitals may provide rehabilitation following a relatively short acute hospital length of stay, the pattern of care observed in some regions. Thus, evidence of discharge destinations after these sub-acute hospital stays would be necessary to achieve a representative picture of the discharge destinations of patients with severe disability in Ireland. In addition to measuring disability at intervals post-stroke, the NDPSS provides discharge destinations for these patients in North Dublin in 2005/2006. Among patients with severe and very severe disability when measured at seven days post-stroke, 27 per cent were dead at 90 days, while 25 per cent were at home, with the remainder still in hospital, in long-term care or in a rehabilitation hospital (Table 20). A higher proportion of those with very severe disability had died by 90 days (42 per cent) while a higher proportion of those with severe (but not very severe) disability were at home at 90 days (39 per cent). When disability measured at 90 days is examined for the same patients, it emerges that 84 per cent of those who are at home no longer have severe or very severe disability, while the majority of those in other settings still have severe or very severe disability. This sub-group who have persistent severe or very severe disability predominantly remain in hospital (47 per cent) or long-term care (35 per cent) at 90 days with only 11 per cent at home and a further six per cent in rehabilitation. Such patients with persistent severe disability (i.e. a Modified Rankin Score of 4 or 5 at both seven and 90 days) represent 18 per cent of hospitalised patients

overall in the NDPSS (N=504) and 42 per cent of all patients scoring as having severe or very severe disability at seven days (N=221).

Since the INASC and NDPSS studies, there has been a growth in stroke unit coverage including units offering specialised inpatient rehabilitation. Whereas only one out of 37 hospitals had a fully resourced stroke unit in 2005 (Irish Heart Foundation 2008), a survey by the HSE National Stroke Programme in 2010 found that 18 per cent of hospitals had an acute stroke unit and 36 per cent had either a combined acute/rehabilitation or rehabilitation stroke unit, while 46 per cent of hospitals still had no stroke unit. There were 34 acute stroke beds nationally and a combined total of 140 acute/rehabilitation stroke beds (HSE National Stroke Programme 2010). Estimation of need for specialized inpatient rehabilitation for patients with severe stroke therefore requires more recent evidence than is available from INASC and the NDPSS.

No individual patient-level data are available in Ireland recording therapy or general rehabilitation utilisation by these patients, although it can be inferred from the analysis of CoSS in Section 3.3 that some patients with severe stroke are recipients of relatively intense therapy delivered in non-acute residential rehabilitation settings (Figure 18, Figure 19 and Figure 20). It is further evident from the HLS analysis that for people aged under 65 with severe disability, such rehabilitation is generally delivered at the National Rehabilitation Hospital in Dun Laoghaire; and for patients aged 65 and over with severe disability, it would appear that outside the West of the country, rehabilitation is delivered in the acute hospital setting, while in the West, such patients are referred to non-acute residential care settings. Although the CoSS analysis suggests that some patients receive intense therapy in residential settings, a study of care for stroke patients in nursing homes in Ireland undertaken in 2007 found that, in general, stroke rehabilitation guidelines were lacking while 68 per cent of managers reported that there was no formal review process in place. Stroke survivors accounted for one in six nursing home residents. The majority (73 per cent) had a high level of dependency; 39 per cent had one of: blindness, deafness or a severe vision or hearing impairment; 81 per cent had difficulties in learning, memory and concentration; and 94 per cent had difficulties in dressing, bathing or mobilising outside the home. None of the residents was considered capable of working or of going outside the nursing home alone to a shop or to visit a doctor’s surgery (Cowman et al. 2010). This survey found low access to psychological and speech services and unmet needs for physiotherapy and occupational therapy (The National Audit of Stroke Care Research Team 2007).

TABLE 19 Discharge Destinations of Patients by Level of Disability at Discharge, INASC 2005

	Independent	Mild disability	Moderate disability	Severe disability	Very severe disability	Very severe + severe disability
Barthel Index	20	15-19	10-14	5-9	0-4	0-9
	Discharge destinations of patients by level of disability					
Discharge home	92%	84%	47%	29%	14%	21%
Discharge to nursing home	2%	7%	25%	33%	54%	44%
Discharge to hospital	4%	7%	18%	23%	23%	23%
Other discharge	2%	1%	10%	15%	9%	12%
N	444	402	236	215	244	459
N as percentage all discharges including inpatient deaths*	23%	21%	12%	11%	13%	24%

Source: INASC 2005 *Expressed as percentage INASC sample with known discharge destination and disability status, plus inpatient deaths (N=1,949) as opposed to total INASC sample (N=2,173).

TABLE 20 Locations and Disability Status at 90 Days of Patients with Severe and Very Severe Disability at Seven Days Post-Stroke, NDPSS

	Severe disability (MRS=4) scored at seven days post-stroke	Very severe disability (MRS=5) scored at seven days post-stroke	Severe or very severe disability (MRS=4 or 5) scored at seven days post-stroke	Disability status at 90 days by discharge location of patients with severe or very severe disability scored at seven days			
	Location at 90 days	Location at 90 days	Location at 90 days	N	Mild/ Moderate %	Severe %	Very severe %
N	102	119	221				
Home	39%	13%	25%	55	84	15	2
LTC	16%	12%	14%	30	7	64	29
Rehab	7%	1%	4%	8	38	38	25
Hospital	23%	28%	25%	56	18	47	29
Dead	9%	42%	27%				
NA	7%	5%	6%				

Source: NDPSS 2005/2006. MRS=Modified Rankin Score.

The majority of patients with mild disability (84 per cent) and almost half of patients with moderate disability (47 per cent) at discharge are discharged home (Table 19), where further rehabilitation will occur, if at all, in community and outpatient settings, with most rehabilitation occurring in Primary Care Services, according to the Community Stroke Services Survey (CoSS) undertaken in 2011 (Section 3.3). For such patients with mild and moderate disability who are discharged to the community, deriving estimates of therapy and care utilisation is a first step to modelling the costs and benefits of alternative pathways of care in Chapter Five of this study. To estimate patterns of care utilisation by such stroke survivors in the community, it is necessary to combine evidence from a number of data sources. It has been observed above that, while it is possible to estimate

the intensity of average therapy delivered from CoSS, this is not an estimate of average therapy received by stroke survivors, since it does not take into account the proportion of stroke patients who receive no therapy. The NDPSS records whether stroke survivors in North Dublin who had been discharged to home were in receipt of care under a number of headings, including therapies, at intervals post-stroke (Table 21). If mean therapy delivered in CoSS is assumed to apply to the proportion of patients in receipt of therapy in the NDPSS, mean therapy utilisation by stroke survivors in the community can be estimated. To capture regional variation, therapy utilisation has been estimated for two case studies, based on CoSS data for therapy delivered in Primary Care Services in North Dublin and in HSE Region South, which are selected to represent lower and upper ends of the range of estimated mean therapy intensity in that setting. For the North Dublin case study, the Community Stroke Service Survey supplies mean estimated therapy delivered for three LHOs in North Dublin in 2011. The estimated proportions of stroke survivors in receipt of therapy are sourced from the NDPSS for patients discharged from hospital and residing at home at 90 days. The relatively low proportion of stroke patients in receipt of therapy leads to a downward adjustment of mean therapy delivered, when divided by all discharged patients (Table 22).

TABLE 21 Evidence of Receipt of Care by Stroke Survivors in North Dublin, NDPSS

Interval post-stroke	90 days	1 year	2 year
N	211	260	258
Physiotherapy	16%	11%	9%
Occupational therapy	9%	4%	2%
Speech and language therapy	5%	2%	0%
Home help	26%	26%	26%
Public Health Nurse	25%	15%	14%
Meals on wheels	9%	8%	7%
Carer	9%	9%	12%
Day Centre	2%	4%	7%

Source: NDPSS 2005/2006.

TABLE 22 Estimated Mean Therapy Hours, North Dublin and HSE Region South Case Studies

Therapy	Mean estimated therapy hours delivered in Primary Care Services[1]	Proportion of stroke survivors receiving therapy[2] %	Adjusted mean therapy hours received by stroke survivors in Primary Care Services[3]
North Dublin case study:			
Physiotherapy	3.3	16	0.5
Occupational therapy	13.0	9	1.2
Speech and language therapy	5.3	5	0.2
HSE Region South case study:			
Physiotherapy	8.7	16	1.4
Occupational therapy	17.8	9	1.7
Speech and language therapy	6.1	5	0.3

Sources and methods:

1: Mean therapy hours delivered estimated in North Dublin (All therapies X 3 LHOs); and in HSE Region South (PT: 4/7 LHOs; OT 4/7 LHOs; SLT 5/7 LHOs), Community Stroke Service Survey (CoSS, 2011).

2: Proportion of stroke patients discharged home at 90 days in receipt of this form of therapy (amount is not quantified), North Dublin Population Stroke Study (NDPSS, 2005/2006).

3: Adjusted mean calculated by multiplying CoSS mean by proportion receiving therapy e.g. for North Dublin PT adjusted mean = 3.3 X 0.16= 0.5.

For the HSE Region South case study, the Community Stroke Service Survey supplies mean estimated PT and OT delivered for four LHOs and mean estimated SLT for five LHOs in the region in 2011. The estimated means exceed those for North Dublin for all three therapies, most notably for PT. This exercise implicitly assumes that the proportion of stroke survivors in receipt of therapies in North Dublin holds true for other regions in Ireland. To test the validity of this assumption, evidence from the Irish Longitudinal Study of Ageing (TILDA) of regional variation in the proportions of the older population in receipt of community therapy was examined and the difference in the proportionate receipt of therapies by community-dwelling older adults in Dublin and the South was found to be statistically insignificant. Therefore, the estimated proportions of stroke survivors in receipt of therapy from the North Dublin Population Stroke Study of 2005/2006 are again applied to derive adjusted mean therapy hours delivered for the HSE Region South case study (Table 22). While the relatively low proportion of stroke patients in receipt of therapy again leads to a downward adjustment of mean therapy delivered, the relatively high estimated mean therapy delivered translates into relatively high adjusted mean therapy hours received.

TABLE 23 Estimated Mean Care Utilisation by Stroke Survivors Discharged to Home in Ireland

	Estimated mean contacts per annum	Sources and methods
Hospital outpatient visits	2.4	Mean hospital outpatient visits p.a. for stroke survivors, TILDA 1st wave;
GP visits	7.3	Mean GP consultations, stroke survivors, Quarterly National Household Survey Health Module 2010;
Community nurse/Public health nurse visits	3.5	Mean nurse visits, stroke survivors, Quarterly National Household Survey Health Module 2010;
Meals on wheels	23.4	Derived from North Dublin Population Stroke Study, in which 9 per cent of stroke patients discharged home at 90 days received meals on wheels, assuming they received meals five days a week for a year, and averaged over total sample;
Home help	47.8	Derived from North Dublin Population Stroke Study, in which 26 per cent of stroke patients discharged home at 90 days received care from home help. Assumes they received care at frequencies recorded for persons with a disability in private households in receipt of home help in the 2006 National Disability Survey and averaged over total sample. Frequencies: 9 per cent throughout the day (assumed as two hours x five days); 45 per cent daily (assumed as one hour x five days); weekly (assumed as one hour per week); 8 per cent less often (assumed as one hour fortnightly).

Sources and methods: as described in table.

Home help and meals on wheels mean utilisation are derived from the North Dublin Population Stroke Study (NDPSS), which records the proportion receiving these services and to which assumptions about their rate of receipt have been applied (Table 23), informed in the case of home helps by the evidence of the 2006 National Disability Survey. Evidence from the NDPSS of stroke survivors' utilisation of home helps and meals on wheels at one year and two years post-stroke is applied to estimate utilisation after the first year post-stroke (Table 24). General practitioner and community/public health nurse visiting rates for stroke survivors are derived from the 2010 Health Module of the Quarterly National Household Survey (QNHS) and mean hospital outpatient visits by stroke survivors is derived from the first wave of The Irish Longitudinal Study on Ageing (TILDA), carried out in 2010. The relatively high rate of doctor visits compared to nurse visiting is further discussed and compared to stroke survivors' utilisation in the UK in the next chapter. It is noteworthy that while the rate of home help utilisation by stroke survivors increases in the years after stroke, the rate of utilisation of meals on wheels reduces, a pattern which could indicate unmet need for meals on wheels (Table 24).

TABLE 24 Estimated Mean Stroke Survivor Utilisation of Home Help and Meals on Wheels to Two Years Post-Stroke

	90 days post-stroke	1 year post-stroke	2 years post-stroke
	Estimated mean contacts p.a.		
Home help[2]	47.8	48.9	49.3
Meals on wheels[3]	23.4	20.3	18.2
	Percentage of survivors in receipt of this form of care		
Home help	25.6 %	26.2%	26.4%
Meals on wheels	9%	8%	7%

Sources and methods: NDPSS and National Disability Survey, method as in Table 23.

3.8 Conclusions

This chapter has reviewed evidence of current rehabilitation services and pathways of rehabilitative care for stroke patients in Ireland. In common with previous studies, the evidence reviewed presents a picture of considerable local and regional variation in the supply of generic community staffing relative to stroke survivors' estimated need for rehabilitation and in the intensity of therapy delivered to stroke survivors. In the acute setting, there is considerable variation in stroke patients' length of stay even when at the same level of disability. Clinicians engaged in stroke care in 24 out of 28 acute hospitals agree that inadequacies in community services lead to referrals of patients post-discharge for rehabilitation services in hospitals or other inpatient locations such as nursing homes, who could be treated at home by community services if these were more readily available. Utilisation of care appears to be related to supply of care: there are more referrals to community therapists in areas where more care is available; there are more discharges to nursing homes in areas where there are more long-stay beds. Pathways of care for stroke patients therefore vary by area and appear to reflect the fragmented development of health services, which was a consequence of their highly localised administration under the former health board structure. There is particular evidence of relatively low supply of therapists and intensity of therapy delivered in Dublin city, while acute inpatient length of stay is particularly long in the East and rehabilitation outside the acute setting appears to be delivered to a greater degree in inpatient or outpatient settings rather than in the community.

Long waits for care, as long as six months wait for discharge to a nursing home for patients with severe disability in one Dublin hospital, are evidence of inadequate specialised long-stay capacity. Waits of over three months are consistently reported for the specialised rehabilitation service offered by the National Rehabilitation Hospital in Dun Laoghaire, which receives referrals nationally of patients with moderate to severe disability, who are aged under 65. Given the evidence reviewed in Chapter 1 of the importance of timely rehabilitation, such

waits could worsen patients' long-term prognoses. This suggests that there is a need for expanded inpatient rehabilitative capacity for younger people with severe stroke in particular.

This study has found a deficit in psychology and counselling services for stroke survivors in acute hospitals and rehabilitation settings, as well as relatively under-resourced generic community psychology services. Combined with the findings from other studies of deficits in the availability of psychological services for stroke survivors in the community and in nursing homes, and of considerable emotional distress in stroke survivors, there appears to be clear need for the development of such services.

The final sections of this chapter have analysed evidence of stroke patients' progress and utilisation of care post-discharge. This evidence will be applied in Chapter 5 to economic evaluation of preferred as compared to conventional care post-discharge. The next chapter discusses and develops best practice pathways of rehabilitation for Ireland.

CHAPTER 4

Best Practice Pathways of Rehabilitation - Findings

4.1 Introduction

This chapter examines best practice pathways of rehabilitation for stroke survivors to develop models for Ireland, so that in the next chapter costs and outcomes of best practice care can be compared to the costs and outcomes of conventional care, informed by the analysis in Chapter Three of current rehabilitation in Ireland. Chapter One reviewed the evidence in the international literature on stroke rehabilitation of a consensus view that survivors with mild or moderate disability are generally considered suited to Early Supported Discharge (ESD), while the needs of survivors with more severe disability are better met by specialised inpatient rehabilitation. The international literature reviewed provides evidence of resource use, costs and outcomes from ESD, which in this chapter informs the development of ESD models for Ireland. The evidence in the case of rehabilitation for people with severe disability after stroke is not adequate to support the development of such models. Substantial numbers of Irish stroke patients with severe disability remain in long-term care without regular review and with, at least in some cases, unmet need for rehabilitation, as reported by The National Audit of Stroke Care Research Team (2007) and Cowman et al. (2010). However, to model costs and outcomes from a best practice pathway of rehabilitation for such patients requires evidence from RCTs, which have not been undertaken in Ireland or elsewhere in a manner generalisable to Ireland. The rehabilitation needs of such patients are discussed further in Chapters Six and Seven.

The focus of this chapter is on the development of ESD models for Ireland. The development of these models must largely rely on evidence from RCTs conducted internationally, since no RCT has been undertaken in Ireland. To address to some degree this paucity of direct Irish evidence, this chapter commences in the next section with a review of the experience of an ESD pilot programme, which was recently implemented in North Dublin. The findings presented here shed some light on the particular challenges to and the feasibility of implementing ESD in Ireland. The next section analyses the resources, outcomes and costs of the ESD pilot in Dublin. Section 4.3 reviews the evidence from the pilot in the light of the international literature on ESD. Two alternative ESD models are developed in detail in Sections 4.4, while Section 4.5 concludes.

4.2 MMUH/North Dublin ESD Pilot Programme

A pilot ESD programme was introduced for stroke patients at the Mater Misericordiae University Hospital (MMUH) in Dublin under the auspices of the HSE National Stroke Programme in 2011-2012. Since this was not an RCT, with a comparator group of patients with similar characteristics receiving usual care, there is no comparator for the outcomes analysed below, so that they cannot be interpreted as treatment effects. The analysis presented is a record of the experience of this programme.

The 49 participants in the MMUH/North Dublin ESD pilot represented 13 per cent of total stroke discharges from MMUH over the pilot period from 1 October 2011 to 30 September 2012. The ESD team's limited capacity and the restriction of the programme to a defined catchment area of North Dublin prevented greater numbers of patients from participating in the pilot; up to 17 per cent of discharged stroke patients were identified as suitable for participation (Health Service Executive/MMUH 2012). The larger, anonymised ESD participant dataset of patients who received ESD up to 30 June 2013 includes 80 patients, of whom 51 per cent are female and 49 per cent male. The age profile of the programme participants is younger than that of hospitalised stroke patients in general with 42 per cent aged under 65 compared to 29 per cent of stroke acute hospital discharges in 2011 (Table 25). Household composition is available for 61 of the 80 patients in the programme, the majority of whom (64 per cent) lived with a partner, family members or other cohabitees, while 36 per cent lived alone.

TABLE 25 Age and Gender of MMUH/North Dublin 2011-2013 ESD Programme Participants and HIPE 2011 Stroke Discharges Compared

	MMUH ESD Participants			HIPE 2011 Stroke Discharges		
Age group	Male %	Female %	Total %	Male %	Female %	Total %
under 45	4	3	6	4	4	7
45-64	26	10	36	14	9	22
65-74	4	11	15	14	8	22
75-84	10	18	28	15	15	30
85 and over	5	10	15	6	12	18
Total	49	51	100	52	48	100

Source: MMUH/North Dublin ESD programme dataset; Hospital Inpatient Enquiry (HIPE) 2011: all acute hospital discharges with overnight, inpatient stay and principal or secondary diagnosis of stroke, excluding those with principal diagnosis of rehabilitation.

The Modified Barthel Index (BI) was used to measure level of independence in activities of daily living (ADL) on initiation of ESD and after discharge from ESD. This version of the Index scores from 1 to 100 (Appendix 8.1 details how this scoring system varies from the version that scores from 1 to 20). Of the 76 programme participants, for whom disability levels were recorded before

initiation of ESD, a quarter (26 per cent) had a BI of 100, which signifies independence in ADL (Table 26). This proportion had increased to 46 per cent after the programme. Few participants had severe (3 per cent) or moderate (4 per cent) levels of disability before the programme. Of the 68 programme participants, for whom BI scores were available before and after ESD, 59 per cent showed an improved score, with a mean improvement in BI score of 14 per cent, a median of eight per cent and a range of from two to 80 per cent.[18] The high proportion of participants who had a BI score of 100 pre-ESD initiation, signifying independence in ADL despite their identified therapy needs, would appear to demonstrate a limitation in reliance on BI to assess the need for or efficacy of ESD. The final report of the ESD pilot programme commented on this BI 'ceiling effect' (Health Service Executive/MMUH 2012: 9). Although BI measures functional ability as defined by activities of daily living, a specific limitation that has relevance to this pilot is that it does not take into account impairments of speech or cognition, which are captured by other measures.

TABLE 26 Disability Levels in ESD participants Before and After ESD Programme

Disability Level	Modified Barthel Index Score	Percentage of ESD Participants pre-ESD %	Percentage of ESD Participants post-ESD %
Severe	0-47	3	0
Moderate	48-72	4	1
Mild:			
Lower end of mild range	73-80	7	3
Mid-mild range	81-90	14	1
Upper end of mild range	91-99	46	38
Independent	100	26	46
Re-admitted acute hospital		-	4
Admitted rehabilitation hospital		-	4
Not available		-	3
Total (N=76)		100	100

Source: MMUH/North Dublin ESD programme dataset. Modified Barthel Index classification explained in Appendix 8, Table 58

In adopting the BI, the MMUH pilot was following common practice in studies of stroke care. BI can readily be converted into a measure of health-related quality of life (Van Exel et al. 2004). However, as Craig et al. (2013) concluded in a review of studies of stroke rehabilitation, the use of a single outcome such as health-related quality of life (and by extension, BI) 'is limited in representing the multiple and wide-reaching consequences of stroke rehabilitation' (Craig et al. 2013: 10). Early Supported Discharge Trialists nonetheless tend to place most emphasis on recorded improvement in measures of disability/dependence such as the Barthel

[18] Individuals' additional points on the BI scale post-ESD are expressed as a percentage of their pre-ESD score on the scale, from which individual percentages the mean, median and range are derived.

Index to determine the success of ESD, although a majority of Trialists also value measuring changes in the patient's subjective quality of life (Fisher et al. 2011).

Other outcome measures recorded in the MMUH/North Dublin programme were:

- The Stroke and Aphasia Quality of Life Scale - 39 (SAQOL39) used to measure self-reported quality of life;
- The Australian Therapy Outcome Measures (AusTOMs) used to measure outcomes from individual therapies in relation to impairment, activity limitation, participation and distress/well-being of patient and carer;
- The Canadian Occupational Performance Measure (COPM) used to measure clients' perception of occupational performance.

The final report on the pilot programme observed that the SAQOL39 score results were 'perhaps the most important, as they reflect clients' own perception of their quality of life and how this changed over the course of the ESD intervention' (Health Service Executive/MMUH 2012: 10). SAQOL scores before and after ESD are available for 49 (61 per cent) of the 80 participants. Within this grouping, 88 per cent showed an increased score, reflecting their perception of an improvement in their quality of life after ESD, with the remaining 12 per cent reporting a disimprovement in their quality of life. The proportion of the full sample with a self-reported improved quality of life on this score was 54 per cent.[19] The SAQOL39 is scaled from 1 to 5. For the 49 participants for whom scores were recorded before and after ESD, the mean change in SAQOL was 0.6 (SD=0.59) with a range of from -1.1 to 1.9 (Table 27).

TABLE 27 SAQOL39 Scores Before and After ESD Programme Participation

	Mean	Standard Deviation	Minimum	Maximum
Before ESD	3.79	0.72	1.39	4.87
After ESD	4.43	0.44	3.28	5.00
Score change	0.64	0.59	-1.10	1.89

Source: MMUH/North Dublin ESD programme dataset.

The Australian Therapy Outcome Measures (AusTOMs) were used by therapists in this pilot to measure impairment before and after ESD. There are nine AusTOMs scales for physiotherapy, 12 for occupational therapy and six for speech pathology. Each scale measures the level/effect of a specified impairment across

[19] Reasons for non-completion of this measure included self-discharge from the programme (N=3), cognitive deficit/unable to complete (N=2) and re-admission to hospital or admission to rehabilitation hospital (N=4).

four sub-scales: impairment; activity limitation; participation restriction; distress/well-being (of participant and carer). The scales run from 0 to 5, with 5 signifying no impairment and 0 signifying profound impairment. Detailed analysis of the AusTOMs measures for the small grouping of participants who were recorded as having impaired speech (9 per cent of total, N=80) identified that a number of these participants had a BI of 100 before ESD despite a level of speech impairment that limited their abilities to participate in everyday life and caused them considerable distress (Table 28). The contrast between the BI and AusTOMs scores for this small sub-grouping of participants would caution against reliance solely on BI to assess outcomes from or the efficacy of ESD.

TABLE 28 AusTOMs Scores for Speech Recorded by Speech and Language Therapists before ESD Compared to Disability Level as Measured by BI

Percentage of ESD participants	Modified Barthel Index score before ESD	Impairment	Activity Limitation	Participation restriction	Distress/Well-being
4%	90-99	2 -3.5	2 - 3.5	2 - 3	2 - 4
4%	100	3 - 4	2 - 5	2 - 4	1 - 3

Source: MMUH/North Dublin ESD programme dataset.

The lowest speech pathology AusTOMs scores for the participants with a BI score of 100 included:

- Scoring 2 on the Activity Limitation scale signifying that this person has such impaired speech that they can only convey needs and wants to their main communication partner;
- Scoring 2 on the Participation Restriction scale signifying that this person has 'moderately severe difficulties in fulfilling social, work, educational or family roles'(La Trobe University 2004);
- Scoring 1 on the Distress scale signifying that this person becomes distressed and loses emotional control easily and requires constant reassurance (ibid).

Within hospital, 67 per cent of ESD participants (N=79) received care in a Stroke Unit (SU) while the remaining 33 per cent did not. The mean LOS for ESD programme participants was 25 days with a standard deviation of 23 days and a range of from two to 148 days. The 49 patients in the original pilot had a mean LOS of 28 days compared to 38.5 for the non-participants discharged from MMUH over the same period (Health Service Executive/MMUH 2012). The final report of the pilot ESD programme commented that despite the ESD team focus on keeping the period between referral for ESD to discharge to a minimum, the range of LOS after referral was from 0 to 36 days with longer periods between referral and ESD reflecting waits for home care package approval or to put social supports in place, or where medical treatment was required (Health Service

Executive/MMUH 2012). While the long LOS of some patients would appear incompatible with the concept of early discharge, in this context 'early' signifies a discharge which is expedited by the availability of ESD or which could not have occurred without ESD support,[20] an understanding of ESD that fits within the broad Fearon and Langhorne (2012) definition as any intervention that aims to accelerate discharge from hospital and provides support in a community setting. In the context of a pilot programme, it is possible that some of the patients with long LOS might have been discharged earlier had the ESD programme been in existence.

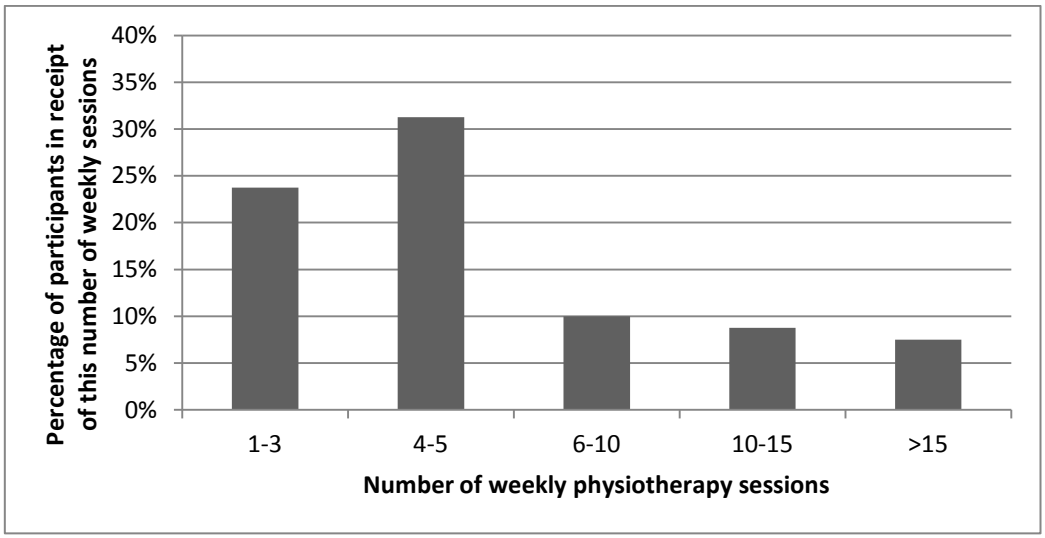
There is great variability in stroke LOS across countries and within Ireland. In a study of European countries, Beech et al. (1996) found that mean length of stay ranged from 11.0 days (in Portugal) to 38.9 days (in the UK). More recently, Saka et al. (2009) reported a mean length of stay for stroke patients in the South London Stroke Register between 2001 and 2006 as 32.2 days (SD 34.2) for patients treated in a stroke unit and 35.3 days (SD 44.9) for patients treated in a general medical ward, while patients participating in a local ESD trial had an LOS of 34 days (SD 34) when receiving ESD and 42 days (SD 41) with conventional care. Within Ireland in 2011, mean LOS ranged from 17.6 days (SD 28) in the HSE South Region to 30 days (SD 57) in Dublin Mid-Leinster (HIPE 2011).

All participants in the MMUH/North Dublin ESD programme were assessed as requiring physiotherapy, occupational therapy and/or speech and language therapy. The therapy required by and provided to participants ranged from solely one SLT session per week for one participant to 26 weekly sessions of all three therapies combined (18 PT, four OT, four SLT) for another participant. The majority of participants required OT (94 per cent) and PT (81 per cent) sessions with a minority requiring SLT (23 per cent) sessions. The duration of therapy sessions was generally 45 minutes.[21] Although OT was required by greater numbers of participants, PT was required most intensely (Figure 33, Figure 34 and Figure 35: N=80). Mean programme duration was 5.2 weeks with 20 per cent of participants discharged from ESD in two weeks or under; 24 per cent discharged after four weeks and a further 24 per cent after six weeks. A third of participants (33 per cent) required interventions of seven to 14 weeks duration (Figure 33).

20 The MMUH ESD programme 'considered anyone for ESD where discharge with ESD expedited the discharge, so, where they would have to have remained in the acute setting unless ESD support was available.' (Personal communication from MMUH ESD programme, October 2013.)

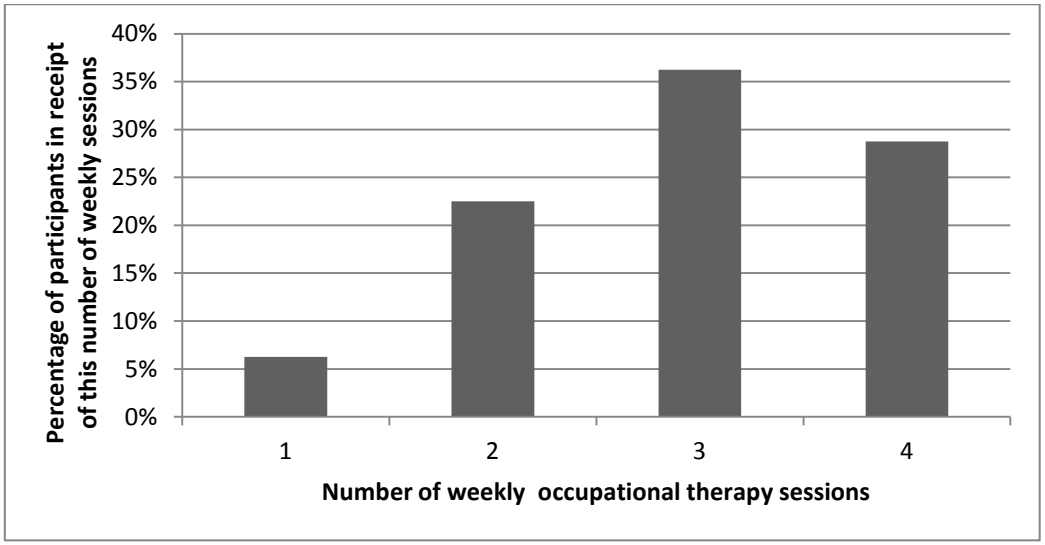
21 Personal communication, MMUH ESD programme, October 2013.

FIGURE 33 MMUH/North Dublin ESD Programme Percentages of Participants in Receipt of Range of Weekly Physiotherapy Sessions



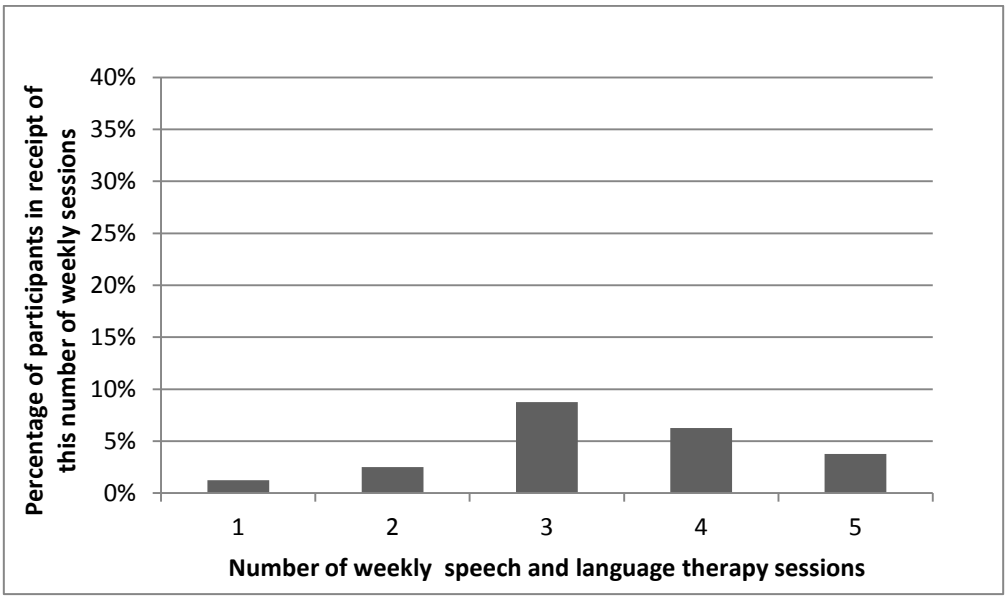
Source: MMUH/North Dublin ESD programme dataset.

FIGURE 34 MMUH/North Dublin ESD Programme Percentages of Participants in Receipt of Range of Weekly Occupational Therapy Sessions



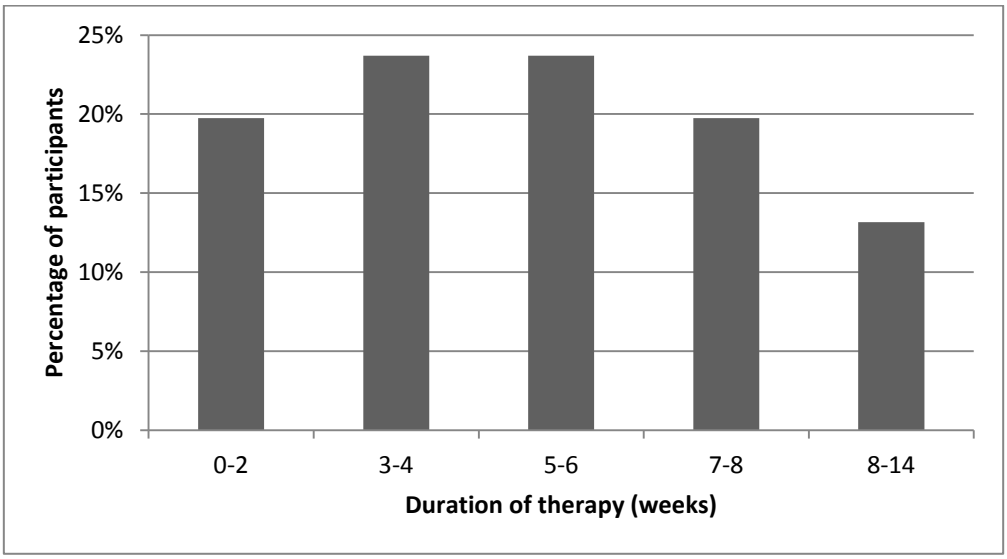
Source: MMUH/North Dublin ESD programme dataset.

FIGURE 35 MMUH/North Dublin ESD Programme Percentages of Participants in Receipt of Range of Weekly Speech and Language Therapy Sessions



Source: MMUH/North Dublin ESD programme dataset.

FIGURE 36 Duration of MMUH/North Dublin ESD Programme

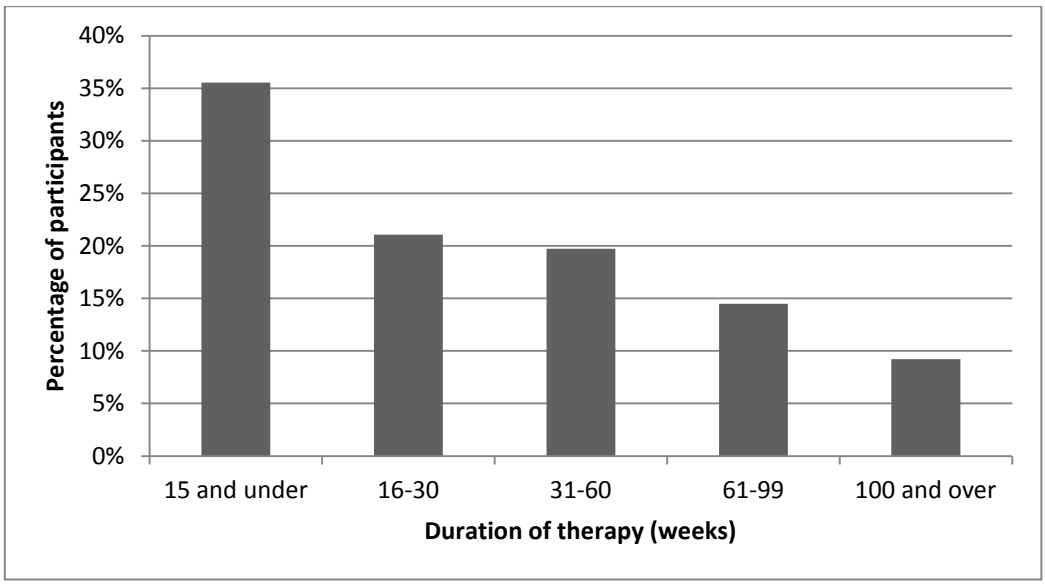


Source: MMUH/North Dublin ESD programme dataset (N=76).

The mean hours of a specific therapy delivered per participant are calculated by summing each participant's total hours of therapy (calculated from their weekly 45-minute sessions and the duration of each participant's ESD programme) then dividing by all programme participants (N=80). Mean therapy delivered was: PT 21 hours; OT 11.4 hours; and SLT four hours. The intensity of all combined therapies delivered per participant is calculated by calculating each participant's combined weekly therapy sessions in hours and multiplying by that participant's programme duration in weeks. The result is expressed in therapy hours. The

mean intensity is 38 hours (SD=36.5) and the median is 25 hours. The range is one to 181 hours. Over a third of participants (35 per cent) were assessed as requiring and received 15 or fewer hours of therapy in total (Figure 37). A further 21 per cent of participants received between 16 and 30 therapy hours; and 20 per cent received between 31 and 60 hours. The programme devoted a high proportion of therapy hours to the remaining 23 per cent of participants, with the most intense therapy of 100 hours and over provided to nine per cent of participants and accounting for 29 per cent of the total therapy hours provided by the programme.

FIGURE 37 ESD Programme Intensity: Total Hours Therapy Per Participant



Source: MMUH/North Dublin ESD programme dataset (N=76).

There is a weak association between therapy intensity and improvement in participants' Barthel Index scores (correlation coefficient=0.22).[22] Participants with high intensity therapy interventions record no changes in their BI scores while participants with relatively low intensity interventions record substantial improvements by this measure. This may indicate inadequacy in the BI as a sole measure of outcome and is also likely to reflect the influence of multiple factors other than therapy on outcomes from ESD, such as age, quality of care in the home setting and the nature of disabilities after stroke. Multi-variate analysis of this dataset for a larger sample of participants could shed greater light on the determinants of outcome after ESD. The association between therapy intensity and improvement in self-reported quality of life is only marginally stronger (correlation coefficient=0.23), with equivalent therapy inputs associated with both increased and decreased SAQOL39 scores. The grouping of participants with

22 This correlation rises to 0.30 with the exclusion of an outlier participant.

AusTOMs scores for speech is too small and too skewed by individual cases to generate a clear pattern of association between intensity of therapy inputs and outcomes. It appears, however, that in this programme in some instances high intensity therapy was a response to a high level of assessed need and distress and, while not delivering a proportionate reduction in impairment, delivered an improvement in self-reported quality of life. [23]

The Final Report of the MMUH pilot estimated annual ESD team staffing costs for therapists and the recommended medical social worker support (added at a late stage of the pilot) at €180,330 (Table 29). Equipment costs and professionals' working expenses added a further €15,381 (Health Service Executive/MMUH 2012). To enable their participation in the ESD programme, 12 per cent of the pilot participants required and received new Home Care Packages (HCP) (Health Service Executive/MMUH 2012). After discharge from the ESD programme, six per cent of participants still required and received these HCPs at the same level of intensity and four per cent required and received HCP but with reduced hours. Since in Ireland there is no consistent system of eligibility for public or subsidised home care (Brick et al. 2010; Wren et al. 2012), such enabling HCPs need to be included in costing ESD implementation. Each HCP is different and tailored to individual needs. In estimating costs for HCPs, the average of ten weekly hours for those participants in the pilot who required HCP is applied. This is equivalent to help with personal needs for an hour each morning and evening Monday to Friday.

Table 30 illustrates that the estimated cost of a HCP for mean programme duration is €1,118. The estimated per capita cost of the MMUH pilot programme is €4,130, when the estimated staffing, equipment and HCP costs of the pilot are combined and averaged across the 49 participants (Table 31).

TABLE 29 Annualised Staffing Costs of MMUH ESD Pilot

	Whole-time equivalent	Estimated annual cost €
Occupational therapist	1	66,257
Physiotherapist	1	66,257
Speech and language therapist	0.4	33,129
Medical social worker	0.2	14,687
Total		180,330

Source: Estimates from Health Service Executive/MMUH (2012) based on full year salary plus overheads at mid-point senior scale, with provision to cover annual leave. (N=49).

[23] This understanding is informed by discussion with therapists engaged in the programme.

TABLE 30 Estimated Costs of Home Care Packages to Enable ESD Participation

	Hours / Euro
Estimated Home Care Package hours per week	10 Hours
Hourly rate for home help/home care attendant	€21.50
Weekly cost for one HCP	€215
Cost for mean ESD 5.2 week programme duration	€1,118

Source: Hours estimated as discussed in text; hourly costing for home help/home care assistant is unit cost per hour of client contact as researched by Brick et al. (2013, forthcoming).

TABLE 31 Estimated Total Annual Costs of MMUH/North Dublin ESD Pilot

	Annualised costs HCP mean programme duration basis €
Staffing	180,330
Home Care Packages for 12% of participants	6,708
Equipment and expenses	15,381
Total costs	202,419
Mean costs per participant	4,131

Source: Derived from Table 32 and Table 29, N=49.

An alternative methodology to develop an average per capita cost of ESD based on the MMUH programme data is to cost for each of the therapies the average hours of therapy per participant in the larger dataset (N=80). This alternative therapy cost is then added to the per capita costs for medical social worker support, equipment and Home Care Packages derived from the MMUH pilot. Applying 2011 unit costs for therapists' contact hours adapted from Brick et al. (forthcoming)[24] this method generates a higher estimated average cost of the programme at €5,325 per capita. Applying this costing methodology to the most intense combination of therapies delivered under this programme demonstrates a maximum therapy cost of €23,470, five times the mean. The advantage of this unit cost methodology is that it can be applied to calculate the costs of funding ESD in any Irish hospital over any period, whereas the MMUH pilot costs are derived from actual staffing deployed during a pilot in a specific hospital over a year, some of whom at times of reduced demand in the programme were engaged in general community care.

24 Hourly costing for therapies is unit cost per hour of client contact, methodology as in Brick et al. (forthcoming), with salary adapted in this study to a weighted mean to reflect relative numbers of senior and non-senior therapists employed in the public health service.

TABLE 32 Estimated Per Capita ESD Programme Cost, Therapy Inputs in Full MMUH/North Dublin Dataset

	Mean hours therapy	Cost per hour €	Mean cost €	Maximum cost €
Physiotherapist	21.1	131	2,768	16,451
Occupational therapist	11.4	128	1,460	3,565
Speech and language therapist	4.0	124	502	3,454
Total therapy costs			4,729	23,470
Mean equipment cost (MMUH p.c.)			160	
Medical social worker (MMUH basis)			300	
Home care package (MMUH programme duration basis)			137	
TOTAL P.C. COST			5,325	

Source: (N=80) Mean and maximum hours sourced from MMUH dataset; hourly costing for therapies is unit cost per hour of client contact, methodology as in Brick et al. (forthcoming), including wages, salary costs, overheads and capital overheads, with salary adapted in this study to a weighted mean to reflect relative numbers of senior and non-senior therapists employed in the public health service.

The experience of the Mater ESD pilot offers insights into the potential for ESD in the Irish healthcare system, the resourcing such a programme requires and the challenges to its implementation. However, this was not a randomised controlled trial so that there was no control group for whom therapy inputs and outcomes could be compared. The ESD pilot participants had a lower average acute hospital length of stay (LOS) than the non-ESD stroke patients at MMUH in this period but, given the selection bias in the pilot group[25] and the absence of a comparable control group, no generalisable conclusion about the extent of potential cost savings in Irish acute hospitals achievable by ESD can be drawn from this comparison. Nonetheless, the assessment by the Mater ESD service that their programme achieved sufficient bed-day savings to fund required therapy staffing is compatible with the evidence in the international literature review of potential cost savings from ESD and is further supported by the finding in the next chapter that ESD could be implemented in Ireland at no additional cost and with potential for cost savings from reduced acute length of stay.

The programme team identified greater ESD team resourcing, comprehensive introduction to remove catchment area restrictions and more rapid access to home care packages as key requirements to realise the full potential for ESD. Access to early community nursing, provision of more community psychology services and greater linkage with general practitioners, who were on occasion

25 Participants in the ESD pilot were selected according to the following criteria: mild to moderate stroke; medically stable; no complex nursing needs; able to transfer with minimal assistance of one person, with supervision or independently; sufficient cognition, visuo-perceptual ability and communication for safe discharge; stable psycho-social home environment; carer support available at home; patient and carer willing to be discharged home under the ESD programme; patient needing intensive rehabilitation from one or more of physiotherapy, occupational therapy and speech and language therapy; and patient resident within a defined catchment area in North Dublin (Personal communication from MMUH ESD programme, October 2013).

unaware of their patient's hospital admission or discharge were also recommended (Health Service Executive/MMUH 2012).

The final report of the MMUH pilot observed that clients who lived alone risked social isolation and a number required extra supports:

> *…it became evident that their impairments were more significant in their own home environment. A lack of family or local next of kin support increased demands on the ESD key worker and subsequently public health nurses (PHNs) to fulfil these roles.*
>
> *(Health Service Executive/MMUH 2012: 16).*

4.3 Evidence Base for an ESD Model for Ireland

Any exercise in modelling ESD versus usual care in Ireland is restricted to some degree because to date there has been no Irish randomised controlled trial (RCT) of ESD versus usual care. Ideally, modelling for Ireland should be informed by Irish data on such parameters as the effects of ESD on acute length of stay, patient outcomes and individual patients' resource requirements for rehabilitation and care in hospital and the community, when compared to the resource requirements and outcomes of a control group of patients. This study addresses this data deficiency, insofar as possible, by applying the Mater data combined with analysis of usual care in the Irish setting in Chapter 3 and supplemented by evidence from the international literature on ESD. The relatively low participation rate and relatively high BI scores (signifying mild disability) of the participants in the Mater pilot indicate that this programme has not so far exploited the full potential of ESD, as evidenced in the international literature (Table 33).

Mean BI for ESD participants was in the range of 10/20 to 17/20 in a review of 14 trials (Fearon and Langhorne 2012), which represents a more challenging level of average disability than the Mater cohort's. The Early Supported Discharge Trialists' 'Consensus on Stroke' (Fisher et al. 2011) defined clear eligibility criteria for ESD with 80 per cent of Trialists agreeing with the statement that 'most patients eligible for early supported discharge would have a Barthel score of between 10/20 and 17/20' (Fisher et al. 2011: 1395). While 24 per cent of Mater programme participants (N=76) had a BI in the range 9/20 to 17/20, the remainder had a BI score above 17/20. Despite clarity on the level of disability appropriate to ESD and other criteria for inclusion such as safety, practicality and medical stability, the Early Supported Discharge Trialists were unable to reach a consensus view on

> *when it is most optimal to make decisions around referral to ESD. The Consensus is based on trials conducted in a small number of countries, and so its effectiveness in the implementation of ESD in other countries (with contrasting health systems) remains to be evaluated*
>
> *(Fisher et al. 2011: 1396).*

In this study, the proportion of patients who are suitable for ESD is estimated with reference to the Irish evidence of disability in stroke survivors and the international literature on ESD. The Irish evidence on the proportion of patients with mild/moderate disability is informed by comparison of disability levels in stroke survivors in ASPIRE-S, the NDPSS and INASC. Comparison of the 2005/2006 NDPSS to the 2011/2012 ASPIRE-S data finds no evidence of statistically significant changes in post-stroke disability patterns in patients discharged to home in North Dublin since the NDPSS. In light of this finding, evidence from the NDPSS is applied to inform the construction of scenarios for eligibility for ESD.

Evidence from Irish studies and the international literature (Table 33) is therefore combined in adopting assumptions about the proportion of patients eligible for ESD, as follows:

- To adopt an upper end of the range for ESD eligibility in Ireland which is lower than the upper end of the range of 70 per cent of hospitalised patients eligible for ESD in studies in other countries, since ESD for such a high proportion of patients has only been achieved in trials in urban areas in countries with more developed community care services than Ireland (Rousseaux et al. 2009; Fearon and Langhorne 2012);

TABLE 33 Criteria for ESD Eligibility; Evidence from International Literature, Mater Pilot Programme, and Irish Datasets

Item	Unit	Value	Data Source(s)
International literature	% of all discharges	7%-68% 13%-70% (median 34%) 37% 20% (current) 43% (cost-effective)	Rousseaux et al. (2009) meta-analysis 11 trials (60+% Trondheim, others <+50%) Fearon and Langhorne (2012) meta-analysis 14 trials Krueger et al. (2012) Canada National Audit Office (2010b)
Irish data	% of all discharges	13% 17% 44% 50%	Mater ESD pilot actual percentage patients participating Mater ESD pilot potential percentage patients participating (i.e. additional 4%) NDPSS Mild and moderate disability at 7 days HIPE 2011 % discharges discharged home
BI at outset of ESD	BI	18 (mean) 10-17 (mean)	Mater ESD programme Fearon and Langhorne (2012) meta-analysis 14 trials

- To limit the proportion of patients assumed to be eligible for ESD to within the 50 per cent of all stroke discharges who were discharged home in Ireland in 2011 (Table 10; HIPE 2011), indicating that these patients had adequate supports at home, whether formal or informal. This compares to 47 per cent of all discharges discharged home in Ireland in 2005 (INASC);
- To adopt 44 per cent of all discharges as the upper end of the range of patients potentially eligible for ESD in Ireland, since in 2005, 44 per cent of stroke patients in the NDPSS had mild/moderate disability at seven days post-stroke. This upper assumption of 44 per cent of all discharges (including inpatient deaths) is equivalent to 54 per cent of hospitalised stroke patients excluding inpatient deaths;
- To adopt 17 per cent of all discharges as the lower end of the range of patients potentially eligible for ESD in Ireland, reflecting the assessment in the MMUH pilot ESD programme that this proportion of Mater patients could have benefited from ESD, within the parameters of that programme;

  Note: This proposed ESD participation rate range of 17 per cent to 44 per cent of all hospitalised stroke patients/ discharges compares to a target ESD participation rate of 37 per cent for Canada in Krueger et al. (2012); a median of 34 per cent from 14 trials reviewed by Fearon and Langhorne (2012); and the conclusion in National Audit Office (2010b) that increasing from a 20 per cent to a 43 per cent ESD participation rate would be cost-effective over a ten-year period (Table 33).

Consensus has not been achieved on the optimal duration for ESD, with ESD Trialists agreeing that other community-based stroke services should be considered in determining required duration (Fisher et al. 2011). The mean duration of 5.2 weeks in the Mater pilot programme compares to 5.4 weeks in an Australian RCT (Anderson et al. 2000) and is within the range of duration for studies across a number of countries (Table 34). Reflecting the Trialists' view, resourcing of generic community care and rehabilitation within Ireland, or within a HSE Region, would appear to be a central consideration in determining the appropriate ESD duration for Ireland or regions of Ireland.

Mean therapy intensity was 38 hours in the MMUH programme with a median of 25 hours and a standard deviation of 36.5 hours. This compares to a median of 44 hours calculated from five trials by Larsen et al. (2006). Therapist staffing levels for the MMUH pilot appear to have been relatively high at 2.4 WTE therapists for 49 patients. This compares to the Trialists' 'representative guide for the composition of an Early Supported Discharge team' for 2.4 therapists for a caseload of 100 patients; and the median from 14 trials of 2.2 therapists per 100 patients (Table 34; Fisher et al. (2011); Fearon and Langhorne (2012)). The ESD Trialists recommend up to a further two WTE in social worker, nurse, medical and

assistant staffing, compared to an additional 0.2 WTE in social worker staffing for the MMUH pilot. Thus, the relatively high level of therapist staffing for the MMUH pilot may reflect under-provision of other staffing on the team and a generally low level of community care staffing to support the team. Although the MMUH pilot observation of a 10.5 day average difference in LOS for ESD participants compared to non-participants cannot be attributed directly to ESD due to the differing characteristics of the two groups of patients, reductions in LOS for ESD participants of between seven and 13 days have been observed in RCTs (Table 34). ESD Trialists generally agree that a successful ESD intervention should achieve a consistent reduction in LOS of eight days or more (Fisher et al. 2011).

TABLE 34 ESD Duration, Resourcing and Effect on LOS, Evidence from Mater Pilot Programme and International Literature

Item	Unit	Value	Data Source(s)
Discharge home: rehab. duration	weeks	5.2 weeks (mean)	Mater ESD programme mean (N=77)
		3 months (max)	Rudd et al. (1997) as reported by Anderson et al. (2002)
		9 weeks (median)	Rodgers et al. (1997) as reported by Anderson et al. (2002)
		5.4 weeks (mean)	Anderson et al. (2000) as reported by Anderson et al. (2002)
		4 weeks	Gladman and Sackley (1998) as reported by Anderson et al. (2002)
		1 month	Indredavik et al. (2000) as reported by Anderson et al. (2002)
Discharge home: therapy intensity	mean hours (SD)	38 (36.5)	Mater ESD programme
	median hours.	44	Larsen et al. (2006) calculated from five trials
Discharge home: therapists and other staff required*	WTE per 49	PT (1) OT(1) SLT(0.4) MSW (0.2)	Mater ESD pilot (for 49 patients in pilot)
	WTE per 100	PT(1) OT(1) SLT (0.4) MSW (0.5) N(0-1.2) M(0.1) A* (0.25)	Fisher et al. (2011) Trialists' consensus
		PT (1.1) OT (1) SLT(0.1) MSW (0-0.5) M (0.08)	Fearon and Langhorne (2012) Medians from 14 trials, urban and rural
Reduced acute hospital LOS due ESD	days	10.5	Mater ESD pilot
		7/7.7/8/10/13	Fearon and Langhorne (2012); Langhorne et al. (2005); Rousseaux et al. (2009); Larsen et al. (2006); Anderson et al. (2002)

Abbreviations: PT-physiotherapist; OT-occupational therapist: SLT-speech and language therapist; MSW-medical social worker/social worker; N-nurse; M-medical; A-assistant. * No consensus view on A.

As discussed in Chapter One, there is cumulative evidence to support the view that for selected patients appropriately-resourced ESD reduces dependency as well as risks of institutional admission and length of acute hospital stay (Fisher et al. 2011; Fearon and Langhorne 2012). The evidence from the MMUH programme shows much less transitioning between disability levels than found in the London RCT, which informs the King's College London Discrete-Event Simulation modelling (National Audit Office 2010b) of the cost-effectiveness of ESD, applied to Ireland in Chapter Five. Using the method applied to analyse disability state transitions in the NDPSS in Chapter Three, the proportions of patients with mild, moderate or severe disability before either ESD or conventional care (based on BI scores) are compared to the proportions at one year after the intervention to obtain the probability of having mild, moderate or severe disability post-ESD or conventional care for the London RCT and the MMUH programme in Table 35 and Table 36. The probability is calculated as the percentage of those at a disability level pre-intervention who are at the same or another specified disability level post-intervention. As discussed above, in the MMUH programme, the majority of participants were already in the Mild category and transitioned within that category.

TABLE 35 Severity Changes after Discharge (National Audit Office DES Model Assumptions)

	Early Supported Discharge			Conventional Discharge Rehabilitation		
Initial Severity	Mild	Moderate	Severe	Mild	Moderate	Severe
Mild	1	0	0	1	0	0
Moderate	0.94	0.06	0	0.91	0.09	0
Severe	0.39	0.08	0.53	0.25	0.05	0.7

Source: National Audit Office (2010b) page 18 Table 4.

TABLE 36 Severity Changes Post-ESD, MMUH ESD Programme

	Early Supported Discharge		
Initial Severity	Mild	Moderate	Severe
Mild	1	0	0
Moderate	0.67	0.33	0
Severe	1	0	0

Source: MMUH/North Dublin ESD programme dataset (N=67).

4.4 Developing ESD Models

To enable modelling of ESD versus usual care in Ireland, two ESD models are derived from the evidence reviewed in this study. The 'Beech Model' is derived from the RCT in London described in Beech et al. (1999); while the 'Fisher Model' is derived from the ESD Trialists' consensus view of the components of ESD as reported in Fisher et al. (2011). Although the 'Beech Model' is based on a

country-specific RCT undertaken in the early 1990s, its evidence of resource use and outcomes with ESD forms the basis for the approach to ESD in the KCL DES model, which is applied to modelling the cost-effectiveness of ESD for Ireland in Chapter Five.

4.4.1 The 'Beech Model'

The template for ESD in modelling the cost-effectiveness of ESD for Ireland in Chapter 5 is provided by the resource use (therapy hours and community service utilisation) in the London RCT described in Beech et al. (1999) for patients discharged with ESD (the 'Beech Model'). The resource use estimated for patients in Ireland in the North Dublin and HSE Region South case studies in Chapter 3 provides the comparator for conventional care post-discharge. In Table 37, therapy utilisation by discharged stroke patients in the London RCT, when participating in the ESD programme or when discharged with conventional care, is compared to mean estimated utilisation for stroke patients in Ireland in the North Dublin and HSE Region South case studies (Table 22). Mean therapy received by participants in the London ESD programme is considerably in excess of therapy received under conventional care in the London RCT. When conventional care is compared for the London RCT and the two Irish case studies, estimated mean hours for physiotherapy and occupational therapy in North Dublin are lower than in London while estimated mean therapy hours in the HSE Region South case study are higher than in conventional care in London. Estimated mean hours for speech and language therapy are lower than with conventional care in London in both Irish case studies.

TABLE 37 North Dublin and HSE Region South Estimated Therapy Utilisation Compared to Beech et al. (1999) Therapy Utilisation

Therapy	North Dublin Estimated mean therapy hours delivered in Primary Care Services	HSE Region South Estimated mean therapy hours delivered in Primary Care Services	Beech (1999) Mean Conventional Care non-inpatient therapy hours	Beech (1999) Mean Community Therapy (ESD) non-inpatient therapy hours
Physiotherapy	0.5	1.4	1.0	4.8
Occupational therapy	1.2	1.7	1.3	6.8
Speech and language therapy	0.2	0.3	0.4	3.6
Total therapy hours combined	1.9	3.4	2.7	15.2

Sources and methods: North Dublin and HSE Region South as in Table 22; Beech non-inpatient units of therapy (unit=20 minutes) converted to hours (Beech et al. 1999: 732 Table 2).

Community service utilisation for participants in the London RCT is expressed as mean annual number of contacts in Table 38 and compared to the most closely equivalent Irish data for estimated community service utilisation among stroke survivors, derived in Chapter Three (Table 23). A noteworthy difference that emerges from comparison of community service utilisation with conventional care is an apparent relatively high rate of GP consultation relative to public health nurse/community nurse visiting in Ireland compared to district nurse visiting in the London RCT. Furthermore, although there is no directly equivalent source for outpatient contacts with hospital physicians, it would appear that Irish stroke survivors have a relatively high rate of hospital outpatient utilisation. Stroke survivors' mean GP and nurse visits combined at 10.8 visits in Ireland in 2010 compared to a mean of 13.9 for stroke patients experiencing Conventional Discharge in the London RCT. These utilisation data for stroke survivors in Ireland are calculated from the 2010 Health Module of the QNHS, which includes survivors who might have experienced their strokes some years previously, a factor which could account for a lower overall visiting rate than among patients in their first year post-discharge in Beech et al. (1999). However, the contrast between the ratios of nurse to GP visits in the two countries appears to require further explanation with nurse visits accounting for 32 per cent of GP and nurse visits combined in Ireland and 68 per cent in the UK. This comparatively low nurse visiting rate in Ireland accords with findings from a study which compared primary care delivery of preventive cardiovascular care in the Republic of Ireland and Northern Ireland (Cupples et al. 2008). While utilisation increases under all headings for those patients assigned to ESD in the London RCT, district nurse visiting increases proportionately the most (Table 38).

TABLE 38 Community Service Utilisation by Stroke Survivors In Ireland, Compared to Beech et al. (1999) Utilisation

	Beech (1999) Conventional Discharge contacts	Irish Conventional Discharge estimated utilisation	Difference between Irish estimates and Beech CD mean contacts	Beech (1999) ESD contacts	Percentage increase in contacts with ESD
	Mean contacts per annum				
Hospital physician	1.5	2.4	0.9	1.9	27%
GP visits*	4.4	7.3	2.9	5.6	14%
District nurses**/ Community/Public health nurses	9.5	3.5	-6.0	26.8	182%
Sum of GP and nurse visits	13.9	10.8	-3.1	32.4	
Proportion of GP and nurse visits delivered by nurses	68.3%	32.4%		82.7%	
Meals on wheels	23.8	23.4	-0.4	30	26%
Home help	52.4	47.8	-4.6	54.8	5%

Sources and methods: Beech Model community service utilisation from Beech et al. (1999: 732 Table 3); Irish utilisation estimates derived in Section 3.6 Table 23. * In Beech, 2.2 of GP visits under Conventional Discharge are home visits, which increase to 3.1 with ESD.

For patients receiving ESD in the 'Beech Model', mean GP visits are one-third higher than with Conventional Discharge at 5.6 per annum compared to 4.4, while nurse visiting is almost three times higher at a mean of 26.8 visits per annum compared to 9.5. The model of ESD in this RCT relies on community nursing to deliver a high proportion of care (83 per cent of GP/nurse contacts). Whether an Irish model of ESD were to continue in the current medical model of Irish primary care delivery or follow the Beech delivery model could have implications for the staffing and costs of implementing ESD in Ireland. Utilisation of meals on wheels and home helps hours also increase with ESD. Estimated mean home help hours for stroke survivors are nine per cent lower with Conventional Discharge in Ireland than the mean home help hours with Conventional Discharge in the London RCT (Table 38). In Chapter 5, this model is further developed by applying Irish unit costs.

4.4.2 The 'Fisher Model'

The alternative ESD model, which provides a further comparator in the analysis of ESD costs in Chapter 4, is derived from Fisher et al. (2011), a consensus document about ESD developed by ESD Trialists, with the intention that it should be used by service providers in implementing ESD services. The Trialists' stated aim is to 'promote the use of recommendations derived from research findings to facilitate successful implementation of stroke services nationally and internationally' (Fisher et al. 2011: 1392). The Trialists' consensus views are applied in Table 39 to develop a template for ESD services. The general methodology applied in this table to estimating recommended mean therapy delivered, implicit in the Trialists' consensus, is to convert the recommended whole-time equivalent professional into their annual contact hours, sourcing these to the work of the Personal Social Service Research Unit (PSSRU) at the University of Kent in the UK (Curtis 2010; 2011) and, in the case of nursing, to Brick et al. (forthcoming). The contact hours are then divided by the 100-patient a year caseload to calculate mean therapy hours per patient. In the case of nursing and social work, in which the Trialists recommended a range of input, higher and lower mean utilisation is calculated. In the case of social work, since much of a social worker's assistance to a client may not require one-to-one contact, utilisation is expressed on a total hours rather than contact hours basis. Both medical and home help hours are derived again from Beech et al. (1999). Fisher does not provide recommendations on home help. Since the consensus view that a 0.1 WTE stroke physician is appropriate to a 100-patient a year caseload is difficult to quantify in a manner that can be costed due to differences in how hospital doctors work across countries, the Beech combination of outpatient and GP visits is substituted in this model.

It is noteworthy that estimating therapy utilisation in this manner results in a mean 22-hour per patient therapy input (Table 39), which compares to a 38-hour mean in the MMUH pilot; a 44-hour median in five trials reviewed by Larsen et al. (2006) (Table 34); and 15.2 non-inpatient therapy hours in the 'Beech Model' (Table 37). The higher 'Fisher Model' estimate of 12 nursing hours compares to 8.9 hours in the 'Beech Model' (assuming 20 minutes per visit). Even without the further addition of up to eight hours of social worker assistance, the 'Fisher Model' is relatively well-resourced. The passage of time between the London RCT in the early 1990s and the publication of the Trialists' consensus in 2011 may well have seen a development in the view of optimal ESD resourcing. There is also a difference between an actual RCT, implemented with available resources, and a template which is constructed from Trialists' views of ideal resourcing, some of whom may be influenced by the relatively well-resourced community care in their country. It should also be noted that, as constructed in Table 39 the estimated mean hours of therapy or other resource may understate the hours implicitly assumed in the Fisher consensus, since conversion of whole-time equivalents into contact hours depends on estimates constructed in the UK and Ireland of the ratio of direct to indirect hours worked by professionals in the community. Such ratios may differ across countries so that some of the trialists may assume that more therapy hours would be delivered than have been calculated here. While cognisant of these caveats, the ESD template derived here from the Fisher consensus offers a more ambitious model of ESD as a useful comparator to the 'Beech Model'. Table 40 summarises the resource assumptions in the two models.

TABLE 39 Applying the Fisher ESD Trialists' Consensus to Develop a Template for ESD Stroke Services

Variable	Unit mean per case	Estimated mean annual utilisation	Sources and Methods
Reduction in acute hospital LOS	Days	8	Nine out of ten ESD trialists agree that a successful ESD intervention should achieve 'a consistent reduction of eight days or more in length of stay in hospital by stroke patients' (Fisher et al. 2011: Table 4 page 1396).
Physiotherapy	Contact hours	9	Ten out of ten ESD trialists strongly agree that an ESD team should have 1.0 WTE physiotherapist for 100-patient a year caseload (Fisher et al. 2011: Table 1 page 1394). This equates to 900 patient contact hours p.a. (Curtis 2010), which is an average of nine hours per patient.
Occupational therapy	Contact hours	9	Ten out of ten ESD trialists strongly agree that an ESD team should have 1.0 WTE occupational therapist for 100-patient a year caseload (Fisher et al. 2011: Table 1 page 1394). This equates to 900 patient contact hours p.a. (Curtis 2010), which is an average of nine hours per patient
Speech and language therapy	Contact hours	3.6	Ten out of ten ESD trialists agree that an ESD team should have a 0.4 WTE speech and language therapist for 100-patient a year caseload (Fisher et al. 2011: Table 1 page 1394). This equates to 900*0.4 patient contact hours p.a., which is an average of 3.6 hours per patient.
All ESD therapy	Contact hours	22	Compares to mean 38 therapy hours in MMUH programme and median of 44 calculated from five trials by Larsen et al. (2006).
Nursing	Contact hours	12(6)	Eight out of nine ESD trialists agree that an ESD team should have between 0 and 1.2 WTE nurse for 100-patient a year caseload (Fisher et al. 2011: Table 1 page 1394). If apply 1,002 contact hours per annum (Brick et al. forthcoming), 1.2 WTE implies (1.2*1002)/100=12 hours per patient. Since trialists' views in Fisher vary, low estimate assumes 0.6 WTE nurse and six contact hours, compares to Beech ESD nursing 26.8*20min contacts=8.9 contact hours.
Medical	Outpatient visits	1.9	Eight out of ten ESD trialists agree that an ESD team should have a 0.1 WTE physician (i.e. stroke physician) for 100-patient a year caseload (Fisher et al. 2011: Table 1 page 1394). This resource use is difficult to quantify in a manner than can be costed. Therefore the estimated ESD medical care in Beech is applied instead: 5.4 GP visits and 1.9 hospital physician contacts at outpatient visit cost.
	GP visits	5.6	
Medical social worker	Hours	8(4)	Nine out of nine ESD trialists agree that an ESD team should have between 0 to 0.5 WTE medical social worker for 100-patient a year caseload (Fisher et al. 2011: Table 1 page 1394). Since social workers may work on a case, when they are not in direct contact with the patient, all hours worked are included here and assumed at approximately 1,500 p.a. (Curtis 2011)
ESD team hours, excl. home help	Hours per case	43(33)	Assumes that hospital outpatient and GP visits last 15 minutes, which equates to 1.9 hours of medical time.
Home Care Package/Home Help	Contact hours per case	54.8	Observed number of contacts for ESD in the Beech et al. RCT, assumed contact is one hour.

Source and Methods: as described. *Lower estimated hours in brackets.

TABLE 40 Resources in Alternative Models of Early Supported Discharge

		Beech ESD Model	Fisher ESD Model
	Unit	Annual mean resource use	Annual mean resource use
Physiotherapist	Hour	4.8	9
Occupational therapist	Hour	6.8	9
Speech and language therapist	Hour	3.6	3.6
Hospital physician	Visit	1.9	1.9
GP	Visit	5.6	5.6
Community nurse	Visit	26.8	18 - 36
Social worker	Hour	-	3.8 - 7.5
Home help	Hour	54.8	54.8
Meals on wheels	Meal	30	-
Acute bed-day savings	Days	-8	-8

4.5 Conclusions

In this chapter, the international literature and the experience of a pilot ESD programme in Dublin have been reviewed to derive two potential ESD models for Ireland. The MMUH/North Dublin pilot found that in North Dublin, the perceived requirements for realization of the full potential for ESD were: greater ESD team resourcing: comprehensive introduction to remove catchment area restrictions; more rapid access to home care packages; access to early community nursing; provision of more community psychology services; and greater linkages with general practitioners. Comparison of estimated utilisation of therapy and other community services by stroke survivors in Ireland and in London (in an RCT in the 1990s) has demonstrated almost three times the mean nurse visiting rate for stroke patients discharged with usual care in London compared to Ireland.

To enable modelling of ESD versus usual care in Ireland, two ESD models are derived in this chapter. The 'Beech Model' is derived from the RCT in London described in Beech et al. (1999); while the 'Fisher Model' is derived from the ESD Trialists' consensus view of the components of ESD as reported in Fisher et al. (2011). In the modelling of the relative resource use and outcomes from ESD and Conventional Discharge in the next chapter, the two models developed in this chapter and the estimated utilisation of therapy and other community services by stroke survivors in Ireland, developed in Chapter Three, provide the templates for ESD and Conventional Discharge respectively. The analysis of eligibility criteria for ESD in this chapter informs the approach taken in the modelling to ESD participation rates.

CHAPTER 5

Economic Evaluation of Alternative Pathways of Stroke Rehabilitation

5.1 Introduction

In this chapter, the results from economic analyses of Early Supported Discharge (ESD) compared to Conventional Discharge (CD) in Ireland are presented. The two modelling methodologies, described in Chapter Two, are applied in the economic analysis: Discrete-Event Simulation (DES) modelling and decision-tree analysis. The next section reviews the data employed in the modelling. Section 5.3 describes the approach adopted to sensitivity analysis. Section 5.4 presents and discusses the findings, including base case analyses, sensitivity analyses adopting alternative scenarios and assumptions, and analysis of the uncertainty surrounding the estimates. Section 5.5 concludes.

5.2 Data Applied To Modelling

In the modelling in this chapter, the base population is the Irish population of 2011 (Table 41), disaggregated by gender and five age cohorts, to replicate the DES model approach for the UK. Stroke incidence rates are estimated from the Hospital Inpatient Enquiry (HIPE) Database for 2011, adjusted for non-hospitalised cases from the evidence of the NDPSS, employing the methodology derived in Wren and Kelly (2013) (Table 42).

TABLE 41 Population, Ireland 2011

Age group	Male	Female	All
Under 45	1,509,142	1,500,838	3,009,980
45-64	520,243	522,636	1,042,879
65-74	149,774	155,054	304,828
75-84	75,054	97,095	172,149
85 and over	18,486	39,930	58,416

Source: Census of Population 2011, de facto basis.

TABLE 42 Stroke Incidence Rates per 1,000 Population, Ireland 2011

Age group	Male	Female	All
Under 45	0.18	0.18	0.18
45-64	2.03	1.29	1.66
65-74	7.25	4.17	5.68
75-84	15.40	12.20	13.59
85 and over	23.30	23.18	23.22

Source: Incidence rates estimated by Wren and Kelly (2013) method. HIPE principal plus secondary diagnoses of stroke (excluding principal diagnosis of rehabilitation) in non-rehabilitation hospitals, all discharges (survivors and deaths) plus 11 per cent for non-hospitalised cases (based on evidence of North Dublin Population Stroke Study). Excludes if daycase or if LOS<1 and discharge home or to another hospital unless non-HIPE, non-acute: exclusions to avoid duplication

TABLE 43 Stroke Patient Characteristics, Ireland

Characteristic	Proportions %	Source
Gender		
Male	52	Hospital Inpatient Enquiry (HIPE) 2011
Female	48	Hospital Inpatient Enquiry (HIPE) 2011
Age Group		
Under 45	7	Hospital Inpatient Enquiry (HIPE) 2011
45-64	22	Hospital Inpatient Enquiry (HIPE) 2011
65-74	22	Hospital Inpatient Enquiry (HIPE) 2011
75-84	30	Hospital Inpatient Enquiry (HIPE) 2011
85 and over	18	Hospital Inpatient Enquiry (HIPE) 2011
Disability before stroke*		
Mild	84	NDPSS 2005/2006 (Rankin scale equivalent)
Moderate	8	NDPSS 2005/2006
Severe	7	NDPSS 2005/2006
Unknown	1	NDPSS 2005/2006
Disability seven days post-stroke*		
Mild	31	NDPSS 2005/2006
Moderate	13	NDPSS 2005/2006
Severe	43	NDPSS 2005/2006
Unknown (incl. deaths)	13	NDPSS 2005/2006
Type of Stroke		
Ischaemic	71	Hospital Inpatient Enquiry (HIPE) 2011
Haemorrhagic	22	Hospital Inpatient Enquiry (HIPE) 2011
Unknown	7.7	Hospital Inpatient Enquiry (HIPE) 2011

Source: HIPE 2011; NDPSS. *The approach to defining disability follows the DES model and includes patients with MRS scores of 0 or 1 in the definition of mild disability at seven days. Exclusion of the most independent grouping (MRS=0) would remove 9% of patients at seven days from the Mild category. On the other hand, a proportion of patients with severe disability at seven days transition to the moderate category and should also be eligible for ESD. (See Appendix 8.1).

The characteristics of the hospital patient population are derived from HIPE 2011 and the NDPSS (Table 43). Proportions of patients by gender, age and stroke subtype are calculated from HIPE 2011. The disability proportions before stroke and at seven days after stroke are calculated from the NDPSS (Table 43) and are equated to the Barthel Index (BI) scores (used in the SLSR) as follows: mild disability (MRS: 0-2), moderate disability (MRS: 3) and severe disability (MRS: 4-5). The proportion identified as 'unknown' at seven days includes those who died,

following the model methodology. In the UK application of the model, length of stay (LOS) in hospital is predicted for individual patients based on their characteristics, applying coefficients derived from regression of the determinants of length of stay in the SLSR dataset. For patients who receive ESD, length of stay is assumed to reduce by eight days based on evidence from the literature (Early Supported Discharge Trialists 2005; Langhorne et al. 2005; Fisher et al. 2011). In the Irish application of the model, a discrete distribution is generated from LOS data for stroke discharges from HIPE 2011, from which LOS data for simulated patients can be randomly drawn.

Deriving measures of cost-effectiveness in the model requires the conversion of disability scores to Quality-Adjusted Life Years (QALYs). The model inputs the probability of transition between disability states from seven days to three months and from three months to one year. In the UK application of the model, In the case of both ESD and CD, the model applies evidence of disability state transitions (DST) from the SLSR to all patients for the period from seven days to three months. For the period from three months to one year, the model inputs the disability state transitions observed in the randomized controlled trial (RCT) of ESD versus Conventional Discharge in London between 1993 and 1995 (Rudd et al. 1997; Beech et al. 1999), hereinafter referred to as the 'Rudd DST' (Table 44).[26] In the Irish application of the model, since there has been no equivalent RCT evidence of disability changes post-ESD, the Rudd DST remain the assumed disability improvements post-ESD in Ireland. For Conventional Discharge, however, equivalent data are available from the NDPSS for disability state transitions in North Dublin in 2005/2006 for periods from seven days post-stroke up to two years post-stroke. While these NDPSS disability state transitions are applied to CD in sensitivity analysis (below), it was decided to retain the Rudd DST for both ESD and CD in the base case. When the NDPSS data for disability state transitions from seven days post-stroke to three months and from three months to one year (Table 45)) are applied to Conventional Discharge, this results in a greater mean QALY gain from ESD than the mean QALY gain when the Rudd DST are applied for both ESD and Conventional Discharge.

This greater QALY gain occurs because the disability state transitions showed poorer outcomes for Conventional Discharge in the NDPSS than in the London RCT (Table 44; Table 45). In the case of patients with moderate disability before Conventional Discharge rehabilitation, in the Rudd DST 91 per cent have transitioned to mild disability after rehabilitation. In contrast, in the NDPSS DST, in the case of patients with moderate disability at seven days post-stroke who are

[26] Also reviewed in Chapter Four (Table 35), when compared to MMUH pilot programme participants' disability state transitions.

subsequently discharged to the community (home or long-term care), 58 per cent transition to mild disability at 90 days; while, of those who still have moderate disability at 90 days, 16 per cent have mild disability at one year, while 19 per cent have become more disabled.

TABLE 44 Severity Changes after Discharge Sourced to Rudd et al. (1997)

	Early Supported Discharge			Conventional Discharge Rehabilitation		
Initial severity	Mild	Moderate	Severe	Mild	Moderate	Severe
Mild	1	0	0	1	0	0
Moderate	0.94	0.06	0	0.91	0.09	0
Severe	0.39	0.08	0.53	0.25	0.05	0.7

Source: National Audit Office (2010b) Table 4 page 18

TABLE 45 Disability State Transitions, NDPSS 2005/2006

7 day severity			90-day severity	
	N	Mild	Moderate	Severe
Mild	130	0.98	0.02	0.01
Moderate	45	0.58	0.40	0.02
Severe	91	0.30	0.26	0.44
90 day severity			1 year severity	
	N	Mild	Moderate	Severe
Mild	169	0.93	0.03	0.04
Moderate	37	0.16	0.65	0.19
Severe	31	0.00	0.06	0.94

Sources and methods: Derived from North Dublin Population Stroke Study, proportions at differing disability states at 90 days post-stroke compared to seven days post-stroke and at one year post-stroke compared to 90 days post-stroke sample of patients discharged from hospital to community by 90 days (including those in long-term care settings). Disability categories follow National Audit Office (2010b: 16) i.e. Modified Barthel Index scores for Mild (15-20), Moderate (10-14) and Severe (0-9), here equated to Modified Rankin Scale Mild (0-2), Moderate (3) and Severe (4-5).

A public healthcare provider perspective is adopted with respect to costing, including costs which are related to treatment but not including wider societal costs such as productivity loss or informal care demand and effect on informal carers. Costs are expressed in Euros (€) in 2011 prices. The KCL model inputs inpatient treatment costs for individual patients by applying SLSR utilisation data for CT scans, thrombolysis, stroke physician and beds on different wards (stroke unit, hyper-acute stroke unit, general medical ward). Individual utilisation data are not available for Ireland (but should become available with the development of the national stroke register). In the absence of such detailed patient-level treatment data, the Irish modelling costs inpatient care using Irish stroke inpatient average bed-day costs. The HSE National Casemix Programme Ready Reckoner for 2013 is the source for a weighted average bed-day cost for a stroke inpatient of €500 based on 2011 cost and utilisation data.

As described in Chapter Two, the methodology to calculate Irish unit costs for therapists is an application of the Personal Social Services Research Unit (PSSRU) method (Curtis 2012), which is also applied in the UK versions of the model. This study applies unit cost estimates developed by Brick et al. (forthcoming), with some adaptations. The Irish and UK applications of the model include wages, salary costs, overheads and capital overheads. The UK model applied the mean cost of a Band 5 therapist. The Irish application in this study adapts the methodology in Brick et al. (forthcoming) by applying a weighted mean salary to reflect relative numbers of senior and non-senior therapists employed in the public health service. The base case unit cost methodology follows the UK analysis by applying unit cost per hour, generated by applying costs to total hours worked, rather than unit cost per hour of client contact, generated by applying costs only to estimated patient contact hours. Sensitivity analysis assumes cost per contact hour. In the DES model, therapy costs for CD for the first year post-stroke are applied as in Table 46 and for ESD as in the Beech Model (Table 47). Therapy is not assumed in subsequent years.

Irish unit costs are applied to estimated Irish community service utilisation with CD (Table 46) and to the Beech Model ESD community service utilisation (Table 47). The DES model is constructed to allow for differing costs for ESD and CD for the first year post-stroke, after which survivors' costs are the same, varying only depending on whether the patient is at home or in long-term care. In the first year, a patient who is admitted to long-term care has attributed both the per diem long-term care rate and the mean ESD utilisation cost for that year, since calculation of mean utilisation in the Beech Model includes patients admitted to long-term care post-ESD, within the first year post-stroke. In the case of CD, community service costs vary for the first three months post-stroke, the remainder of the first year and the period from one to ten years, reflecting Irish evidence of varying stroke survivor utilisation of meals on wheels and home helps over these periods (Table 46). Costs are assumed to remain stable after two years. As in the case of therapists, public health nursing hours are costed on two bases: with a lower cost including all hours worked and a higher cost calculated on a client contact hour basis.

TABLE 46 Irish Conventional Discharge Estimated Resource Use and Unit Costs

Resource Category	Resource Use		Unit	Unit Cost		Unit Cost Source And Methodology
	Low (North Dublin)	High (HSE Region South)		Low	High	
	Annual mean	Annual mean		€	€	
Non-inpatient therapy						
Physiotherapy	0.5	1.4	Hour	79	131	Therapy staffing costs from Brick et al. (forthcoming) adjusted to reflect weighting of senior to more junior staff, high cost assigns all costs to contact hours
Occupational therapy	1.2	1.7	Hour	77	128	
Speech and language therapy	0.2	0.3	Hour	74	124	
Community Services						
	National Mean					
Outpatient visits	2.4		Visit	130	-	Brick et al. (forthcoming) estimated hospital public outpatient visit rate
GP	7.3		Visit	48	-	Brick et al. (forthcoming) mean estimated cost public/private visit
Community/Public health nurse	3.5		Visit	25	41	Brick et al. (forthcoming) public health nurse costs: 20 minute average visit, high cost assigns all costs to contact time
	First 89 days/90 days–1 year/ 1–10 years					
	Annual mean					
Meals on wheels	23.5/20.3/18.2		Meal	10.6	-	Brick et al. (forthcoming) cost per meal, public supplier estimate of unit cost
Home help	47.9/48.9/49.3		Hour	21.5	-	Brick et al. (forthcoming) unit cost per hour of client contact, average charged by private supplier
Inpatient and long-term care						
	National Mean					
Mean LOS for discharges home, mild/ moderate disability*	15.8		Day	500	-	HSE National Casemix Programme Ready Reckoner for 2013: weighted average bed-day cost for a stroke inpatient, 2011 cost and utilisation data
Long-term care	DES Model output		Day	137	-	Brick et al. (forthcoming) daily rate calculated from average weekly cost of care from reported costs, HSE Nursing Home Support Scheme, for public and private nursing homes

Source: Costs as stated. Resource use as developed in Chapter Three. *Mean LOS for stroke patients discharged home in HIPE 2011 of 17.2 days is adjusted to reflect the relative LOS of patients discharged home with mild or moderate disability in INASC 2005 (22 days compared to 24 days for all home discharges): 17.2 X (22/24) = 15.8.

TABLE 47 Beech ESD Model Estimated Resource Use and Unit Costs

Resource Category	Resource Use	Unit	Unit Cost		Unit Cost Source and Methodology
	Annual mean		Low	High	
			€	€	
Non-inpatient therapy					
Physiotherapy	4.8	Hour	79	131	Therapy staffing costs from Brick et al. (forthcoming) adjusted to reflect weighting of senior to more junior staff, high cost assigns all costs to contact hours
Occupational therapy	6.8	Hour	77	128	
Speech and language therapy	3.6	Hour	74	124	
Community Services					
Hospital physician	1.9	Visit	130	-	Brick et al. (forthcoming) estimated hospital public outpatient visit rate
GP	5.6	Visit	48	-	Brick et al. (forthcoming) mean estimated cost public/private visit,
District nurse	26.8	Visit	25	41	Brick et al. (forthcoming) hourly rate applied to 20 minute average visit, high cost assigns all costs to contact time
Meals on wheels	30	Meal	10.6	-	Brick et al. (forthcoming) cost per meal, public supplier estimate of unit cost
Home help	54.8	Hour	21.5	-	Brick et al. (forthcoming) unit cost per hour of client contact, average charged by private supplier
Inpatient and long-term care					
LOS reduction with ESD	-8	Day	500	-	HSE National Casemix Programme Ready Reckoner for 2013: weighted average bed-day cost for a stroke inpatient, 2011 cost and utilisation data.
Long-term care	DES Model output	Day	137	-	Brick et al. (forthcoming) daily rate calculated from average weekly reported costs, HSE Nursing Home Support Scheme, public and private nursing homes

Source: Costs as stated. Resource use as developed in Chapter 4.

The decision-tree analysis follows the costing approach applied to the DES model and the Beech Model of ESD, with the difference that mean first-year costs only are compared, while the DES model simulates the patient journey to ten years post-stroke. The decision-tree analysis also compares resource use and costs for CD and the Fisher ESD Model (Table 48). Since the Fisher Model translates recommended ESD staffing levels into contact hours, to ensure consistency in costing, unit costs for therapy, social work and nursing are applied on a contact hours basis only.

TABLE 48 Fisher ESD Model Estimated Resource Use and Unit Costs

Resource Category	Resource Use		Unit	Unit Cost	Unit Cost Source and Methodology
	High use	Low use			
	Annual mean	Annual mean		€	
Non-inpatient therapy					
Physiotherapy	9	-	Hour	131	Therapy staffing costs from Brick et al. (forthcoming) adjusted to reflect weighting of senior to more junior staff, high cost assigns all costs to contact hours
Occupational therapy	9	-	Hour	128	
Speech and language therapy	3.6	-	Hour	124	
Community Services					
Hospital physician	1.9	-	Visit	130	Brick et al. (forthcoming) estimated hospital public outpatient visit rate
GP visits	5.6	-	Visit	48	Brick et al. (forthcoming) mean estimated cost public/private visit,
Community/Public health nurse visits	12	6	Hour	123	Brick et al. (forthcoming) 20 minute average visit, high cost assigns all costs to contact time
Medical social worker	7.5	3.8	Hour	10.6	Brick et al. (forthcoming) cost per meal, public supplier estimate of unit cost
Home help	54.8	-	Hour	21.5	Brick et al. (forthcoming) unit cost per hour of client contact, average charged by private supplier
Inpatient care					
LOS reduction with ESD	-8	-	Day	500	HSE National Casemix Programme Ready Reckoner for 2013: weighted average bed-day cost for a stroke inpatient, 2011 cost and utilisation data.

Source: Costs as stated. Resource use as developed in Chapter 4, Section 4.4.2.

5.3 Modelling Approach to Sensitivity Analysis

In the DES modelling, several scenarios have been tested which vary the proportion of patients receiving ESD. The results presented compare two scenarios, in the first of which all patients with mild or moderate disability at seven days are assigned to ESD, so that 44 per cent of patients are eligible for inclusion; and, in the second of which all patients have Conventional Discharge. Univariate, multi-variate and probabilistic sensitivity analyses are employed to address uncertainty. Model assumptions which are varied in the univariate and multi-variate analyses are: therapy utilisation rates; unit costs for therapy and nursing; and disability state transition assumptions (Table 49). In the probabilistic sensitivity analysis, multiple replications randomly assign patients to the model, with varying characteristics, which consequently change the probabilities in the model of the patient progressing along differing paths such as inpatient death, discharge to long-term care or recurrent stroke. The incremental costs and

effects of ESD and CD are then calculated for each of these replications. The probability of ESD achieving cost-effectiveness at differing threshold values for cost-effectiveness, expressed as incremental cost per QALY gained, can then be calculated and graphed (Figure 38).

The decision-tree analysis may be viewed as a form of sensitivity analysis in that it examines the resource and cost implications of varying aspects of the preferred models of ESD: 'Beech' and 'Fisher'. Model assumptions which are varied in the decision-tree sensitivity analyses are: therapy utilisation rates; unit costs for therapy and nursing; proportions of hospitalised patients receiving ESD; inpatient per diem costs; assumed reduction in LOS as a consequence of ESD; and mean nursing and social worker hours per ESD participant (Table 49).

TABLE 49 Input Parameters for Base-Case and Sensitivity Analyses, DES and Decision-Tree Models

Input parameter	Base-case analysis	Sensitivity analysis
Conventional Discharge		
Therapy utilisation	North Dublin Low	HSE Region South High
Unit Cost (therapy and nursing)	Low, hourly cost	High, contact hour cost
Disability State Transitions/QALY gain	Rudd high	NDPSS low
Early Supported Discharge		
Beech ESD Model (Discrete-Event Simulation)		
Unit Cost (therapy and nursing)	Low, hourly cost	High, contact hour cost
Beech ESD Model (Decision-Tree Analysis)		
Unit Cost (therapy and nursing)	Low, hourly cost	High, contact hour cost
Eligible patients	44% discharges	17% discharges
Inpatient per diem cost	€500	€300, €700
Reduction in LOS	8 days	5 and 11 days
Fisher ESD Model (Decision-Tree Analysis)		
Nursing hours	12	6
Medical Social Worker hours	7.5	3.8
Unit Cost (therapy and nursing)	Low, hourly cost	High, contact hour cost
Eligible patients	44% discharges	17% discharges
Inpatient per diem cost	€500	€300, €700
Reduction in LOS	8 days	5 and 11 days

5.4 Findings

5.4.1 Discrete-Event Simulation Model Findings

In the base case analysis, the DES model finds that implementing ESD in Ireland is expected to be more costly and more effective than CD over a time horizon of ten

years. In such cases, an incremental cost-effectiveness ratio (ICER)[27] is calculated and compared to the threshold value for the maximum that the health system would be willing to pay for an additional unit of effect. The results indicate that the ICER for ESD is €4,734 per quality-adjusted life year (QALY) gained over ten years (Table 50). This compares favourably to standard UK National Institute for Health and Clinical Excellence (NICE) benchmarks of £20,000 to £30,000 (€20,750 to €31,122) per QALY. Moreover, in the first year for the base case, there would be a cost-saving of €955 per patient, with a greater saving in inpatient stay than the cost of additional ESD therapy and community services. Notably, although the model inputs an assumption of an eight-day reduction in LOS with ESD, the modelling methodology results in a mean saving of 5.7 inpatient days for ESD participants. In the base case, the mean incremental cost of ESD arises in subsequent years chiefly from longer survival and utilisation of long-term care (reflecting the probabilities of these outcomes assigned in the model). In the base case, Irish therapy utilisation for Conventional Discharge is assumed to be at the lower North Dublin case study rate; unit costs are at the lower total hours rate; and Rudd disability state transitions apply so that the QALY gain over ten years is relatively low. The latter two assumptions apply in the UK application of the model.

In sensitivity analysis (scenario 1, Table 50) that varies only the disability state transitions by applying those observed in the NDPSS, the QALY gain is greater and ESD achieves a cost-saving per QALY gained. This is also the case when Irish therapy utilisation for Conventional Discharge is assumed to be at the higher HSE Region South case study rate (scenario 3). When Irish therapy utilisation is at the HSE Region South rate and the Rudd disability state transitions are assumed, the cost of ESD per QALY is minimal (scenario 2). A combination of assumptions which leads to the high cost per QALY of €46,632 is North Dublin CD therapy utilisation, Rudd DST and higher costs at the contact hour rate (scenario 4). If, however, NDPSS DST replaces the Rudd DST for Conventional Discharge, even with the application of higher unit costs, the cost per QALY gained is €4,477 (scenario 5). The contrast between costs per QALY in scenarios 4 and 5 arises because the assumed Rudd disability state transition is relatively lower than the NDPSS disability state transition, reflecting the better disability status of participants who receive Conventional Discharge in the Rudd RCT (in London in the 1990s) than in the NDPSS (in North Dublin in 2005/2006). This leads to a

[27] The incremental cost-effectiveness ratio is calculated by dividing the mean difference in costs between ESD and CD, by the mean difference in QALY gained between ESD and CD.

much lower mean QALY gain at 0.025 in scenario 4 than the gain of 0.189 in scenario 5.[28]

TABLE 50 Discrete-Event Simulation Model Incremental Cost-Effectiveness results: ESD versus Conventional Discharge

Scenarios	Mean first-year cost	Mean 10-year incremental cost	Mean 10-year incremental QALY	Mean incremental cost per QALY gained	Assumptions
Base case (North/ Rudd/ Low cost)	-€955	€118	0.025	€4,734	North Dublin therapy, Rudd DST, 47% discharged with ESD versus none, costs on total hours basis
Sensitivity analysis					
1. North Dublin/ NDPSS/ Low cost	-€1,052	-€207	0.189	ESD a cost saving	North Dublin therapy, NDPSS DST, 47% discharged with ESD versus none, costs on total hours basis
2. HSE Region South/ Rudd/ Low cost	-€1,169	€1	0.025	€54	HSE Region South therapy, Rudd DST, 47% discharged with ESD versus none, costs on total hours basis
3. HSE Region South/ NDPSS/ Low cost	€97	-€324	0.189	ESD a cost saving	HSE Region South therapy, NDPSS DST, 47% discharged with ESD versus none, costs on total hours basis
4. North Dublin/ Rudd/ High cost	€97	€1,166	0.025	€46,632	North Dublin therapy, Rudd DST, 47% discharged with ESD versus none, costs on contact hours basis
5. North Dublin/ NDPSS/High cost	€1	€846	0.189	€4,477	North Dublin therapy, NDPSS DST, 47% discharged with ESD versus none, costs on contact hours basis

This analysis demonstrates the sensitivity of the modelling outcome to the assumptions applied. Applying the Rudd DST to both ESD and CD, as in the UK application of the model, would appear a robust approach because these disability state transitions for ESD and CD were measured in an RCT based on patients randomly selected from the same population in London. However, the resource use that is assumed and costed for Conventional Discharge in this Irish application of the model is not the resource use observed in that RCT and has been instead estimated from multiple Irish data sources, including the NDPSS. To

[28] This difference in mean QALY gain has the arithmetic effect that the mean cost per QALY is multiplied by a factor of 40 to calculate mean incremental cost per QALY gained in scenario 4, while in scenario 5 it is multiplied by a factor of 5.

source disability state transitions with CD in Ireland from the NDPSS appears to be a defensible alternative assumption, particularly in the North Dublin case, in which therapy delivered in the community with Conventional Discharge is markedly less than in the Rudd RCT, with lesser rehabilitation resourcing associated with poorer CD outcomes. Either approach to unit costs can be defended: if staff assigned to ESD were already employed within the health service, using their marginal hourly cost appears to be a valid approach; if on the other hand, staff are newly hired to implement the programme, their unit cost per estimated contact hour may be more appropriate. It is noteworthy that while incremental cost per QALY gained is highly dependent on the assumptions about disability state improvements with ESD and the consequent effects on costs after the first year post-stroke, the net cost of ESD in the first year ranges from a net cost saving to the low mean cost of €97 (Table 50), which is 0.5 per cent of first-year costs with Conventional Discharge, and under one-fifth of the cost of an inpatient day.

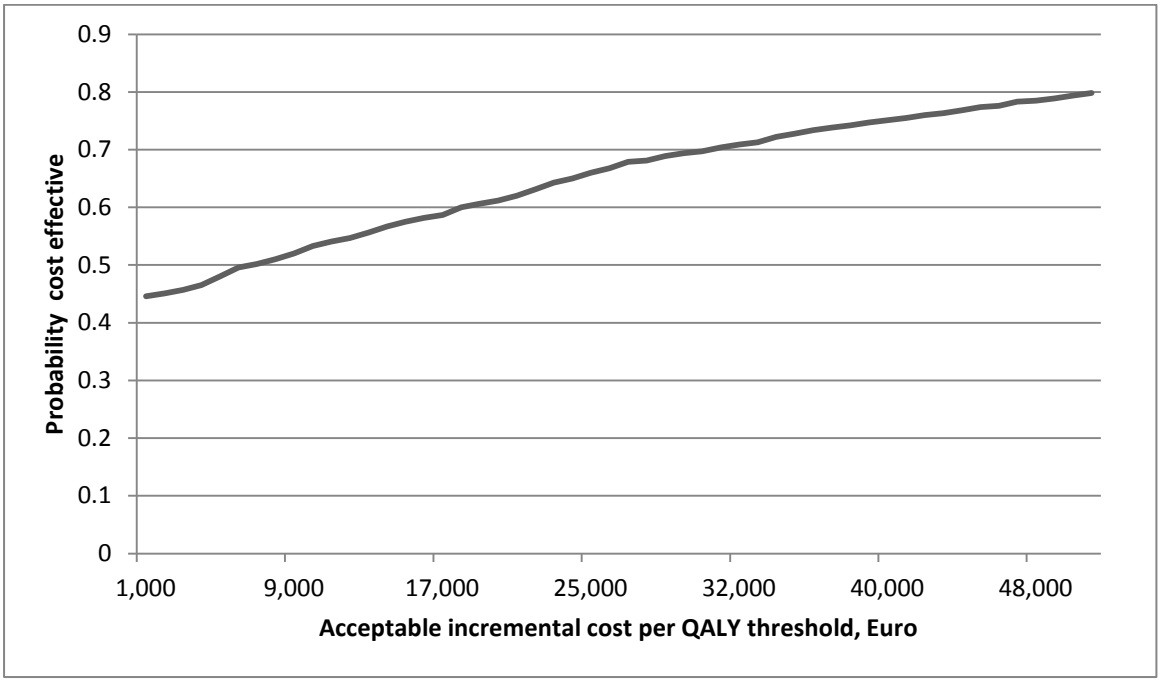
The outcome of probabilistic sensitivity analysis for the base case is demonstrated in Figure 38 and compared to equivalent analysis for scenarios 4 and 5 in Table 51. This analysis is designed to investigate the effects of uncertainty in the model input parameters. From multiple replications of the model with randomly assigned patients, with varying characteristics, the incremental costs and effects of ESD and CD are calculated. The probability of ESD achieving cost-effectiveness in the base case is shown at differing acceptability threshold values for incremental cost per QALY gained in Figure 38. This exercise demonstrates that, if €25,000 is considered an acceptable cost per QALY in Ireland, on base case assumptions there is a 66 per cent probability of cost-effectiveness. This probability of cost-effectiveness would increase to 70 per cent, were the threshold value €30,000 (Table 51). In the case of the most costly scenario 4, the probability of cost-effectiveness at a €25,000 threshold reduces to 58 per cent, rising to 61 per cent at a €30,000 threshold. In scenario 5, with assumptions of NDPSS disability state transitions and high unit costs, this analysis generates very high probabilities of cost-effectiveness at thresholds from €15,000. This analysis of probable cost-effectiveness measured against differing thresholds affords policy-makers a basis to compare ESD as a treatment to other potential allocations of resources in health care. Determining the acceptability threshold and acceptable probability at that threshold are policy decisions.

TABLE 51 Probability of Cost-Effectiveness for Range of Threshold Values, DES Model Base Case and Alternative Scenarios

Threshold value	Base case	Scenario 4	Scenario 5
€5,000	0.48	0.38	0.58
€10,000	0.53	0.42	0.81
€15,000	0.58	0.47	0.94
€20,000	0.61	0.53	0.99
€25,000	0.66	0.58	1.00
€30,000	0.70	0.61	1.00
€35,000	0.73	0.65	1.00
€40,000	0.75	0.68	1.00

Source: Generated by multiple replications of the base case and sensitivity analyses applied to the King's College London DES model.

FIGURE 38 Cost-Effectiveness Acceptability Curve, DES Model Base Case



Source: Generated by multiple replications of the base case applied to the King's College London DES model.

5.4.2 Decision-Tree Analysis Findings

The decision-tree analysis compares CD to ESD for both the Beech and Fisher models and calculates mean incremental costs or savings in the first year post-stroke. The base case for the Beech Model, which is equivalent to the base case in the DES modelling, finds a net saving from ESD of €2,319 (Table 52). This exceeds the net saving in the first year for the base case in the DES model, largely because this more static analysis applies an eight-day reduction in inpatient stay to all ESD participants. It can be seen from sensitivity analyses that the mean costs are highly sensitive to the assumed reduction in LOS with ESD, with savings reduced to €817 if the LOS reduction is five days (scenario 15) and increased to €3,820 if an 11-day LOS reduction with ESD is assumed (scenario 16), in the Beech

Model of ESD. Similarly, the incremental cost of ESD is sensitive to the assumed cost of a stroke patient's inpatient day (Beech model, scenarios 13 and 14), which is the arithmetic consequence of assuming a €300 or €700 daily rate. Varying the proportion of patients who are eligible for ESD has no effect on mean incremental cost (scenario 10 compared to the Beech base case). Changing the unit cost method to the cost per contact hour basis has the effect of reducing savings from ESD (scenario 12), while assuming the higher HSE Region South case study therapy inputs for Conventional Discharge increases savings from ESD compared to the base case, since additional ESD therapy inputs and costs are less than in the North Dublin case study.

If the ESD programme is designed with the Fisher Model resourcing, the base case and most sensitivity analyses show a cost saving with ESD (Table 52). A mean incremental cost arises when the Fisher ESD model with higher nursing and social worker hours (Table 48) is compared to the North Dublin Conventional Discharge case study (scenario 4). The mean incremental cost of implementing this most highly resourced of the ESD models at €183 represents an increase of two per cent over the cost of Conventional Discharge and is equivalent to approximately one-third of the cost of an inpatient day. It can be seen that, as in the Beech model scenarios, costs are sensitive to assumed LOS reductions and the assumed inpatient cost per day, with net costs arising in the scenarios which assume a five-day LOS reduction with ESD (scenario 8) or a €300 unit cost per inpatient day (scenario 6), which would be conservative assumptions.

When applied to 2011 stroke discharges and expressed in 2011 Euro, the potential savings if 44 per cent of stroke discharges nationally (3,056 discharges) were to receive ESD would be over €7 million, in the base case for the Beech Model, and over €2 million in the base case, if the Fisher Model were implemented (Table 53). With 44 per cent ESD participation, reduced hospital length of stay would save €12.2 million, freeing up over 24,000 hospital bed days, the equivalent of 67 hospital beds annually. The cost of resourcing community therapy and other services to implement the Beech Model of ESD would be €5.2 million and the cost of resourcing the Fisher model of ESD would be €10.1 million. If CD is assumed to be resourced on the HSE Region South basis, the savings are respectively €7.4m and €2.4m. On high unit cost assumptions, the savings with North Dublin CD are respectively €3.9m and €2.6m. With 17 per cent ESD participation, which was considered feasible with adequate resourcing in the MMUH pilot, if applied nationally (1,181 discharges), the base case assumptions would potentially save €2.7m with the Beech Model of ESD and €800,000 with the Fisher Model. With 17 per cent ESD participation, reduced hospital length of stay would save €4.7 million, while the cost of resourcing community therapy and

other services to implement the Beech Model of ESD would be €2 million and the cost of resourcing the Fisher model of ESD would be €3.9 million.

TABLE 52 Decision-Tree Model Incremental Cost Analysis Results: ESD versus Conventional Discharge

Scenario	Mean incremental cost/ saving	Scenario Assumptions
DECISION-TREE ANALYSIS - FISHER		
Base case		
North Dublin/Low cost/Low ESD	-€681	Eligible Population 44%; North Dublin therapy; Low Unit Cost for Usual Care; Low ESD Utilisation; Standard ECD Cost
Sensitivity analysis		
1. North Dublin/Low cost/Low ESD - 17%	-€681	Eligible Population 17%; North Dublin therapy; Low Unit Cost for Usual Care; Low ESD Utilisation; Standard ECD Cost
2. HSE Region South/Low cost/Low ESD	-€798	Eligible Population 44%; HSE Region South therapy; Low Unit Cost for Usual Care; Low ESD Utilisation; Standard ECD
3. North Dublin/High cost/Low ESD	-€834	Eligible Population 44%; North Dublin therapy; High Unit Cost for Usual Care; Low ESD Utilisation; Standard ECD Cost
4. North Dublin/High cost/High ESD	€183	Eligible Population 44%; North Dublin therapy; High Unit Cost for Usual Care; High ESD Utilisation; Standard ECD Cost
5. HSE Region South/High cost/High ESD	-€12	Eligible Population 44%; HSE Region South therapy; High Unit Cost for Usual Care; High ESD Utilisation; Standard ECD
6. Base case with €300 p.d.	€922	Eligible Population 44%; North Dublin therapy; Low Unit Cost for Usual Care; Low ESD Utilisation; Standard ECD Cost;
7. Base case with €700 p.d.	-€2,278	Eligible Population 44%; North Dublin therapy; Low Unit Cost for Usual Care; Low ESD Utilisation; Standard ECD Cost;
8. Base case with five day LOS reduction	€820	Eligible Population 44%; North Dublin therapy; Low Unit Cost for Usual Care; Low ESD Utilisation; Standard ECD Cost;
9. Base case with 11 day LOS reduction	-€2,182	Eligible Population 44%; North Dublin therapy; Low Unit Cost for Usual Care; Low ESD Utilisation; Standard ECD Cost;
DECISION-TREE ANALYSIS - BEECH		
Base case		
North Dublin/Low cost	-€2,319	Eligible Population 44%; North Dublin therapy; Low Unit Cost
Sensitivity analysis		
10. North Dublin/Low cost - 17% participation.	-€2,319	Eligible Population 17%; North Dublin therapy; Low Unit Cost
11. HSE Region South/Low cost	-€2,436	Eligible Population 44%; HSE Region South therapy; Low Unit Cost
12. North Dublin/High cost	-€1,267	Eligible Population 44%; North Dublin therapy; High Unit Cost
13. Base case with €300 p.d.	-€716	Eligible Population 44%; North Dublin therapy; Low Unit Cost; Inpatient Cost per Day = €300
14. Base case with €700 p.d.	-€3,916	Eligible Population 44%; North Dublin therapy; Low Unit Cost; Inpatient Cost per Day = €700
15. Base case with five day LOS reduction	-€817	Eligible Population 44%; North Dublin therapy; Low Unit Cost; ESD Reduction five days
16. Base case with 11 day LOS reduction	-€3,820	Eligible Population 44%; North Dublin therapy; Low Unit Cost; ESD Reduction 11 days

TABLE 53 Decision-Tree Model - Incremental Total Cost

Decision-Tree Analysis	Incremental Total Cost €'m	Assumed number of programme participants
Fisher base case	-€2.08	3,056
Sensitivity analysis		
1. North Dublin/Low cost/Low ESD - 17% participation.	-€0.80	1,181
2. HSE Region South/Low cost/Low ESD	-€2.44	3,056
3. North Dublin/High cost/Low ESD	-€2.55	3,056
4. North Dublin/High cost/High ESD	€0.56	3,056
5. HSE Region South/High cost/High ESD	-€0.04	3,056
6. Base case with €300 p.d.	€2.82	3,056
7. Base case with €700 p.d.	-€6.96	3,056
8. Base case with five day LOS reduction	€2.51	3,056
9. Base case with 11 day LOS reduction	-€6.67	3,056
Beech base case	-€7.08	3,056
Sensitivity analysis		
10. North Dublin/Low cost - 17% participation.	-€2.74	1,181
11. HSE Region South/Low cost	-€7.44	3,056
12. North Dublin/High cost	-€3.87	3,056
13. Base case with €300 p.d.	-€2.19	3,056
14. Base case with €700 p.d.	-€11.97	3,056
15. Base case with five day LOS reduction	-€2.50	3,056
16. Base case with 11 day LOS reduction	-€11.67	3,056

Comparison of the alternative ESD models and estimated Conventional Discharge care for stroke survivors in Ireland indicates that ESD would require a substantial increase in the resourcing of community therapists and other community care from current levels in Ireland, with even the better-resourced 'HSE Region South' case study falling far short of the requirements for delivery of ESD (Table 54).

TABLE 54 Estimated Receipt of Therapies and Other Community Services with Conventional Discharge Care In Ireland Compared to Resource Requirements of Two ESD Models

		North Dublin case study	HSE Region South case study	Beech ESD Model	Fisher ESD Model	Resource difference HSE Region South case study and Fisher Model
	Unit	Annual mean resource use	Annual mean resource use	Annual mean resource use	Annual mean resource use	Percentage difference %
Physiotherapist	Hour	0.5	1.4	4.8	9	543
Occupational therapist	Hour	1.2	1.7	6.8	9	429
Speech and language therapist	Hour	0.2	0.3	3.6	3.6	1,100
Hospital physician	Visit	2.4	2.4	1.9	1.9	-21
GP	Visit	7.3	7.3	5.6	5.6	-23
Community nurse	Visit	3.5	3.5	26.8	18 - 36	414
Social worker	Hour	-	-	-	3.8 - 7.5	
Home help	Hour	47.8	47.8	54.8	54.8	15
Meals on wheels	Meal	23.4	23.4	30	-	
Acute bed days	Days	15.8	15.8	-8	-8	

In the Fisher ESD programme compared to the HSE Region South case study: mean physiotherapy hours are over 500 per cent higher; mean occupational therapy hours are over 400 per cent higher; and mean speech and language therapy hours are over 1,000 per cent higher. Compared to the Irish mean, mean community nurse visiting is 400 per cent higher; and mean home help hours (applying Beech hours) are 15 per cent greater. Notably, as previously discussed in Chapter Four, Irish stroke survivors appear to have higher rates of GP visiting than in the UK's Beech model of ESD, which may reflect a reliance on general practitioner care due to the unavailability of other community services. The cost saving per participant in reduced acute length of stay and the costs of resourcing the higher community therapy and service requirements to implement ESD are demonstrated in Table 55.

TABLE 55 Cost per Participant Comparison of Conventional Discharge and Two ESD Models

	Conventional Discharge	Beech Model	Fisher model
Scenario	High cost/ North Dublin therapy	High cost	High cost/ low ESD*
Unit	Mean cost	Mean cost	Mean cost
Physiotherapy	€66	€629	€1,179
Occupational therapy	€154	€870	€1,152
Speech and language therapy	€25	€446	€446
Total therapy costs	€244	€1,946	€2,777
Hospital physician	€312	€247	€247
GP	€350	€269	€269
Community/Public health nurse	€144	€670	€738
Social worker	-	-	€278
Meals on wheels	€249	€318	-
Home help*	€1,030	€1,178	€1,178
Total non-inpatient costs	€2,329	€4,359	€5,487
Inpatient bed-day cost	€7,910	€3,907	€3,907
Total	€10,239	€8,266	€9,394

Source: Conventional Discharge, Beech and Fisher Models, as in Table 46, Table 47 and Table 48; *Lower inputs for nursing and social work (Table 39 and associated discussion).

5.5 Conclusions

The decision-tree analysis of the costs of ESD compared to Conventional Discharge in the first year after stroke in this chapter suggests that ESD could be implemented in Ireland at no additional cost. On most assumptions, savings from reduced length of stay by stroke patients in Irish hospitals would more than offset the additional costs of an ESD programme requiring more intense therapy in the community, greatly increased community nursing and increases in other community services. Sensitivity analysis shows that this finding generally holds, assuming an eight-day reduction in LOS with ESD and applying Irish average stroke bed-day costs. In one scenario, a marginal cost of ESD implementation arises, when high unit costs are applied to the most generously-resourced ESD model. Even in this scenario, the marginal cost of implementing ESD is one-third of the cost of an inpatient day.

Applying Irish data to the DES model developed in the UK suggests that ESD implementation in Ireland could also be cost-effective with a low cost per QALY gained over a ten-year period. This conclusion is sensitive to assumptions about the improvement in disability levels consequent on ESD and the costing methodology applied. Analysis of the probability of cost-effectiveness at

alternative cost-effectiveness thresholds has been undertaken by this study, which finds a 66 per cent probability of cost-effectiveness at a €25,000 threshold for the base case. Probabilities at a range of thresholds have been compared for alternative modelling scenarios. Determining the acceptability threshold and acceptable probability at that threshold are policy decisions.

The collaboration between researchers at King's College London, the ESRI and NUIG to apply the DES model to Ireland has afforded this study the opportunity to model the incremental cost per QALY over a ten-year time frame, incorporating effects of treatment on life expectancy and disability, and on the probabilities of admission to long-term care or of recurrent stroke and re-admission to hospital. This application of the DES model to Ireland must nonetheless acknowledge that there are limitations in applying a model which is still largely reliant on UK data in its design and which may not adequately reflect the population health or health system characteristics of Ireland. Furthermore, in both the DES and decision-tree models, the resource use assumed for Conventional Discharge in Ireland has been estimated from multiple data sources and may understate CD resourcing (with consequent over-estimate of the incremental cost of ESD) or by over-stating CD resourcing, may under-estimate the incremental costs of ESD. The regional analysis of therapy inputs in this study would suggest that the cost of implementing ESD will vary across Ireland, depending on the level of resourcing of existing therapy and other community services for stroke survivors. On the other hand, potential gains from reduced hospital LOS may be greater than assumed in this analysis, particularly in those regions with longer LOS and more poorly resourced community services.

The development of the Irish stroke register could potentially facilitate a development of this modelling, which would be more reflective of Irish data and circumstances, provided the register incorporates measurement of outcomes and of resource use outside the hospital setting. Optimally, were a randomised controlled trial of ESD versus Conventional Discharge undertaken in Ireland, this modelling could be undertaken with observed resource use and outcomes informing each of the comparator arms of the analysis. Such an RCT would, however, reflect resources and the population in the region and the caveats above about regional variability in resourcing would have to be taken into account in its interpretation.

CHAPTER 6

Summary of Findings and Conclusions

6.1 Introduction

The central objective of this study has been to examine rehabilitation services for stroke patients in the Irish healthcare system, identifying patterns of use, and assessing the economic implications and health outcomes of existing and new models of care. This report has reviewed evidence of current services for stroke patients in Ireland after the acute phase of their care and has applied analyses of complementary sources of data to assess pathways of rehabilitative care for stroke patients and their utilisation of care in differing settings. From this analysis has emerged a picture of great variability across regions, hospitals and residential and community care settings in how stroke patients receive rehabilitative care.

This study has found evidence of poor resourcing of community and inpatient rehabilitation for stroke survivors in Ireland. Considerable regional and hospital variation in stroke survivors' length of stay in acute hospitals appears to reflect differing regional pathways of care and differing resourcing of care in alternative settings. There is evidence of long waits for nursing home care and specialist inpatient rehabilitation for patients with severe stroke. Great variability has been found in the availability of community therapy staff and the intensity with which therapy is delivered in differing areas and settings. Yet even where community care appears to be relatively better resourced in Ireland, it falls far short of the required resourcing to implement best practice in stroke rehabilitation.

From detailed review of the international literature on stroke rehabilitation, this study has found a consensus that stroke survivors with mild or moderate disability are in general suited to Early Supported Discharge (ESD) from acute hospitals, while the needs of survivors with more severe disability are better met by specialised inpatient rehabilitation. There is inadequate evidence on the feasibility of ESD in rural areas with dispersed populations, which may limit the applicability of ESD to such areas in Ireland. The feasibility of ESD in such areas requires further research.

The report has described the data, methods and techniques applied to model costs and outcomes of implementing ESD for stroke patients with mild to

moderate disability in Ireland. The decision-tree analysis of the costs of ESD compared to Conventional Discharge (usual care as delivered in Ireland) in the first year after stroke suggests that ESD could be implemented in Ireland at no additional cost. On most assumptions, savings from reduced length of stay by stroke patients in Irish hospitals would more than offset the additional costs of an ESD programme requiring more intense therapy in the community, greatly increased community nursing and increases in other community services. Applying Irish data to the Discrete-Event Simulation (DES) model developed in the UK suggests that ESD implementation in Ireland could also be cost-effective with a low cost per Quality-adjusted Life Year (QALY) gained over a ten-year period. This conclusion is sensitive to assumptions about the improvement in disability levels consequent on ESD and the costing methodology applied. Up to 44 per cent of all hospitalised stroke patients could benefit from ESD. Potentially, therefore, 54 per cent of stroke patients who do not die as inpatients, could receive ESD. On the evidence from international trials, ESD would improve their health outcomes, reducing disability and the likelihood of their admission to long-term care.

This chapter summarises and discusses the findings in this report. The detailed nature of this study has produced extensive new information across a range of areas. The next section summarises the findings from Chapter 3 on current rehabilitation services in Ireland. Section 6.3 summarises the findings from Chapter 3 on pathways of care from acute hospitals. Section 6.4 summarises the findings from Chapter 4 on best practice pathways of stroke rehabilitation. Section 6.5 summarises the findings from Chapter 5 on the comparison of costs, outcomes and cost effectiveness of ESD and Conventional Discharge. Section 6.6 discusses the policy implications and concludes. Chapter Seven presents recommendations for stroke rehabilitation developed by the research team in consultation with the expert members of the steering group of this study and informed by the analysis in this report.

6.2 Summary of Findings from Chapter 3 on Current Rehabilitation Services

Analysis of current rehabilitation services for stroke patients in Ireland has found great variability in the availability of therapy staff and the intensity with which therapy is delivered in differing areas and settings.

6.2.1. Availability of Community Therapists

Analysis of the supply of community therapy staff employed by the Health Service Executive (HSE) in Primary Care and Older Persons Services in the 17 HSE Integrated Service Areas (ISAs) in December 2012, when related to estimated need for stroke rehabilitation, finds that:

6.2.1.1 The ISAs which have more highly resourced community physiotherapy relative to estimated stroke rehabilitation need are: Donegal, Midlands, Cavan-Monaghan and Kerry;

6.2.1.2 The least well-resourced ISAs for community physiotherapy relative to estimated stroke rehabilitation need are: Dublin South-West/Kildare/West Wicklow; and Dublin North City;

6.2.1.3 The ISAs which have more highly resourced community occupational therapy relative to estimated stroke rehabilitation need are: Sligo-Leitrim/West Cavan; Dublin North; Midlands; and Donegal;

6.2.1.4 The least well-resourced ISAs for community occupational therapy relative to estimated stroke rehabilitation need are: Dublin North City, Kerry and the Mid-West;

6.2.1.5 The ISAs with more highly resourced community speech and language therapy relative to estimated stroke rehabilitation need are: Midlands; Carlow-Kilkenny/South Tipperary; and Sligo-Leitrim/West Cavan.

6.2.1.6 The least well-resourced ISAs for community speech and language therapy relative to stroke rehabilitation need are: Dublin South-West/Kildare/West Wicklow; Dublin North City; and Dublin South Central.

6.2.2 Availability of Psychologists and Counsellors

The role of psychology in stroke services in Ireland is relatively under-developed:

6.2.2.1 Analysis of the psychologists and counsellors employed by the HSE in December 2012 finds fewer employed in Primary Care Services than the other therapies and fewer than two whole-time equivalent psychologists/counsellors in Older Persons' Services;

6.2.2.2 In the Hospital Leads' Survey (HLS), conducted by this project in 2013, respondents from only four out of 28 acute hospitals confirmed that the services of a psychologist were offered to patients undergoing inpatient rehabilitation after stroke;

6.2.2.3 Respondents from 23 of these 28 hospitals said that psychology was not available to patients undergoing inpatient rehabilitation after stroke;

6.2.2.4 Respondents identified only five non-acute rehabilitation locations where availability of psychology would be a criterion in their decision to refer for rehabilitation.

6.2.3 Intensity of Therapy Delivered to Stroke Survivors

Analysis of responses to the HSE Stroke Programme's Community Stroke Services Survey (CoSS), conducted in April/May 2011, assessed intensity of therapy delivered to stroke survivors. Although based on estimates by managers of mean therapy *delivered* rather than recorded therapy inputs, and although not indicative of the *proportion* of stroke survivors in receipt of therapy in an area, this analysis finds:

6.2.3.1 Some of the most intense therapy interventions occur in residential rehabilitation: with a national mean intensity for physiotherapy (PT) of 62 hours; occupational therapy (OT) of 41 hours; and speech and language therapy (SLT) of 35 hours;

6.2.3.2 Most therapy received by stroke survivors in the community is delivered through Primary Care Services and is of relatively low intensity with national mean intensity for therapy delivered of: PT 5.4 hours, OT 13 hours and SLT eight hours;

6.2.3.3 Community rehabilitation teams and community stroke teams deliver more intense care in home settings but are available in few areas;

6.2.3.4 There is considerable regional variability in the intensity with which therapy is delivered in differing settings;

6.2.3.5 In Dublin, physiotherapy is delivered at above national average intensity in non-acute outpatient rehabilitation but at below average intensity in other settings;

6.2.3.6 HSE Region South delivers higher than average intensity physiotherapy in Primary Care Services;

6.2.3.7 In HSE Region West, physiotherapy is delivered at close to the national average intensity in Primary Care Services, community day hospitals and residential rehabilitation but highly intense therapy is delivered by one community rehabilitation team.

6.3 Summary of Findings from Chapter 3 on Pathways of Care from Hospital

Evidence of pathways of care from hospital for stroke patients in Ireland has been analysed from two patient-level databases, the Hospital Inpatient Enquiry Database (HIPE) 2011 and the 2005 Irish National Audit of Stroke Care (INASC) clinical audit, and from a survey conducted by the authors of this report in 2013, the Hospital Leads' Survey (HLS). This analysis finds differing pathways of stroke patient care, rehabilitation and long-stay institutionalisation in different regions and hospitals; and hospital-level differences in length of stay and by

implication pathways of care even for patients at the same level of disability post-stroke.

6.3.1 Length of Stay In Hospital

HIPE 2011 data for acute hospitals show that:

6.3.1.1 Mean LOS was longest in Dublin Mid-Leinster (30 days) and Dublin North-East (28 days); and shorter in the South and West (18 days);

6.3.1.2 Mean LOS for stroke patients discharged to nursing homes was 79 days in Dublin North-East, 76 days in Dublin Mid-Leinster, 49 days in the South and 24 days in the West;

6.3.1.3 Median (mid-range) LOS showed less variation across regions, indicating that mean LOS in the Dublin-based regions is influenced by some patients with particularly long stays;

6.3.1.4 At hospital level, mean length of stay ranged from under ten to 48 days;

6.3.1.5 A factor in determining LOS may be regional/local nursing home bed capacity, with a strong positive correlation between numbers of long-term care beds and numbers of stroke discharges to nursing homes by area of residence from HIPE.

6.3.2 Evidence of Pathways of Care from Hospital Leads Survey

A survey of clinical stroke leads in acute hospitals, the Hospital Leads' Survey (HLS), conducted by the authors of this study in 2013, found that:

Acute Hospital On-Site Rehabilitation

6.3.2.1 In 27 of 28 hospitals, respondents confirmed that their hospitals provided onsite inpatient rehabilitation;

6.3.2.2 The major rehabilitation therapies (PT, OT and SLT) were available in 27 out of 28 hospitals;

6.3.2.3 A dietician was available in 24 hospitals and a psychologist in only four hospitals;

6.3.2.4 A majority of hospitals (17 out of 28) also offered rehabilitation in the outpatient department or day hospital.

6.3.2.5 Respondents from a major regional hospital volunteered the supplementary information that, due to a moratorium on recruitment, staffing was insufficient to meet national guidelines for stroke rehabilitation.

Off-Site Referrals For Inpatient Rehabilitation

6.3.2.6 When respondents were asked to identify locations to which they refer stroke patients for inpatient rehabilitation, hospitals in Dublin, the greater Dublin Region and Cork showed a pattern of referrals to a few major institutions;

6.3.2.7 Networks of community hospitals, day centres and other forms of stepdown facility were identified as locations to which patients were referred for rehabilitation in a number of areas of the country;

6.3.2.8 There is a generally discernible pattern across the country of referral from major acute hospitals to smaller, satellite acute hospitals, which, in this context, effectively operate as stepdown facilities playing a rehabilitation role;

6.3.2.9 Throughout the country, some patients are referred to the National Rehabilitation Hospital (NRH) in Dublin.

Factors Determining Off-Site Referrals For Inpatient Rehabilitation

6.3.2.10 NRH provides most inpatient rehabilitation for stroke survivors who are aged under 65 and with moderate to severe disability, while older stroke survivors' rehabilitation needs may be met through older persons' services;

6.3.2.11 Respondents from seven hospitals identified that a patient with severe disability and aged under 65 would be referred for inpatient rehabilitation to NRH in Dublin;

6.3.2.12 Respondents from 11 hospitals identified NRH as a referral location for patients with moderate disability and aged under 65;

6.3.2.13 No respondent identified NRH as a referral location for patients with severe disability who were aged 65 and over;

6.3.2.14 No respondent from acute hospitals outside the West of the country identified any referral locations for the rehabilitation of older patients with severe disability, which suggests that hospitals outside the West either undertake rehabilitation for such patients on-site, or they neither offer nor refer these patients for inpatient rehabilitation;

6.3.2.15 Respondents from 21 hospitals identified 19 locations to which they referred patients with moderate disability for offsite inpatient rehabilitation.

Inadequacy of Community Rehabilitation Services

6.3.2.16 Respondents from 27 out of 28 hospitals referred stroke patients for community rehabilitation when discharged to home;

6.3.2.17 But respondents from 24 hospitals at least sometimes referred patients post-discharge for rehabilitation services in hospitals or other inpatient locations such as nursing homes, who could be treated at home by community services, if these were more readily available.

Inadequacy of Inpatient Rehabilitation and Nursing Home Capacity

6.3.2.18 Six hospitals reported average waits of longer than three months for transfer to offsite inpatient rehabilitation in hospitals or other inpatient locations such as nursing homes: three of these referring hospitals were in Dublin, two in neighbouring counties and one in Cork city. Average waits of from one month to three months were reported in a further eight hospitals spread throughout the country;

6.3.2.19 There is clear evidence of insufficient capacity at NRH to treat the demand for rehabilitation for younger patients with severe stroke, with a number of respondents citing waits of over three months;

6.3.2.20 A respondent from a large Dublin hospital said that patients with severe disability could remain up to six months in the acute hospital until a nursing home bed became available.

6.4 Summary of Findings from Chapter 4 on Best Practice Pathways of Stroke Rehabilitation

6.4.1 Early Supported Discharge

6.4.1.1 A consensus has emerged from the international trial literature reviewed in this study that stroke survivors with mild or moderate disability are in general suited to Early Supported Discharge (ESD) while the needs of survivors with more severe disability are better met by specialised inpatient rehabilitation;

6.4.1.2 There is inadequate evidence on the feasibility of ESD in rural areas with dispersed populations, which may limit the applicability of ESD to such areas in Ireland. The feasibility of ESD in such areas requires further research;

6.4.1.3 Systematic reviews of the published results of ESD trials have found a significant reduction in the odds of requiring long-term institutional care for patients receiving ESD compared to conventional care;

6.4.1.4 Measures of dependence have also been found to show relatively greater improvement with ESD;

6.4.1.5 Hospital length of stay has been found to reduce by between seven to 13 days with ESD;

6.4.1.6 Mortality rates show no significant difference with ESD compared to usual care.

6.4.2 Rehabilitation after Severe Stroke

6.4.2.1 The international literature suggests that patients with severe stroke benefit from specialised inpatient rehabilitation in relation to reduced mortality, reduced length of stay and increased likelihood of discharge home;

6.4.2.2 The evidence is less clear regarding functional outcomes for patients with severe stroke;

6.4.2.3 Early identification of patients with severe stroke who have a realistic possibility of being discharged home following rehabilitation has been recommended;

6.4.2.4 Economic evaluation of alternative rehabilitation interventions for patients with severe stroke cannot currently be undertaken because generalisable randomised controlled trials (RCTs) of such interventions have not been conducted;

6.4.2.5 It is recommended that such an RCT should be conducted in Ireland to assess the relative costs and outcomes of systematically providing specialised inpatient rehabilitation for severe stroke as compared to usual care.

6.5 Summary of Findings from Chapter 5 on Economic Evaluation of ESD and Usual Care

This study has compared the resources required, the costs and the potential outcomes of implementing ESD for stroke patients with mild to moderate disability in Ireland compared to their usual care;

6.5.1 Approach to Modelling

Two methodologies have been applied in this analysis:

1. Discrete-Event Simulation (DES) modelling in collaboration between researchers at King's College London (KCL), the ESRI and NUIG applied Irish data to the KCL model, in which resource use, costs and outcomes for ESD compared to Conventional Discharge care (CD) are analysed by following the simulated journey of stroke patients for ten years post-stroke with the cost-effectiveness of ESD expressed in terms of cost per Quality-Adjusted Life Year (QALY) gained;
2. Decision-tree analysis compared only the costs of treatment in the first year after stroke for ESD and CD.

Two models of ESD have been derived from the literature:

1. The 'Beech Model' follows the approach to resourcing ESD applied in an RCT in London in the 1990s and is the assumed approach to ESD in the Discrete-Event Simulation modelling;
2. The 'Fisher Model' has been derived by this study from the consensus view of ESD Trialists in 2011 about appropriate resourcing of ESD. The costs of this relatively better resourced ESD approach are compared to the alternative Beech model and Conventional Discharge care in the decision-tree analysis.

Two case studies have been derived from the analysis of current rehabilitation in Ireland to act as Conventional Discharge care comparators to ESD:

1. The 'North Dublin' case study assumes that therapy is delivered in the community at the mean level of intensity recorded for three local health office (LHOs) in North Dublin in 2011 in the CoSS survey and that the proportion of stroke patients receiving this therapy is at the level recorded in the North Dublin Population Stroke Study (NDPSS) in 2005/2006;
2. The 'HSE Region South' case study assumes that therapy is delivered in the community at the mean level of intensity recorded for four LHOs in the region in 2011 in the case of PT and OT and for five LHOs in the region in the case of SLT and that the proportion of stroke patients receiving this therapy is at the level recorded in the NDPSS in 2005/2006;
3. Assumed utilisation by stroke survivors of other post-discharge care - GP visits, community nurse visits, meals on wheels, home helps, outpatient visits - is estimated from survey evidence.

6.5.2 Central Findings from Modelling of ESD versus Usual Care

Decision-Tree Analysis Findings

6.5.2.1 The base-case decision-tree analysis finds a first-year cost saving, which ranges from €680 per patient when usual care is compared to the more generously resourced Fisher model of ESD, to a first-

year cost saving of €2,319, when usual care is compared to the Beech model of ESD (Table 56);

6.5.2.2 Sensitivity analysis shows that the finding of a first-year cost saving generally holds, assuming an eight-day reduction in LOS with ESD and applying Irish average stroke bed-day costs;

6.5.2.3 In one scenario, a marginal first-year cost of ESD implementation arises, when high unit costs are applied to the most generously-resourced ESD model. Even in this scenario, the marginal cost of implementing ESD is one-third of the cost of an inpatient day.

Discrete-Event Simulation Modelling Findings

6.5.2.4 The central base case finding from the DES modelling is that implementing ESD in Ireland could deliver a mean additional Quality-Adjusted Life Year (QALY) for a mean additional cost of €4,734 over ten years (Table 56). This compares favourably to standard UK National Institute for Health and Clinical Excellence (NICE) benchmarks of £20,000 to £30,000 (€20,750 to €31,122) per QALY;

6.5.2.5 In the first year for the DES modelling base case, there would be a cost-saving of €955 per patient, with a greater saving in inpatient stay than the cost of additional ESD therapy and community services (Table 56);

6.5.2.6 The level of cost-effectiveness is sensitive to assumptions about the improvement in disability levels consequent on ESD and the costing methodology applied;

6.5.2.7 Analysis of the probability of cost-effectiveness finds a 66 per cent probability of cost-effectiveness at a €25,000 threshold for the base case;

6.5.2.8 Probabilities at a range of thresholds have been compared for alternative modelling scenarios. Determining the acceptability threshold and acceptable probability at that threshold are policy decisions.

TABLE 56 Central Base-Case Findings from Cost and Cost-Effectiveness Modelling of ESD Versus Usual Care

Modelling approach	Mean first-year cost	Mean 10-year incremental cost	Mean incremental cost per QALY gained
DES modelling base case: North Dublin usual care versus Beech model ESD	-€955	€118	€4,734
Decision-tree analysis base case 1: North Dublin usual care versus Fisher model ESD	-€681		
Decision-tree analysis base case 2: North Dublin usual care versus Beech model ESD	-€2,319		

6.5.3 Potential Budgetary Impact from Implementation of ESD

The base-case decision-tree analysis finds:

6.5.3.1 Potential savings if 44 per cent of stroke discharges nationally (3,056 discharges) were to receive ESD would be over €7 million for the Beech Model of ESD and over €2 million for the Fisher Model (2011 prices and discharges);

6.5.3.2 With 44 per cent ESD participation, reduced hospital length of stay would save €12.2 million, while the cost of resourcing community therapy and other services to implement the Beech Model of ESD would be €5.2 million and the cost of resourcing the Fisher model of ESD would be €10.1 million;

6.5.3.3 With 44 per cent participation, ESD could free up over 24,000 hospital bed days, the equivalent of 67 hospital beds, annually;

6.5.3.4 With 17 per cent ESD participation, which was considered feasible with adequate resourcing in the Mater Misericordiae University Hospital (MMUH) pilot, if applied nationally (1,181 discharges), this would potentially save €2.7m with the Beech Model of ESD and €800,000 with the Fisher Model;

6.5.3.5 With 17 per cent ESD participation, reduced hospital length of stay would save €4.7 million, while the cost of resourcing community therapy and other services to implement the Beech Model of ESD would be €2 million and the cost of resourcing the Fisher model of ESD would be €3.9 million.

Resource Requirements to Implement ESD

Comparison of the alternative ESD models and estimated Conventional Discharge care for stroke survivors in Ireland indicates that ESD would require a substantial increase in the resourcing of community therapists and other community care from current levels in Ireland, with even the better-resourced 'HSE Region South' case study falling far short of the requirements for delivery of ESD:

6.5.3.6 Mean physiotherapy hours in the Fisher ESD programme are over 500 per cent higher than the HSE Region South case study mean;

6.5.3.7 Mean occupational therapy hours in the Fisher ESD programme are over 400 per cent higher than the HSE Region South case study mean;

6.5.3.8 Mean speech and language therapy hours in the Fisher ESD programme are over 1,000 per cent higher than the HSE Region South case study mean;

6.5.3.9 Mean community nurse visiting in the Fisher ESD programme is 400 per cent greater than the Irish mean;

6.5.3.10 Mean home help hours assumed for the Fisher ESD programme are 15 per cent greater than the Irish mean;

Notably, Irish stroke survivors appear to have higher rates of GP visiting than in the UK's Beech model of ESD, which may reflect a reliance on general practitioner care due to the unavailability of other community services.

6.6 Discussion and Conclusions

Analysis in this report has found that approximately 5,000 to 6,000 people annually, who have experienced a stroke and been hospitalised, require some level of rehabilitation. Approximately 3,000 of these stroke survivors have mild to moderate disability at seven days post-stroke and can potentially benefit from Early Supported Discharge. A further 2,500 surviving patients have severe disability at seven days after stroke, of whom 1,000 to 1,200 patients may have persistent severe disability for at least three months after stroke. This report has examined how to optimise the prospects for rehabilitation of stroke survivors at any level of disability post-stroke.

Internationally and in Ireland, guidelines have been developed for best practice in stroke patients' treatment, care and rehabilitation (Appendix 8.6). The Canadian guidelines, in particular, are viewed as a gold standard (Lindsay et al. 2010). Generally, international guidelines recommend that all patients with stroke, who are admitted to hospital and who require rehabilitation, should be treated in a comprehensive or rehabilitation stroke unit by an inter-professional team and that, after leaving hospital, stroke survivors should have access to specialised stroke care and rehabilitation services appropriate to their needs, with ESD considered for patients discharged to the community.

The analysis in this report supports a move to such international best practice in stroke rehabilitation in Ireland, with implementation of Early Supported Discharge for patients with mild to moderate disability offering the potential for better outcomes for patients from better care in the community. Decision-tree analysis in this study of the costs of ESD compared to Conventional Discharge (usual care as delivered in Ireland) suggests that ESD could be implemented in Ireland at no additional cost. On most assumptions, savings from reduced length of stay by stroke patients in Irish hospitals would more than offset the additional costs of an ESD programme requiring more intense therapy in the community, greatly increased community nursing and increases in other community services. Sensitivity analysis shows that this finding generally holds, assuming an eight-day reduction in LOS with ESD and applying Irish average stroke bed-day costs. In one

scenario, a marginal cost of ESD implementation arises, when high unit costs are applied to the most generously-resourced ESD model. Even in this scenario, the marginal cost of implementing ESD is one-third of the cost of an inpatient day.

Applying Irish data to the DES model developed in the UK suggests that ESD implementation in Ireland could also be cost-effective with a low cost per QALY gained over a ten-year period. This conclusion is sensitive to assumptions about the improvement in disability levels consequent on ESD and the costing methodology applied. Analysis of the probability of cost-effectiveness at alternative cost-effectiveness thresholds has been undertaken by this study, which finds a 66 per cent probability of cost-effectiveness at a €25,000 threshold for the base case. Probabilities at a range of thresholds have been compared for alternative modelling scenarios. Determining the acceptability threshold and acceptable probability at that threshold are policy decisions.

While this study concludes that ESD could be achieved at a net saving in national health expenditure by freeing up acute hospital beds, moving from this analysis to implementation of best practice in a context of constrained national healthcare expenditures and inadequately resourced community care will require a planned and integrated approach. It is the majority view of clinicians in acute hospital stroke care that community services are inadequate to meet stroke survivors' rehabilitation needs on discharge. There is considerable local and regional variation in the supply of community staffing relative to stroke survivors' estimated need for rehabilitation and in the intensity of therapy delivered to stroke survivors. The evidence in this study of mean therapy delivered in Primary Care Services to stroke survivors, estimated from a range of sources, has been found to fall far short of the required therapy to implement an ESD programme. Estimated community nursing for stroke survivors compares unfavourably to UK district nurse visiting rates, recorded in the 1990s, and would require a substantial increase to implement the ESD models reviewed here.

In the acute setting, there is considerable variation in stroke patients' length of stay even when at the same level of disability. Some clinicians have expressed concern about their ability to offer adequate inpatient rehabilitation due to staffing shortages. Utilisation of care appears to be related to supply of care: for example there are more referrals to community therapists in areas where more therapists are available; there are more discharges to nursing homes in areas where there are more long-stay beds. Pathways of care for stroke patients therefore vary by area and appear to reflect the fragmented development of health services, which was a consequence of their highly localised administration under the former health board structure. There is particular evidence of relatively

low supply of therapists and intensity of therapy delivered in Dublin city, while acute inpatient length of stay is particularly long in the East and rehabilitation outside the acute setting appears to be delivered to a greater degree in inpatient or outpatient settings rather than in the community.

Long waits for care, as long as six months wait for discharge to a nursing home for patients with severe disability in one Dublin hospital, are evidence of inadequate specialised long-stay capacity. Waits of over three months are consistently reported for the specialised rehabilitation service offered by the National Rehabilitation Hospital in Dun Laoghaire, which receives referrals nationally of patients with moderate to severe disability, who are aged under 65. Given the importance of timely rehabilitation, such waits could worsen patients' long-term prognoses. This suggests that there is a need for expanded inpatient rehabilitative capacity for younger people with severe stroke in particular.

This study has found a deficit in psychology and counselling services for stroke survivors in acute hospitals and rehabilitation settings, as well as relatively under-resourced community psychology services. Combined with the findings from other studies of deficits in the availability of psychological services for stroke survivors in the community and in nursing homes, and of considerable emotional distress in stroke survivors, there appears to be clear need for the development of such services.

Although this is not a resource allocation study, this study does point to a need for transparent resource allocation criteria, with assessment of need potentially expanded beyond the factors analysed in this report. Allocation of resources to community care should reflect regularly updated, administrative area-level analysis of resourcing, such as that undertaken in this report, and should prioritise those areas which are relatively under-resourced.

Translating acute care savings into community care resourcing requires shifting the balance in the Irish healthcare system from over-reliance on the acute sector to greater delivery of care in the community. While it has been outside the scope of this study to analyse the reasons for this imbalance in Irish health care and the policy measures required to remedy it, other studies have pointed a way. The deficit in rehabilitation services for stroke survivors in Ireland can be understood as symptomatic of 'the poorly developed system of community health services', which the 2010 *Report of the Expert Group on Resource Allocation and Financing in the Health Sector* identified as 'perhaps the greatest deficiency in the current provision of public health services in Ireland... this sector remains small and weak

when compared to provision in other European countries..' (Ruane 2010: 48). Achieving the integration of community and acute care required to implement ESD and improve rehabilitation services and outcomes for stroke survivors requires an acceptance of the Expert Group's analysis of the need for system change so that the development of community health services is clearly based on protocols for care and there is a system of 'clearer and more logical entitlements to community health services' (Ruane 2010: 113).

The analysis in this report has, to the greatest degree possible, encompassed the needs of all stroke survivors, including those with severe disability post-stroke. Regrettably, limited international research on best practice in their rehabilitation has meant that this study could not undertake an economic analysis of implementing best practice for severe stroke patients. However, the study has analysed Irish services for this grouping to the degree that the data allow. Recommendations for their care are presented in Chapter 7.

Notwithstanding the research undertaken in this study, there remain significant deficits in our understanding of the detailed care pathways, outcomes and utilisation of care by people who suffer a stroke in Ireland. More research is needed in relation to severe stroke. Further research is also needed in relation to stroke survivors with mild to moderate disability living in areas of dispersed population, for whom the potential benefits of ESD have not yet been adequately researched internationally. This study has been undertaken without an Irish RCT to inform understanding of the resources, outcomes and costs pertaining to stroke survivors' rehabilitative care in Ireland. In addition, although a national stroke register has been in development, there was no national, longitudinal data source on the epidemiology and utilisation of care of stroke patients in Ireland available to this study.

While the collaboration between researchers at King's College London, the ESRI and NUIG to apply the DES model to Ireland has afforded this study the opportunity to model the incremental cost per QALY of implementing ESD over a ten-year time frame, it is acknowledged that there are limitations in applying a model which is still largely reliant on UK data in its design and which may not adequately reflect the population health or health system characteristics of Ireland. Furthermore, in both the DES and decision-tree models, the resource use assumed for Conventional Discharge in Ireland has been estimated from multiple data sources and may understate CD resourcing (with consequent over-estimate of the incremental cost of ESD) or, by over-stating CD resourcing, may under-estimate the incremental cost of ESD. The regional analysis of therapy inputs in this study would suggest that the cost of implementing ESD will vary across Ireland, depending on the level of resourcing of existing therapy and other

community services for stroke survivors. On the other hand, potential gains from reduced hospital LOS may be greater than assumed in this analysis, particularly in those regions with longer LOS and more poorly resourced community services.

While the analysis in this report has recognised uncertainties in the data available and has addressed that uncertainty by means of sensitivity analyses, it is desirable that planning for stroke care should rely on more comprehensive data. This suggests that the national stroke register should be developed and resourced to inform ongoing analysis of stroke patient care and outcomes and facilitate optimal resourcing and planning for care in the future.

CHAPTER 7

Recommendations

7.1 Introduction

The recommendations in this chapter have been developed from reflection and discussion on the findings of the analysis between the research team and the expert members of the Stroke Rehabilitation in Ireland project steering group, many of whom are clinical professionals directly involved in delivering stroke care.

7.2 Recommendations

7.2.1 Recommendations for Patients with Mild to Moderate Disability After Stroke

In light of the international evidence that Early Supported Discharge can improve patient outcomes, reduce the likelihood of long-term institutional care and reduce acute hospital length of stay, and in light of the evidence in this study that ESD is a cost-effective intervention with a cost per QALY gained that compares favourably to other healthcare interventions, this study recommends that:

1. Early Supported Discharge should be the preferred rehabilitation option in Ireland for patients with mild to moderate disability after stroke;
2. Savings from reduced acute bed days achieved by ESD should be applied to resourcing community care staff: physiotherapists, occupational therapists, speech and language therapists, community nurses, social workers, home helps, psychologists and counsellors;
3. Further research is required to assess the feasibility of ESD in rural areas of dispersed population. If implementation of ESD is not found to be feasible, inpatient or centre-based rehabilitation programmes should be maintained or developed and resourced.

7.2.2 Recommendations for Patients with Severe Disability After Stroke

In light of the international evidence that patients with severe stroke benefit from specialised inpatient rehabilitation in relation to reduced mortality, reduced hospital length of stay and increased likelihood of discharge home, this study recommends that:

4. Capacity and staffing should be expanded for specialist inpatient rehabilitation for patients with severe stroke;

5. Numbers of nursing home places suitable for support and care for stroke patients with significant disability should be increased, particularly in areas where there is evidence of long delays in discharge from hospital due to difficulties in accessing nursing home care;
6. Early identification of patients with severe stroke who could potentially be discharged home following rehabilitation is recommended and such patients should be offered specialised inpatient rehabilitation;
7. The rehabilitation needs of survivors of a severe or moderate stroke should be reassessed weekly for the first month, and then at intervals as indicated by their health status;
8. Given the relatively limited research on best practice in rehabilitation for patients with severe stroke, a randomised controlled trial (RCT) should be conducted in Ireland to assess the relative costs and outcomes of systematically providing specialised inpatient rehabilitation for severe stroke as compared to usual care;
9. Such an RCT should measure functional outcomes and include the costs of long-term care, whether delivered at home or in an institutional setting and by formal or informal carers.

7.2.3 General Recommendations for Stroke Rehabilitation in Ireland

10. Services should be provided to stroke survivors on a needs basis, without regard to age or region and with standardised delivery of care, meeting international and national best practice guidelines;
11. Any stroke survivor with declining physical activity, ability to undertake everyday tasks or mobility at six months or later after stroke should be assessed for appropriate targeted rehabilitation;
12. Evidence from this and other studies of deficits in the availability of psychological services for stroke survivors in the acute setting, in the community and in nursing homes, combined with evidence of considerable emotional distress in stroke survivors, indicates a clear need for the development of psychological and counselling services;
13. Any stroke survivor with declining cognitive function or mood at six months or later after stroke should be assessed for appropriate targeted rehabilitation.

To ascertain need for rehabilitation, it is desirable that the national stroke register should routinely record disability at discharge and at intervals post-stroke. In general, the national stroke register should be resourced to record systematically inpatient and post-discharge disabilities, resource utilisation and outcomes for stroke patients, in the community and in long-stay settings. Not only is this information critical to communication about individual patients between primary and secondary care sectors,

but collection of this minimum dataset is essential to enable planning for and investment in adequately resourced stroke rehabilitation services in acute hospitals, specialised rehabilitation facilities, long-stay settings and the community, so that each patient who suffers a stroke should have a care plan, which their clinicians can prescribe with confidence that the resources are available to deliver it. To plan stroke services and ensure that the spending on the care of stroke patients is deployed to best effect to optimise their recovery, this study recommends:

14. A national stroke register should be resourced to sustain the systematic recording of treatment, outcomes (including measures of disability) and care in hospital, the community and long-term care settings of patients with stroke.

8.

Appendices

8.1 Disability and Outcome Measurement

The datasets that inform this study employ differing disability measurement scales (Table 59). The Modified Rankin Scale (MRS) scoring system is shown in Table 57 and the Barthel Index (BI) scoring system is shown in Table 58. Both are commonly used scales that measure disability or dependence in activities of daily living post-stroke, although they have been found to be interpreted inconsistently in defining favourable outcomes (Sulter et al. 1999). In the modelling in this report, the two scales are interpreted as measures of three levels of disability: mild disability (including no disability/independent), moderate disability, and severe disability. This interpretation of the BI follows the methodology of the Discrete-Event Simulation model employed in National Audit Office (2010b) (Table 59). The interpretation of the MRS follows Sulter et al. (1999), who found that, in general, an MRS of <=1 or <=2 was considered a favourable outcome in acute stroke trials; and recommended that an MRS of >3 should be considered a poor outcome. Analyses of disability levels in INASC in Chapter 3 and in the MMUH pilot in Chapter 4 separates the scales into four measures of disability, distinguishing mild disability and independence.

TABLE 57 Modified Rankin Scale

MRS score	Description of abilities/disabilities
0	No symptoms
1	No significant disability, despite symptoms; able to perform all usual duties and activities
2	Slight disability; unable to perform all previous activities but able to look after own affairs without assistance
3	Moderate disability; requires some help, but able to walk without assistance
4	Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
5	Severe disability; bedridden, incontinent, and requires constant nursing care and attention

Source: Sulter et al. (1999).

TABLE 58 Barthel Index

BI measure	INASC scoring system		Alternative scoring system
Bowels	0 = Incontinent (or needs to be given enemata)		
	1 = Occasional accident (once/week)		5
	2 = Continent		10
Bladder	0 = Incontinent, or catheterised		
	1 = Occasional accident (max once per 24 hrs)		5
	2 = Continent (over seven days)		10
Grooming	0 = Needs help with personal care		
	1 = Independent face / hair / teeth / shaving (implements provided)		5
Toilet Use	0 = Dependent		
	1 = Needs some help, can do something alone		5
	2 = Independent (on and off, dressing / wiping)		10
Feeding	0 = Unable		
	1 = Needs help cutting, etc		5
	2 = Independent (food in reach)		10
Mobility	0 = Immobile		
	1 =Wheelchair independent including corners etc.		5
	2 =Walks with help of one person (verbal or physical)		10
	3 = Independent (may use stick etc.)		15
Transfer	0 = Unable - no sitting balance		
	1 = Major help (one / two people) can sit		5
	2 = Minor help (verbal or physical)		10
	3 = Independent		15
Dressing	0 = Dependent		
	1 = Needs help, can do half unaided		5
	2 = Independent (including buttons, zips, laces etc)		10
Stairs	0 = Unable		
	1 = Needs help (verbal/physical)		5
	2 = Independent		10
Bathing	0 = Dependent		
	1 = Independent		5

Source: INASC Clinical Audit Questionnaire (2005), with alternative scoring system inserted above to demonstrate how, in contrast to the common UK method of scoring as 0, 1, 2 or 3, an alternative method scores as 0, 5, 10 or 15, giving a potential maximum of 100 rather than 20. (The scores are convertible by multiplying or dividing by 5.) In analysis of the MMUH/North Dublin data, 0-45 signifies severe; 50-70 signifies moderate and 75-100 signifies mild. If a score falls between these points on the scale e.g. BI=47, which is equivalent to 9.4 on the 1-20 scale, it is assigned to the category in which it would fall if the score were rounded on the 1-20 scale, which in this case would be severe disability.

TABLE 59 Categorisation of Disability Measurement Scales into Three Disability Levels

Dataset	Scale	Mild disability	Moderate disability	Severe disability
ASPIRE-S	MRS	0-2	3	4-5
NDPSS	MRS	0-2	3	4-5
INASC	BI	15-20	10-14	0-9
MMUH Pilot	Alternative BI	65-100	50-60	0-45

Source: Categorisation as explained in text.

Other measures of outcome after stroke which are referenced in the report are explained below:

8.2 Functional Independence Measure (FIM)

Dimensions assessed include: eating, grooming, bathing, upper body dressing, lower body dressing, toileting, bladder management, bowel management, bed to chair transfer, toilet transfer, shower transfer, locomotion (ambulatory or wheelchair level), stairs, cognitive comprehension expression, social interaction, problem solving and memory. Ability is scored as in Table 60.

TABLE 60 Functional Independence Measure (FIM) Scoring Criteria

No Helper Required	
Score	Description
7	Complete Independence
6	Modified Independence (patient requires use of a device, but no physical assistance)
Helper (Modified Dependence)	
Score	Description
5	Supervision or Setup
4	Minimal Contact Assistance (patient can perform 75 per cent or more of task)
3	Moderate Assistance (patient can perform 50 per cent to 74 per cent of task)
Helper (Complete Dependence)	
Score	Description
2	Maximal Assistance (patient can perform 25 per cent to 49 per cent of tasks)
1	Total assistance (patient can perform less than 25 per cent of the task or requires more than one person to assist)
0	Activity does not occur

Source: http://www.rehabmeasures.org/lists/rehabmeasures/.

8.3 Scandinavian Stroke Scale (SSS)

TABLE 61 Scandinavian Stroke Scale (SSS) Scoring System

Function	Score
Consciousness:	
-fully conscious	6
-somnolent, can be awaked to full consciousness	4
-reacts to verbal command, but is not fully conscious	2
Eye movement:	
-no gaze palsy	4
-gaze palsy present	2
-conjugate eye deviation	0
Arm, motor power*:	
-raises arm with normal strength	6
-raises arm with reduced strength	5
-raises arm with flexion in elbow	4
-can move, but not against gravity	2
-paralysis	0
Hand, motor power*:	
-normal strength	6
-reduced strength in full range	4
-some movement, fingertips do not reach palm	2
-paralysis	0
Leg, motor power*:	
-normal strength	6
-raises straight leg with reduced strength	5
-raises leg with flexion of knee	4
-can move, but not against gravity	2
-paralysis	0
Orientation:	
-correct for time, place and person	6
-two of these	4
-one of these	2
-completely disorientated	0
Speech:	
-no aphasia	10
-limited vocabulary or incoherent speech	6
-more than yes/no, but not longer sentences	3
-only yes/no or less	0
Facial palsy:	
-none/dubious	2
-present	0
Gait:	
-walks 5 m without aids	12
-walks with aids	9
-walks with help of another person	6
-sits without support	3
-bedridden/wheelchair	0

Source: http://www.stroke.org/site/DocServer/SCU_-_Jan-Feb_2006.pdf?docID=5166]

* Motor power is assessed only on the affected side.

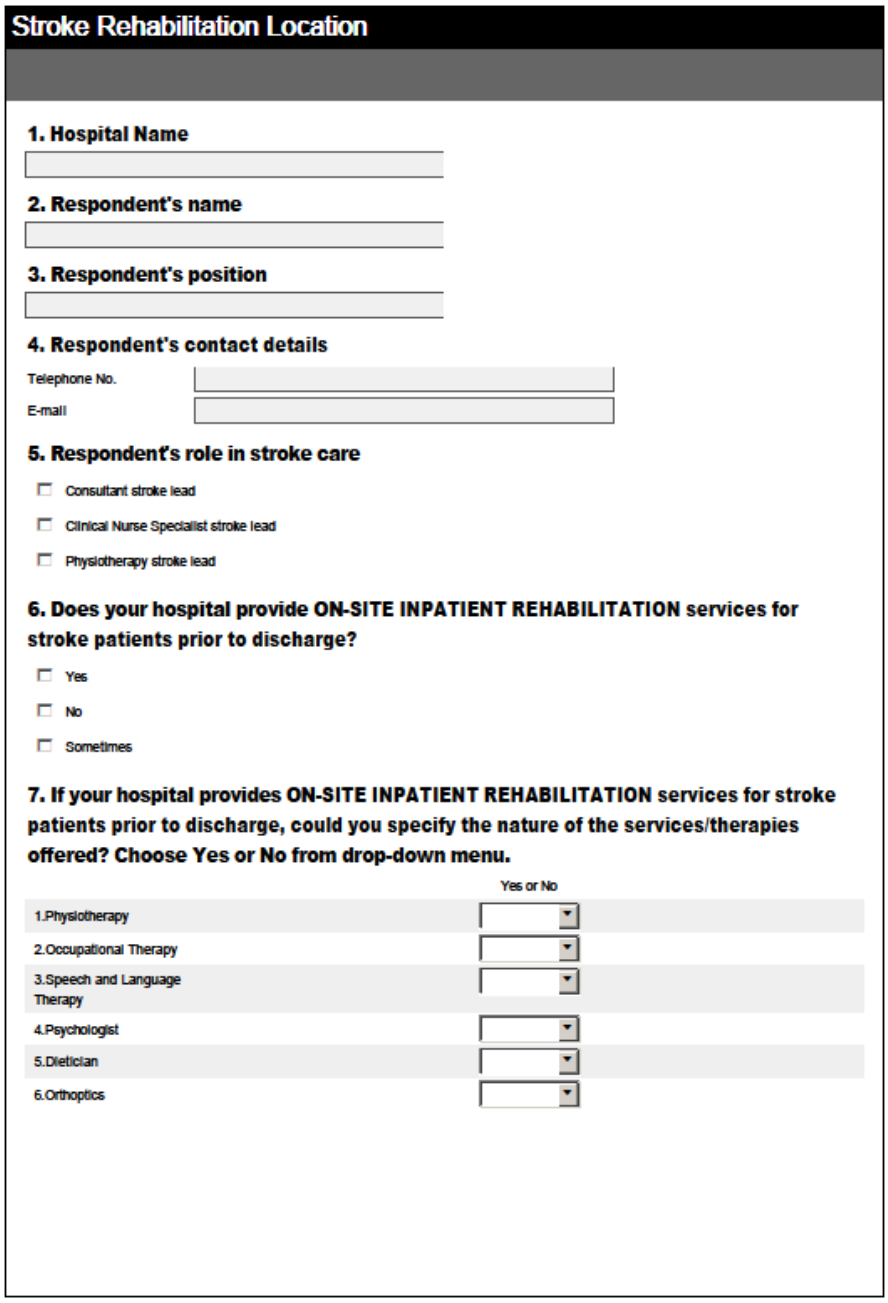
8.4 Orpington Prognostic Score

TABLE 62 Orpington Prognostic Score Scoring System

Clinical features	Score
Motor deficit in arm (MRC grade)	
5	0
4	0.4
3	0.8
1-2	1.2
0	1.6
Proprioception (eyes closed)	
Locates affected thumb	
Accurately	0
Slight difficulty	0.4
Finds thumb via arm	0.8
Unable to find thumb	1.2
Balance	
Walks ten feet without help	0
Maintains standing position	0.4
Maintains sitting position	0.8
No sitting balance	1.2
Cognition	
Mental test score	
10	0
8-9	0.4
5-7	0.8
0-4	1.2

Source: Deutsch et al. (2006) Total score = 1.6 + motor + proprioception + balance + cognition; MRC indicates Medical Research Council.

8.5 Hospital Leads Survey Questionnaire



Stroke Rehabilitation Location

1. Hospital Name

2. Respondent's name

3. Respondent's position

4. Respondent's contact details

Telephone No.

E-mail

5. Respondent's role in stroke care

- ☐ Consultant stroke lead
- ☐ Clinical Nurse Specialist stroke lead
- ☐ Physiotherapy stroke lead

6. Does your hospital provide ON-SITE INPATIENT REHABILITATION services for stroke patients prior to discharge?

- ☐ Yes
- ☐ No
- ☐ Sometimes

7. If your hospital provides ON-SITE INPATIENT REHABILITATION services for stroke patients prior to discharge, could you specify the nature of the services/therapies offered? Choose Yes or No from drop-down menu.

	Yes or No
1.Physiotherapy	
2.Occupational Therapy	
3.Speech and Language Therapy	
4.Psychologist	
5.Dietician	
6.Orthoptics	

Stroke Rehabilitation Location

8. Does your hospital refer stroke patients post-discharge for OFF-SITE INPATIENT REHABILITATION services in any of the following locations? Choose Yes or No from drop-down menu.

	Yes or No
Nursing homes	
Geriatric hospitals	
Rehabilitation hospitals	
Psychiatric hospitals	
Non-acute hospitals in the same hospital group	
Other hospitals	

9. Could you supply the names of other hospitals or other inpatient locations, to which you refer stroke patients for off-site inpatient rehabilitation? Please, if possible, name individual locations, including nursing homes.

1. Rehabilitation Location Name	
2. Rehabilitation Location Name	
3. Rehabilitation Location Name	
4. Rehabilitation Location Name	
5. Rehabilitation Location Name	
6. Rehabilitation Location Name	
7. Rehabilitation Location Name	
8. Rehabilitation Location Name	
9. Rehabilitation Location Name	
10. Rehabilitation Location Name	

Stroke Rehabilitation Location

10. Please identify the features which determine your referral decision for off-site inpatient rehabilitation. Drop-down menus offer range of responses including NA, if not applicable. Each numbered row applies to the location listed by you for the same number in Question 9.

	Disability Level	Patient's Age	Physiotherapy Available	Occupational Therapy Available	Speech and Language Therapy Available	Psychology Available	Other therapies Available
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							

11. What is the average waiting time for stroke patients at your hospital from referral to transfer to off-site inpatient rehabilitation in hospitals or other inpatient locations such as nursing homes?

- ☐ Less than 1 week
- ☐ 1 to 2 weeks
- ☐ 2 weeks to 1 month
- ☐ 1 month to 3 months
- ☐ Longer than 3 months

12. Does your hospital offer ON-SITE OUTPATIENT REHABILITATION in the outpatient department or day hospital?

- ☐ Yes
- ☐ No
- ☐ Sometimes

13. Does your hospital refer patients to other hospitals or community stroke units for OUTPATIENT REHABILITATION?

- ○ Yes
- ○ No

Stroke Rehabilitation Location

14. If your hospital refers patients for OUTPATIENT REHABILITATION in other hospitals or community stroke units, could you please identify these hospitals or units?

1.
2.
3.
4.
5

15. Does your hospital refer stroke patients for COMMUNITY REHABILITATION services when discharged to home?

- ☐ Yes
- ☐ No
- ☐ Sometimes

16. Does your hospital implement an EARLY SUPPORTED DISCHARGE (ESD) programme i.e. rapid discharge to home for suitable patients to receive specialist community rehabilitation services?

- ☐ Yes
- ☐ No
- ☐ Sometimes

17. Does your hospital refer stroke patients post-discharge for rehabilitation services in hospitals or other inpatient locations such as nursing homes who could be treated at home by community services, if these were more readily available?

- ☐ Yes
- ☐ No
- ☐ Sometimes

8.6 International Guidelines for Stroke Rehabilitation

Country	Location	Timing	Amount/ Intensity	Duration	Professionals	Mode of delivery in community
Ireland (2010a)			Minimum of 45 minutes daily of each therapy required	Withdrawal of rehabilitation may occur appropriately when the person with stroke wishes or no new achievable goals can be identified Continuous or intermittent input from the rehabilitation team may remain necessary over long periods of time depending on goals	Specific clinicians and nursing staff and generic multidisciplinary (MD) team: 1. Physicians, 2. Nurses, 3. Physiotherapists, 4. Occupational therapists, 5. Speech and language therapists, 6. Dieticians, 7. Psychologists, 8. Social workers	Primary care providers Any patient with residual impairment at the end of initial rehabilitation should be offered six monthly reviews and referral to specialist services;

Country	Location	Timing	Amount/ Intensity	Duration	Professionals	Mode of delivery in community
Ireland (2010b)	Inpatient early stroke rehabilitation: All hospitals admitting patients with acute stroke should have a stroke unit, as defined by the European Stroke Organisation. Discharge from acute hospital: Patients should have a full needs assessment prior to admission to hospital, aiming to support discharge home or to their place of residence. ESD: For patients with stroke who are suitable for ESD, resources and systems should be in place to facilitate early rehabilitation in a community setting, delivered by an MD team with input from rehabilitation and geriatric medicine. Community: A partnership framework should be developed between the HSE and the voluntary sector to enable expansion of stroke rehabilitation support	A MD assessment of rehabilitation needs, using a formal procedure or protocol, should be completed within five working days of admission for stroke			SU requires specialist teams led by clinicians with relevant expertise. 1. Physicians, 2. Nurses, physiotherapy, 3. Physiotherapists, 4. Occupational therapists, 5. Speech and language therapists, 6. Dieticians, 7. Neuropsychologists 8. Social workers Technical support staff/Database manager Pharmacist Community liaison co-ordinator	
Ireland (2011)					Requirements for staffing ratios will vary across services depending on needs and the intensity and complexity of services Staffing ratios and competencies should be a component of a neuro-rehabilitation services accreditation process.	

Country	Location	Timing	Amount/ Intensity	Duration	Professionals	Mode of delivery in community
UK (2012)	All hospitals receiving acute medical admissions (including potential stroke) should admit directly to a specialist acute stroke unit (onsite or at a neighbouring hospital); Patients who need ongoing inpatient rehabilitation after diagnosis and treatment should be treated in a specialist stroke rehabilitation unit; Location: Any stroke patient who cannot be admitted to hospital and who is not receiving palliative care should be seen by the specialist teams at home or on an outpatient basis within 24 hours at a standard comparable to other patients.	Should be assessed and managed by stroke nursing staff and at least one member of the specialist rehabilitation team within 24 hours of admission to hospital, and by all relevant members of the specialist team within 72 hours, with goals agreed within five days.	Minimum of 45 minutes of each appropriate therapy required, minimum of five days a week, as long as the patient is continuing to benefit	Appropriate to end when all achievable goals have been reached and no new attainable goals can be set; If planning to stop rehabilitation, ensure that any continuing support needed to maintain and/or improve health is provided; Any patient with residual impairment after the end of initial rehabilitation should be offered a formal review at least every six months	<u>Stroke-specific expertise</u>: 1. Physicians, 2. Nurses, 3. Physiotherapists, 4. Occupational therapists, 5. Speech and language therapists, 6. Dieticians, 7. Psychologists, 8. Social workers, (Easy access to other relevant services).	Not stated

Country	Location	Timing	Amount/ Intensity	Duration	Professionals	Mode of delivery in community
Scotland (2010)	Stroke patients requiring admission to hospital should be admitted to a stroke unit staffed by a co-ordinated multidisciplinary team with a special interest in stroke care. In exceptional circumstances, when admission to a stroke unit is not possible, rehabilitation should be provided in a generic rehabilitation ward on an individual basis. Home or hospital based (outpatient or day hospital) rehabilitation should be considered for people after stroke.	Stroke patients should be mobilised as early as possible after stroke.	Where considered safe, every opportunity to increase the intensity of therapy for improving gait should be pursued	Not stated	Generic/Team with a special interest in stroke care (Members should undertake a continuing programmeof specialist training and education): 1. Physicians, 2. Nurses, 3. Physiotherapists, 4. Occupational therapists, 5. Speech and language therapists, 6. Dieticians, 7. Psychologists, 8. Social workers, Ophthalmologists, Orthoptists, Orthotists, Psychiatrists.	Specialist therapy-based rehabilitation services
Europe (2008)	Admission to a stroke unit recommended for acute stroke patients to receive co-ordinated MD rehabilitation; Early discharge from SU care possible in medically stable patients with mild or moderate impairment providing rehabilitation in community by MD team with stroke expertise.	Early initiation of rehabilitation	Increase the duration and intensity of rehabilitation.	Recommended to continue rehabilitation after discharge during the first year after stroke	A multidisciplinary ESD team with stroke expertise, comprising (at least) nursing, physiotherapy and occupational therapy.	MD team with stroke expertise

Country	Location	Timing	Amount/ Intensity	Duration	Professionals	Mode of delivery in community
Canada (2010)	All patients with stroke who are admitted to hospital and who require rehabilitation should be treated in a comprehensive or rehabilitation stroke unit by an inter-professional team; Post–acute stroke care should be delivered in a setting in which rehabilitation care is formally co-ordinated and organised; Recommend inpatient setting for patients with moderate or severe stroke who need rehabilitation services; A less optimal solution is inpatient rehabilitation on a mixed rehabilitation unit; After leaving hospital, stroke survivors must have access to specialised stroke care and rehabilitation services appropriate to their needs (acute and/or inpatient); ESD should be considered for patients discharged to the community	Initial assessment by team within 24 to 48 hours of admission (hospital, clinic or community); All patients with acute stroke with any residual stroke-related impairments who are not admitted to hospital should undergo an outpatient assessment, preferably within two weeks.	Begin rehabilitation therapy as early as possible once medical stability; Patients should receive intensity and duration of therapy defined in their individual plan Patients should receive a minimum of 3 hours of direct task-specific therapy by stroke team for a minimum of five days per week.	The rehabilitation needs of survivors of a severe or moderate stroke should be reassessed weekly for the first month, and then at intervals as indicated by their health status; Community: Post–acute stroke patients should be followed up by a primary care provider at least every six months and for at least three years following stroke.	Generic/'...disciplines, experienced in providing post-stroke care': 1. Physicians, 2. Nurses, 3. Physiotherapists, 4. Occupational therapists, 5. Speech and language therapists, 7. Psychologists Recreation therapists Family and/or caregivers	Stroke survivors and caregivers should have their individual psychosocial and support needs reviewed on a regular basis; Stroke survivors living in the community who have difficulty with ADL should have access, to therapy to improve or prevent deterioration; Any stroke survivor with declining physical activity, ADL or mobility at six months or later after stroke should be assessed for appropriate targeted rehabilitation.

Country	Location	Timing	Amount/ Intensity	Duration	Professionals	Mode of delivery in community
US (2010)	Determine optimal environment for care by the patient's severity, needs, availability of support and resources, goals and preferences. ESD for patients with mild to moderate disability. Recommend patient remains in inpatient setting if daily services/interventions are needed. Inconclusive evidence to recommend the superiority of one type of rehabilitation setting over another. Strongly recommend that patients with mild to moderate disability in need of rehabilitation services have access to a setting with a co-ordinated and organized team experienced in providing stroke services. Severely disabled patients with poor prognosis for recovery may not benefit from rehabilitation services and may be discharged to home or nursing home.	Not stated	Patients should receive as much therapy as they are able to tolerate in order to adapt, recover, and/or re-establish their pre-morbid or optimal level of functional independence. (Because of the heterogeneity of the literature, no specific guidelines regarding intensity of treatment is justified).	Initiate/continue rehabilitation program and interventions indicated by patient status, impairment, function, activity level and participation. (Because of the heterogeneity of the literature, no specific guidelines regarding duration of treatment is justified).	Strongly recommended that all professionals involved in any aspect of the stroke care be trained and certified to perform the NIHSS. 1. Physicians, 2. Nurses, 3. Physiotherapists, 4. Occupational therapists, 5. Speech and language therapists, 7. Psychologist 8. Social worker Kinesiotherapist Recreational therapist Family/caregivers	Patients who do not require any additional rehabilitation services and are discharged to home (or nursing home in the case of severely disabled patients), require follow-up with their primary care provider within one month of discharge. Patient and caregiver education; Caregiver training should be provided in a variety of methods.

Country	Location	Timing	Amount/ Intensity	Duration	Professionals	Mode of delivery in community
New Zealand (2010)	STROKE UNIT:See Australia (2010) ONGOING INPATIENT REHABILITATION:See Australia (2010) COMMUNITY/FOLLOW UP:MD community rehabilitation services and support services should be made available to enable ESD for people with mild to moderate disability.Health services with organised inpatient stroke services should provide comprehensive, experienced MD community rehabilitation and support services for people with stroke and their family/carers.Rehabilitation services after hospital discharge should be offered to all stroke patients and where available, delivered in the home setting.Service providers should incorporate education of the recognition and management of depression, screening and assistance to co-ordinate appropriate interventions via a medical practitioner.	Patients should be mobilised as early and as frequently as possible.	Should be structured to provide as much practice as possible within the first six months after stroke; Physiotherapy and OT should be a minimum of one hour active practice per day at least five days a week.	The duration of the formal rehabilitation phase of care should be tailored to the individual patient based on their response to interventions, not on an arbitrary time limit.	1. Physicians, 2. Nurses, 3. Physiotherapists, 4. Occupational therapists, 5. Speech and language therapists, 6. Dieticians, 7. Psychologists 8. Social workers Pharmacists May also include: Psychiatrists,Ophthalmologists, Orthoptists, Podiatrists, Orthotists, Recreation therapists and therapy assistants, General ward staff, Family/carers	Those with residual impairment at the end of the formal rehabilitation phase of care should be reviewed regularly (ie, at least annually) usually by the GP. People with stroke should be encouraged to participate long-term in appropriate exercise programmes.

Country	Location	Timing	Amount/ Intensity	Duration	Professionals	Mode of delivery in community
Australia (2010)	Should be admitted to hospital and treated in a SU preferably within three hours of stroke onset; If suspected stroke patients present to non-SU hospitals, transfer protocols should be used to guide urgent transfers to the nearest SU hospital. Patients should be transferred to a stroke rehab unit if inpatient rehab required; If stroke rehab unit not available, patients should be transferred to conventional rehab unit with stroke-specific expertise. If such services are available, then ESD should be offered for all with mild to moderate disability. Rehabilitation in the home setting should be offered to all as needed. Where unavailable, patients requiring rehab should receive centre-based care.	Patients should be mobilised as early and as frequently as possible	Should be structured to provide as much practice as possible within the first six months after stroke; -Physical therapy (physiotherapy and occupational therapy should be a minimum of one hour active practice per day at least five days a week.	Stroke survivors should have regular and ongoing review by a member of a stroke team, including at least one specialist medical review. The first review should occur within three months, then again at six and 12 months post-discharge.	1. Physicians, 2. Nurses, 3. Physiotherapists, 4. Occupational therapists, 5. Speech and language therapists, 6. Dieticians, 7. Psychologists 8. Social workers Pharmacists May also include: Psychiatrists, Ophthalmologists, Orthoptists, Podiatrists, Orthotists, Therapy assistants, General ward staff, Family/carers	Stroke survivors who have residual impairment at the end of the formal rehabilitation phase of care should be reviewed annually, usually by the GP or rehab provider. A referral for further assessment should be offered for relevant health professionals or general rehabilitation services if there are new problems or if physical or social environment has changed

Abbreviations

ASA	American Stroke Association
NIHSS	National Institutes of Health Stroke Scale
ESD	Early Supported Discharge
MD	Multidisciplinary
SU	Stroke Unit

Sources:	
Ireland (2010a)	Irish Heart Foundation (2010) National Clinical Guidelines and Recommendations for the Care of People with Stroke and Transient Ischaemic Attack.
Ireland (2010b)	Department of Health and Children (2010) Changing Cardiovascular Health: National Cardiovascular Health Policy 2010-2019. Dublin: Government Publications
Ireland (2011)	Department of Health (2011) National Policy and Strategy for the Provision of Neuro-Rehabilitation Services in Ireland 2011-2015.
UK (2012)	Royal College of Physicians of London, Intercollegiate Stroke Working Party Clinical Effectiveness and Evaluation Unit. *National clinical guidelines for stroke.* 4th ed. London (UK): The College; 2012.
Scotland (2010)	Scottish Intercollegiate Guidelines Network (SIGN). Management of patients with stroke: rehabilitation, prevention and management of complications, and discharge planning. A national clinical guideline. Edinburgh (Scotland): Scottish Intercollegiate Guidelines Network (SIGN); 2010 Jun. (SIGN publication; no. 118).
Europe (2008)	European Stroke Organization (ESO) Executive Committee, ESO Writing Committee. *Guidelines for the management of ischaemic stroke and transient ischaemic attack 2008.* Cerebrovasc Dis 2008;25:457-507.
Canada (2010)	Lindsay MP, Gubitz G, Bayley M, Hill MD, Davies-Schinkel C, Singh S, and Phillips S. Canadian Best Practice Recommendations for Stroke Care (Update 2010). On behalf of the Canadian Stroke Strategy Best Practices and Standards Writing Group. 2010; Ottawa, Ontario Canada: Canadian Stroke Network.
US (2010)	Dept of Veteran Affairs, Dept of Defence, The AHA/ASA (2010), VA/DoD Clinical Practice Guideline for the Management of Stroke Rehabilitation Version 2.0 2010.
New Zealand (2010)	Stroke Foundation of New Zealand and New Zealand Guidelines Group. Clinical Guidelines for Stroke Management 2010. Wellington: Stroke Foundation of New Zealand; 2010.
Australia (2010)	National Stroke Foundation. Clinical guidelines for stroke management 2010. Melbourne Australia.

9.

References

Anderson, C., C. N. Mhurchu, P. M. Brown and K. Carter, 2002. "Stroke rehabilitation services to accelerate hospital discharge and provide home-based care." *Pharmacoeconomics* **20**(8): 537-552.

Anderson, C., C. N. Mhurchu, S. Rubenach, M. Clark, C. Spencer and A. Winsor, 2000. "Home or hospital for stroke rehabilitation? Results of a randomized controlled trial II: cost minimization analysis at 6 months." *Stroke* **31**(5): 1032-1037.

Appelros, P., I. Nydevik, Å. Seiger and A. Terént, 2002. "Predictors of severe stroke influence of preexisting dementia and cardiac disorders." *Stroke* **33**(10): 2357-2362.

Beech, R., M. Ratcliffe, K. Tilling and C. Wolfe, 1996. "Hospital Services for Stroke Care: A European Perspective." *Stroke* **27**: 1958-1964.

Beech, R., A. G. Rudd, K. Tilling and C. D. Wolfe, 1999. "Economic consequences of early inpatient discharge to community-based rehabilitation for stroke in an inner-London teaching hospital." *Stroke* **30**(4): 729-735.

Brewer, L. and D. Williams, 2010. "A review of early supported discharge after stroke." *Reviews in Clinical Gerontology* **20**(04): 327-337.

Brick, A., A. Nolan, J. O'Reilly and S. Smith, 2010. "Evidence for the Expert Group on Resource Allocation and Financing in the Health Sector", The Economic and Social Research Institute. **I and II**.

Brick, A., S. Smith, C. Normand, S. O'Hara and E. Tyrell, forthcoming. "Economic Evaluation of Palliative Care in Ireland". Dublin, ESRI/TCD.

Briggs, A., K. Claxton and M. Sculpher, 2006. Decision Modelling for Health Economic Evaluation Oxford, Oxford University Press.

Carr-Hill, R., G. Hardman, S. Martin, S. Peacock, T. Sheldon and P. Smith, 1994. "A formula for distributing NHS revenues based on small area use of hospital beds". CHE Occasional Paper. Centre for Health Economics, The University of York.

Chiu, L., W.-C. Shyu and Y.-H. Liu, 2001. "Comparisons of the cost-effectiveness among hospital chronic care, nursing home placement, home nursing care and family care for severe stroke patients." *Journal of Advanced Nursing* **33**(3): 380-386.

Connolly, S. and D. O'Reilly, 2009. "Variation in care home admission across areas of Northern Ireland." *Age Ageing* **38**: 461–465.

Cowman, S., M. Royston, A. Hickey, F. Horgan, H. McGee and D. O'Neill, 2010. "Stroke and Nursing Home care: a national survey of nursing homes." *BMC Geriatr* **10**(1): 4.

Craig, L. E., O. Wu, J. Bernhardt and P. Langhorne, 2013. "Approaches to economic evaluations of stroke rehabilitation." *International Journal of Stroke*: n/a-n/a.

Cupples, M. E., M. C. Byrne, S. M. Smith, C. S. Leathem and A. W. Murphy, 2008. "Secondary prevention of cardiovascular disease in different primary healthcare systems with and without pay-for-performance." *Heart* **94**.

Curtis, L., 2010. "Unit Costs of Health and Social Care 2010". Personal Social Services Research Unit, University of Kent.

Curtis, L., 2011. "Unit Costs of Health and Social Care 2011". Personal Social Services Research Unit, University of Kent.

Curtis, L., 2012. "Unit Costs of Health and Social Care 2012", Personal Social Services Research Unit, University of Kent.

Department of Health and Health Service Executive, 2011. National Policy and Strategy for the Provision of Neuro-Rehabilitation Services in Ireland 2011-2015. Dublin, Government Publications.

Department of Health and Children, 2010. Changing Cardiovascular Health. National Cardiovascular Health Policy 2010-2019. Dublin, Government Publications.

Department of Health and Children, 2011. "Longstay Activity Statistics 2011". Dublin, Department of Health and Children.

Department of Health and Children, 2011b. "Health Statistics 2011: Table L4 Estimated Overall Health Expenditure", Department of Health and Children.

Deutsch, A., C. V. Granger, A. W. Heinemann, R. C. Fiedler, G. DeJong, R. L. Kane, K. J. Ottenbacher, J. P. Naughton and M. Trevisan, 2006. "Poststroke rehabilitation: outcomes and reimbursement of inpatient rehabilitation facilities and subacute rehabilitation programs." *Stroke* **37**(6): 1477-1482.

Donnelly, M., M. Power, M. Russell and K. Fullerton, 2004. "Randomized controlled trial of an early discharge rehabilitation service: the Belfast Community Stroke Trial." *Stroke* **35**(1): 127-133.

Drummond, M. F., M. J. Sculpher, G. W. Torrance, J. O'Brien and G. L. Stoddart, 2005. Methods for the Economic Evaluation of Healthcare Programmes. Oxford, Oxford University Press.

Early Supported Discharge Trialists, 2005 "Services for reducing duration of hospital care for acute stroke patients." *The Cochrane Database of Systematic Reviews*.

ESRI, 2009. Hospital In-patient Enquiry Scheme (HIPE) Data Dictionary 2009 Version 1.0, Economic and Social Research Institute.

ESRI, 2012. "Activity in Acute Public Hospitals in Ireland Annual Report 2011". Dublin, ESRI.

Evers, S. M., J. N. Struijs, A. J. Ament, M. L. van Genugten, J. Jager and G. A. van den Bos, 2004. "International comparison of stroke cost studies." *Stroke* **35**: 1209-1215.

Fagerberg, B., L. Claesson, G. Gosman-Hedstrom and C. Blomstrand, 2000. "Effect of acute stroke unit care integrated with care continuum versus conventional treatment: A randomized 1-year study of elderly patients: the Goteborg 70+ Stroke Study." *Stroke* **31**(11): 2578-2584.

Fearon, P. and P. Langhorne, 2012. "Services for reducing duration of hospital care for acute stroke patients." *Cochrane Database Syst Rev* **9**: CD000443.

Fisher, R. J., C. Gaynor, M. Kerr, P. Langhorne, C. Anderson, E. Bautz-Holter, B. Indredavik, N. E. Mayo, M. Power, H. Rodgers, O. M. Ronning, L. Widen Holmqvist, C. D. Wolfe and M. F. Walker, 2011. "A consensus on stroke: early supported discharge." *Stroke* **42**(5): 1392-1397.

Fjaertoft, H., B. Indredavik, R. Johnsen and S. Lydersen, 2004. "Acute stroke unit care combined with early supported discharge. Long-term effects on quality of life. A randomized controlled trial." *Clin Rehabil* **18**(5): 580-586.

Fjaertoft, H., B. Indredavik and S. Lydersen, 2003. "Stroke unit care combined with early supported discharge: long-term follow-up of a randomized controlled trial." *Stroke* **34**(11): 2687-2691.

Fjaertoft, H., B. Indredavik, J. Magnussen and R. Johnsen, 2005. "Early supported discharge for stroke patients improves clinical outcome. Does it also reduce use of health services and costs? One-year follow-up of a randomized controlled trial." *Cerebrovasc Dis* **19**(6): 376-383.

Forder, J., 2009. "Long-term care and hospital utilisation by older people: an analysis of substitution rates." *Health Economics* **18**: 1322-1338.

Gagnon, D., S. Nadeau and V. Tam, 2005. "Clinical and administrative outcomes during publicly-funded inpatient stroke rehabilitation based on a case-mix group classification model." *Journal of Rehabilitation Medicine* **37**(1): 45-52.

Gaynor, E. J., S. E. Geoghegan and D. O'Neill, 2014. "Ageism in stroke rehabilitation studies." *Age Ageing* **43**(3): 429-431.

Gladman, J. R. and C. Sackley, 1998. "The scope for rehabilitation in severely disabled stroke patients." *Disability & Rehabilitation* **20**(10): 391-394.

Grundy, E. and M. Jitlal, 2007. "Socio-demographic variations in moves to institutional care 1991-2001: a record linkage study from England Wales." *Age Ageing* **36**: 424-430.

Health Information and Quality Authority, 2013. "Draft Guidelines for the Economic Evaluation of Health Technologies in Ireland".

Health Service Executive/MMUH, 2012. "National Stroke Programme Early Supported Discharge programme for stroke, Mater Misericordiae University Hospital North Dublin City pilot - final report". Dublin, MMUH.

Hickey, A., D. Holly, H. McGee, R. Conroy and E. Shelley, 2012. "Knowledge of stroke risk factors and warning signs in Ireland: development and application of the Stroke Awareness Questionnaire (SAQ)." *International Journal of Stroke*.

Hickey, A., F. Horgan, D. O'Neill and H. McGee, 2012. "Community-based post-stroke service provision and challenges: a national survey of managers and inter-disciplinary healthcare staff in Ireland." *BMC Health Serv Res* **12**(1): 111.

Holloway, R. G., C. G. Benesch, W. S. Burgin and J. B. Zentner, 2005. "Prognosis and decision making in severe stroke." *JAMA: the journal of the American Medical Association* **294**(6): 725-733.

Horgan, F., H. McGee, A. Hickey, D. L. Whitford, S. Murphy, M. Royston, S. Cowman, E. Shelley, R. M. Conroy, M. Wiley and D. O'Neill, 2011. "From prevention to nursing home care: a comprehensive national audit of stroke care." *Cerebrovasc Dis* **32**(4): 385-392.

Horgan, F., M. Walsh, R. Galvin, C. Macey and C. Loughnane, 2014. "National Survey of Stroke Survivors 2013: Experiences and long-term needs reported by stroke survivors living in the community in Ireland". Dublin, National Disability Authority/ Irish Heart Foundation.

HSE National Stroke Programme, 2010. "Hospital Emergency Stroke Services Survey (HESS / unpublished)".

HSE National Stroke Programme, 2011. "Community Stroke Service (CoSS) Survey: Report 1 (unpublished)", HSE Strategy and Programmes Directorate.

Indredavik, B., H. Fjærtoft, G. Ekeberg, A. D. Løge and B. Mørch, 2000. "Benefit of an Extended Stroke Unit Service With Early Supported Discharge A Randomized, Controlled Trial." *Stroke* **31**(12): 2989-2994.

Intercollegiate Stroke Working Party, 2012. "National clinical guideline for stroke, 4th edition". London: Royal College of Physicians.

Irish Heart Foundation, 2008. "Irish Heart Foundation National Audit of Stroke Care". Dublin, Irish Heart Foundation.

Jorgensen, H. S., L. P. Kammersgaard, J. Houth, H. Nakayama, H. O. Raaschou, K. Larsen, P. Hubbe and T. S. Olsen, 2000. "Who benefits from treatment and rehabilitation in a stroke Unit? A community-based study." *Stroke* **31**(2): 434-439.

Jorgensen, H. S., H. Nakayama, H. O. Raaschou, K. Larsen, P. Hubbe and T. S. Olsen, 1995. "The effect of a stroke unit: reductions in mortality, discharge rate to nursing home, length of hospital stay, and cost. A community-based study." *Stroke* **26**(7): 1178-1182.

Kalra, L., P. Dale and P. Crome, 1993. "Improving stroke rehabilitation. A controlled study." *Stroke* **24**(10): 1462-1467.

Kalra, L. and J. Eade, 1995. "Role of stroke rehabilitation units in managing severe disability after stroke." *Stroke* **26**(11): 2031-2034.

Kelly, P. J., G. Crispino, O. Sheehan, L. Kelly, M. Marnane, A. Merwick, N. Hannon, D. Ni Chroinin, E. Callaly, D. Harris, G. Horgan, E. B. Williams, J. Duggan, L. Kyne, P. McCormack, E. Dolan, D. Williams, J. Moroney, C. Kelleher and L. Daly, 2012. "Incidence, event rates, and early outcome of stroke in Dublin, Ireland: the North Dublin population stroke study." *Stroke* **43**(8): 2042-2047.

Korner-Bitensky, N., 2013. "When does stroke rehabilitation end?" *International Journal of Stroke* **8**(1): 8-10.

Krueger, H., P. Lindsay, R. Cote, M. K. Kapral, J. Kaczorowski and M. D. Hill, 2012. "Cost avoidance associated with optimal stroke care in Canada." *Stroke* **43**(8): 2198-2206.

La Trobe University, 2004. "AusTOMs for Speech Pathology". Victoria, La Trobe University.

Langhorne, P., J. Bernhardt and G. Kwakkel, 2011. "Stroke rehabilitation." *Lancet* **377**(9778): 1693-1702.

Langhorne, P., G. Taylor, G. Murray, M. Dennis, C. Anderson, E. Bautz-Holter, P. Dey, B. Indredavik, N. Mayo, M. Power, H. Rodgers, O. M. Ronning, A. Rudd, N. Suwanwela, L. Widen-Holmqvist and C. Wolfe, 2005. "Early supported discharge services for stroke patients: a meta-analysis of individual patients' data." *Lancet* **365**(9458): 501-506.

Larsen, T., T. S. Olsen and J. Sorensen, 2006. "Early home-supported discharge of stroke patients: a health technology assessment." *Int J Technol Assess Health Care* **22**(3): 313-320.

Lindsay, M., G. Gubitz, M. Bayley, M. Hill, C. Davies-Schinkel, S. Singh and S. Phillips, 2010. "Canadian best practice recommendations for stroke care (update 2010)." *Ottawa, Ontario Canada: Canadian Stroke Network*.

Martin, S. and P. Smith, 1996. "Explaining variations in inpatient length of stay in the National Health Service." *Journal of Health Economics* **15**(3): 279-304.

Mas, M. À. and M. Inzitari, 2012. "A critical review of Early Supported Discharge for stroke patients: from evidence to implementation into practice." *International Journal of Stroke*: n/a-n/a.

Maulden, S. A., J. Gassaway, S. D. Horn, R. J. Smout and G. DeJong, 2005. "Timing of initiation of rehabilitation after stroke." *Arch Phys Med Rehabil* **86**(12 Suppl 2): S34-S40.

McNamee, P., J. Christensen, J. Soutter, H. Rodgers, N. Craig, P. Pearson and J. Bond, 1998. "Cost analysis of early supported hospital discharge for stroke." *Age Ageing* **27**(3): 345-351.

McPake, B., L. Kumaranayake and C. Normand, 2002. Health Economics - An International Perspective. London, Routledge.

Moon, L., P. Moïse and S. Jacobzone, 2003. "Stroke care in OECD Countries: a comparison of treatment, costs and outcomes in 17 countries", OECD Publishing.

National Audit Office, 2010. "Report by the Comptroller and Auditor General: Department of Health - Progress in improving stroke care". London.

National Audit Office, 2010b. "Report by the Comptroller and Auditor General: Report on the findings from our modelling of stroke care provision". London.

National Centre for Classification in Health (NCCH), 2004. "The International Statistical Classification of Diseases and Related Health ProblemsTenth Revision, Australian Modification (4th Edition)". e book. Sydney, NCCH, Faculty of Health Sciences, The University of Sydney.

Nolfe, G., A. M. D'Aniello, R. Muschera and S. Giaquinto, 2003. "The aftermath of rehabilitation for patients with severe stroke." *Acta Neurol Scand* **107**(4): 281-284.

O'Connor, R. J., E. M. Cassidy and M. A. Delargy, 2005. "Late multidisciplinary rehabilitation in young people after stroke." *Disabil Rehabil* **27**(3): 111-116.

O'Neill, D., F. Horgan, A. Hickey and H. McGee, 2008. "Long term outcome of stroke: Stroke is a chronic disease with acute events." *BMJ* **336**: 461.

Outpatient Service Trialists, 2003 "Therapy-based rehabilitation services for stroke patients at home." *Cochrane Database of Systematic Reviews* DOI: 10.1002/14651858.CD002925.

Pereira, S., J. R. Graham, A. Shahabaz, K. Salter, N. Foley, M. Meyer and R. Teasell, 2012. "Rehabilitation of individuals with severe stroke: synthesis of best evidence and challenges in implementation." *Top Stroke Rehabil* **19**(2): 122-131.

Pereira, S., R. Teasell, R. Graham, K. Salter, N. Foley and S. Donaldson, 2013. "Rehabilitation of Severe Stroke" in Evidence-based Review of Stroke Rehabilitation - Module 23. R. Teasell, www.EBRSR.com.

Roderick, P., J. Low, R. Day, T. Peasgood, M. A. Mullee, J. C. Turnbull, T. Villar and J. Raftery, 2001. "Stroke rehabilitation after hospital discharge: a randomized trial comparing domiciliary and day-hospital care." *Age Ageing* **30**(4): 303-310.

Rodgers, H., J. Soutter, W. Kaiser, P. Pearson, R. Dobson and C. Skilbeck, 1997. "Early supported hospital discharge following acute stroke: pilot study results." *Clin Rehabil* **11**: 280-287.

Ronning, O. M. and B. Guldvog, 1998. "Outcome of subacute stroke rehabilitation: a randomized controlled trial." *Stroke* **29**(4): 779-784.

Rossnagel, K., C. Nolte, J. Muller-Nordhorn, G. Jungehulsing, D. Selim, B. Bruggenjurgen, A. Villringer and S. Willich, 2005. "Medical resource use and costs of health care after acute stroke in Germany." *European Journal of Neurology* **12**: 862-868.

Rousseaux, M., W. Daveluy and R. Kozlowski, 2009. "Value and efficacy of early supported discharge from stroke units." *Ann Phys Rehabil Med* **52**(3): 224-233.

Ruane, F., 2010. "Report of the Expert Group on Resource Allocation and Financing in the Health Sector". Dublin, Department of Health and Children,.

Rudd, A. G., C. D. Wolfe, K. Tilling and R. Beech, 1997. "Randomised controlled trial to evaluate early discharge scheme for patients with stroke." *BMJ* **315**(7115): 1039-1044.

Saka, O., V. Serra, Y. Samyshkin, A. McGuire and C. C. Wolfe, 2009. "Cost-effectiveness of stroke unit care followed by early supported discharge." *Stroke* **40**(1): 24-29.

Sandstrom, R., P. J. Mokler and K. M. Hoppe, 1998. "Discharge destination and motor function outcome in severe stroke as measured by the functional independence measure/function-related group classification system." *Arch Phys Med Rehabil* **79**(7): 762-765.

Schmidt, J. G., J. Drew-Cates and M. L. Dombovy, 1999. "Severe disability after stroke: outcome after inpatient rehabilitation." *Neurorehabil Neural Repair* **13**(3): 199-203.

Smith, S., F. Horgan, E. Sexton, M. Wiley, S. Cowman, A. Hickey, P. Kelly, H. McGee, S. Murphy, D. O'Neill, M. Royston and E. Shelley, 2010. Cost of Stroke in Ireland. Estimating the annual economic cost of stroke and transient ischaemic attack (TIA) in Ireland. Dublin, Irish Heart Foundation.

Sritipsukho, P., A. Riewpaiboon, P. Chaiyawat and K. Kulkantrakorn, 2010. "Cost-effectiveness analysis of home rehabilitation programs for Thai stroke patients." *J Med Assoc Thai* **93 Suppl 7**: S262-270.

Sulter, G., C. Steen and J. De Keyser, 1999. "Use of the Barthel index and modified Rankin scale in acute stroke trials." *Stroke* **30**(8): 1538-1541.

Teasell, R., N. Foley, K. Salter, M. Richardson, L. Allen, N. Hussein, S. Bhogal, J. Jutai and M. Speechley, 2013. "Evidence-based review of stroke rehabilitation. 16th ed. Available at www.EBRSR.com. ."

Teasell, R., M. Meyer, N. Foley, K. Salter and D. Willems, 2009. "Stroke rehabilitation in Canada: a work in progress." *Top Stroke Rehabil* **16**(1): 11-19.

Teasell, R. W., N. C. Foley, S. K. Bhogal, R. Chakravertty and A. Bluvol, 2005. "A rehabilitation program for patients recovering from severe stroke." *Can J Neurol Sci* **32**(4): 512-517.

Teasell, R. W., N. C. Foley, S. K. Bhogal and M. R. Speechley, 2003. "Early supported discharge in stroke rehabilitation." *Top Stroke Rehabil* **10**(2): 19-33.

Teng, J., N. E. Mayo, E. Latimer, J. Hanley, S. Wood-Dauphinee, R. Cote and S. Scott, 2003. "Costs and caregiver consequences of early supported discharge for stroke patients." *Stroke* **34**(2): 528-536.

The Cochrane Collaboration. 2014. "Cochrane Reviews." Retrieved August 14th, 2014, from http://www.cochrane.org/cochrane-reviews.

The National Audit of Stroke Care Research Team, 2007. "Community Audit: National Survey of Nursing Homes, 2007". Unpublished, Irish Heart Foundation in Association with the Department of Health and Children

Tummers, J., A. Schrijvers and J. Visser-Meily, 2012. "Economic evidence on integrated care for stroke patients; a systematic review." *International Journal of Integrated Care* **12**(1).

Van Exel, N., W. S. op Reimer and M. Koopmanschap, 2004. "Assessment of post-stroke quality of life in cost-effectiveness studies: The usefulness of the Barthel Index and the EuroQoL-5D." *Quality of Life Research* **13**(2): 427-433.

von Koch, L., J. de Pedro-Cuesta, V. Kostulas, J. Almazán and L. Widén Holmqvist, 2001. "Randomized Controlled Trial of Rehabilitation at Home after Stroke: One-Year Follow-Up of Patient Outcome, Resource Use and Cost." *Cerebrovascular Diseases* **12**: 131-138.

Wade, D., 1992. Measurement in neurological rehabilitation. Oxford, Oxford University Press.

World Health Organization, 2006. "WHO STEPS Stroke Manual: the WHO STEPwise approach to stroke surveillance". Geneva, World Health Organization.

Wren, M.-A., 2009. "Long-Term Health and Social Care" in Projecting the Impact of Demographic Change on the Demand for and Delivery of Health Care in Ireland, Research Series Number 13. R. Layte. Dublin, Economic and Social Research Institute.

Wren, M.-A. and P. Kelly, 2013. "Deriving a Method to Estimate Incidence of Stroke in Ireland". ESRI Working Paper No 469. Dublin, ESRI.

Wren, M.-A., C. Normand, D. O'Reilly, S. M. Cruise, S. Connolly and C. Murphy, 2012. "Towards the Development of a Predictive Model of Long-Term Care Demand for Northern Ireland and the Republic of Ireland". Dublin, Trinity College Dublin.

Wyller, T. B., 2000. "Rehabilitation after severe stroke-an enthusiastic approval and a cautionary note." *Disability & Rehabilitation* **22**(4): 193-195.



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