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Review

Geriatric rehabilitation following fractures in older people: a systematic review

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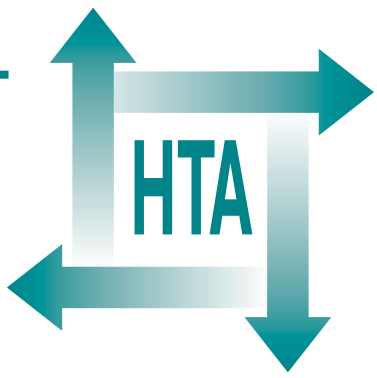
Health Technology Assessment
NHS R&D HTA Programme



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Geriatric rehabilitation following fractures in older people: a systematic review

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This report is one of a series covering acute care, diagnostics and imaging, methodology, pharmaceuticals, population screening, and primary and community care. It was identified as a priority by the Acute Sector Panel and funded as project number 95/36/02.

The views expressed in this publication are those of the authors and not necessarily those of the Standing Group, the Commissioning Board, the Panel members or the Department of Health. The editors wish to emphasise that funding and publication of this research by the NHS should not be taken as implicit support for the recommendations for policy contained herein. In particular, policy options in the area of screening will be considered by the National Screening Committee. This Committee, chaired by the Chief Medical Officer, will take into account the views expressed here, further available evidence and other relevant considerations.

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Contents

List of abbreviations

ADL	activities of daily living*
CCT	controlled clinical trial
CI	confidence interval
Cohort (C)	cohort with contemporary controls*
Cohort (H)	cohort with historical controls*
df	degrees of freedom*
ESD	early supported discharge
GHFP	geriatric hip fracture programme
GORU	geriatric orthopaedic rehabilitation unit
HRQL	health-related quality of life
LOS	length of stay*
MARU	mixed assessment and rehabilitation unit
NHP	Nottingham Health Profile*
OR	odds ratio
OT	occupational therapy*
PFF	proximal femoral fracture*
PPS	prospective payment system
PT	physiotherapy*
RCT	randomised controlled trial
SD	standard deviation*
WMD	weighted mean difference

* Used only in tables and figures

Executive summary

Background

The prevalence of fractures in older people is increasing rapidly. Different types of programmes are available for rehabilitation after these fractures. However, the effectiveness of these programmes is uncertain.

Objectives

These were to identify, critically appraise and synthesise the published evidence for the effectiveness and cost-effectiveness of programmes of care following the acute management of fractures in older people. The principal focus is on rehabilitative care after proximal femoral fracture.

Methods

Data sources

- Electronic searching of MEDLINE, EMBASE and CINAHL databases.
- Search of bibliographies of all electronically identified studies.
- Search of databases of group members.
- Personal communication with experts in the field.

Study selection

The inclusion criteria for the review were any systematic review or randomised, quasi-randomised or controlled cohort study reporting the outcome of a programme designed to improve function or reduce hospital stay in older people who have sustained a fragility/fall associated fracture in the lower limbs, pelvis, upper limbs or spine. Economic evaluations of studies meeting the inclusion criteria were also eligible. Published audit data from the UK in the last 5 years were examined to provide an indication of current treatment and outcome.

Data extraction

Included studies were each sent to two reviewers for methodological appraisal and data extraction. Where reviewers differed on any item, each was asked to reconsider their decision. The two principal reviewers working together compiled the quality scores and data derived from each individual study. A nine-item methodological quality score was derived for each included study.

Data synthesis

Individual studies were grouped by the type of intervention programme into seven categories defined by the two principal reviewers. Where similarity of interventions and outcomes allowed, the data were pooled using the Cochrane Collaboration Review Manager software.

Results

Forty-one comparative studies (of which 14 were randomised trials) and seven audit studies were included. The comparative studies were classified into seven groups on the basis of the experimental intervention being investigated:

- geriatric orthopaedic rehabilitation unit (GORU) – seven studies
- geriatric hip fracture programme (GHFP) – five studies
- early supported discharge (ESD) programme – six studies
- introduction of clinical pathways for treatment of hip fracture – three studies
- impact of the introduction of prospective payment systems (PPSs) – six studies
- miscellaneous hospital programmes – four studies
- specific types of therapy, nursing or medical care – 10 studies.

These studies were heterogeneous. Striking variation was found in the reporting of outcomes, the details of the 'control' interventions, and the case mix; this limited pooling of data. The very limited data that were available suggest that:

- GHFP, ESD and clinical pathways reduce total length of stay in hospital
- there is no evidence that length of stay in a GORU is less than in a conventional orthopaedic unit
- length of stay may be reduced by the introduction of a PPS

- readmission rate after ESD shows a statistically non-significant increase
- significantly higher rates of return to previous residential status are achieved by GHFP and by ESD
- PPSs have led to increased use of nursing homes in the USA
- there is no evidence that any of the programmes evaluated, nor the introduction of PPSs, are associated with changes in mortality
- there are insufficient data to assess the impact of any programme on level of function, morbidity, quality of life or impact on carers
- from a health and social services perspective, GHFP and ESD are likely to be cost-saving. The economic implications of GORU are less clear. Cost-saving associated with these programmes is achieved largely through the increased rate of return to previous residential status.

Conclusions

Geriatric service interventions after hip fracture are complex: their form and outcomes are strongly influenced by local conditions. Comparative studies comparing different treatments and strategies are of poor to moderate quality, allowing only tentative conclusions. As an overall strategy for rehabilitation after hip and other lower limb fractures, GORUs are unlikely to be cost-effective, but some frailer patients may benefit in respect of reduced readmission rates and need for nursing home placement. GHFPs and ESD are probably cost-effective, since they appear to shorten the average length of hospital stay, and are associated with significantly increased rates of return to previous residential status. These programmes are not mutually exclusive; an optimal GHFP is likely to involve several elements. As ESD is suitable only for a subset of less disabled patients, an alternative programme for more disabled patients is needed; this is likely to require transfer following surgery, initially to an inpatient setting which might be provided in a GORU or a mixed assessment and rehabilitation unit (MARU). No direct comparison of GORUs and MARUs has been published. Both comparisons of packages of care (such as the GORU or MARU) and comparison of individual elements in these packages may require further research. The adoption of an agreed outcome data set for audit and research would be justified.

Implications for practice

The authors consider that:

(1) ESD should be a component of GHFPs to maximise opportunities for suitable individuals to return to their own homes as soon as possible.
(2) New GORUs should not be established unless their superiority over mixed assessment and rehabilitation units (MARUs) is demonstrated. However, acute units managing hip fractures should retain access to assessment and rehabilitation services in GORUs or MARUs for the more disabled but previously community-dwelling patients.
(3) There are insufficient data to recommend the introduction of formal clinical pathways in association with these practices, although there is weak evidence that they may be advantageous.

Recommendations for research

(1) A study comparing the outcome of transfer of people previously living in the community unsuitable for ESD to a GORU or to a MARU should be considered. Given the paucity of cost-effectiveness information to date, this should include an economic evaluation.
(2) Further studies of ESD and GHFPs to establish the evidence for best practice should be conducted. These should include evaluation of individual elements of care packages. Particular attention to methodological quality is required.
(3) The adoption of an agreed outcome data set for research into and audit of rehabilitation after lower limb fractures in the elderly should be a priority, ideally before any new trials or new audit programmes are funded. Such a data set should include assessment of function, health-related quality of life, carer burden, and information allowing an economic analysis that takes a societal perspective and establishes the costs and savings of different models of care in relation to primary care services.
(4) Adopted data sets/frameworks should be reviewed at least every 5 years.

Chapter 1
Background

The consequences of fall-associated osteoporotic fractures in older people create a significant and increasing burden of illness in the community. The majority of the burden is attributable to lower limb fractures, of which around half occur in the proximal femur (femoral neck and trochanteric region); these carry a first year mortality of over 20%.[1] Of the survivors, 50% can no longer walk unaided, 20–40% require formal care in the community or in residential/nursing homes, and many others depend on informal carers.[2] In Western countries the lifetime risk of proximal femoral fracture is 17.5% in women and 6% in men.[3] The incidence doubles in each 5 year age cohort above 65 years. There is some evidence of an increase in age-specific incidence.[4] Without change in the age-specific incidence, approximately 50,000 women in the UK each year will suffer a hip fracture by 2006.[5] If the trend of increase in incidence continues, the figure at that point will be around 80,000. The annual cost to the NHS for osteoporotic fractures among women alone has been estimated at £354 million, and total public sector costs (including residential care) has been estimated to exceed £700 million. Hip fractures account for about 87% of the total cost, at around £12,000 each, and including male hip fractures increases the total cost to £940 million.[6]

The magnitude of the individual suffering, social dislocation, and costs of these injuries have encouraged the development of new strategies for postsurgical care following osteoporotic fractures. These approaches have mainly been driven both by health professionals concerned to improve outcomes, and by the management of provider units anxious to contain costs, particularly following the introduction of prospective payment by funders in the USA. Descriptive studies have raised some concerns about the consequences of the introduction of prospective payment systems on outcomes after hip fracture.[7]

In the UK and in other countries with similar health systems, one approach to improve outcomes (and to meet the disposal imperative felt by acute orthopaedic units) has been specialised inpatient rehabilitation supervised by a geriatrician within a multidisciplinary team. This has taken a number of forms. The geriatric orthopaedic rehabilitation unit (GORU) is dedicated to this patient group. Geriatric mixed assessment and rehabilitation units[8] (MARUs) may also admit patients after hip fracture. In the USA a range of nursing home and rehabilitative facilities providing different mixes of care have been used. These types of units are separate from the acute orthopaedic unit, necessitating discontinuity in care and (usually) transfer to another site. In geriatric hip fracture programmes (GHFPs), involvement of the geriatric team begins in the orthopaedic surgical unit, early after admission. As part of this programme, frailer patients who were previously living in the community may be transferred to a rehabilitation unit, but those with less disability remain in the orthopaedic unit until able to live at home. In an attempt to reduce the tension between the acute-sector disposal imperative and optimal rehabilitation, early supported discharge (ESD) programmes have been introduced. Reduced length of acute hospital stay may be achieved by the planned provision of additional support in the patient or carer's home in the community. Further details of the characteristics of some of these programmes are in appendix 1.

Audit data are now becoming increasingly available.[9–15] Although these audits rarely provide detailed comparisons between different strategies, their data capture systems could offer an excellent framework to do so. In addition, these data could provide a regularly updated record of what is actually being achieved outside the context of formal research programmes.

The literature describing the outcomes of the various rehabilitative strategies has included some trials, but most studies have been descriptive in nature or have used a historical control group, and have varied widely in the estimate of the proportion of patients suitable for the different approaches. Little is known about the relative benefits to the patient, or impact on carers of these forms of care. This systematic review was therefore commissioned and conducted in the expectation that its results will inform planners,

purchasers and providers of care of the strengths and weaknesses of current strategies, and indicate directions for future research and development.

The review was carried out by a group which included members with expertise in geriatric medicine (specifically in rehabilitation following hip fracture), orthopaedic surgery, nursing, health economics, public health, review methodology and statistics. The majority had also contributed to systematic reviews within the Cochrane Collaboration.

Chapter 2

Objective

The overall objective was to identify, critically appraise, and synthesise the published evidence for the effectiveness and cost-effectiveness of programmes or interventions by multidisciplinary geriatric care teams, or by their individual members, following the acute management of fracture in the elderly. The principal focus is on rehabilitative care after proximal femoral fracture.

Chapter 3

Hypotheses tested

Specific hypotheses, based on the original proposal, were formulated following completion of the search strategy and scrutiny of its product, which allowed an overview of the clustering of intervention types that had been reported. We were not able to frame a single hypothesis in respect of a group of trials that examined particular rehabilitative interventions.

The main hypotheses tested for the rehabilitation following fractures in older people were:

- there is no difference in outcome between rehabilitation in a GORU and rehabilitation in an orthopaedic unit
- there is no difference in outcome between treatment/rehabilitation in a unit providing a GHFP and standard orthopaedic care
- there is no difference in outcome between ESD and an inpatient rehabilitation programme
- the introduction of clinical pathways has no effect on outcomes
- the introduction of a prospective payment system (PPS) has no effect on outcomes.

Chapter 4

Review methods

Selection criteria

Types of study

This review included any systematic review, randomised controlled trial (RCT), quasi-randomised controlled clinical trial (CCT) or cohort study (non-randomised comparative study with a control population, either contemporary or historical) reporting the outcome of a programme designed to improve function or reduce hospital stay in older people who have sustained a fragility/fall-associated fracture in the lower limbs, pelvis, upper limbs or spine. Reports of programmes of care in which less than 30% of the participants had sustained a lower limb orthopaedic injury were excluded. However, we included reports of RCTs and CCTs of specific rehabilitative treatment after fracture at any site in older people. Any economic evaluation of a study or studies meeting the inclusion criteria was also eligible for inclusion.

Data from published audits, conducted without a control population, were included only if these described current practice (within the last 5 years) in the UK; the purpose being to indicate current practice and to establish an estimate of the absolute risk of outcomes of interest outside the context of RCTs.

Types of participant

Patients aged 65 years or more with any fracture of the lower limbs, pelvis, upper limbs or spine which required hospital care either as an inpatient or in ambulatory care were included. Studies that included a small proportion of younger patients (less than 10%) were admissible. Studies whose main focus was fractures sustained from high-energy transfer (e.g. road traffic accidents or building collapse) and trials of rehabilitation following fractures of the ribs or facial skeleton were excluded.

Types of intervention

Interventions included were those designed to improve function (mobility and self-care) and/or reduce hospital stay. These fell into three broad categories: packages of care (GORU, GHFP, ESD, application of a clinical pathway); the consequences of the introduction of PPSs; and specific rehabilitative interventions by nurses, therapists, other health or social care workers, and carers, designed to improve particular aspects of mobility or self-care. Interventions starting after the primary rehabilitation period were excluded.

Types of outcome measure

The principal outcomes sought were:

- length of hospital stay
- readmission to hospital (to an acute care facility)
- residence following discharge (immediate and longer term)
- all cause mortality
- morbidity, including postoperative complications and episodes of treated co-morbidity
- mobility
- ability to perform activities of daily living
- health-related quality of life (HRQL) measures.

Other outcomes noted in the data extraction were:

- carer burden and stress
- cognitive function
- any cost data
- compliance with intervention.

Protocol development and strategy

A preliminary protocol devised through consultation to meet the requirements of the project specifications was presented in the grant application. At the beginning of the project, two meetings of the core members of the group (grant holders and the research assistant) were held to discuss and establish the general scope and content of the review, individual areas of responsibility, the preliminary search strategy and a provisional timetable. Agreement was reached on a working version of the protocol that incorporated minor changes to the selection criteria (see appendix 2). Further minor changes to the protocol and methodology (also listed in appendix 2) occurred during the project, reflecting evolution of ideas in

the light of experience (e.g. the restriction of economic evaluations to those within comparative studies) or practical considerations (e.g. the limited availability of translations, and lack of time for return to trialists for further data).

Search strategy

Studies for inclusion were identified by:

(1) Electronic searching of MEDLINE (1976 to August 1998), EMBASE (1980 to July 1998) and CINAHL (1982 to April 1998). A comprehensive subject-specific and intentionally overinclusive search strategy was developed and tested for use on MEDLINE SilverPlatter. Pilot searches were carried out for 1995 and 1996 to refine the search strategy. Search end-point 2 was used in the final version of the MEDLINE search strategy listed in appendix 3, and the results of the 1995 pilot search using the same end-point are shown in appendix 4. After MEDLINE, the search strategy was adapted for use in EMBASE and CINAHL.
(2) Searching of bibliographies of all studies considered for the review, as well as those of review articles.
(3) Personal communication with experts in the 'field'.
(4) Searching of reference collections of group members, including that of the Cochrane Musculoskeletal Injuries Group specialist database. The search strategy for the latter included a monthly search of Current Contents (Clinical Medicine and Life Sciences), seeking 'rehab*' or 'fracture*' in the title or keywords.

Searching for full reports of studies identified in abstract continued until the end of November 1998. No language restriction was applied but the bias towards English language publications was acknowledged as an inevitable consequence of the above search strategy.

Study selection

Triage of the search product was iterative and always overinclusive, with a system of checks devised to ensure consistency and validity. First, all fields of electronically identified reports were scrutinised by the research assistant (KQ) and graded into three categories ('highly', 'possibly' or 'not relevant'). A second reviewer (HH) also checked all reports, and a consensus reached. Citations for the first two categories were entered into Reference Manager® software, and paper copies of all studies in the first category obtained. Citations of possibly relevant studies were forwarded to a third reviewer (RM) who identified those for which paper copies were to be obtained. A selection of references from other sources such as bibliographies was collected by KQ, who also took account of contextual information provided by the sources. Paper copies were screened and graded by KQ using the inclusion criteria in the protocol, with a second opinion sought (HH) when uncertain. Definitely relevant studies were put forward for immediate review. If potentially relevant, the two principal reviewers (IC and WG) considered them further and completed a study eligibility form (see appendix 5). The principal reviewers reached consensus on the inclusion or exclusion of the studies for further consideration. All reviewers were invited to comment on the relevance of studies allocated to them for reviewing by completing, where appropriate, the study eligibility form. These were taken account of by the two principal reviewers in their final inclusion or exclusion of studies.

Copies of UK audit studies, identified mainly from collections of group members and from the above search strategy, were separately appraised for relevance by three reviewers (IC, RM and WG).

Methodological appraisal and data extraction

Concurrently with searching, draft methodological appraisal and data extraction documents were designed to cover all study types. All grant holders and the research assistant piloted these for two study reports of two different study types. Consensus on content and layout were then achieved, and the final methodological appraisal and data extraction documents were drawn up (see appendices 6 and 7).

Studies identified for review were each sent separately to two of the reviewers (IC, MC, TF, LG, WG, HH, SK and RM), at least one of whom was a content expert, for methodological appraisal and data extraction. Reviewers were not allocated their own studies. Strategies for identifying and resolving discrepancies between forms returned by reviewers were developed. Where reviewers differed on key items in the methodological appraisal form or most items, including any outcome item, in the data extraction form or gave inconsistent answers, each received notification of the difference and

was asked to reconsider their decision. When consensus between the reviewers was not reached, one of the two principal reviewers made the final decision.

From the methodological appraisal form, a nine-item methodological quality score (see appendix 8) was devised by WG and distributed to the grant holders for comments. This included both internal and external validity criteria. The quality scores and data derived from each included study were drawn up by the two principal reviewers (IC and WG) working together.

Data synthesis

Data from RCTs and cohort comparisons were analysed as separate subgroups. When studies included a mixed population, only the data for orthopaedic injury in older people were extracted where possible. Statistics employed were odds ratios (ORs) with 95% confidence intervals (CIs) for dichotomous outcomes, and weighted mean differences (WMDs) with 95% CIs for continuous outcomes. Statistical heterogeneity within and between subgroups was calculated. Where the similarity of interventions and outcomes allowed, pooling of data was carried out with the Cochrane Collaboration Review Manager software (REVMAN v.3.1), using a random effects model to calculate the pooled ORs. RCTs and cohort studies were analysed as separate subgroups. We chose the random effects model because the interventions being pooled were inherently heterogeneous. Where insufficient data were available to allow calculation of CIs, overall point estimates of difference were calculated with the range of the data also noted.

Economic analysis

We anticipated before starting the review that cost and benefit data were likely to be expressed in disparate ways. Therefore, two approaches were used. First we summarised the changes in physical quantities of the resources that would occur as a result of moving from one form of care to another. This approach allowed a number of different cost estimates to be attached to the resources; hence enhancing the generalisability of the results. Second, in order to estimate the incremental costs or savings by using one care package or another, we attached estimates of the cost of these resources using recently published estimates of social care costs.[16]

A marginal or incremental cost analysis was used. Thus, for example, increases or decreases in hospital stay were priced using only the additional 'hotel' cost element as it would be unlikely that increases or decreases in length of stay would affect capital costs such as building costs.[17] To estimate any net cost saving due to an improved rate of return to prefracture residence we used recently published estimates of additional costs incurred by patients who sustained a hip fracture when they are living in their own home and the cost of care in a nursing home.[6]

Sensitivity analyses were undertaken by taking the upper and lower 95% CIs of additional resource use or saving and describing the additional resource use or saving which would occur if these had been the true estimate of an intervention's effectiveness. Discounting of costs was not undertaken as it was assumed all the costs and savings occurred within 12 months.

Presentation of data

The results of the review are presented in two sections. First, the results of the search and report selection strategy are described. The included studies are then categorised and described and the results of methodological appraisal and outcome presented. A list of comparisons from individual studies without study identifiers or outcomes was viewed independently by the two principal reviewers (IC and WG), who developed a provisional grouping of six comparisons. This was further refined upon completion of data extraction, resulting in seven categories. The two principal reviewers working together allocated studies into comparison groups to allow testing of the research hypotheses and formulation of the economic analysis. The categories are:

(1) Comparisons between two hospital programmes: rehabilitation in a dedicated geriatric facility (GORU) versus rehabilitation in a general orthopaedic unit.
(2) Comparisons between two hospital programmes: admission to a GHFP within an orthopaedic unit versus orthopaedic team care in a general orthopaedic unit.
(3) Comparisons between an ESD programme and an in-hospital care package.
(4) Comparisons between two hospital programmes: application of care plans/clinical pathways versus standard (previous) care programmes.
(5) Investigations of the effect of changes in health system strategy or funding.

(6) Comparisons between two hospital programmes: miscellaneous comparisons.
(7) Specific therapy/nursing/medical intervention after hip or other fracture.

The items tabulated and discussed in this review reflect its principal aim – an analysis of rehabilitative care after proximal femoral fracture. The items selected provide a description of: patient characteristics, age and preinjury residence (the principal proxies for prefracture health status, which is the major determinant of outcome after hip fracture);[18] length of hospital stay (as a proxy for cost); discharge to home or geriatric rehabilitative care (as an indicator for the type of post injury care used); and mortality, residential status and functional outcome at defined times after fracture (providing a summary of functional recovery).

Chapter 5

Details of included studies

The results of the search strategy and triage of reports are summarised in appendix 9. Primary electronic searching of MEDLINE produced 2186 reports, of which 332 were downloaded as possibly relevant. Searching of other databases, scrutiny of bibliographies of retrieved studies, and communication with experts in the field resulted in downloading of a further 218 references. Following further scrutiny, 428 of these 550 reports were discarded as definitely not meeting the inclusion criteria. The remaining 122 reports were read by a minimum of two reviewers. Thirty-four were preliminary, partial or duplicate reports of other studies. Forty-seven studies were excluded at this stage for the reasons listed (see appendix 10), leaving a total of 41 comparative studies included in the review. One relevant study nearing completion was also identified. We found only one trial (a pilot study) amongst the non-English references retrieved.

Seven of the 15 audit reports identified were considered relevant to the review.[9–15] Requests for further data on outcomes of interest were sent, but no new data were obtained. The audit data were reviewed by one of the reviewers (IC). The results from four studies are summarised in appendix 11.

Two relevant previous systematic reviews were identified in the Cochrane Library.[19,20] One of these was the review[19] of randomised trials which looked at inpatient rehabilitation of hip fracture patients and acted as a starting point for this review. Its included studies (together with any recently published updates) are all considered in this review, but have been individually reappraised in the same manner as other studies.

The studies

The 41 included studies had been published in a total of 66 reports.[7,17,21–84] They are listed by intervention type in *Table 1*. Fourteen were randomised trials, two were quasi-randomised, 10 were cohort studies with concurrent controls and 15 were cohort studies with a historical control group. Data were unavailable for one additional randomised trial[85] undergoing data analysis.

Seven studies were classified as primarily investigating a GORU (*Table 1*), five as a GHFP (*Table 2*), six as an ESD programme following hip fracture (*Table 3*), three as clinical pathways for treatment of hip fracture (*Table 4*), six as examining the impact of a PPS (*Table 5*), four as miscellaneous comparisons of hospital programmes (*Table 6*) and 10 as specific types of therapy, nursing or medical care following hip or other fractures in older people (*Table 7*). Two or more randomised trials were available only in the first two and last of the above categories.

The interventions were complex and varied, and classification has been dependent on the reviewers' interpretation of the information provided in the report. For example, if the report evaluated the impact of introducing a new overall programme based in an acute orthopaedic unit, it was classified as a GHFP. Some reports of GHFPs included elements of both ESD and access to inpatient rehabilitation. Similarly, the rehabilitative programmes within the 'control' interventions also varied (see footnote to appendix 1).

The 41 included studies had been conducted in nine countries (see *Table 1*). The 31 studies evaluating rehabilitation programmes were carried out in six countries, mainly Australia (five studies), Sweden (four studies), the UK (eight studies) and the USA (11 studies). It is notable that five of the seven GORU studies (including three RCTs) came from the UK, and that all but one of the six PPS studies (all cohort studies) came from the USA.

Types of participants

Thirty-seven of the included studies included patients with proximal femoral fractures. The study by Richards,[72,73] an RCT evaluating ESD, reported data for a mixed population which included 10% stroke patients and 21% other injuries. The other four studies,[23,41,60,81] all RCTs, investigated treatment programmes for older people with upper limb fractures.

The majority of participants were women with a mean age of approximately 80 years. Most studies had excluded patients with a poor prognosis, including those with metastatic cancer or those who were resident in a nursing home at the time of the hip fracture. Selection criteria were stricter for some types of intervention. In particular, ESD programmes enrolled patients with suitable home accommodation and relatively limited disability.

Types of outcomes

For the principal outcomes in the 27 studies of programme effects (GORUs, GHFPs, ESD, clinical pathways and PPSs), the striking feature was the variation in the reporting of outcomes. Reported data items frequently had incompatible units of measurement. Mortality data were presented in 26 studies. Other frequently measured outcomes were proxies for resource consumption, such as length of hospital stay (27 studies) and place of residence on discharge (24 studies). Some measure of mobility following discharge was given in only 13 studies, and readmission to hospital in seven. Morbidity data, generally postoperative complications, were reported in eight studies, some measure of function in activities in daily living in seven, and quality of life in four. Economic interpretations of varying degrees of rigour were included in 11 studies.

In the reports of specific rehabilitative interventions, functional outcomes were specific and technical. Impact of the intervention on the activities of daily living was reported in three of the 10 studies, but none recorded quality of life measures.

Methodological quality

From a possible score of 14, the included studies scored in a range from 2 to 11. The mean score overall was 6.2. For RCTs (this included two quasi-randomised trials) it was 9.9, and for the other studies 5.7, the difference representing the lesser likelihood of selection bias in the RCTs. The score for each included study is shown in *Table 1*. Appendix 12 shows the score for each individual item in all included studies, and the scores by programme type. The mean quality score ranged between programme types from 8.0 for GORU studies to 4.3 for clinical pathway and miscellaneous groups. Thus, overall, the quality of the studies is not high; the strength of evidence is particularly limited for PPSs and clinical pathways. Evidence from comparative studies of rehabilitative programmes for older fracture patients has accrued over two decades. A plot of study quality over time, for each category of intervention, is included as appendix 13. Within each category (RCT or cohort study) there was no evidence of improvement in study quality over time.

Lack of randomisation was a major cause of a lower quality score. For detection and attrition bias, and in a simple assessment of external validity, there was no difference in the mean scores achieved by RCTs and cohort studies. Common deficiencies were inappropriately defined outcome measures, lack of blinding of outcome assessment and limited duration of follow-up.

TABLE 1 *Comparisons between two hospital programmes: rehabilitation in a dedicated geriatric facility (GORU) versus rehabilitation in a general orthopaedic unit*

Study	Study type	Quality score (max. 14)	Location and dates	Intervention numbers	Participant	Age (years)			Inclusion criteria	Exclusion criteria
						Mean (median)	SD	Range		
Fordham (1986)[32]	RCT	10	UK 1984–1985	GORU Orthopaedic unit	50 58			65–95	Women > 65 years with PFF	Terminal illness Dementia
Kennie (1988)[51–54]	RCT	11	UK Mid-1980s	GORU Orthopaedic unit	54 54	(79) (84)		65–94 66–94	Women > 65 years with PFF	Fit, active, with home support Pathological fracture Medical problems
Gilchrist (1988)[38,39]	RCT	9	UK 1984–1986	GORU Orthopaedic unit	97 125	82 80.6	56.1 86.1	65–98 66–96	Women > 65 years with PFF	Referred from other hospital for surgery Rapid recovery and home discharge
Hempsall (1990)[42]	Cohort (C)	6	UK Mid-1980s	GORU Orthopaedic unit	82 73	(83) (83)		66–98 65–97	Men and women > 65 years with PFF	None stated
Fox (1993)[34,35]	Cohort (C)	5	UK Early 1990s	GORU Orthopaedic unit	142 193	No data			Men and women with PFF	None stated
Galvard (1995)[36]	RCT	9	Sweden 1988–1989	GORU Orthopaedic unit	182 196	80.4 78.2			Any patient with first PFF	Nursing home or hospital domiciled
Fordham (1995)[33]	Cohort (C)	6	Australia 1990–1994	GORU Orthopaedic unit	521 202	80.4 80.5	9.6 7.8	55 to > 95	Any patient with PFF	None stated

Cohort (C), cohort with contemporary controls; PFF, proximal femoral fracture; SD, standard deviation

TABLE 2 *Comparisons between two hospital programmes: admission to a GHFP within an orthopaedic unit versus orthopaedic team care in a general orthopaedic unit*

Study	Study type	Quality score (max. 14)	Location and dates	Intervention	Participant numbers	Age (years)			Inclusion criteria	Exclusion criteria
						Mean	SD	Range		
Jette (1987)[46]	CCT	8	USA 1983–1984	GHFP Standard orthopaedic unit care	35 40	78			Men and women aged > 55 years with PFF	None stated
Zuckerman (1992)[82–84]	Cohort (H)	6	USA 1985–1988	GHFP Standard orthopaedic unit care	431 60	80.4 80.3			Men and women aged > 65 years with PFF	Pathological fracture Severe dementia
Cameron (1993)[24–27]	RCT	10	Australia 1989–1990	GHFP Standard orthopaedic unit care	127 125	82.4 85.4			Men and women aged > 50 years with PFF, residing in home or nursing home (in district) Surgery in < 7 days	Pathological fracture or additional fracture
Elliot (1996)[29,30]	Cohort (C)	5	New Zealand 1992–1993	GHFP Standard orthopaedic unit care	61 57	80.7 81.8			Men and women aged > 65 years with PFF	None stated
Swanson (1998)[78,79]	RCT	9	Australia 1994–1995	GHFP Standard orthopaedic unit care	38 33	78.5 77.8	9.8 10.7		Men and women aged > 55 years with PFF, residing at home or in hostel. Independently mobile	Pathological fracture Dementia

Cohort (H), cohort with historical controls

TABLE 3 *Comparisons between ESD and in-hospital care package*

Study	Study type	Quality score (max. 14)	Location and dates	Intervention	Participant numbers	Age (years)			Inclusion criteria	Exclusion criteria
						Mean (median)	SD	Range		
Ceder (1987)[28]	Cohort (H)	6	Sweden 1972 and 1977	ESD Hospital rehabilitation	135 94	77 76			Men and women aged > 50 years with PFF	From mental hospital
Holmberg (1989)[45]	Cohort (H)	4	Sweden 1995–1996	ESD Hospital rehabilitation	86 84	78 80			Admitted to hospital PFF sustained at home	None stated
Peterborough (1993)[17,67–71]	Cohort (C)	5	UK 1987–1991	ESD Hospital rehabilitation	779 301	78.7 79.8	11.2 10.9		Men and women with PFF. Residing at home in area, suitable for early discharge	Visitor to area Death as inpatient
Shiell (1993)[74–76]	Cohort (H)	5	Australia 1989–1990	ESD Hospital rehabilitation	67 71	78.4 79.8	8.8 10.7		Men and women with PFF	Conservative management Multiple trauma Pathological fracture Medical problems
O'Cathain (1994)[61,62]	Cohort (C)	5	UK 1990–1991	ESD Hospital rehabilitation	76 34	76.4 77.6	10.0 9.7		Men and women with PFF. Medically stable, oriented	Unsuitable accommodation
Richards (1998)[72,73]	RCT	11	UK 1994–1995	ESD Hospital rehabilitation	160 81	(79) (79)		74–84 72–84	At home prior to sustaining PFF, other injury, stroke, or joint replacement	Unsuitable accommodation

TABLE 4 *Comparisons between two hospital programmes: application of care plans/clinical pathways versus standard (previous) care programmes*

Study	Study type	Quality score (max. 14)	Location and dates	Intervention	Participant numbers	Age (years)			Inclusion criteria	Exclusion criteria
						Mean	SD	Range		
Pachter (1987)[64]	Cohort (H)	3	USA 1986	Nurse/physiotherapist joint care plans Normal care	24 23			65–80	Men and women with PFF	Pathological fracture Medical problems
Ogilvie-Harris (1993)[63]	Cohort (H)	5	Canada Early 1990s	Clinical pathway Normal care	55 51			65–85	Men and women with PFF	None stated
Tallis (1995)[80]	Cohort (H)	5	Australia 1992–1993	Clinical pathway Normal care	88 90	82.1 81.7			Men and women aged > 50 years with PFF	Multiple fractures Pathological fractures

TABLE 5 *Investigations of the effect of changes in health system strategy or funding*

Study	Study type	Quality score (max. 14)	Location and dates	Intervention	Participant numbers	Age (years)			Inclusion criteria	Exclusion criteria
						Mean	SD	Range		
Fitzgerald (1987)[7]	Cohort (H)	4	USA 1981–1985	After PPS Before PPS	23 47	75.4 74.6			Aged > 65 years with PFF	Hospitalised or institutionalised Pathological fracture Previous fracture on the same side
Fitzgerald (1988)[31]	Cohort (H)	5	USA 1981–1986	After PPS Before PPS	189 149	79.9 79.0			Aged > 65 years with PFF	Hospitalised or institutionalised Pathological fracture Previous fracture on same side
Gerety (1989)[37]	Cohort (H)	5	USA 1982–1986	After PPS Before PPS	115 65	83.1 83.6			Aged > 69 years with PFF	Pathological fracture
Palmer (1989)[65]	Cohort (H)	4	USA 1981–1987	After PPS Before PPS	196 190	79.9 79.8			Aged > 65 years with PFF Living independently	Hospitalised or institutionalised Pathological fracture Previous fracture on same side
Kahn (1990)[47,48]	Cohort (H)	5	USA 1981–1986	After PPS Before PPS	1358 1404			58% aged > 80 years	With PFF Diagnosis related groups 820.0, 820.2, 820.8	Fracture as a complication of hospitalisation
Stromberg (1997)[77]	Cohort (H)	5	Sweden 1990–1992	After PPS Before PPS	1179 1060	81.9 80.9			Aged > 65 years with PFF Living independently	None stated

TABLE 6 *Comparisons between two hospital programmes: miscellaneous comparisons*

Study	Study type	Quality score (max. 14)	Location and dates	Intervention	Participant numbers	Age (years)			Inclusion criteria	Exclusion criteria
						Mean	SD	Range		
Pearson (1988)[66]	RCT	6	UK 1983–1985	Nursing rehabilitation unit Normal care	35 27	No data			Stroke or PFF	None stated
Kane (1996)[49]	Cohort (C)	5	USA 1988–1996 (Sample from US-wide database)	Discharge to: rehabilitation unit skilled nursing unit nursing home	 89 45 237	 79.5 80.9 83.9	 7.8 7.1 6.6		Men and women with PFF	None stated
Kramer (1997)[57,58]	Cohort (C)	2	USA 1991–1994 (Sample from US-wide database)	Discharge to: rehabilitation unit skilled nursing unit nursing home	 168 190 121	 80.9 83.1 83.1			Men and women aged > 65 years with PFF	Pathological fracture
Koval (1998)[55,56]	Cohort (H)	4	USA 1987–1994	Selected individuals to off-site rehabilitation GHFP in orthopaedic unit	308 301	No data			Men and women with PFF aged > 65 years Ambulant Cognitively intact	Pathological fracture

TABLE 7 *Specific therapy/nursing/medical intervention after hip or other fracture*

Study	Study type	Quality score (max. 14)	Location and dates	Intervention	Participant numbers	Age (years)			Inclusion criteria	Exclusion criteria
						Mean (median)	SD	Range		
Karumo (1977)[50]	RCT	8	Finland 1973–1974	PT twice daily PT once daily	38 49	73.6 72.4			Age > 50 years Displaced PFF Previously independently ambulant	None stated
Lundberg (1979)[60]	RCT	11	Sweden Early 1970s	Early therapist contact Instruction/self-training Ambulatory PT 1–2/week for 2 months	20 22	 65 			Minimally displaced proximal humeral fracture	None stated
Bertoft (1984)[23]	RCT	9	Sweden Early 1980s	Self-conducted PT Supervised PT	10 10	66 62		50–75 50–75	Patients with minimally displaced proximal humeral fracture at 10–12 days postinjury	None stated
Gronlund (1990)[41]	RCT	9	Denmark 1987–1988	Early therapist contact and self-treatment after plaster removal at about 5 weeks Therapist treatment following plaster removal	17 23	 (74.5) 		 47–93 	Age > 45 years with unilateral Colles fracture undergoing plaster immobilisation	Dementia Wrist arthritis Other fracture in same limb
Baker (1991)[22]	CCT	6	Australia 1985	Treadmill gait retraining Conventional gait retraining	20 20	83.4 83.7	5.66 6.02		Women with PFF	Active rheumatoid arthritis Neurological or cardiac disease
Antonelli Incalzi (1993)[21]	Cohort (H)	5	Italy 1985–1990	Daily geriatric consultation Daily consultation by general internist	174 365	 ~80 years 			Men and women aged > 70 years with PFF	None stated
Taylor (1994)[81]	RCT	7	Australia Early 1990s	Passive finger joint mobilisation Sham mobilisation	61.9 63.2	9.1 8.2			Recent Colles fracture Aged > 35 years	Concurrent upper limb fracture Inflammatory arthritis Previous wrist fracture

continued

TABLE 7 contd *Specific therapy/nursing/medical intervention after hip or other fracture*

Study	Study type	Quality score (max. 14)	Location and dates	Intervention	Participant numbers	Age (years)			Inclusion criteria	Exclusion criteria
						Mean (median)	SD	Range		
Gill (1994)[40]	Cohort (C)	2	Canada Early 1990s	Nursing staff Education programme Control	90 63	79.77 79.25	6.94 7.45		Aged > 65 years with unilateral hip fracture	None stated
Hoenig (1997)[43,44]	Cohort (C)	3	USA Early 1980s	High exposure (> 5 sessions) of PT/OT Low PT/OT exposure	316/1079 236/801	> 85 years			Aged > 65 years with PFF Ambulatory, not from nursing home	Pathological fracture Multiple fracture Various medical conditions
Lamb (1998)[9]	RCT	8 (Abstract only)	UK Late 1990s	Electrical stimulation of quadriceps muscle Placebo stimulation	12 12	84 83	3 4		Recent PFF	Residential or nursing home Cognitive or neurological impairment Psychiatric illness or unstable fixation

PT, physiotherapy; OT, occupational therapy

Chapter 6

Results

The data from individual studies are presented, arranged by outcome and by intervention, in *Tables 8–53*. In the text, we report the results first by outcome, comparing the effects of different programmes of care, and then summarise the results by each of the programme groups (GORUs, GHFPs, ESD, clinical pathways and PPSs).

Only limited pooling of data has been possible due to incompatible and incomplete recording of outcomes across the studies. Sufficient data for some comparisons are available to make cautious generalisations for the following outcomes: length of hospital stay (but, because of the few reports that included standard deviation, a point estimate only is possible for most types of treatment), readmission to hospital, residence at discharge from hospital, mortality and level of function. Graphical displays of the results are provided (*Figures 1–12*).

For clarity, the cited tables and figures are placed at the end of the chapter.

Length of hospital stay

GORU (*Table 8* and *Figure 1*)

Four reports provided standard deviations to allow pooling. Amongst the RCTs there was marked heterogeneity between the studies. In Galvard[36] (RCT), length of stay was almost doubled in the GORU participants, but in Gilchrist[38] (RCT) and Kennie[51] (RCT) there was a reduction. A cohort study[33] reported a slightly shorter length of stay in the GORU group. The pooled data (WMD 1.5 days, 95% CI –16.0 to +19.1) show no evidence that this type of care reduces length of stay. In some local circumstances it may even lengthen it.

GHFP (*Table 9*)

All but one of the included studies showed a reduction in inpatient length of stay in the GHFP group. Standard deviations were not provided; therefore a simple average of the mean reductions in length of stay was calculated (9.0 days).

ESD (*Table 10*)

All studies reported a reduction in orthopaedic ward length of stay. Standard deviations were not provided; therefore a simple average reduction in mean days stay was calculated (6.9 days). In two studies providing data,[17,61] there was a reduction in mean total duration of care (the sum of the inpatient stay and supported care at home) of 2.0 days.

Clinical pathways (*Table 11*)

Each of the three included studies showed a reduced length of stay. Standard deviations were not provided; therefore a simple average reduction in mean days stay was calculated (5.3 days).

PPS (*Table 12*)

The six included studies documented a reduction in acute hospital length of stay following the introduction of a PPS. Standard deviations were not provided; therefore a simple average reduction in mean days stay was calculated (3.2 days). However, a large Swedish study[77] reported increased length of stay in subacute hospital bed days of 17 days, and most of the American studies demonstrated increased use of nursing homes.

Miscellaneous hospital programmes (*Table 13*)

The two miscellaneous interventions presenting data for length of stay reported an increase in total days of care in the experimental group.

Specific therapy, nursing and medical interventions (*Table 14*)

All but one of these interventions reported a reduction in length of stay from application of the experimental intervention.

Readmission to hospital

GORU (*Table 15*)

The one study in this group that reported readmissions[36] showed a reduction in number of readmissions (OR 0.59, 95% CI 0.36–0.95).

GHFP (*Table 16*)

Only one RCT reported readmissions and showed no significant difference (OR 1.49, 95% CI 0.66–3.36).

ESD (*Table 17* and *Figure 2*)
Three cohort studies provided data which showed a non-significant increase in readmissions (OR 1.74, 95% CI 0.79–3.82).

Clinical pathways (*Table 18*)
One small study found no significant difference in readmissions (OR 0.77, 95% CI 0.20–2.98).

PPS (*Table 19*)
One study[48] found no significant difference in readmissions (OR 0.82, 95% CI 0.54–1.25).

Miscellaneous hospital programmes; specific therapy, nursing and medical interventions
No data on readmissions were available for these interventions.

Residential status

GORU (*Table 20* and *Figure 3*)
Pooling of data from four RCTs showed a tendency towards an increase in return to previous level of residence after admission to GORUs but this was not significant (OR 1.36, 95% CI 0.86–2.13). Pooling from the three cohort studies showed no significant difference (OR 0.85, 95% CI 0.24–2.98).

GHFP (*Table 21* and *Figure 4*)
There was a significantly increased rate of return home in the GHFP group. Results from the two RCTs (OR 2.06, 95% CI 1.08–3.93) and two cohort studies (OR 1.89, 95% CI 1.10–3.24) were highly consistent.

ESD (*Table 22* and *Figure 5*)
Three studies reported a significant increase in return home at final follow-up, which ranged from 6 weeks to 4 months (OR 2.62, 95% CI 1.27–5.37).

Clinical pathways (*Table 23*)
One study[80] showed no evidence of a difference in discharge residence (OR 1.55, 95% CI 0.25–9.53).

PPS (*Table 24* and *Figure 6*)
The summary measure in this category is residence in nursing home at 6 months or later, as each of the five studies reported a minimum of 6 months follow-up. There was heterogeneity in the data from the individual studies. There was a non-significant tendency to an increase in the number of patients requiring nursing home care (OR 1.75, 95% CI 0.96–3.16).

Miscellaneous hospital programmes (*Table 25*)
The only study reporting this outcome,[55] comparing off-site rehabilitation of selected patients with an acute hospital GHFP, found no significant difference between the groups (OR 1.35, 95% CI 0.91–2.00).

Specific therapy, nursing and medical interventions
No studies in this category provided data for this outcome.

Mortality

There was no evidence that interventions in any of the categories had an effect on mortality (*Tables 26–32*). The pooled data for GORUs, GHFPs, ESD, clinical pathways and PPSs are included in the summary by intervention later in the results section and shown in *Figures 7–11*.

For miscellaneous hospital programmes, results from three studies are listed in *Table 31*. No significant differences in mortality are apparent.

In the specific interventions group, one study[21] reported mortality data (*Table 32*). Provision of medical care by a geriatrician rather than a general physician was associated with a significantly lower mortality (OR 0.52, 95% CI 0.31–0.88).

Morbidity

Morbidity data were reported in 13 studies (*Tables 33–39*). There was no consistent trend in these data, and no evidence that any programme type was, overall, superior. Interpretation was difficult due to the number of different outcomes reported, for example pressure sores, post-operative complications and reoperation. Data could only be pooled for two studies of clinical pathways that reported a frequency of one or more complications (*Figure 12*).

Level of function (mobility and activities of daily living)

Pooling was not possible for these outcomes due to the variety of measures used to assess mobility (*Tables 40–46*) and activities of daily living function (*Tables 47–51*). No study reporting function status data showed long-term detriment as a result of the intervention. Only Fordham,[33] Kennie[51,52]

and Swanson[78,79] demonstrated improvement in these outcomes for the intervention group.

Following proximal femoral fracture, frequency/intensity of physiotherapy was evaluated by Karumo[50] (RCT) and Hoenig[43,44] (cohort study using routine hospital activity data). Karumo did not report any function data; Hoenig found that a higher provision of physiotherapy was associated with earlier independent ambulation (mean 2.2 days).

Kramer,[57,58] using samples from US-wide databases of routine hospital activity data, reported some functional outcomes from patients transferred from acute facilities to three levels of rehabilitative/nursing care after proximal femoral fracture (*Tables 45* and *50*). Comparability of the different streams at entry were unclear; thus the association shown in Kramer of poorer functional outcomes with lower rehabilitative input may possibly be explained by confounding.

Baker[22] (treadmill gait retraining) and Lamb[59] (electrical stimulation of quadriceps muscle) evaluated specific technical approaches to restoration of mobility after proximal femoral fracture. Both claimed an improvement in the number of participants regaining prefracture mobility at the end of the study. Gill[40] evaluated a nursing staff educational programme but was unable to demonstrate a significant effect on functional outcomes.

For upper limb fractures (humeral and distal radial) there is some evidence that a therapist supervised home exercise programme is at least as effective as a traditional outpatient programme.[23,41,60]

Other outcomes

HRQL data were reported by four studies (*Tables 52* and *53*). No significant change was reported.

Data concerning the impact of the interventions on carers were reported in only two studies.[27,52] These showed no definite differences between the interventions compared.

Summary of results by programme type

GORUs

Length of hospital stay

Significant heterogeneity is present between units who have conducted RCTs. The pooled results from RCTs are similar to those from a large cohort study. Overall, there is no evidence of difference in total hospital stay between programmes with access to a GORU and those without (WMD 1.5 days, 95% CI –16.0 to +19.1).

Readmission to hospital (to acute care facility)

Only one study reported this outcome, finding a significant reduction (OR 0.59, 95% CI 0.36–0.95).

Residential status

RCTs showed a non-significant tendency to improved return to previous residence in the GORU group (OR 1.36, 95% CI 0.86–2.13). This trend was not apparent in three cohort studies (OR 0.85, 95% CI 0.24–2.98).

All cause mortality

There was no evidence of benefit from rehabilitation in a GORU (RCTs – OR 0.92, 95% CI 0.57–1.48; cohorts – OR 1.44, 95% CI 1.00–2.08).

Morbidity

Two cohort studies (*Table 33*) reported in-hospital events using different criteria. Reported incidence was higher in the GORU group in one, and lower in the other. There is no evidence of benefit from GORUs for this outcome.

Mobility and activities of daily living

One cohort study[33] reported that the proportion independently mobile at 6 months was significantly higher from the orthopaedic unit than the GORU (OR 1.94, 95% CI 1.17–3.24). Data for activities of daily living from one RCT (OR 3.78, 95% CI 1.37–10.44) and one cohort study (OR 1.00, 95% CI 0.70–1.43) showed no evidence of difference.

HRQL

Two studies reported this outcome (*Table 52*). No significant differences were reported.

GHFPs

Length of hospital stay

The introduction of GHFPs was associated with a reduction in length of hospital stay in four of the five included studies. The crude average reduction from the published data (*Table 9*) is 9 days.

Readmission to hospital (to acute care facility)

One study (*Table 16*) reported this outcome. There was no evidence of benefit from participation in the GHFP (OR 1.49, 95% CI 0.66–3.36).

Residential status
There was a significantly increased rate of return home in the GHFP group. Results from the two RCTs (OR 2.06, 95% CI 1.08–3.93) and two cohort studies (OR 1.89, 95% CI 1.10–3.24) were highly consistent.

All cause mortality
There was no evidence of benefit from introduction of a GHFP (RCTs – OR 0.85, 95% CI 0.48–1.51; cohorts – OR 1.18, 95% CI 0.47–2.93).

Morbidity
One cohort study (*Table 34*) reported in-hospital complications. The reported incidence was lower in the GHFP group (OR 0.32, 95% CI 0.18–0.57).

Mobility and activities of daily living
Three studies (*Table 41*) reported mobility outcomes using different outcome measures which precluded pooling. All indicated benefit from the introduction of a GHFP. Two studies (*Table 48*) reported on activities of daily living. There was a significant benefit for the GHFP group in the Barthel Index in Swanson[79] but no evidence of difference in capability of activities of daily living in Jette.[46]

HRQL
No studies reported this outcome.

ESD
Length of hospital stay
The introduction of ESD was associated with a reduction in length of both acute hospital stay and total number of days in hospital in those studies which also included data on those unsuitable for this option. The crude average reduction from the published data (*Table 10*) is 6.9 days in acute hospital stay and 2 days in total duration of care.

Readmission to hospital (to acute care facility)
Three studies (*Table 17*) reported this outcome. There was a non-significant increase when the data were pooled applying a random effects model (OR 1.74, 95% CI 0.79–3.82).

Residential status
Four studies (*Table 22*) reported a residence outcome from which data were poolable in three. There was a significantly increased rate of return to previous residence in the ESD group (OR 2.62, 95% CI 1.27–5.37).

All cause mortality
There was no evidence of benefit or disadvantage from introduction of ESD (*Table 28*) in one RCT (OR 1.01, 95% CI 0.37–2.81) or five cohort studies (OR 0.93, 95% CI 0.65–1.33).

Morbidity
One cohort study (*Table 35*) reported in-hospital complications (OR 1.26, 95% CI 0.56–2.80). There was no significant difference between the groups.

Mobility and activities of daily living
One study (*Table 42*) reported a mobility outcome, and one (*Table 49*) reported activities of daily living. In neither case was there evidence of significant difference between the groups.

HRQL
Two studies (*Table 53*) reported HRQL scores. Neither found any evidence of difference between groups.

Introduction of clinical pathways

The introduction of clinical pathways as a means of making explicit the content and pace of a rehabilitation programme was examined in three studies. These studies found that the introduction was associated with a shorter length of hospital stay (mean reduction of 5.3 days). There was no evidence of difference in readmission to hospital, residential status, mortality (OR 0.78, 95% CI 0.35–1.76) or morbidity (OR 0.79, 95% CI 0.28–2.26). There was a non-significant increase in numbers achieving independent mobility at discharge (OR 2.25, 95% CI 0.95–5.31).

Introduction of PPSs

The introduction of PPSs was examined in six studies. These studies found that a shorter length of acute hospital stay (mean reduction of 3.2 days) followed the introduction, although one study[77] found a doubling of rehabilitation unit stay (*Table 12*). There was no evidence of difference in readmission to hospital (OR 0.82, 95% CI 0.54–1.25).[48] There was a strong but non-significant trend to increased frequency of residence in a nursing home after introduction of a PPS (OR 1.75, 95% CI 0.96–3.16).

Audit studies

A descriptive review of recent studies that have audited outcomes following hip fracture in the UK was undertaken to provide information on current practice. These studies give a summary of current

practice against which the research studies can be compared. The Scottish Hip Fracture Audit[9–11] provided most of the usable audit data.

Current hip fracture patients have a mean age of approximately 80 years with a range in participating hospitals of 78–82 years. Approximately 30% (range 21–40%) of patients reside in long-term residential care facilities at the time of the fracture.

The median total length of hospital stay is approximately 20 days (range 15–23 days) with an acute hospital mortality of 7.5% (range 6.6–8.3%). The proportion of patients discharged from hospital direct to their prefracture residence varies greatly due to the availability of support services in the community and the number previously resident in residential care facilities (range 15–72%). As a corollary, 10–56% of patients are reported as being transferred to geriatric rehabilitation wards.

Longer-term functional outcomes and survival have been audited. At 4 months after fracture, mortality was approximately 21% (range 14–31%) and, by this time, 50–73% of patients admitted from home were residing at home. Only 19–42% of patients who walked using no aids prefracture were walking without aids at 4 months. Another audit[32] demonstrated a 37% return to prefracture activities of daily living function at 3 months after fracture.

Economic analysis

Tables 54–63 list estimates of costs and benefits accruing from the interventions studied in the review, from two perspectives – that of the funders and providers of hospital services, and from a broader health and social services perspective. There were no data to allow inclusion of the perspective of the patient or carers. *Tables 64–66* provide a cost analyses, with some sensitivity analyses. Relative risk was used as the measure of effectiveness.

GORUs

In *Table 64* the estimated cost increases and reductions associated with GORUs are shown. GORUs tended to increase inpatient stay and medical and physiotherapy inputs and, using a marginal cost estimate for bed days, gives a cost estimate of about £400 per patient. This extra cost per patient is unlikely to be materially affected by the reduction in the readmission rate achieved by GORUs; hence, for the hospital budget, GORUs are likely to increase costs. On the other hand GORUs tended to increase the chance of a patient returning to their own home. It has been estimated[6] that extra costs incurred by a hip fracture patient returning home are in the region of £1600 per year. This is considerably less than the annual cost (approximately £19,000) of caring for someone within a nursing home. Thus the middle estimate for GORUs suggests a saving of about £800 per patient per year, although due to the uncertainty with respect to reductions in residential care this is bounded by a CI of between a saving of £2000 and an additional cost of £300. A more optimistic estimate of the resource consequences of GORUs, that is, low implementation costs and a high reduction in patients going into residential accommodation, resulted in a cost saving of nearly £2200 whilst a more pessimistic estimate suggested a net cost of nearly £600.

GHFPs

In *Table 65* the extra costs and possible savings associated with GHFPs are shown. The additional cost of a GHFP ranges from £85 to £522 per patient. The difference in the cost estimates hinge largely on how the additional visit to a geriatrician is valued. If it is costed solely as an hour of medical time then this is the lower cost; however, if it is costed at an average cost of a geriatric referral (which will include overheads such as staff support costs) then this is the larger cost. However, if the point estimate of a 9 day reduction in bed days were to be true then, even with the higher cost estimate, A GHFP is likely to be cost saving on a hospital budget. Furthermore, as with GORUs and ESD, the bulk of any cost savings from a health and social services perspective is through potential reductions in nursing home care.

ESD

ESD, despite increases in readmission rates, appears to be cost-saving, due to a shorter length of hospital stay and a significantly increased percentage return to previous level of residence. In *Table 66* it can be seen that the cost savings of a reduction in length of stay are unlikely to be offset by increased costs through readmissions to hospital.

Conclusions

Overall, GHFPs and ESD (and possibly GORUs) appear to be associated with savings from the perspective of health and social services when compared with 'standard care'. The absence of data on the impact upon, and costs of, informal care prevents cost estimation from a comprehensive societal perspective.

TABLE 8 *GORU versus orthopaedic unit: length of stay*

Study	Unit of measurement	Intervention	
		GORU	**Orthopaedic unit**
Fordham (1986) (RCT)	Mean overall hospital days	56	44
Kennie (1988) (RCT)	Mean overall hospital days (SD)	37.0 (33.0)	56.0 (54.0)
Gilchrist (1988) (RCT)	Mean overall hospital days (SD)	44.0 (56.1)	47.7 (86.1)
Hempsall (1990) (Cohort (C))	Mean overall hospital days Median (range)	30.2 27 (3–126)	43.0 34 (2–258)
Fox (1993) (Cohort (C))	Mean overall hospital days	30.8	15.7
Galvard (1995) (RCT)	Mean overall hospital days (SD) Median (range)	53.3 (47.7) 40 (24–63)	28.0 (24.2) 21 (12–35)
Fordham (1995) (Cohort (C))	Mean overall hospital days (SD) Median (range)	22.5 (21) 17 (2–141)	23.4 (23) 16 (1–185)

TABLE 9 *GHFP versus standard orthopaedic unit care: length of stay*

Study	Unit of measurement	Intervention	
		GHFP	**Standard orthopaedic unit care**
Jette (1987) (CCT)	Mean overall hospital days	Overall 21.7 'No significant difference'	
Zuckerman (1992) (Cohort (H))	Mean overall hospital days Total hospital days	23.2 9998	27.7 1662
Cameron (1993) (RCT)	Mean overall hospital days Total hospital days	19.5 2477	28.1 3513
Elliot (1996) (Cohort (C))	Mean overall hospital days Total hospital days	33.4 1976	45.2 2576
Swanson (1998) (RCT)	Mean overall hospital days Total hospital days	20.8 790	32.6 1076

TABLE 10 *ESD versus hospital rehabilitation: length of stay*

Study	Unit of measurement	Intervention	
		ESD	**Hospital rehabilitation**
Ceder (1987)	Mean days:		
(Cohort (H))	in hospital ward	22.3	26.7
	of home care	No data	No data
	Total days:		
	in hospital ward	3013	2511
	of home care	No data	No data
Holmberg (1989)	Mean days:		
(Cohort (H))	in hospital ward	25.9	44.2
	of home care	No data	No data
	Total days:		
	in hospital ward	1629	2522
	of home care	No data	No data
Peterborough (1993)	Mean days (standard error):		
(Cohort (C))	in hospital ward	32.5 (2.0)	41.7 (3.5)
	of home care	4.3 (0.2)	Not applicable
	Total days:		
	in hospital ward	25,318	12,552
	of home care	3350	Not applicable
Shiell (1993)	Mean days to nursing home	7.3	10.2
(Cohort (H))	Mean days to hospital/own home	21.5	28.2
O'Cathain (1994)	Mean days:		
(Cohort (C))	in hospital ward	10	17
	in home care	8	Not applicable
	Total days:		
	in hospital ward	760	544
	in home care	608	Not applicable
Richards (1998)	Mean days:		
(RCT)	in hospital ward	7.8[a]	17.2[a]
	in home care	12.8	No data
	Total days:		
	in hospital ward	1232[a]	1359[a]
	in home care	2022	No data

[a] *For Richards (1998) a mean period of 5 days in the acute ward prior to randomisation has been assumed*

TABLE 11 *Clinical pathways versus standard (previous) care programmes: length of stay*

Study	Unit of measurement	Intervention	
		Clinical pathway[a]	**Standard care**
Pachter (1987)	Mean days stay (SD)	15.6 (3.9)	17.4 (5.1)
(Cohort (H))	Total days	371	399
Ogilvie-Harris (1993)	Mean days stay	13.6	15.3
(Cohort (H))	Total days	748	780
Tallis (1995)	Mean days stay	11.0	19.3
(Cohort (H))	Total days	968	1737

[a] *Multidisciplinary other than Patcher (1987) (nurse/physiotherapist joint care plans)*

TABLE 12 *Postintroduction of PPS versus preintroduction of PPS: length of stay*

Study	Unit of measurement	Intervention	
		After PPS introduction	**Before PPS introduction**
Fitzgerald (1987) (Cohort (H))	Mean acute hospital days Total days	10.3 237	16.6 780
Fitzgerald (1988) (Cohort (H))	Mean acute hospital days Total days	12.6 2381	21.9 3263
Gerety (1989) (Cohort (H))	Mean acute hospital days Total days	11.0 1265	12.3 800
Palmer (1989) (Cohort (H))	Mean acute hospital days Total days	12.9 2528	17.0 3230
Kahn (1990) (Cohort (H))	Mean acute hospital days Total days	14.5 20,358	20.1 27,296
Stromberg (1997) (Cohort (H))	Mean acute hospital days Total days (acute) Geriatric hospital days	18 21,222 32.7	20 21,200 15.8

TABLE 13 *Comparisons between miscellaneous hospital programmes: length of stay*

Study	Unit of measurement	Intervention	
		Nursing rehabilitation unit	**Normal care**
Pearson (1988) (RCT)	Mean days (SD) in acute facility Mean days (SD) total hospital stay	7.6 (6.0) 43.5 (28.1)	18.7 (10.3) 27.9 (24.6)
Study	**Unit of measurement**	**Intervention**	
		Selected individuals to off-site rehabilitation	**GHFP in orthopaedic unit**
Koval (1998) (Cohort (H))	Mean days	23.9	21.9

TABLE 14 *Comparisons between specific therapy/nursing/medical interventions: length of stay*

Study	**Unit of measurement**	**Intervention**	
		PT twice daily	**PT once daily**
Karumo (1977) (RCT)	Mean days	32.2	35.0
Study	**Unit of measurement**	**Intervention**	
		Treadmill gait retraining	**Conventional gait retraining**
Baker (1991) (CCT)	Mean days	54	67
Study	**Unit of measurement**	**Intervention**	
		Daily geriatric consultation	**Daily consultation by general internist**
Antonelli Incalzi (1993) (Cohort (H))	Mean days (SD)	28.0 (12.9)	28.6 (15.9)
Study	**Unit of measurement**	**Intervention**	
		Nursing staff education programme	**Control**
Gill (1994) (Cohort (C))	Mean days (SD)	17.4 (11.7)	21.7 (20.0)
Study	**Unit of measurement**	**Intervention**	
		High exposure (> 5 sessions) of PT/OT	**Low PT/OT exposure**
Hoenig (1997) (Cohort (C))		'No significant difference'	

TABLE 15 *GORU versus orthopaedic unit: readmission to hospital*

Study	**Unit of measurement**	**Intervention**	
		GORU	**Orthopaedic unit**
Galvard (1995) (RCT)	Readmitted to hospital within 1 year	36/182	57/196

TABLE 16 *GHFP versus standard orthopaedic unit care: readmission to hospital*

Study	**Unit of measurement**	**Intervention**	
		GHFP	**Standard orthopaedic unit care**
Cameron (1993) (RCT)	Readmitted to hospital within 4 months	16/127	11/125

TABLE 17 *ESD versus hospital rehabilitation: readmission to hospital*

Study	Unit of measurement	Intervention	
		ESD	**Hospital rehabilitation**
Peterborough (1993) (Cohort (C))	Within 1 year	53/779	8/301
Shiell (1993) (Cohort (H))	Within 1 year	4/67	6/71
O'Cathain (1994) (Cohort (C))	Within 3 months	12/76	3/34

TABLE 18 *Clinical pathways versus standard (previous) care programmes: readmission to hospital*

Study	Unit of measurement	Intervention	
		Clinical pathway	**Standard care**
Tallis (1995) (Cohort (H))	Within 28 days	4/88	5/86

TABLE 19 *Postintroduction of PPS versus preintroduction of PPS: readmission to hospital*

Study	Unit of measurement	Intervention	
		After PPS introduction	**Before PPS introduction**
Kahn (1990) (Cohort (H))	Readmission within 1 year	42/1045	48/985

TABLE 20 *GORU versus orthopaedic unit: residential status*

Study	Unit of measurement	Intervention	
		GORU	**Orthopaedic unit**
Fordham (1986) (RCT)	Home Residential care In hospital	24 5 5	35 6 8
Kennie (1988) (RCT)	Nursing home Home	5 31	16 19
Gilchrist (1988) (RCT)	Home to home	60/80	72/103
Hempsall (1990) (Cohort (C))	In more supportive environment: at 6 months at 12 months	 12/52 18%	 16/44 38%
Fox (1993) (Cohort (C))	Home to home	69/92	71/130
Galvard (1995) (RCT)	Return to same level of dependence	139/179	129/192
Fordham (1995) (Cohort (C))	Home to home Return to same level of dependence	205/270 303/377	99/133 135/173

TABLE 21 *GHFP versus standard orthopaedic unit care: residential status*

Study	Unit of measurement	Intervention	
		GHFP	**Standard orthopaedic unit care**
Jette (1987) (CCT)	At discharge		No significant difference overall 32% to own homes 40% to rehabilitation hospital
	At 12 months		74% of survivors at home
Zuckerman (1992) (Cohort (H))	Return home	331/406	41/57
Cameron (1993) (RCT)	Return home	87/103	74/100
Elliot (1996) (Cohort (C))	Return to same or better residential level	50/56	41/53
Swanson (1998) (RCT)	Return to same residential level	34/36	26/31

TABLE 22 *ESD versus hospital rehabilitation: residential status*

Study	Unit of measurement	Intervention	
		ESD	**Hospital rehabilitation**
Ceder (1987) (Cohort (H))	Returned to own home	76/95	38/63
Holmberg (1989) (Cohort (H))	Returned to own home by 4 months	63/84	57/86
Peterborough (1993)[a] (Cohort (C))	Returned to own home by 6 weeks	64/68	34/48
Shiell (1993) (Cohort (H))	Admitted to nursing home within 1 year	7/50	7/39

[a] *Subgroup of complete sample only*

TABLE 23 *Clinical pathways versus standard (previous) care programmes: residential status*

Study	Unit of measurement	Intervention	
		Clinical pathway	**Standard care**
Ogilvie-Harris (1993) (Cohort (H))		No usable data	
Tallis (1995) (Cohort (H))	Return to same residential level	79/88	81/90

TABLE 24 *Postintroduction of PPS versus preintroduction of PPS: residential status*

Study	Unit of measurement	Intervention	
		After PPS introduction	**Before PPS introduction**
Fitzgerald (1987) (Cohort (H))	Survivors in nursing home:		
	at discharge	48%	21%
	at 6 months	39% (8/21)	13% (6/44)
Fitzgerald (1988) (Cohort (H))	Survivors in nursing home:		
	at discharge	60%	38%
	at 1 year	33% (55/166)	9% (13/139)
Gerety (1989) (Cohort (H))	Survivors at home:		
	at discharge	20%	30%
	at 1 year	59%	58%
	Survivors in nursing home:		
	at discharge	78%	70%
	at 1 year	32% (28/89)	27% (15/55)
Palmer (1989) (Cohort (H))	Survivors at 6 months:		
	home	79%	76%
	nursing home	21% (39/185)	24% (42/174)
Kahn (1990) (Cohort (H))	Home to home at discharge	48% (474/987)	56% (501/894)
Stromberg (1997) (Cohort (H))	Survivors at 1 year:		
	home	65%	68%
	nursing home	14% (130/931)	11% (92/837)

TABLE 25 *Comparisons between miscellaneous hospital programmes: residential status*

Study	Unit of measurement	Intervention	
		Selected individuals to off-site rehabilitation	**GHFP in orthopaedic unit**
Koval (1998) (Cohort (H))	At 12 months, return to same residential level	239/296	221/292

TABLE 26 *GORU versus orthopaedic unit: mortality*

Study	Final measurement	Intervention	
		GORU	**Orthopaedic unit**
Fordham (1986) (RCT)	At a minimum 4 weeks	10/50	9/58
Kennie (1988) (RCT)	At 1 year	10/54	18/54
Gilchrist (1988) (RCT)	At 6 months	14/97	23/125
Hempsall (1990) (Cohort (C))	At 1 year	36/82	30/73
Fox (1993) (Cohort (C))	In hospital[a]	11/92	8/130
Galvard (1995) (RCT)	At 1 year	45/182	40/196
Fordham (1995) (Cohort (C))	At 6 months	82/522	22/202

[a] *For subgroup of patients from home*

TABLE 27 *GHFP versus standard orthopaedic unit care: mortality*

Study	Unit of measurement	Intervention	
		GHFP	**Standard orthopaedic unit care**
Jette (1987) (CCT)	Death in hospital		Overall 5%
Zuckerman (1992) (Cohort (H))	Death in hospital	25/431	3/60
Cameron (1993) (RCT)	At 4 months	24/127	25/125
Elliot (1996) (Cohort (C))	Death in hospital	5/61	4/57
Swanson (1998) (RCT)	Death in hospital At 6 months	2/38 3/38	2/33 5/33

TABLE 28 *ESD versus hospital rehabilitation: mortality*

Study	Unit of measurement	Intervention	
		ESD	**Hospital rehabilitation**
Ceder (1987) (Cohort (H))	At 4 months At 1 year	20/135 28/135	16/94 24/94
Holmberg (1989) (Cohort (H))	At 4 months	7/84	9/86
Peterborough (1993)[a] (Cohort (C))	At 90 days	40/284	14/126
Shiell (1993) (Cohort (H))	At 1 year	16/67	19/71
O'Cathain (1994) (Cohort (C))	At 3 months	4/76	2/34
Richards (1998) (RCT)	At 3 months	12/160	6/81

[a] *Subgroup only*

TABLE 29 *Clinical pathways versus standard (previous) care programmes: mortality*

Study	Unit of measurement	Intervention	
		Clinical pathway	**Standard care**
Ogilvie-Harris (1993) (Cohort (H))	At 6 months	11/55	14/51
Tallis (1995) (Cohort (H))	In hospital	3/88	2/90

TABLE 30 *Postintroduction of PPS versus preintroduction of PPS: mortality*

Study	Unit of measurement	Intervention	
		After PPS introduction	**Before PPS introduction**
Fitzgerald (1987) (Cohort (H))	At 6 months	9%	6%
Fitzgerald (1988) (Cohort (H))	At 1 year	12%	7%
Gerety (1989) (Cohort (H))	At 1 year	23%	15%
Palmer (1989) (Cohort (H))	At 6 months	6%	7%
Kahn (1990) (Cohort (H))	At 6 months	14.8%	17.9%
Stromberg (1997) (Cohort (H))	At 1 year	21%	21%

TABLE 31 *Comparisons between miscellaneous hospital programmes: mortality*

Study	Unit of measurement	Intervention		
		Discharge to rehabilitation unit	**Discharge to skilled nursing unit**	**Discharge to nursing home**
Kane (1996) (Cohort (C))	At 12 months	11%	22%	16%
Kramer (1997) (Cohort (C))	At 6 months	7/108	12/190	23/121
Study	**Unit of measurement**	**Intervention**		
		Selected individuals to off-site rehabilitation		**GHFP in orthopaedic unit**
Koval (1998) (Cohort (H))	At 12 months	31/296	42/292	

TABLE 32 *Comparisons between specific therapy/nursing/medical interventions: mortality*

Study	Unit of measurement	Intervention	
		Daily geriatric consultation	**Daily consultation by general internist**
Antonelli Incalzi (1993) (Cohort (H))	In hospital	21/174	37/192

TABLE 33 *GORU versus orthopaedic unit: morbidity*

Study	Unit of measurement	Intervention	
		GORU	**Orthopaedic unit**
Fox (1993) (Cohort (C))	Broken pressure sores	17/142	8/193
Fordham (1995) (Cohort (C))	Postoperative complications	102 registered events in 521 admissions	95 registered events in 202 admissions

TABLE 34 *GHFP versus standard orthopaedic unit care: morbidity*

Study	Unit of measurement	Intervention	
		GHFP	**Standard orthopaedic unit care**
Zuckerman (1992) (Cohort (H))	Number with one or more complications	162/431	39/60

TABLE 35 *ESD versus hospital rehabilitation: morbidity*

Study	Unit of measurement	Intervention	
		ESD	**Hospital rehabilitation**
Shiell (1993) (Cohort (H))	One or more complications in hospital	17/63	15/66

TABLE 36 *Clinical pathways versus standard (previous) care programmes: morbidity*

Study	Unit of measurement	Intervention	
		Clinical pathway	**Standard care**
Ogilvie-Harris (1993) (Cohort (H))	One or more complications in hospital	10/55	17/51
Tallis (1995) (Cohort (H))	One or more complications in hospital	26/88	22/90

TABLE 37 *Postintroduction of PPS versus preintroduction of PPS: morbidity*

Study	Unit of measurement	Intervention	
		After PPS introduction	**Before PPS introduction**
Palmer (1989) (Cohort (H))	One or more complications in hospital	32%	39%
Stromberg (1997) (Cohort (H))	Reoperation after arthroplasty Reoperation after fixation	4% 18%	7% 23%

TABLE 38 *Comparisons between miscellaneous hospital programmes: morbidity*

Study	Unit of measurement	Intervention	
		Selected individuals to off-site rehabilitation	**GHFP in orthopaedic unit**
Koval (1998) (Cohort (H))	One or more complications in hospital	27/296	16/292

TABLE 39 *Comparisons between specific therapy/nursing/medical interventions: morbidity*

Study	Unit of measurement	Intervention	
		Early therapist contact: instruction/self-training	**Ambulatory PT 1–2/week for two months**
Lundberg (1979) (RCT)	Pain at 1 month	Severe 3 Moderate 10 Insignificant 7	Severe 2 Moderate 12 Insignificant 8
	Pain at 3 months	Severe 0 Moderate 4 Insignificant 16	Severe 0 Moderate 2 Insignificant 20
Study	**Unit of measurement**	**Intervention**	
		Early therapist contact and self-treatment	**Therapist treatment following plaster removal**
Gronlund (1990) (RCT)	Evidence of reflex sympathetic dystrophy assessed blindly	3/17	2/23
Study	**Unit of measurement**	**Intervention**	
		Daily geriatric consultation	**Daily consultation by general internist**
Antonelli Incalzi (1993) Cohort (H)	One or more complications in hospital	79/169	99/164
Study	**Unit of measurement**	**Intervention**	
		Nursing staff education programme	**Control**
Gill (1994) (Cohort (C))	Number of complications per patient, mean (SD)	0.30 (0.55)	0.35 (0.54)

TABLE 40 *GORU versus orthopaedic unit: mobility*

Study	Unit of measurement	Intervention	
		GORU	**Orthopaedic unit**
Fordham (1986) (RCT)	No usable data		
Galvard (1995) (RCT)	Data for 20% sample only		
Fordham (1995) (Cohort (C))	At 6 months: independently mobile requiring assistance of people or aids	 221/316 (69%) 43/316 (14%)	 104/127 (82%) 8/127 (6%)

TABLE 41 *GHFP versus standard orthopaedic unit care: mobility*

Study	Unit of measurement	Intervention	
		GHFP	**Standard orthopaedic unit care**
Zuckerman (1992) (Cohort (H))	Independent at discharge	204/362 (56%)	8/44 (18%)
Cameron (1993) (RCT)	Physical independence recovered	63/127 (50%)	51/125 (41%)
Swanson (1998) (RCT)	20 m walk time	44.8 seconds	59.1 seconds

TABLE 42 *ESD versus hospital rehabilitation: mobility*

Study	Unit of measurement	Intervention	
		ESD	**Hospital rehabilitation**
O'Cathain (1994) (Cohort (C))	NHP mobility dimension mean score	48	50

TABLE 43 *Clinical pathways versus standard (previous) care programmes: mobility*

Study	Unit of measurement	Intervention	
		Clinical pathway	**Standard care**
Ogilvie-Harris (1993) (Cohort (H))	Independent walker at 6 months	21/55 (38%)	11/51 (22%)
Tallis (1995) (Cohort (H))	Mean days after surgery to walking	3.0	4.3

TABLE 44 *Postintroduction of PPS versus preintroduction of PPS: mobility*

Study	Unit of measurement	Intervention	
		After PPS Introduction	**Before PPS introduction**
Fitzgerald (1987) (Cohort (H))	Time from surgery to start PT	3.4 days	4.2 days
Fitzgerald (1988) (Cohort (H))	Time from surgery to start PT	3.8 days	8.4 days
	Ambulatory at discharge	40%	56%
Gerety (1989) (Cohort (H))	At discharge:		
	walking independently	23%	38%
	walking with aid	41%	34%
	At 1 year:		
	walking independently	73%	76%
	walking with aid	10%	13%
Palmer (1989) (Cohort (H))	At 6 months:		
	walking independently	25%	30%
	walking with aid	61%	55%

TABLE 45 *Comparisons between miscellaneous hospital programmes: mobility*

Study	Unit of measurement	Intervention		
		Discharge to rehabilitation unit	**Discharge to skilled nursing unit**	**Discharge to nursing home**
Kramer (1997) (Cohort (C))	Return to preinjury status at 6 months	123/154 (80%)	119/166 (72%)	71/89 (80%)
Study	**Unit of measurement**	**Intervention**		
		Selected individuals to off-site rehabilitation		**GHFP in orthopaedic unit**
Koval (1998) (Cohort (H))	Return to preinjury status at 12 months	96/193 (50%)		96/215 (45%)

TABLE 46 *Comparisons between specific therapy/nursing/medical interventions: mobility*

Study	Unit of measurement	Intervention	
		Early therapist contact and self-treatment	**Therapist treatment following plaster removal**
Gronlund (1990) (RCT)	Restoration of range of motion at three months Median (range)	80% (40–100)	80% (50–90)
Study	**Unit of measurement**	**Intervention**	
		Treadmill gait retraining	**Conventional gait retraining**
Baker (1991) (CCT)	Restoration of prefracture mobility at discharge	13/20 (65%)	8/20 (40%)
Study	**Unit of measurement**	**Intervention**	
		Nursing staff education programme	**Control**
Gill (1994) (Cohort (C))	Able to weight bear and walk to chair, mean days (SD)	2.12 (1.62)	2.67 (1.90)
Study	**Unit of measurement**	**Intervention**	
		High exposure (> 5 sessions) of PT/OT	**Low PT/OT exposure**
Hoenig (1997) (Cohort (C))	Time to achieve independent ambulation	Intervention group achieved independent ambulation 2.2 days sooner than controls	
Study	**Unit of measurement**	**Intervention**	
		Electrical stimulation of quadriceps muscle	**Placebo stimulation**
Lamb 1998 (RCT)	Restoration of prefracture mobility at 7 weeks	Greater in intervention group, $p < 0.05$	

TABLE 47 *GORU versus orthopaedic unit: activities of daily living (ADL)*

Study	Unit of measurement	Intervention	
		GORU	**Orthopaedic unit**
Fordham (1986) (RCT)	No usable data		
Kennie (1988) (RCT)	Survivors' Katz ADL score at 12 months:		
	recovered	21/44 (48%)	7/36 (19%)
	worse	22/44 (50%)	28/36 (78%)
Hempsall (1990) (Cohort (C))	More dependent at 6 months	26/47 (55%)	31/48 (65%)
Fordham (1995) (Cohort (C))	Survivors' Katz ADL score at 6 months:		
	recovered	241/407 (59%)	107/181 (59%)
	worse	166/407 (41%)	74/181 (41%)

TABLE 48 *GHFP versus standard orthopaedic unit care: ADL*

Study	Unit of measurement	Intervention	
		GHFP	**Standard orthopaedic unit care**
Jette (1987) (CCT (quasi-random), cluster *n* = 1)		No significant difference at discharge 3, 6 or 12 months	
Swanson (1998) (RCT)	Modified Barthel Index (95% CI)	92.8 (90–95.6)	85.6 (81.3–89.8)

TABLE 49 *ESD versus hospital rehabilitation: ADL*

Study	Unit of measurement	Intervention	
		ESD	**Hospital rehabilitation**
Richards (1998) (RCT)	Change in Barthel Index baseline to 3 months (SD)	1.9 (3.22)	1.7 (2.68)

TABLE 50 *Comparisons between miscellaneous hospital programmes: ADL*

Study	Unit of measurement	Intervention		
		Discharge to rehabilitation unit	**Discharge to skilled nursing unit**	**Discharge to nursing home**
Kramer (1997) (Cohort (C))	Attaining preinjury competence:			
	bathing	100/154 (65%)	88/166 (53%)	44/89 (49%)
	dressing	128/154 (83%)	106/166 (64%)	54/89 (61%)
	toileting	132/154 (86%)	121/166 (73%)	51/89 (57%)
Study	**Unit of measurement**	**Intervention**		
		Selected individuals to off-site rehabilitation		**GHFP in orthopaedic unit**
Koval (1998) (Cohort (H))	Attaining preinjury competence	156/193 (81%)		168/215 (78%)

TABLE 51 *Comparisons between specific therapy/nursing/medical interventions: ADL*

Study	Unit of measurement	Intervention	
		Self-conducted PT	**Supervised PT**
Bertoft (1984) (RCT)	Not stated	'No significant difference between groups'	
Study	**Unit of measurement**	**Intervention**	
		Early therapist contact and self-treatment	**Therapist treatment following plaster removal**
Gronlund (1990) (RCT)	Hand function score at weeks after plaster removal, median score (range)	5 weeks 13 (2–22) 9 weeks 10 (1–22) 13 weeks 10 (1–12)	5 weeks 18 (2–24) 9 weeks 11 (3–22) 13 weeks 9 (3–18)
Study	**Unit of measurement**	**Intervention**	
		Passive finger joint mobilisation	**Sham mobilisation**
Taylor (1994) (RCT)	Wrist extension at discharge, mean range in degrees (SD)	53 (13.2)	55 (9.1)

TABLE 52 *GORU versus orthopaedic unit: HRQL*

Study	Unit of measurement	Intervention	
		GORU	**Orthopaedic unit**
Kennie (1988) (RCT)	Life satisfaction score at 1 year, median (range)	17 (6–22)	18 (6–21)
Fordham (1995) (Cohort (C))	EuroQoL score at: 1 year 2 years Sickness Impact Profile dysfunction score at: 1 year 2 years	 0.652 0.597 32.4 20.1	 0.579 0.622 28.8 19.3

TABLE 53 *ESD versus hospital rehabilitation: HRQL*

Study	Unit of measurement	Intervention	
		ESD	**Hospital rehabilitation**
O'Cathain (1994) (Cohort (C))	Nottingham Health Profile (NHP) dimension mean scores	Pain 22 Sleep 28 Energy 26 Social isolation 13 Emotional response 15	Pain 21 Sleep 24 Energy 28 Social isolation 16 Emotional response 24
Richards (1998) (RCT)	EuroQoL (EQ5D) (possible score 5–15) Mean difference at 3 months	–0.04 (–0.13 to 0.06), $p = 0.20$	

TABLE 54 *GORU versus orthopaedic unit: resource and cost data available from included studies*

Study	Costing data
Kennie (1988) (RCT)	Extra costs: six-bed unit in rehabilitation hospital, general practitioner – daily visit, social worker – occasional visit, orthotist – occasional visit, 1 full-time physiotherapist, 1 half-time occupational therapist
Gilchrist (1988) (RCT)	No extra resources or costs described: existing staff and beds changed to new role
Hempsall (1990) (Cohort (C))	No resource or cost data provided
Fox (1993) (Cohort (C))	No resource or cost data provided
Galvard (1995) (RCT)	Actual costs of days stay, walking aids, and adjustment of living quarters provided
Fordham (1995) (Cohort (C))	Detailed cost analysis in chapter 6 Measure of effectiveness "the rehabilitated patient" described No significant difference between groups

TABLE 55 *GORU versus orthopaedic unit: summary cost data*

Parameter	Summary cost data
Extra costs	Variable staff requirements, e.g. see Kennie (1988) Non-significant increase in overall days of hospital stay in GORU group WMD, 95% CI (random effects model) 3 RCTs: WMD 1.6 days, 95% CI –28.0 to +31.2 1 cohort: WMD –0.9 days, 95% CI –4.5 to +2.7 Overall: WMD 1.5 days, 95% CI –16.0 to +19.1
To whom?	Rehabilitation hospital Funder and provider units
Reduced costs	Reduction in number of readmissions to hospital in GORU group Data from Galvard (1995) only, OR 0.59, 95% CI 0.36–0.95
To whom?	Funder and provider units
Extra benefits	Increase in number returning to own home Pooled OR, 95% CI (random effects model) 4 RCTs: OR 1.36, 95% CI 0.86–2.13 3 cohort studies: OR 0.85, 95% CI 0.24–2.98
To whom?	Patients and relatives Funders of residential aged care services

TABLE 56 *GHFP versus standard orthopaedic care: resource and cost data available from included studies*

Study	Costing data
Jette (1987) (CCT (quasi-random))	Extra costs in GHFP: additional 2–4 h of PT geriatric team evaluation
Zuckerman (1992) (Cohort (H))	No data recorded
Cameron (1993) (RCT)	Extra costs in GHFP: 30 min per patient per day of extra nurse/therapist time 15 min per patient per day medical time Extra outpatient costs: 1 additional medical consultation Costs otherwise after discharge were about 10% higher (including readmissions) than conventional care costs
Elliot (1996) (Cohort (C))	15 patients per month evaluated by geriatrician
Swanson (1998) (RCT)	Extra costs in GHFP: 1 full-time physiotherapist, 1 full-time nurse consultant, 1 full-time occupational therapist, 1 half-time social worker

TABLE 57 *GHFP versus standard orthopaedic care: summary cost data*

Parameter	Summary cost data
Extra costs	Costs of GHFP programmes. See individual studies
To whom?	Provider unit
Reduced costs	Mean reduction of 9 days stay in GHFP group (point estimate only)
To whom?	Provider unit
Extra benefits	Return to prefracture residence or better Pooled OR, 95% CI (random effects model) 2 RCTs: OR 2.06, 95% CI 1.08–3.93 2 cohort studies: OR 1.89, 95% CI 1.10–3.24 Significant improvement in ADL (single study – Swanson (1998))
To whom?	Patient Relatives Funders of residential aged care services

TABLE 58 *ESD versus hospital rehabilitation: resource and cost data available from included studies*

Study	Costing data
Ceder (1987) (Cohort (H))	No resource or cost data provided
Holmberg (1989) (Cohort (H))	Extra resources for ESD programme: 1 part-time occupational therapist
Peterborough (1993) (Cohort (C))	Extra resources for ESD programme: Home nursing as required, up to 30 days 1 full-time physiotherapist, 1 full-time occupational therapist
Shiell (1993) and Farnworth 1994 (Cohort (H))	Extra resources for ESD programme: 1 full-time nurse coordinator, 1 physiotherapist, 1 part-time occupational therapist, 1 part-time social worker
O'Cathain (1994) (Cohort (C))	No records of staff time in hospital group In ESD programme, mean input was nurse 19.9 h, PT 1.75 h, OT 2.4 h

TABLE 59 *ESD versus hospital rehabilitation: summary cost data*

Parameter	Summary cost data
Extra costs	Additional readmissions in ESD group Pooled OR, 95% CI (random effects model) 3 cohort studies: OR 1.74, 95% CI 0.79–3.82
	Costs of new staff in ESD programmes (see individual studies)
To whom?	Provider unit
Reduced costs	Mean reduction of 2 days of overall care (hospital plus hospital at home) Mean reduction of 6.9 acute hospital days (Point estimates only)
To whom?	Provider unit
Extra benefits	Greater percentage return to previous residential status in ESD group Pooled OR, 95% CI (random effects model) 3 cohort studies: OR 2.62, 95%CI 1.27 to 5.37
To whom?	Patient Funders of residential aged care services

TABLE 60 *Clinical pathways versus standard (previous) care programmes: resource and cost data available from included studies*

Study	Costing data
Pachter (1987) (Cohort (H))	No resource or cost data provided
Ogilvie-Harris (1993) (Cohort (H))	Detailed description of the care plan provided No indication of incremental resource requirements if any Improvement in rate of independent walking at 6 months OR 2.18, 95% CI 0.96–4.99
Tallis (1995) (Cohort (H))	No resource or cost data provided

TABLE 61 *Clinical pathways versus standard (previous) care programmes: summary cost data*

Parameter	Summary cost data
Extra costs	Costs of deriving care plans No identified additional resources mentioned in the individual studies
To whom?	Funders and providers
Reduced costs	Mean reduction of 5.3 days stay (point estimate only)
To whom?	Funders and providers
Extra benefits	Earlier discharge; assured tracking of key points in rehabilitation
To whom?	Patients and relatives

TABLE 62 *Postintroduction of PPS versus preintroduction of PPS: resource and cost data available from included studies*

Study	Costing data
Fitzgerald (1987) (Cohort (H))	Reduced acute hospital stay, increased proportion in nursing homes
Fitzgerald (1988) (Cohort (H))	Reduced acute hospital stay, increased proportion in nursing homes
Gerety (1989) (Cohort (H))	Reduced acute hospital stay, increased proportion in nursing homes
Palmer (1989) (Cohort (H))	Reduced acute hospital stay, decreased proportion in nursing homes
Kahn (1990) (Cohort (H))	Reduced acute hospital stay, no difference in readmission rates, decreased proportion in nursing homes
Stromberg (1997) (Cohort (H))	Increased length of stay in geriatric hospital but reduced acute hospital stay, decreased proportion in nursing homes

TABLE 63 *Postintroduction of PPS versus preintroduction of PPS: summary cost data*

Parameter	Summary cost data
Extra costs	Mean increase in overall days of 14.9 days (1 cohort study only) Increased number in nursing home at six months or later Pooled OR, 95% CI (random effects model) 5 cohort studies: OR 1.75, 95% CI 0.96–3.16
To whom?	Nursing home funders
Reduced costs	Mean reduction of 3.2 acute hospital days (point estimate only, 5 cohort studies)
To whom?	Acute sector provider
Extra benefits	None identified
To whom?	

TABLE 64 *GORU versus orthopaedic unit: cost analysis*[a]

Parameter	Quantity per patient	Unit cost	Cost per patient
Extra costs			
Inpatient stay	3.6 days (range 0.4–6.9 days)	£72[b]	£259 (range £29–497)
PT	1.5 h	£15	£23
Geriatrician	5 h	£26	£130
Total			£412 (range £182–650)
Cost savings	0.106 readmissions (range 0.01–0.2)	Depends on length of stay 1 day = £72 3 days = £216 5 days = £360	 £7.63 (range £0.72–14.4) £22.90 (range £2.16–43.2) £38.16 (range £3.60–72)
Threshold	Each inpatient readmission to cost £3887 to balance extra costs (i.e. £412/0.106)		

[a] *Cost savings accruing to the hospital budget by adopting GORU is not likely to balance out the extra costs of its implementation. However, if we consider a wider perspective in our analysis, that of social care, then a different picture emerges. Assuming the extra cost of GORU is in the region of £400 per patient then the cost per extra patient returned to their own home is £400/relative risk difference (0.072), which is £5555 (95% CI £2898–400,000). However, the cost of a person in residential care is approximately £52 per day (i.e. £18,980 per year at 1995–1996 prices), whilst the extra cost of supporting a person in their own home is £1574 – the difference being £17,506. This difference is far greater than the middle estimate of £5555 of GORU. Therefore, assuming the true estimate of the effect of GORU is 2.2 per 100 or greater, then it appears to be cost-neutral or cost-saving*

[b] *Marginal bed stay from Hollingsworth* et al. *inflated to 1996 prices*

TABLE 65 *GHFP versus standard orthopaedic care: cost analysis*[a]

Parameter	Quantity per patient	Unit cost	Cost per patient
Extra costs			
Nurse/therapist time	30 min	£15 per hour	£7.50
Medical time	15 min	£26 per hour	£6.50
Additional outpatient consultation	1	£26 or £463[b]	£26 or £463
Total			£85 or £522
Cost savings			
Bed days	9	£72	£648
Cost saving based on reductions in nursing home admissions:			
high cost = £522		–£1308 (95% CI £278 to –£2889)[c]	
low cost = £85		–£1743 (95% CI –£159 to –£3326)	

[a] *With the large reduction in bed stays it would seem this programme would be cost-saving within hospital budgets. However, there are likely to be very large savings from social care budgets by reducing the numbers of people entering nursing homes or other types of expensive accommodation*
[b] *Based on York NHS trust prices for referral for medical consultation*
[c] *Assumed that GHFP reduced referrals to nursing home accommodation by 10.5 per 100 (range 1.4–19.6), costing an extra £17,406 (i.e. £18,980 nursing home minus £1574 for care at home)*

TABLE 66 *ESD versus hospital rehabilitation: cost analysis*[a]

Parameter	Quantity per patient	Unit cost	Cost per patient
Extra costs			
Readmissions	0.036 (range 0.01–0.061)	Depends on length of stay	
		1 day = £72	£2.59 (range £0.72–4.39)
		3 days = £216	£7.77 (range £2.16–13.17)
		5 days = £360	£12.95 (range £3.60–21.95)
PT and/or OT	Not known	£10 per hour	
Cost savings			
Reduced length of stay	2 days or 6.9 days	£72	£144 or £497
Threshold analysis	Cost savings = £144 – £12.95 or £497 – £12.95; thus each patient could have at least 10 h of PT or OT for intervention to remain cost-saving		

[a] *It is likely that ESD would be cost-saving*

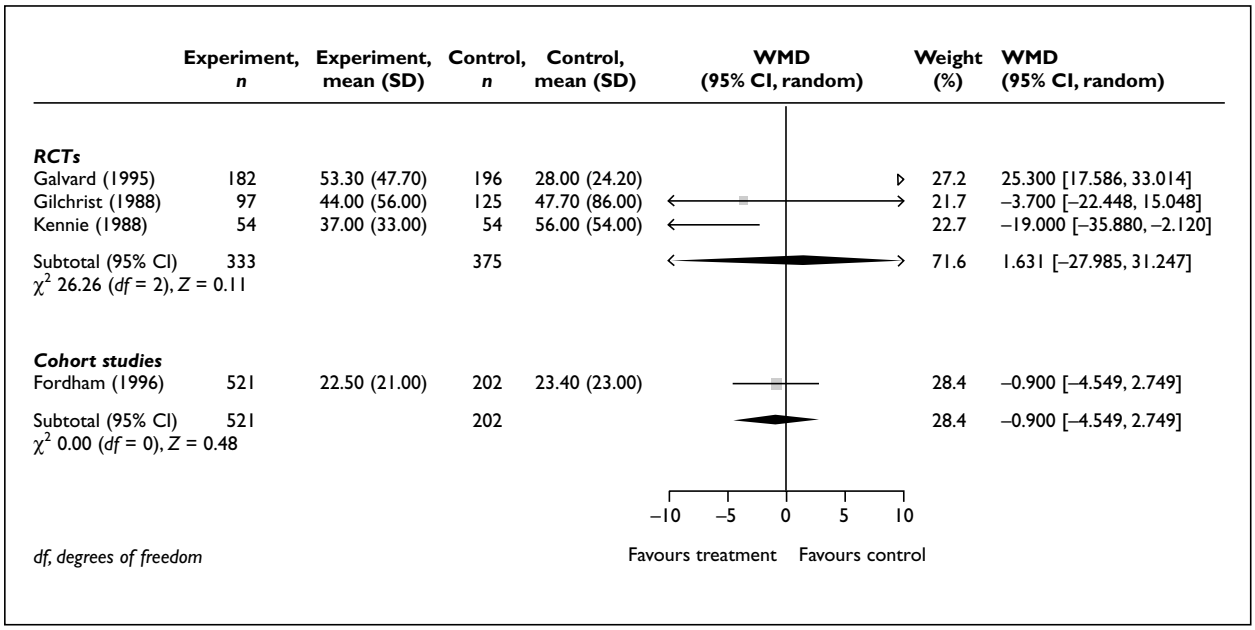

FIGURE 1 *Length of hospital stay: GORU versus orthopaedic unit. (Arrows in* Figures 1–12 *indicate 95% CI exceeding the range of a plot)*

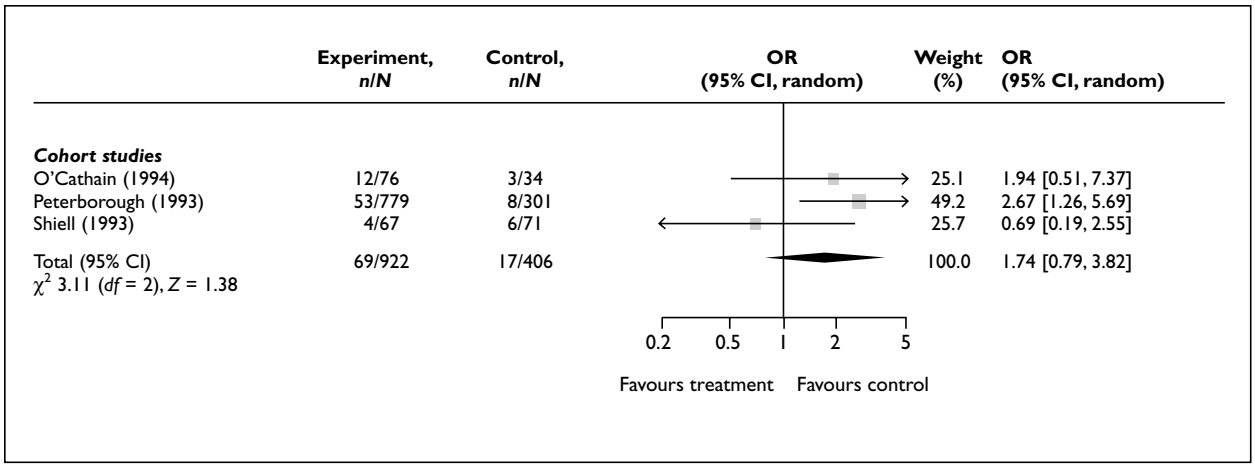

FIGURE 2 *Readmission to hospital: ESD versus standard orthopaedic unit care*

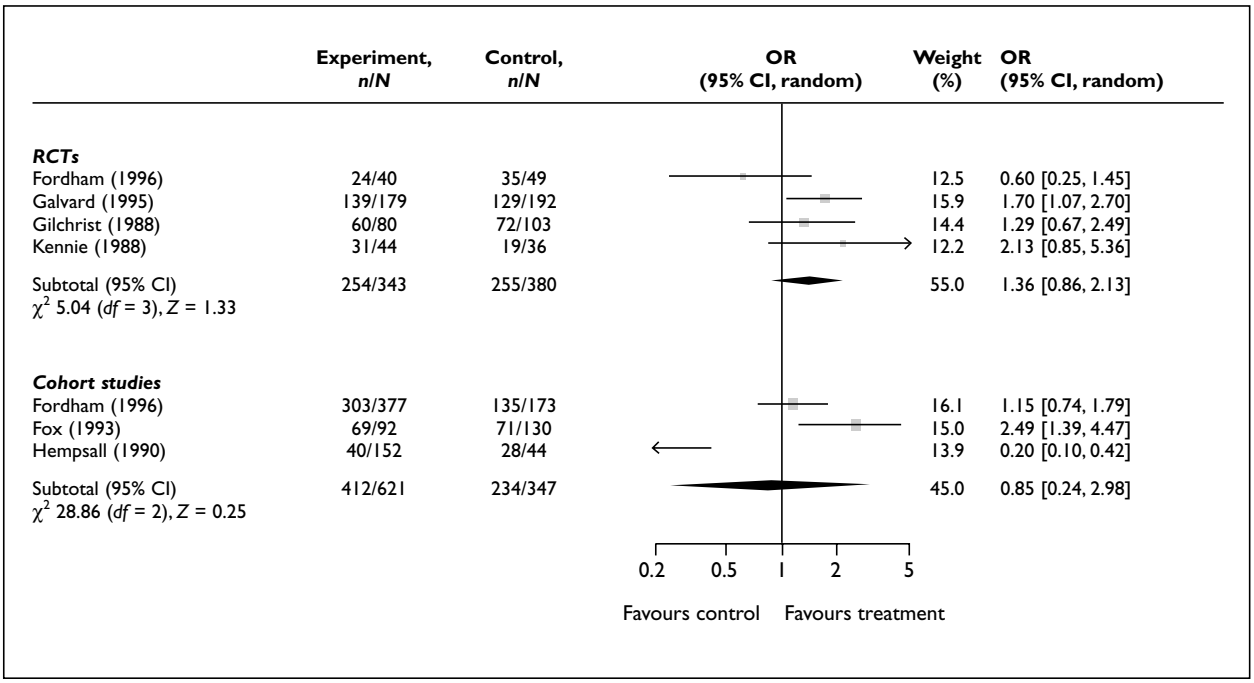

FIGURE 3 *Residential status (return home): GORU versus orthopaedic unit*

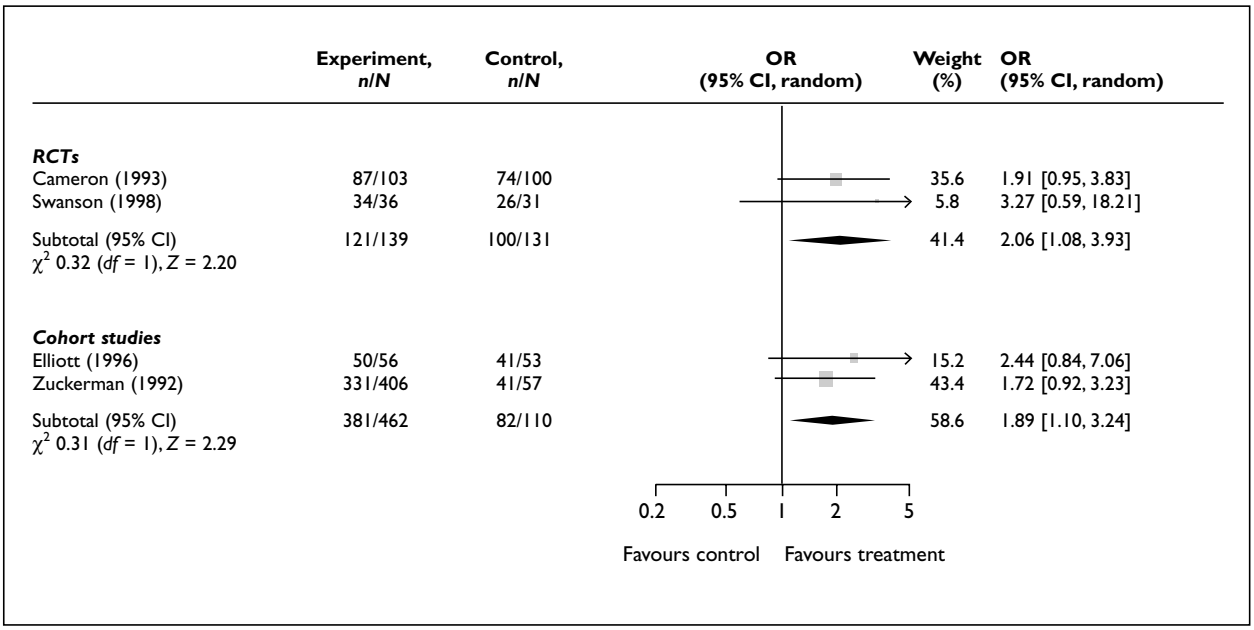

FIGURE 4 *Residential status (return home): GHFP versus standard orthopaedic unit care*

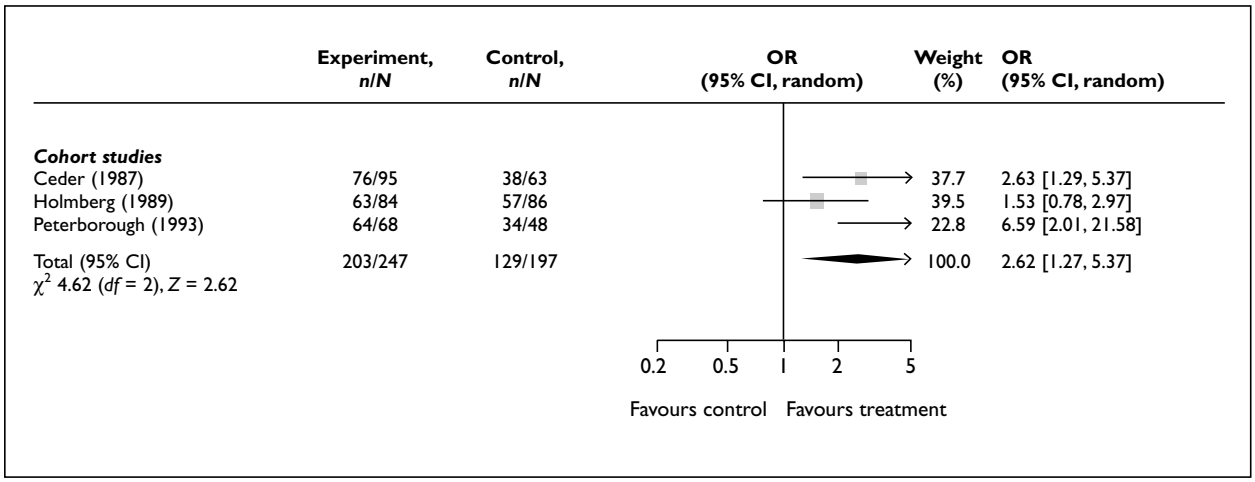

FIGURE 5 *Residential status (return home): ESD versus standard orthopaedic unit care*

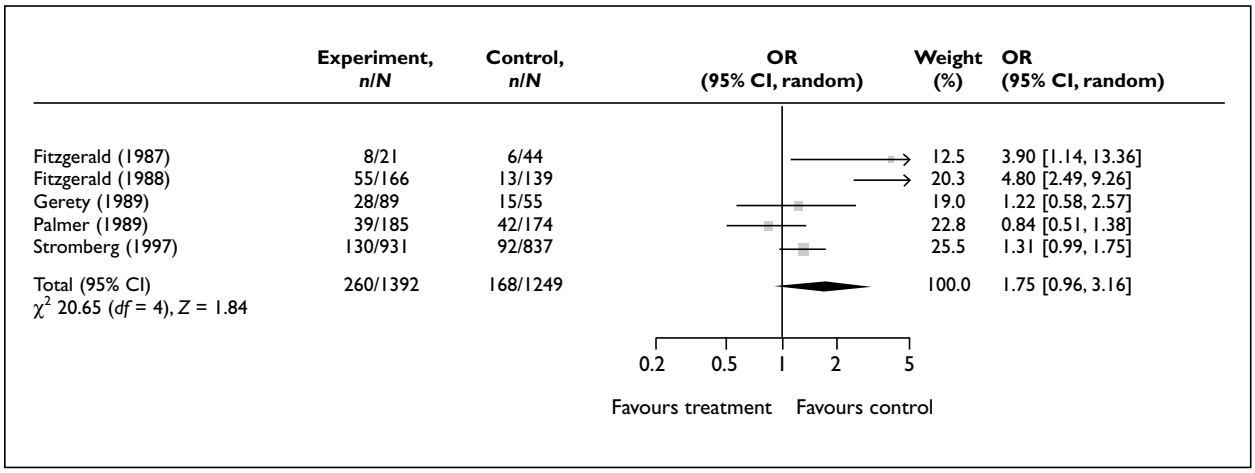

FIGURE 6 *Residential status (in nursing home by 6 months or more postdischarge): postintroduction of a PPS versus preintroduction of a PPS*

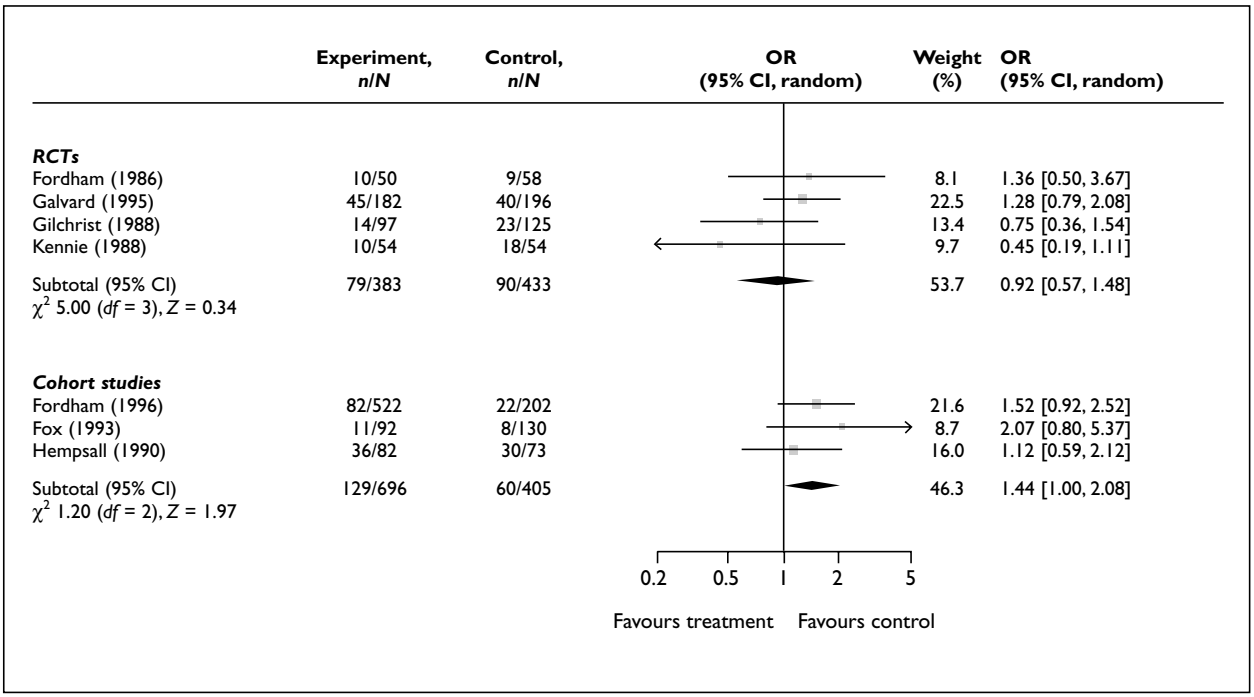

FIGURE 7 *Mortality (death by 1 year): GORU versus orthopaedic unit*

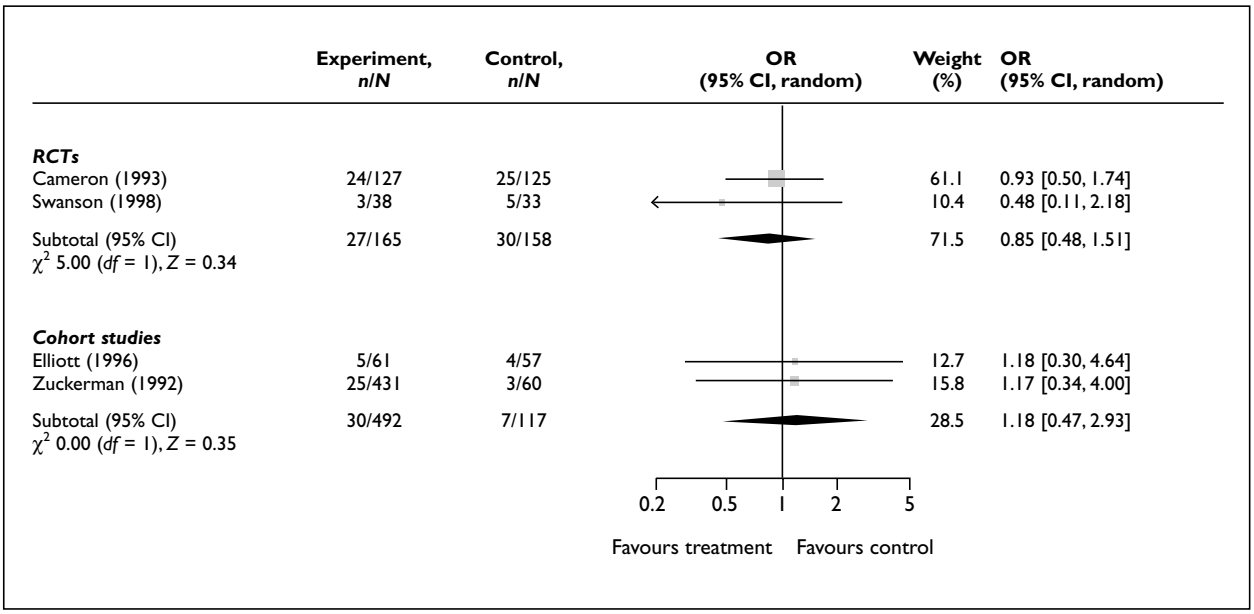

FIGURE 8 *Mortality (death by 1 year): GHFP versus standard orthopaedic unit care*

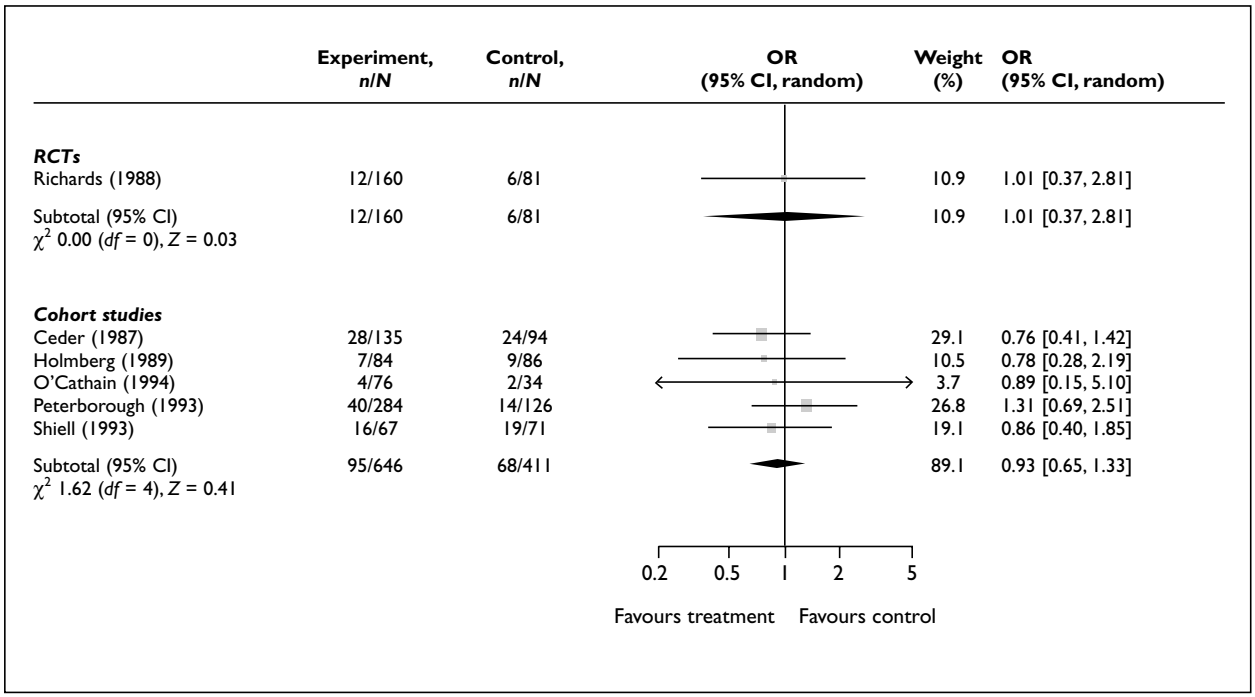

FIGURE 9 *Mortality (death by 1 year): ESD versus standard orthopaedic unit care*

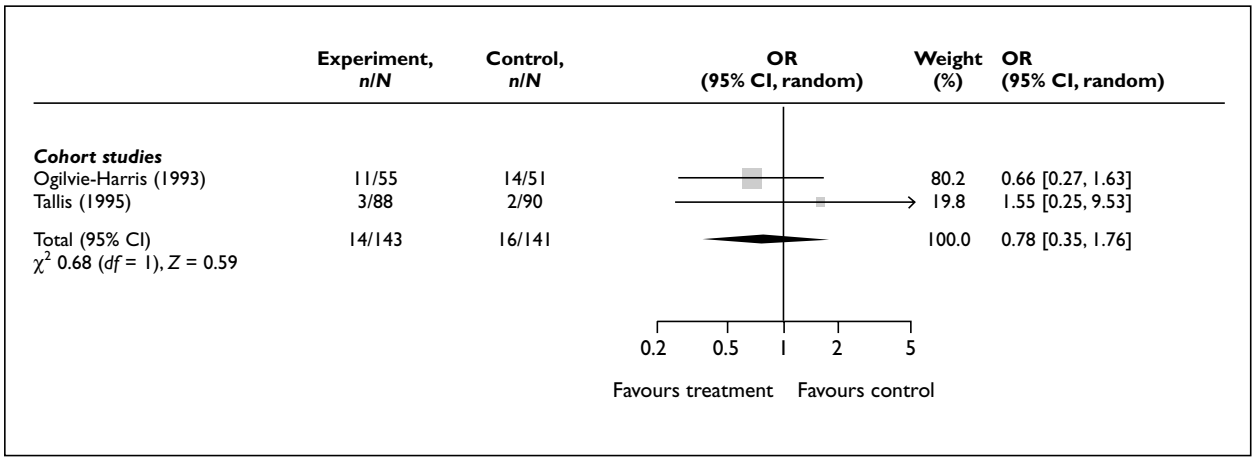

FIGURE 10 *Mortality (death by 1 year): clinical pathways versus standard (previous) care programmes*

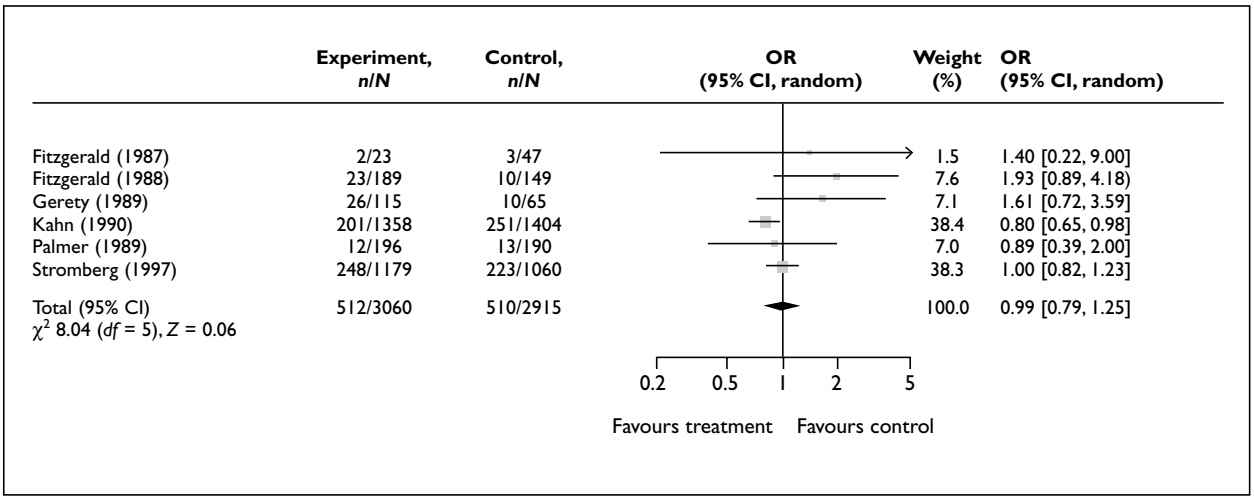

FIGURE 11 *Mortality (death by 1 year): postintroduction of a PPS versus preintroduction of a PPS*

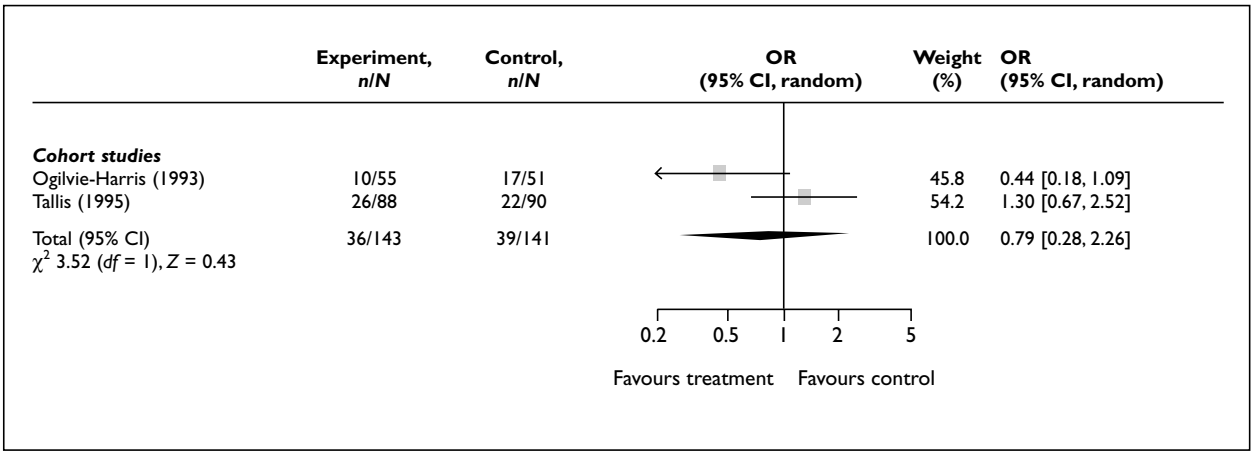

FIGURE 12 *Morbidity (one or more complications): clinical pathways versus standard (previous) care programmes*

Chapter 7

Analysis of the robustness of the results

In this review, we used a comprehensive search strategy to identify possibly relevant studies. As we found only one pilot study in the non-English literature, we believe that our conclusions are not biased as a result of its exclusion. We identified but excluded a number of trials in which hip fracture patients were included but not analysed as a separate group. It is possible that if we had been able to analyse individual patient data useful additional information might have emerged which could have influenced our conclusions. We designed an explicit triage system to select studies from which data were extracted and reported. These studies have been scrutinised for methodological quality, and data from RCTs and cohort studies have been pooled in separate groups for key outcomes. The economic analysis, based on the summaries in *Tables 54–63*, uses data from RCTs where available, and includes sensitivity analyses. Some outcomes (e.g. return to prefracture residence after a GHFP) show remarkable homogeneity.

For others (e.g. length of stay in evaluations of GORUs) there is greater heterogeneity between RCTs than between the pooled data from RCTs and that from cohort studies. Therefore, in pooling data, we have used a random effects model. We accept that the heterogeneity is likely to arise in large part from bias and confounding, both identified and unidentified. Differences in case mix within study populations may have been partly responsible, since it would be expected that, in general, treatments and programmes targeting those most likely to benefit are most likely to demonstrate effectiveness. There was a lack of explicit data on case mix in many of the included studies. Heterogeneity is difficult to avoid when the studies evaluated have been conducted at different times in the evolution of systems of care, in very different healthcare environments, or both. Nevertheless, we believe that where we have attempted pooling, it has been conducted, and interpreted, conservatively.

Chapter 8
Discussion

Geriatrician interventions are generally complex, multidisciplinary, highly dependent on good organisation and leadership, and highly variable because of local factors such as interspecialty and interagency relationships and health funding mechanisms. Generalisability of studies from individual units may be limited. Design and conduct of good comparative studies in such a context is difficult. Perhaps for these reasons, the number of randomised trials examining rehabilitative strategies has been small, and the quality only moderate. The majority of comparative studies have used historical controls or have compared apparently similar patient groups in different hospitals. In rapidly changing health systems, substantial biases may have been introduced.

The complex and varied nature of both 'experimental' and 'control' interventions has meant that classification has been dependent on the reviewers' interpretation of the information provided in the report. For example, if the report evaluated the impact of introducing a new overall programme based in an acute orthopaedic unit, it was classified as a GHFP. Some reports of GHFPs included elements of both ESD and access to inpatient rehabilitation. We believe that the classification has face validity, although the groups are not entirely mutually exclusive. We can see no method of externally validating this in the short term. However, when the available data are classified in this way, the results are (with a few exceptions) relatively consistent within programme types.

We have found that some interventions are associated with reduced length of stay in hospital after hip fracture, and that some are able to assist an increased number of patients to return to their prefracture residence. Overall, there is no evidence that geriatrician intervention reduces mortality or morbidity. It is difficult to comment on the impact on function due to variable reporting of this outcome, or upon quality of life and carer burden, as these outcomes were almost never reported in the included studies.

The original GORU model – a specialist rehabilitation unit to which all but the most active or previously institutionalised elderly lower limb fracture patients were transferred – has been overtaken by more recent developments which extend the use of other, probably less expensive, models of care.

GHFPs, ESD, the introduction of clinical pathways and PPSs all appear to reduce the length of acute hospital stay after hip fracture. For ESD, this reduction in length stay comes at a cost of increased readmissions to hospital. As long as the number of readmissions is limited, these are unlikely to outweigh the benefits of earlier discharge, but the threshold might vary considerably.

In the GORU studies, we found a non-significant trend towards an increase in numbers of participants returning to their own homes. Reports of GHFPs and ESD indicate a significant increase in the number of patients who are able to return to their previous accommodation, but as the data for each programme type are limited, this finding should be interpreted with caution. PPSs may increase the number of patients who stay in nursing homes in the medium to long term, the significance depending on the model of analysis employed.

It is important to note that ESD is suitable only for a subset of patients. These are patients who have limited prefracture disability, and for whom it is feasible and cost-effective to provide adequate levels of support at home. An alternative needs to be available for the more disabled patients. The audit data suggests that currently in the UK these patients are transferred to a GORU or general geriatric rehabilitation facility. We found no studies comparing the effectiveness of GORUs with MARUs, yet in an atmosphere of cost containment the questions of the specialisation, distribution and accessibility of rehabilitation units appear important. Either an RCT or a prospective cohort study comparing the effectiveness of different types of longer multidisciplinary rehabilitation in avoiding institutional placement in more disabled patients could provide useful data but would need to be large, and have a multicentre design to ensure generalisability.

The audit studies give an indication of current practice and outcomes in the UK. They can and have been used to compare outcomes between hospitals and significant differences have been detected.[15] Reporting of different outcome data limits an overall view of the audit data. Requests were made for additional audit data in a format that was comparable but no information was received by the time of publication. The Scottish Hip Fracture Audit[9–11] utilises a database that has been widely used in Europe and has evolved into the Standardisation of Audit of Hip Fracture in Europe (SAHFE) database. Key elements of this could form the basis of a consensus data set for both audit and future research.

This review has provided a perspective that the previous Cochrane Review,[19] concentrating on randomised trials, was unable to do due to the absence of any data for some types of treatment programme and some outcomes. Residence at discharge has been identified as an outcome that implies improved function and greater patient satisfaction and quality of life.[86] While residence at home suggests that increased support services may be required for a time, long-term costs for care are likely to be reduced.

Reporting of the range of outcomes that we sought was limited. Units of measurement varied; the potential benefits of pooling were therefore reduced. Death rates over the study period were commonly reported; there was no evidence that any of the rehabilitation programmes influenced mortality. Therefore, any improvement that an individual patient might experience from such a programme would require a better HRQL. It was particularly disappointing that measures of HRQL were rarely reported. These should be included in any future consensus data set. As a recent *Health Technology Assessment* review[87] noted, "patient-based outcome measures of function and HRQL may provide data that are not only more standardised, reliable, and validated but also more relevant and appropriate".

In interpreting the data it is important to bear in mind the limitations in quantity, quality of the individual studies, and the wide variation in context, time and place. Health systems have evolved rapidly. Therefore, the implications for practice and for research that we propose must be seen as contextual also. However, although there have been differences in ideology and operation of the various healthcare systems in the developed world in the past, common themes have emerged more recently. The NHS reforms in the UK in the early 1990s introduced purchaser–provider split and created internal markets that had parallels with the North American healthcare system. In particular, most healthcare systems have drawn attention to cost containment especially by targeting acute hospital care and placing more emphasis on primary and community care.

Thirty-seven of the 41 included studies have been published since 1986, an average of three new studies per year. If studies of specific intervention therapies are excluded, the average is less than two per year. The GORU was an early rehabilitative initiative; as ideas about alternative strategies have developed, clusters of studies have emerged. Overall, though, the field has changed slowly.

Cost containment, though, must be achieved while retaining acceptable clinical outcomes. An intervention which reduced costs significantly might not be 'cost-effective' if health outcomes were worsened. The cost analyses indicate that ESD reduces costs and there is little evidence that outcomes are significantly worsened. Therefore, on present evidence, it is likely that ESD is cost-effective if offered to appropriate patients. GORUs and GHFPs both probably increase hospital costs; however, if we widen the cost analysis to take more of a societal perspective then they may be associated with a large reduction in social care costs. Furthermore, assuming patients prefer to live in their own home environment rather than nursing homes then appropriate provision of in-hospital rehabilitation for the more disabled patients who previously lived at home may reduce overall costs to society and also improve their quality of life and that of their carers.

Chapter 9
Conclusions

Implications for practice

The available data have significant limitations in quantity and quality and allow only tentative conclusions. Nevertheless, the evidence, such as it is, has the following implications.

(1) There is limited evidence for an overall benefit from GORUs in respect of hospital admission (one RCT) and residential status following discharge (non-significant, pooled data from four RCTs). The evidence concerning cost-effectiveness in comparison with MARUs and other models is insufficient to inform policy and practice.
(2) There is moderate evidence that both GHFPs and ESD are cost-effective, since they appear to shorten the average length of hospital stay, and are associated with significantly increased rates of return to previous residential status (based on pooled data from two RCTs and two cohort studies for GHFPs, and from three cohort studies for ESD). Although there may be differences in emphasis, and ESD is unsuitable for frail and socially isolated patients, these programme types typically share many overlapping features, including:
   – involvement of a multidisciplinary geriatric team in the acute orthopaedic surgical facility
   – provision of early assessment of rehabilitation needs and potential of all patients
   – provision of an opportunity for suitable individuals to return to their own homes as soon as possible
   – retention of access for the more disabled but previously community-dwelling patients to assessment and rehabilitation services in an inpatient facility (GORU or MARU).

It is current practice to discharge patients previously resident in a nursing home back to the nursing home soon after surgical treatment. This has not been formally investigated.

There is weak evidence (three cohort studies) that adoption of formal clinical pathways in association with these practices may be advantageous.

Recommendations for research

It is recommended that:

(1) A study comparing the outcome of transfer of people previously living in the community unsuitable for ESD to a GORU or to a MARU should be considered. Given the paucity of cost-effectiveness information to date, this should include an economic evaluation.
(2) Further studies of ESD and GHFPs to establish evidence for best practice should be conducted. These should include evaluation of individual elements of care packages. Particular attention to methodological quality is required.
(3) The adoption of an agreed outcome data set for research into and audit of rehabilitation after lower limb fractures in the elderly should be a priority, ideally before any new trials or new audit programmes are funded. Such a data set should include assessment of function, HRQL, carer burden and information allowing an economic analysis that takes a societal perspective and establishes the costs and savings of different models of care in relation to primary care services.
(4) Adopted data sets/frameworks should be reviewed at least every 5 years.

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Contributors to the review

Gordon Murray was the principal grant holder, and provided statistical input. Ian Cameron (IC), Maria Crotty (MC), Terence Finnegan (TF), Lesley Gillespie (LG), William Gillespie (WG), Helen Handoll (HH), Susan Kurrle (SK) and Rajan Madhok (RM) were reviewers. Helen Handoll (HH) and Kathryn Quinn (KQ) developed search strategies, coordinated data collections and managed the project. William Gillespie and Ian Cameron collaborated in project development, acted as principal reviewers, planned and conducted the analyses and wrote the draft report. David Torgerson planned and conducted the economic analyses. Colin Currie provided access to the Scottish Hip Fracture Audit data. All named contributors assisted with compilation of the final report.

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Appendix 1

Types of intervention considered in this review*

Intervention	Location	Geriatric team responsibility	Staffing and multidisciplinarity	Financial background
GORU	Usually physically separate and for specifically oriented to orthopaedic patients	In charge of selection for rehabilitation and its supervision following admission to the unit. Fracture care remains responsibility of orthopaedic team	Acute and postacute care seen as requiring separate expertise. Postacute care multidisciplinary. Decisions generally taken for individual patients following multidisciplinary consensus	Clinical care model drives costs
GHFP	Usually within an existing acute orthopaedic unit (with transfer of selected patients)	Geriatrician influences and participates in care in orthopaedic unit from admission	Multidisciplinary professional expertise encompassing acute care and rehabilitation	Clinical care model drives costs
ESD	Transfer of selected patients to home after early identification in orthopaedic unit. May exist as a component of a GHFP	May not include significant geriatrician input, but requires skills in assessment, discharge planning, community resources and coordination	Usually multidisciplinary, requires expertise in discharge planning, community care, and rehabilitation	Stimulated by cost issues in the acute sector. May transfer costs to community sector
Clinical pathways	Protocol driven, in acute orthopaedic unit, emphasises standard approaches; allows variances but may not be sensitive to individual patient variation	Variable and determined by the pathway	An explicit, time-dependent framework involving the expertise of multiple disciplines drives decision taking	Stimulated by cost issues in the acute sector. Also designed to improve clinical outcomes
PPS	Provides overall payment irrespective of location, encouraging less costly care settings	Variable	Care models dominated by cost issues	Cost factors drive choice of clinical model
Other hospital programmes	Variable; usually involve transfer to other care settings	Variable	Variable	Variable
Specific therapies	Variable	Usually individual team members	Variable	Variable

* The control groups for these programmes vary. In general, the control group received care in an orthopaedic ward with access to other health professionals (including geriatricians) on a consultative basis. The timing of discharge from the orthopaedic ward and arrangements after discharge depended on local conditions.

Appendix 2

Changes to the original protocol

The basic aims and criteria of the original protocol were upheld. Changes resulted from comprehensive discussions of the issues and processes involved, the development and piloting of search strategies, quality assessment and data extraction tools, as well as insights gained from the review process. Some constraints such as non-availability of translators, the international multireviewer nature of the project, the early leave-taking of the research assistant and time limitations also prompted change.

The following changes were made to the selection criteria.

Types of study

Reports of programmes of care in which less than 30% of the participants had sustained a lower limb fracture (e.g. where the majority of participants were recovering from stroke) were excluded to limit dilution of the participant group of interest.

Audit data were included only if based on current practice in the UK (reported in the last 5 years).

Economic evaluations were only included if based on studies meeting the inclusion criteria.

Types of participant

Studies that included fewer than 10% of younger patients, rather than 5%, were admissible. This reflected the lower mean age of certain fracture group patients (e.g. distal radius).

Studies whose main focus was fractures sustained from high-energy transfer (e.g. road traffic accidents or building collapse) or sports injuries, and trials of rehabilitation following fractures of the ribs or facial skeleton where excluded.

Types of intervention

These were clarified to be interventions to improve function (mobility and self-care) and/or reduce hospital stay. The three broad categories elaborated on in the text were packages of care, consequences of PPS systems and specific rehabilitative interventions. Papers reporting the outcomes of PPS implementation were included if they provided comparative data for at least one principal outcome of interest for older people after hip fracture. Although not in itself a rehabilitative intervention, the introduction of a significant change in funding has the potential to influence the choice of management programme.

Interventions started after the primary rehabilitation period were excluded.

Types of outcome measure

Compliance with the intervention was necessary.

Included studies were required to record at least one of the listed outcome measures.

Appendix 3

Search strategy

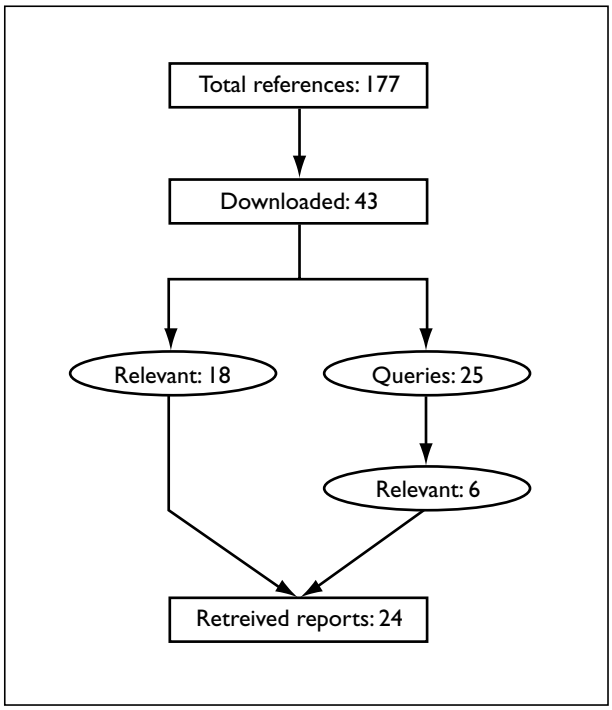
This was developed for report retrieval in MEDLINE SilverPlatter, and was adapted for use in MEDLINE Ovid, EMBASE and CINAHL.

(1) Explode "FRACTURES"/all subheadings
(2) FRACTUR*
(3) #1 or #2
(4) Explode "REHABILITATION"/all subheadings
(5) REHAB* in TI, AB, MESH
(6) #4 or #5
(7) "PATIENT-DISCHARGE"/all subheadings
(8) DISCHARGE* near (PATIENT* or HOSPITAL*)
(9) "GERIATRIC-ASSESSMENT"/all subheadings
(10) GERIATRIC* near (ASSESS* or EVALUAT*)
(11) "HEALTH-SERVICES-FOR-THE-AGED"/all subheadings
(12) "GERIATRICS"/all subheadings
(13) GERIATRIC* in TI,AB,MESH
(14) "GERIATRIC-NURSING"/all subheadings
(15) Explode "HOME-CARE-SERVICES"/all subheadings
(16) "HOME-CARE-AGENCIES"/all subheadings
(17) PHYSI* near ((THERAP*) in TI,AB,MESH)
(18) PHYSIOTHERAP* in TI,AB,MESH
(19) OCCUP* near ((THERAP*) in TI,AB,MESH)
(20) #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19
(21) Explode "FRACTURES"/rehabilitation
(22) #3 and #20
(23) #21 or #22
(24) Explode "CHILD"/all subheadings
(25) Explode "AGED"/all subheadings
(26) #24 or #25
(27) #24 not #26
(28) TG = ANIMAL not ((TG = HUMAN) and (TG = ANIMAL))
(29) TG = CASE-REPORT
(30) TG = IN-VITRO
(31) Explode "CADAVER"/all subheadings
(32) CADAVER* in TI, AB, MESH
(33) #31 or #32
(34) Explode "DENTISTRY"/all subheadings
(35) Explode "BONE-NEOPLASMS"/all subheadings
(36) Explode "HAND-INJURIES"/all subheadings
(37) Explode "SKULL-FRACTURES"/all subheadings
(38) Explode "FRACTURES,-MALUNITED"/all subheadings
(39) Explode "FRACTURES,-OPEN"/all subheadings
(40) Explode "FRACTURES,-STRESS"/all subheadings
(41) Explode "TOOTH-FRACTURES"/all subheadings
(42) Explode "RIB-FRACTURES"/all subheadings
(43) #23 not (#27 or #28 or #29 or #30 or #33 or #34). Search end-point 1
(44) #23 and #25
(45) #44 not (#28 or #29 or #30 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40 or #41 or #42). Search end-point 2

Appendix 4

Pilot MEDLINE 1995 search

Search results



Retrieved reports (*n* = 24)

Type	Number	Notes
Rehabilitation — comparative studies for review	3	
Rehabilitation — other (non-comparative/not in scope)	3	1 pressure sores 1 Parkinson's disease 1 non-comparative
Epidemiology	1	
Background	1	
Predictor/prognostic factors	7[a]	
Reviews	1	
Cost	2	
Audit	1	
Editorials	2	
Letters	2	
Other — miscellaneous	1	Vertebral fracture, functional outcomes, non-comparative

[a] *Refers to references rather than studies*

Appendix 5

Study eligibility and/or additional comments

REVIEWER: ..... **STUDY ID:** ☐

If you consider that a study sent to you for review is not suitable for inclusion, or that further information or discussion is required, or would like to make some major comments on the study, then please complete the relevant section(s) below.

SUGGESTED ACTION (please tick appropriate box)

1. Study should be excluded ☐

Please give reasons:

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.....
.....

2. Defer study inclusion ☐

Please give reasons (e.g. requires discussion):

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3. Return to authors for more information ☐

Please summarise information required:

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Additional comments on study: ☐

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Appendix 6

Methodological checklist

REVIEWER: ..... **STUDY ID:** ☐

* (Guidelines provided)

SECTION A: STUDY POPULATION **- Selection**	**Yes**	**No**	**Not Sure**	**N/A**
1. Was this a comparative study?				
***If yes**, please state study type and answer the following questions. **If no**, stop here.*				
Study type (please tick): Randomised controlled trial ☐ Cohort with concurrent controls ☐ Quasi-randomised controlled trial ☐ Cohort with historic controls ☐ Other - please specify: ☐				
2. Were all the data collected prospectively?				
3. If randomised:				
- Was the method of randomisation stated?				
***If yes**, please describe in writing (and tick appropriate boxes):* Concealed Allocation/Masked*: ☐ Quasi*: ☐ Cluster*: ☐ No. of Clusters ☐				
4. If not randomised, was the selection method defined?				
***If yes**, please describe (e.g. by geographical location, hospital records in time period):*				
5. Were study groups drawn from the same population?				
6. Was there a clear description of the inclusion/exclusion criteria?				
7. Were all participants fitting the inclusion criteria of the study included in the study?*				
8. If study involved retrospective selection of a sub-group of eligible patients, was this done by random sampling?				
- Description				
9. Was the study population described?				
10. Were **all** of the following baseline characteristics (gender, age, fracture type, any measure of mental status, any measure of pre-fracture functional status) given for both groups?*				
***If yes**, please list:*				

REVIEWER: ..... **STUDY ID:**

SECTION A: STUDY POPULATION - Selection	**Yes**	**No**	**Not Sure**	**N/A**
12. Were the study groups comparable in terms of items listed in Q9 and Q10 above?				
***If no**, list important imbalances (and, if available, trialist's comment on significance):*				
13. Was the study population a highly non-representative sample of the standard users of the intervention (e.g. all > 90; all stroke)				
***If yes**, give reasons:*				

SECTION B: PERFORMANCE	**Yes**	**No**	**Not Sure**	**N/A**
14. Was the description of the intervention adequate (including study personnel)?				
15. Was the description of the control adequate (including study personnel)?				
16. Were participants blinded to study interventions?				
17. Were treatment providers blinded to study interventions?				
18. Was the level of training/motivation of staff comparable between study groups?				
***If no**, give reasons:*				
19. Were sufficient details provided of care programmes (aside from trial or selected interventions)?				
20. If yes, or explicitly stated, were care programmes comparable (aside from trial or selected interventions)?				
***If no**, give reasons:*				
21. Were the interventions consistent (i.e. not changed) throughout the trial period?				
22. Was the level of compliance to the intervention reported (or data available to determine this)?				
For study types involving retrospective sampling: 23. Was exposure reliably ascertained and verified?				

REVIEWER: ..... **STUDY ID:**

SECTION C: PARTICIPANT FLOW	**Yes**	**No Sure**	**Not**	**N/A**
24. Were all patients accounted for (e.g. trial profile given)?				
For studies drawn from the same population (e.g. RCTs): 25a. What was the participation rate (participants/eligibles)*: (please give figures)				
For studies with groups drawn from different populations - ***For each group:*** 25b. What was the participation rate (participants/eligibles)*: (please give figures)				
26. Do the results allow for an intention-to-treat analysis?*				
27. Number of patients lost to follow-up at final assessment (not including deaths)?				
28. Were dropout rates similar in both groups (i.e. within 5%)?				

SECTION D: DETECTION	**Yes**	**No Sure**	**Not**	**N/A**
29. Were outcome assessors blinded to study interventions?				
30. Were **any** of the listed review outcomes reported?*				
31. Did the outcomes measured provide a comprehensive summary of outcome?*				
32. Were the methods used for key outcome measurements clearly stated?*				
33. Were systematic methods of surveillance used?*				
34. Were the same methods of ascertainment used for all outcomes for both groups?				
***If no**, state exceptions:*				
35. Was the overall length of follow-up appropriate (= 1 year)?				
36. Was the length of follow-up similar between the two groups?				

Appendix 7

Data extraction form

REVIEWER: ..... **STUDY ID:**

STUDY DESCRIPTION

TYPE (please specify)

Location (hospital name, town, country) of study	Period of study (dates)

PARTICIPANTS

Describe:	
Inclusion Criteria	**Exclusion Criteria**

INTERVENTION DETAILS

	Group A	**Group B**
Description of Intervention		
Timing (start, frequency, duration, end)		
Health professional involvement (role, timing)		

	Group A	**Group B**
Overall length of follow-up		

REVIEWER: ..... **STUDY ID:**

STUDY POPULATION

(Please enter interventions)

Baseline Characteristics	Group A	Group B	Overall
Sex (m/f)			
Age (Range, Mean, SD)			
Fracture (type/location)			
Other conditions/illnesses			
Pre-fracture status (e.g. mobility, independence, ADL)			
Mental status (e.g. test score)			
Treatment (e.g type of surgery)			

PARTICIPANT FLOW

(Please enter interventions)

Baseline Characteristics	Group A	Group B	Overall
Number eligible			
Number assigned/selected to each group			
Number withdrawn (self-withdrawal e.g. consent withdrawn)			
Number excluded (by trialists) (give reasons)			
Number lost to final follow-up			
Number completed/analysed at final follow-up (potentially available)			

REVIEWER: .....

STUDY ID:

OUTCOMES (please state outcomes as reported in study in appropriate sections)

(please enter interventions)

Outcome (please specify)	How measured (inc. timing, and assessor blinding)	Notes (e.g. level of significance, subgroup etc.)
All cause mortality		
Morbidity (e.g. post-op complications)		
Length of hospital stay (days)		
Residential status		
Mobility		

GROUP A	N =	GROUP B	N =

REVIEWER: .....

STUDY ID:

OUTCOMES (please state outcomes as reported in study in appropriate sections)

(please enter interventions)

Outcome (please specify)	**How measured (inc. timing, and assessor blinding)**	**Notes (e.g. level of significance, subgroup etc.)**
Ability to perform activities of daily living		
QOL		
Cognitive function		
Other: Readmission		
Compliance		
Costs		

GROUP A	**N =**	**GROUP B**	**N =**

REVIEWER: .....

STUDY ID:

OUTCOMES (please state outcomes as reported in study in appropriate sections)

(please enter interventions)

Outcome (please specify)	How measured (inc. timing, and assessor blinding)	Notes (e.g. level of significance, subgroup etc.)

GROUP A	N =	GROUP B	N =

Appendix 8

Nine-item quality assessment score for included trials

Section A. Selection bias

1. Allocation to group?	Individual randomisation	= 4
	Cluster randomisation	= 3
	Quasi-randomisation	= 2
	Not randomised	= 0
2. Allocation concealed?	Individually randomised studies:	
	Yes	= 1
	No or not described	= 0
	Any other study type	= 0
3. Groups comparable on all principal baseline characteristics?		
	Yes, in all	= 3
	In at least age, functional status	= 1
	Not described or no	= 0

Section B. Detection/attrition bias

4. Blinding of outcome assessors?		
	Confirmed	= 1
	Not described or no	= 0
5. Losses during study?	Less than 20% overall	= 1
	More than 20%	= 0
6. Loss comparable in each group (within 5%)?		
	Yes	= 1
	Not described or no	= 0
7. Analysis by intention to treat completed or possible?		
	Yes	= 1
	No	= 0

Section C. External validity

8. Study population representative?		
	Yes	= 1
	Not described or no	= 0
9. Length of follow-up > 1 year?		
	Yes	= 1
	Not described or no	= 0

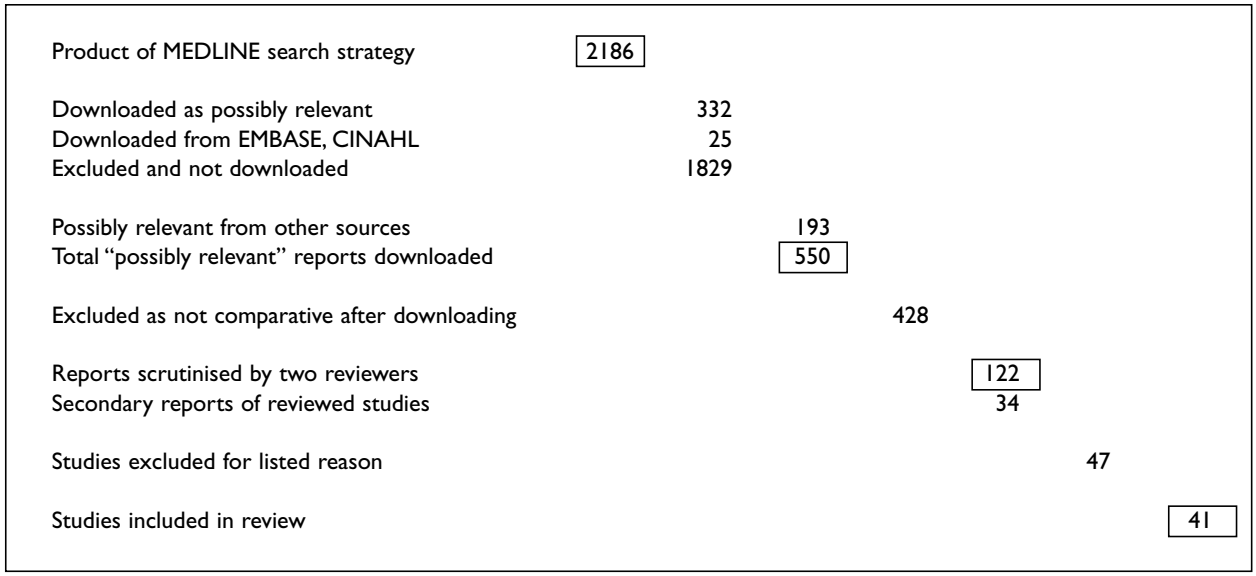
Attribution of scores

11–14	Relevant comparative study with low risk of selection bias
5–10	Relevant comparative study with moderate to high risk of selection bias
< 5	Comparative study of low relevance or high risk of bias

Appendix 9

Search and triage results

Sources of included and excluded trials



Results of electronic database search*

Database	Years completed	Citations downloaded
MEDLINE SilverPlatter	1984–1998 (January–May)	323
MEDLINE Ovid	1976–1984	9
EMBASE	1980 –1998 (July)	19
CINAHL	1982–1998 (April)	6

Search results – additional sources

Source	Citations down-loaded
Bibliographic checking	124
Peer referral	69

Sensitivity of primary MEDLINE search strategy

Total number of reports identified	Number of reports selected for reviewer scrutiny	Number of trials of which at least one report was identified by primary MEDLINE search strategy[a]	Number of included trials
2186	122 (87 studies)	58/87 (68%)	41

[a] *Trials not identified by MEDLINE include 24 trials not coded with the index term 'fracture', four abstracts and unpublished work*

* Citations identified by other methods or preceding databases not downloaded.

Appendix 10

Excluded studies: references and reasons for exclusion

Study	References	Reason for exclusion
Applegate (1990)	Applegate WB, Miller ST, Graney MJ, Elam JT, Burns R, Akins DE. A randomized, controlled trial of a geriatric assessment unit in a community rehabilitation hospital. *N Engl J Med* 1990;**322**:1572–8	RCT. Role of geriatric assessment unit. Less than 10% had hip fracture
Barker (1985)	Barker HW, Williams TF, Zimmer GJ. Geriatric consultation teams in acute hospitals: impact on back-up of elderly patients. *J Am Geriatr Soc* 1985;**33**:422–8	No extractable fracture data
Bentur (1993)	Bentur N, Eldar R. Quality of rehabilitation care in two inpatient geriatric settings. *Qual Assur Health Care* 1993;**5**(3):237–42 Bentur N, Eldar R, Davies MA. Process and outcome of care: comparison of two inpatient geriatric rehabilitation settings. *Clin Rehabil* 1994;**8**(4):307–13	Comparison of two settings. No extractable fracture data
Bidsted (1993)	Bidsted D. Klinisk sygepleje – hurtigt hjem efter hoftebrud [Clinical nursing – rapid return home after hip fracture]. *Sygeplejersken* 1993;**93**(31):8–10 Bidsted D, Hollander L, Stilling I. Klinisk sygepleje – genoptraening [Clinical nursing – rehabilitation]. *Sygeplejersken* 1993;**93**(31):11–13,21	Descriptive study. No comparative data
Blacklock (1988)	Blacklock C, Woodhouse KW. Orthogeriatric liaison. *Lancet* 1988;**i**(8592):999	Audit data; no comparison group. More than 10 years old
Boyer (1986)	Boyer N, Chuang JL, Gipner D. An acute care geriatric unit. *Nurs Manage* 1986;**17**(5):22–5	RCT. No extractable data on fracture patients
Bradley (1995)	Bradley CF, Kozak C. Nursing care and management of the elderly hip fractured patient. *J Gerontol Nurs* 1995;**21**(8):15–22	Descriptive study. No comparative data
Braun (1987)	Braun KJ, Rose CL. Geriatric patient outcomes and costs in three settings: nursing home, foster family and own home. *J Am Geriatr Soc* 1987;**35**:387	Cohort study. No extractable fracture data
Burns (1992)	Burns A, Park K. Proximal femoral fractures in the female patient, a controlled trial: the role of the occupational therapist and the physiotherapist. *Br J Occupat Ther* 1992;**55**(10):397–400	RCT. No extractable fracture data
Campion (1987)	Campion EW, Jette AM, Cleary PD, Harris BA. Hip fracture: a prospective study of hospital course, complications, and costs. *J Gen Intern Med* 1987;**2**(2):78–82	Descriptive study. No comparative data
Collard (1985)	Collard AF, Bachman SS, Beatrice DF. Acute care delivery for the geriatric patient: an innovative approach. *QRB Qual Rev Bull* 1985;**11**(6):180–5	RCT. No extractable fracture data

continued

contd

Study	References	Reason for exclusion
Cooney (1997)	Cooney LMJ. Hip fracture outcomes. *Arch Intern Med* 1997;**157**:485–6	Editorial. No comparative data
Evans (1980)	Evans JG, Wandless I, Prudham D. A prospective study of fractured proximal femur: hospital differences. *Public Health* 1980;**94**(3):149–54	Audit data; no comparison group. More than 10 years old
Franz (1988)	Franz TA, Nicholson JJ, Robinson LR. Rehabilitation in hip fracture. *Arch Phys Med Rehabil* 1988;**69**(6):463	Letter. No comparative data
Gibson (1995)	Gibson PD. Collaboration with orthopaedic surgeons. *Age Ageing* 1995;**24**:367	Letter. No comparative data
Hansen (1992)	Hansen FR, Spedtsberg K, Schroll M. Geriatric follow-up by home visits after discharge from hospital: a randomized controlled trial. *Age Ageing* 1992;**21**:445–50	RCT. Effect of home visit by geriatric team following discharge. Less than 10% 'orthopaedic'
Hoenig (1996)	Hoenig H, Rubenstein L, Kahn K. Rehabilitation after hip fracture – equal opportunity for all? *Arch Phys Med Rehabil* 1996;**77**(1):58–63	Not a comparative study (investigation of characteristics predicting rehabilitation)
Idland (1993)	Idland G, Bjercke KA, Ljunggren AE. Pilotprosjekt pa Ulleval – tidlig rehabilitering av eldre med larhalsbrudd [Pilot project in Ulleval – early rehabilitation of elderly patients with femoral neck fractures]. *Sykepl Fag* 1993;**81**(6):48–51	Translation not obtained
Jacobsen (1993)	Jacobsen S, Engfred KF, Nielsen PR, Larsen HJ, Jespersen PT. Behandling af hoftefrakturer pa alment kirurgisk og ortopaedkirurgisk specialafdeling. En sammenligning [Treatment of hip fractures in a department of general surgery and a department of orthopedic surgery. A comparison]. *Ugeskr Laeger* 1993;**155**(10):701–3	Comparison of acute care settings
Jalovaara (1992)	Jalovaara P, Berglund Roden M, Wingstrand H, Thorngren KG. Treatment of hip fracture in Finland and Sweden. Prospective comparison of 788 cases in three hospitals. *Acta Orthop Scand* 1992;**63**(5):531–5	Study of variable operative treatment, not rehabilitation intervention
Jarnlo (1984)	Jarnlo G-B, Ceder L, Thorngren KG. Early rehabilitation at home of elderly patients with hip fractures and consumption of resources in primary care. *Scand J Prim Health Care* 1984;**2**:105–12	Descriptive study. No comparative data
Kauffman (1987)	Kauffman TL, Albright L, Wagner C. Rehabilitation outcomes after hip fracture in persons 90 years old and older. *Arch Phys Med Rehabil* 1987;**68**(6):369–71	Descriptive study of rehabilitation outcomes. No comparative data
Levi (1997)	Levi SJ. Post-hospital setting, resource utilization, and self-care outcome in older women with hip fracture. *Arch Phys Med Rehabil* 1997;**78**(9):973–9	Descriptive study. No comparative data
Lewis (1987)	Lewis MA, Leake B, Leal-Sotelo M, Clark V. The initial effects of the prospective payment system on nursing home patients. *Am J Public Health* 1987;**77**:819–21	No extractable fracture data
Lipson (1990)	Lipson MJ, Minassian P. Differences in outcome: hospital rehabilitation vs skilled nursing facility rehabilitation. *Arch Intern Med* 1990;**150**(7):1550–1	Letter. No extractable fracture data

continued

contd

Study	References	Reason for exclusion
Melin (1992–1993)	Melin AL, Bygren LO. Efficacy of the rehabilitation of elderly primary health care patients after short-stay hospital treatment. *Med Care* 1992;**30**:1004–15 Melin AL, Hakansson S, Bygren LO. The cost-effectiveness of rehabilitation in the home: a study of Swedish elderly. *Am J Public Health* 1993;**83**(3):356–62 Melin AL, Bygren LO. Perceived functional health of frail elderly in a primary home care programme and correlation of self-perception with objective measurements. *Scand J Soc Med* 1993;**21**(4):256–63	RCT. Less than 10% of participants enrolled with fractures and other traumatic injuries
Melin (1995)	Melin AL. A randomized trial of multidisciplinary in-home care for frail elderly patients awaiting hospital discharge. *Aging* 1995;**7**(3):247–50 Melin AL, Wieland D, Harker JO, Bygren LO. Health outcomes of post-hospital in-home team care: secondary analysis of a Swedish trial. *J Am Geriatr Soc* 1995; **43**(3):301–7	RCT. Less than 5% of participants met fracture entry criteria. No extractable fracture data
Molloy (1995)	Molloy DM, Lever J, Vandenberg A, Principi E, Tuttle I, Strang D, *et al*. Effects of geriatric assessment in elderly orthopaedic patients on length of hospital stay. *Ann Roy Coll Physicians Surg Can* 1995;**28**:399–402	Cohort with historical controls; no extractable hip fracture data
Murphy (1987)	Murphy PJ, Rai GS, Lowy M, Bielawska C. The beneficial effects of joint orthopaedic-geriatric rehabilitation. *Age Ageing* 1987;**16**(5):273–8	Reviews length of stay trends; no extractable comparative data
Nicholson (1997)	Nicholson CM, Czernwicz S, Mandilas G, Rudolph I, Greyling MJ. The role of chair exercises for older adults following hip fracture. *S Afr Med J* 1997;**87**(9):1131–8	Comparative study; intervention applied to deliberately selected different groups
Oskarsson (1997)	Oskarsson GV, Hjall A, Aaser P. Physiotherapy: an overestimated factor in after-treatment of fractures in the distal radius? *Arch Orthop Trauma Surg* 1997; **116**(6–7):373–5	RCT. 66% of participants were under 65 years of age
Ostrow (1989)	Ostrow P, Parent R, Ottenbacher KJ, Bonder B. Functional outcomes and rehabilitation: an acute care field study. *J Rehabil RD* 1989;**26**(3):17–26	No data for fracture patients
Reuben (1995)	Borok GM, Reuben DB, Zendle LJ, Ershoff DH, Wolde-Tsadik G, Rubenstein LZ, *et al*. Rationale and design of a multi-center randomized trial of comprehensive geriatric assessment consultation for hospitalized patients in an HMO. *J Am Geriatr Soc* 1994;**42**(5):536–44 Reuben DB, Borok GM, Wolde Tsadik G, Ershoff DH, Fishman LK, Ambrosini VL, *et al*. A randomized trial of comprehensive geriatric assessment in the care of hospitalized patients. *N Engl J Med* 1995; **332**(20):1345–50	Methodology only RCT. No extractable data on fracture patients

continued

contd

Study	References	Reason for exclusion
Rubenstein (1984)	Rubenstein LZ, Josephson KR, Wieland GD, English PA, Sayre JA, Kane RL. Effectiveness of a geriatric evaluation unit. A randomized clinical trial. *N Engl J Med* 1984; **311**:1664–70	RCT. No extractable data on fracture patients
Rubenstein (1990)	Rubenstein LV, Kahn KL, Reinisch EJ, Sherwood MJ, Rogers WH, Kamberg C, *et al*. Changes in quality of care for five diseases measured by implicit review, 1981 to 1986. *J Am Med Assoc* 1990;**264**(15):1974–9	Descriptive study. No comparative data
Rubenstein (1991)	Rubenstein LZ, Stuck AE, Siv AL. Impacts of geriatric evaluation and management programmes on defined outcomes: overview of the evidence. *J Am Geriatr Soc* 1991;**39s**:8–16	Review article: overview of comprehensive geriatric assessment. No data
Shepperd (1998)	Shepperd S, Harwood D, Jenkinson C, Gray A, Vessey M, Morgan P. Randomised controlled trial comparing hospital at home with inpatient hospital care. I: three month follow-up of health outcomes. *Br Med J* 1998;**316**:1786–96	RCT examining early supported discharge. No extractable data on fracture patients
Sherrington (1997)	Sherrington C, Lord SR. Home exercise to improve strength and walking velocity after hip fracture: a randomized controlled trial. *Arch Phys Med Rehabil* 1997;**78**(2):208–12	Patients studied many months after hip fracture
Sikorski (1985)	Sikorski JM, Davis NJ, Senior J. The rapid transit system for patients with fractures of proximal femur. *Br Med J (Clin Res Ed)* 1985;**290**(6466):439–43	No comparative data
Sikorski (1993)	Sikorski JM, Senior J. The Domiciliary Rehabilitation and Support Programme. Rationale, organisation and outcome. *Med J Aust* 1993;**159**(1):23–5	No comparative data
Siu (1996)	Siu AL, Kravitz RL, Keeler E, Hemmerling K, Kington R, Davis JW, *et al*. Postdischarge geriatric assessment of hospitalized frail elderly patients. *Arch Intern Med* 1996;**156**:76–81	RCT. Only 5% had "hip fracture history"
Smith (1988)	Smith N. Effectiveness of geriatric rehabilitative care. *Br Med J* 1988;**297**(6663):1609	Letter. No extractable fracture data
von Sternberg (1997)	von Sternberg T, Hepburn K, Cibuzar P, Convery L, Dokken B, Haefemeyer J, *et al*. Post-hospital sub-acute care: an example of a managed care model. *J Am Geriatr Soc* 1997;**45**(1):87–91	Retrospective review; some comparative data but no extractable hip fracture data
Webster (1986)	Webster P, Clark A, Robinson L. Geriatric and rehabilitation services: an evaluation of two units. Hornsby: Hornsby Kuring-gai Hospital (for the Dept of Community Services), 1986;66–75	Audit data; no comparison group. More than 10 years old
West (1995)	West R. Fractured neck of femur patients. *J Public Health Med* 1995;**17**(1):116–7	Letter. No extractable fracture data
Whitaker (1988)	Whitaker JJ, Currie CT. An evaluation of the role of geriatric orthopaedic rehabilitation units in Edinburgh. *Health Bull (Edinb)* 1988;**46**(5):273–6	Audit data; no comparison group. More than 10 years old

continued

contd

Study	References	Reason for exclusion
Zetterberg/ Ziden (1990–1997)	Zetterberg C, Gneib C, Mellstrom D, Sundh V, Ziden L. Rikshoft – utvardering av fysisk funktion och vardkonsumtion efter hoftfraktur [The standard hip – evaluation of physical function and health care utilization following hip fracture]. *Lakartidningen* 1990;**87**(23):2040–5	Methodology only
	Ziden L, Aniansson A, Gneib C, Johansson C, Mellstrom D, Zetterberg C. Svaleboprogrammet – framgangsrik rehabilitering for hoftfrakturpatienter [The Svalebo programme – successful rehabilitation of hip fracture patients]. *Lakartidningen* 1990;**87**(23):2034–9	No comparison group
	Ziden L, Zetterberg C, Wollin EB, Landahl S, Hansson T. Mindre akutvard for hoftfrakturpatienter. Adelreformen gav andrat vardflode pa avsett satt [Reduced emergency care of patients with hip fractures. The Adel-reform changed the continuity of care, as intended]. *Lakartidningen* 1996; **93**(40):3478–80	No rehabilitative outcomes
	Ziden L, Zetterberg C. Two case-control studies of the effect of rehabilitation programme for hip fracture patients. *Acta Orthop Scand* 1997;**68**(Suppl 274):16–17	No extractable rehabilitation data

Appendix 11

Included audit reports

	Scottish Hip Fracture Audit (1998)[11]	Audit Commission (1997)[12]	Pinderfields Trust[13]	Quality of care to hip fracture patients[14]
Admission data				
Mean age (years)	80–81			
Male (%)	20			
Admitted from home or residential care (%)	60 (range 51–66)[a]			
Admitted from long-term care (%)	30 (range 21–40)			
Outcome data				
Acute stay mortality (%)	7.5 (range 6.6–8.3)			
Home from acute facility (%)	45 (range 15–72)			
Transfer to rehabilitation facility (%)	38 (range 10–56)			
Total days LOS (median)	20 (range 15–23)		20 (range 14–25)	
Acute facility days LOS (median)	12 (range 9–16)	11 (range 8–15)		
Dead at 4 months (%)	20			At 3 months: 22 (range 14–31)
Home at 4 months (%)	?			At 3 months: 62 (range 50–73)
ADL function at 4 months (? unit of measurement)	?			At 3 months: 37 (range 23–53)
Mobility at 4 months (? unit of measurement)	30			At 3 months: 67 (range 52–80)

LOS, length of stay

[a] *Ranges in parentheses*

Appendix 12

Methodological assessment: quality scores of included trials

Item scores for individual trials

	Item number[a]									
	1	2	3	4	5	6	7	8	9	Total
Antonelli Incalzi (1993)	0	0	1	0	1	1	1	1	0	5
Baker (1991)	2	0	0	0	1	1	1	1	0	5
Bertoft (1984)	4	1	0	1	0	1	0	1	1	9
Cameron (1993)	4	1	0	0	1	1	1	1	1	10
Ceder (1987)	0	0	1	0	1	1	1	1	1	6
Elliot (1996)	0	0	1	0	1	1	1	1	0	5
Fitzgerald (1987)	0	0	1	0	1	1	1	0	0	4
Fitzgerald (1988)	0	0	1	0	1	1	1	1	0	5
Fordham (1986)	4	1	1	0	1	1	1	1	0	10
Fordham (1995)	0	0	1	0	1	1	1	1	1	6
Fox (1993)	0	0	1	0	1	1	1	1	0	5
Galvard (1995)	4	0	0	0	1	1	1	1	1	9
Gerety (1989)	0	0	1	0	1	1	0	1	1	5
Gilchrist (1988)	4	0	1	0	1	1	1	1	0	9
Gill (1994)	0	0	0	0	1	0	0	1	0	2
Gronlund (1990)	4	0	0	1	1	1	1	1	0	9
Hempsall (1990)	0	0	1	0	1	1	1	1	1	6
Hoenig (1997)	0	0	0	0	1	1	1	0	0	3
Holmberg (1989)	0	0	0	1	0	1	1	0	1	4
Jette (1987)	2	0	1	0	1	1	1	1	1	8
Kahn (1990)	0	0	1	0	1	1	1	1	0	5
Kane (1996)	0	0	0	0	1	1	1	1	1	5
Karumo (1977)	4	0	1	1	1	0	0	1	0	8
Kennie (1988)	4	1	1	0	1	1	1	1	1	11
Koval (1998)	0	0	0	0	1	1	1	0	1	4
Kramer (1997)	0	0	0	0	0	0	1	1	0	2
Lamb (1998)	4	0	1	0	1	1	1	0	0	8
Lundberg (1979)	4	0	1	1	1	1	1	1	1	11
O'Cathain (1994)	0	0	1	0	1	1	1	1	0	5
Ogilvie-Harris (1993)	0	0	1	0	1	1	1	1	0	5
Pachter (1987)	0	0	0	0	1	1	1	0	0	3
Palmer (1989)	0	0	1	0	1	1	1	0	0	4
Pearson (1988)	4	1	0	1	0	0	0	0	0	6
Peterborough (1993)	0	0	1	0	1	1	1	1	0	5
Richards (1998)	4	1	3	0	1	1	1	0	0	11
Shiell (1993)	0	0	0	0	1	1	1	1	1	5
Stromberg (1997)	0	0	0	0	1	1	1	1	1	5
Swanson (1998)	4	0	1	0	1	1	1	1	0	9
Tallis (1995)	0	0	1	0	1	1	1	1	0	5
Taylor (1994)	4	0	1	0	1	0	0	1	0	7
Zuckerman (1992)	0	0	1	1	1	1	1	1	0	6

[a] *See appendix 8 (methodological checklist) for items*

Summary of quality scores by programme type

Quality score	GORU (*n* = 7)	GHFP (*n* = 5)	ESD (*n* = 6)	Clinical pathways (*n* = 3)	PPS (*n* = 6)	Miscellaneous hospital programmes (*n* = 4)	Specific therapies, etc. (*n* = 10)
10–14	2	1	1	0	0	0	1
5–9	5	4	4	2	2	2	7
< 5	0	0	1	1	4	2	2
Mean	8.0	7.4	6.0	4.3	4.6	4.3	6.8

Appendix 13

Plots of quality scores by publication year for each category of intervention

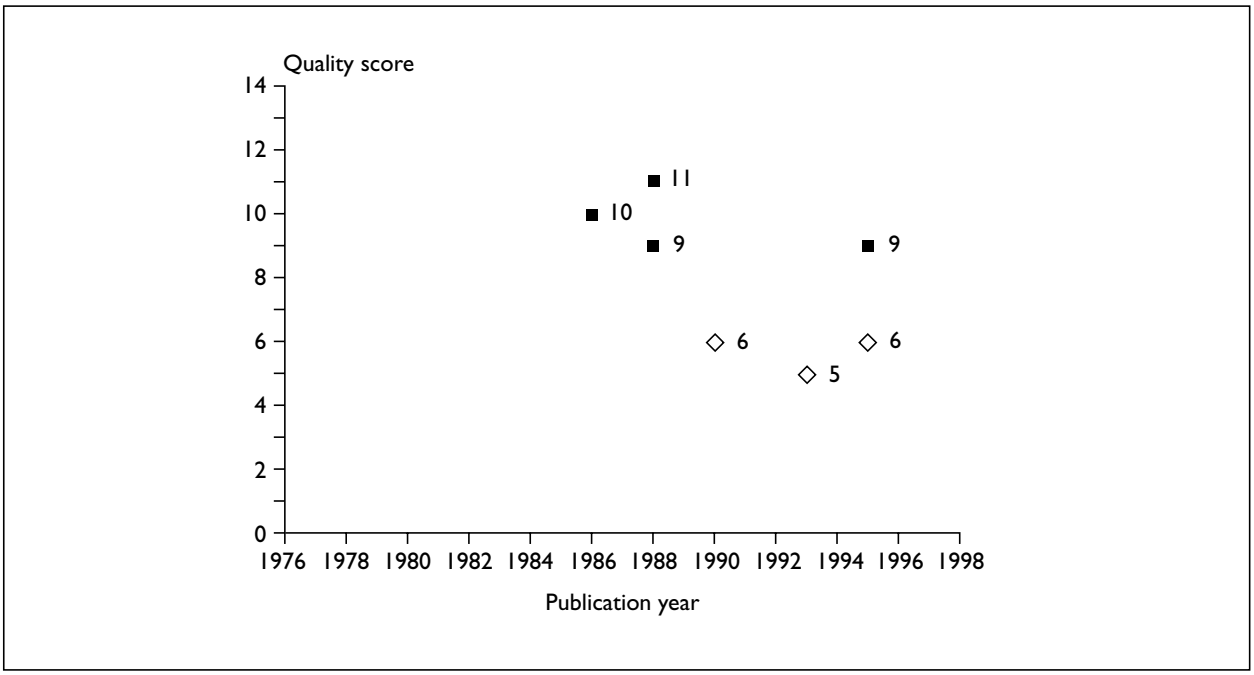


FIGURE 13 *Quality scores by publication year for studies comparing two hospital programmes: rehabilitation in a dedicated geriatric facility (GORU) versus rehabilitation in a general orthopaedic unit (■, RCT; ◇, Cohort (C))*

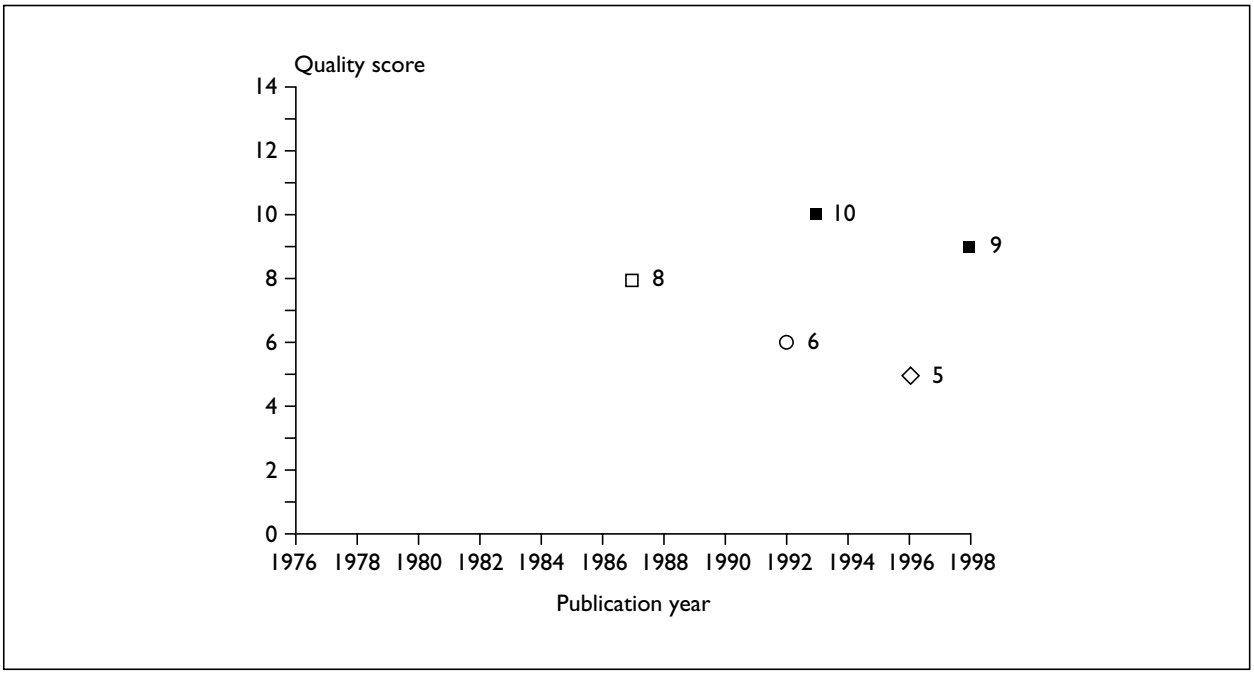


FIGURE 14 *Quality scores by publication year for studies comparing two hospital programmes: admission to a GHFP within an orthopaedic unit versus orthopaedic team care in a general orthopaedic unit (■, RCT; □, CCT; ◇, Cohort (C); ○, Cohort (H))*

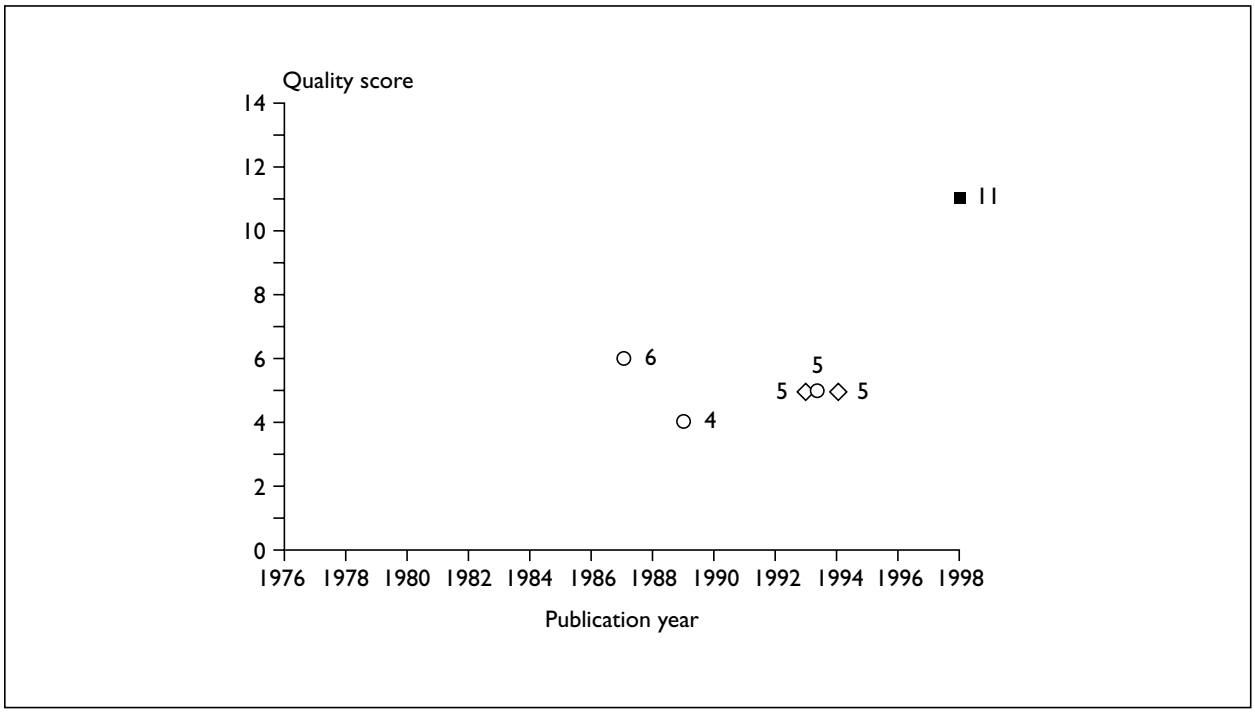


FIGURE 15 *Quality scores by publication year for studies comparing ESD programmes and in-hospital care packages (■, RCT; ◇, Cohort (C); ○, Cohort (H))*

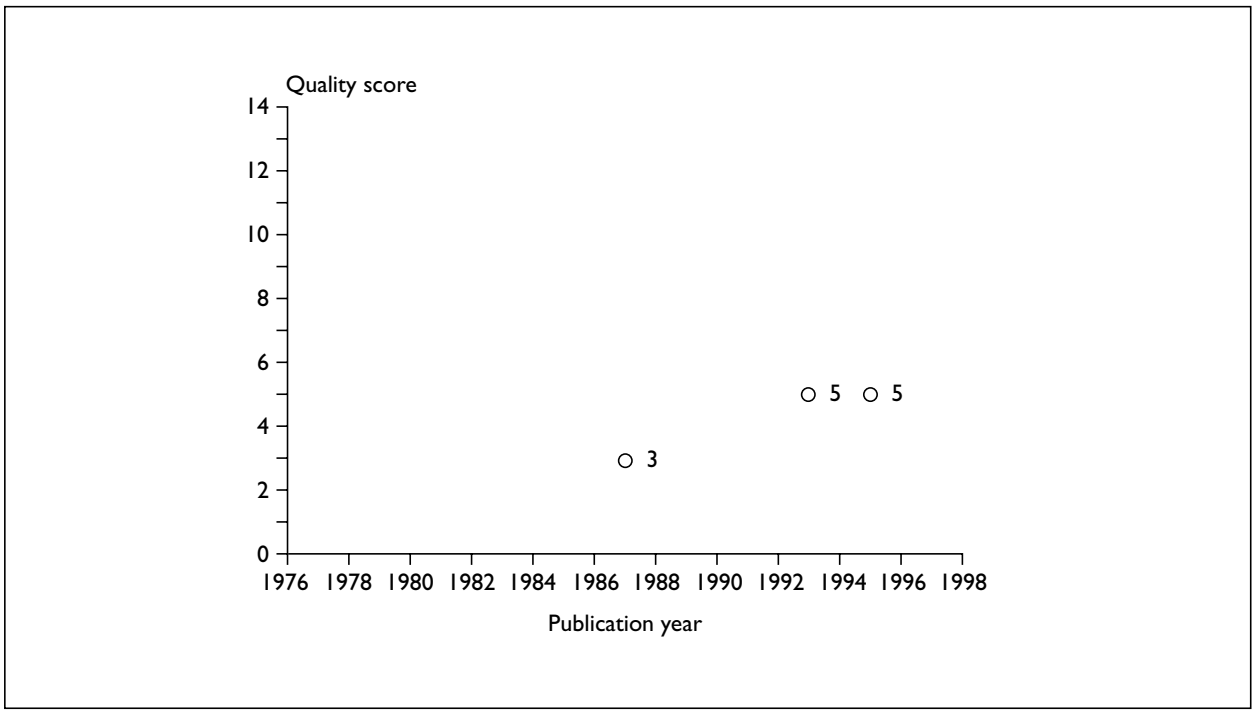


FIGURE 16 *Quality scores by publication year for studies comparing two hospital programmes: application of care plans/clinical pathways versus standard (previous) care programmes (○, Cohort (H))*

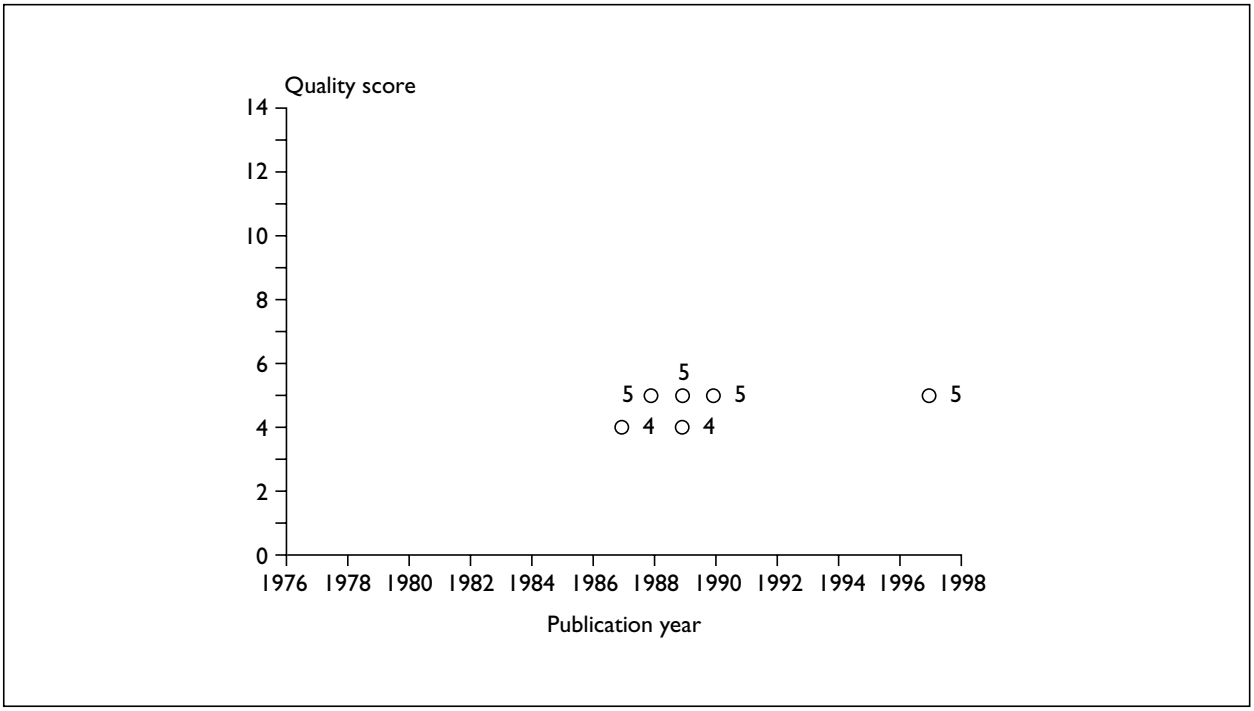


FIGURE 17 *Quality scores by publication year for investigations of the effect of changes in health system strategy or funding (PPS) (○, Cohort (H))*

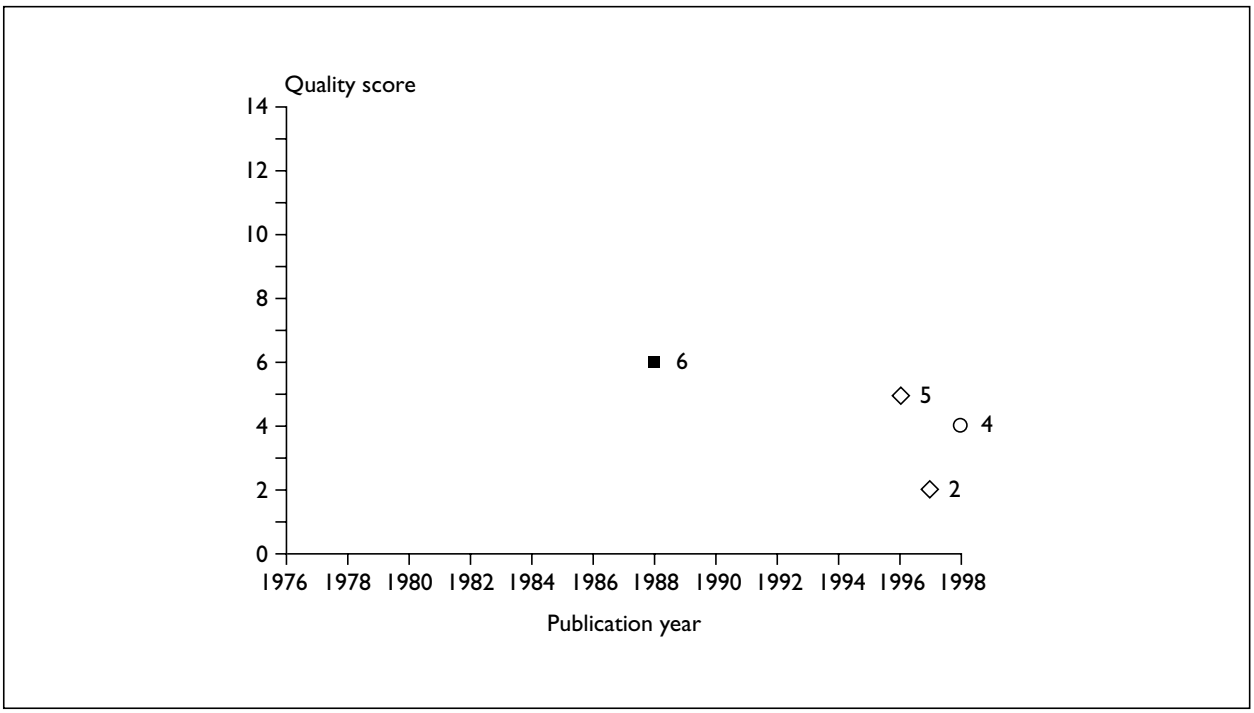


FIGURE 18 *Quality scores by publication year for studies comparing two hospital programmes: miscellaneous comparisons (■, RCT; ◇, Cohort (C); ○, Cohort (H))*

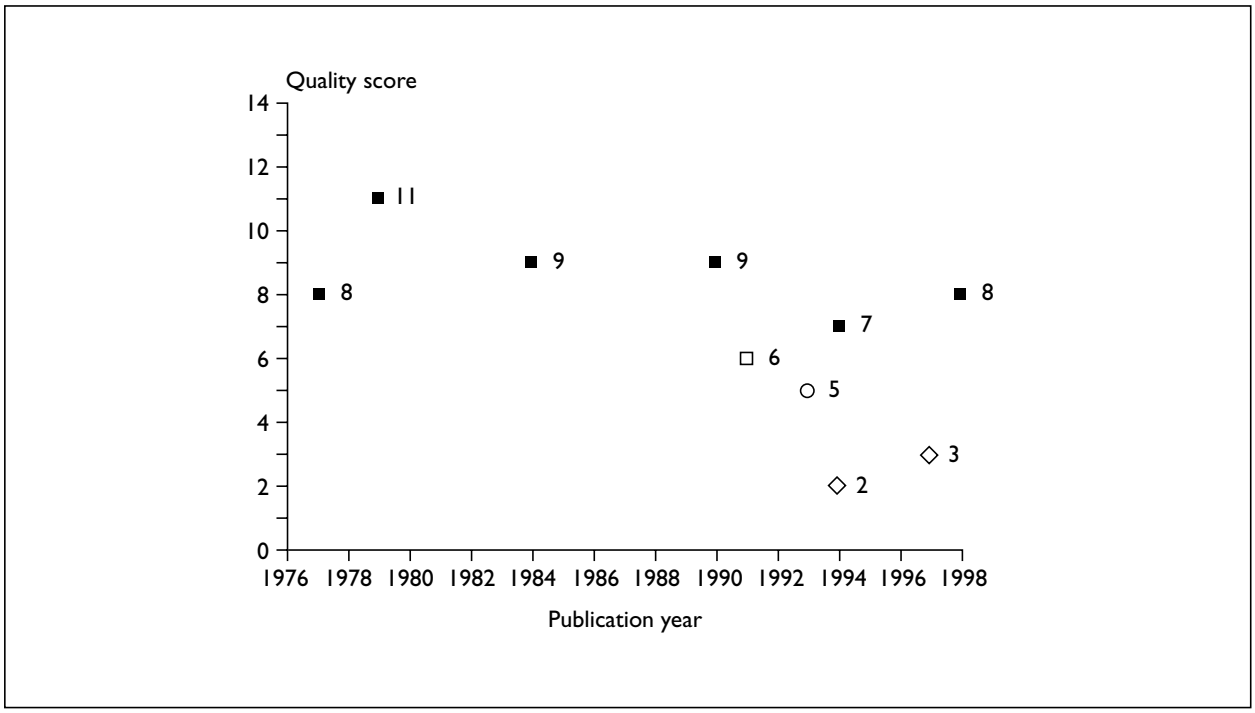


FIGURE 19 *Quality scores by publication year for studies comparing specific therapy/nursing/medical interventions after hip or other fracture (■, RCT; □, CCT; ◇, Cohort (C); ○, Cohort (H))*

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This report was identified as a priority by the Acute Sector Panel.

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